Features

- Low Noise Figure
- Excellent Input Return Loss
- Single Voltage Bias 4 V
- Integrated Active Bias Circuit
- Current Adjustable 20 - 80 mA with an External Resistor
- High Linearity, OIP3 >32 dBm
- 8-Lead Hermetic Package
- RoHS* Compliant

Description

The MAAL-010705-CR10 is a high dynamic range single stage MMIC LNA with excellent linearity and low noise figure designed for operation from 0.5 to 3 GHz. The LNA is packaged in an RoHS compliant, 8-lead hermetically sealed ceramic package.

This MMIC has an integrated active bias circuit allowing direct connection to 4 V voltage supply and minimizing variation over temperature and process. The bias current and gain can be set with external resistors to allow the user to customize the current and gain value to fit the application.

The MAAL-010705-CR10 offers less than 0.7 dB noise figure, more than 32 dBm OIP3 and 20 dB output return loss. The excellent match, low noise figure and high OIP3 along with the flexibility of setting current and gain make this LNA ideal UHF, L, and S-band satellite applications.

Functional Block Diagram

Pin Configuration

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Pin Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>N/C</td>
<td>No Connection</td>
</tr>
<tr>
<td>2</td>
<td>RF_IN</td>
<td>RF Input</td>
</tr>
<tr>
<td>3</td>
<td>Bias CCT</td>
<td>Bias Circuit Reference</td>
</tr>
<tr>
<td>4</td>
<td>V_BIAS</td>
<td>Bias Voltage</td>
</tr>
<tr>
<td>5</td>
<td>RF GND</td>
<td>RF Ground</td>
</tr>
<tr>
<td>6</td>
<td>N/C</td>
<td>No Connection</td>
</tr>
<tr>
<td>7</td>
<td>RF_OUT</td>
<td>RF Output</td>
</tr>
<tr>
<td>8</td>
<td>N/C</td>
<td>No Connection</td>
</tr>
</tbody>
</table>

1. The exposed pad centered on the package bottom must be connected to RF, DC and thermal ground.

Ordering Information

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAAL-010705-CR10</td>
<td>Chip Scale Package</td>
</tr>
</tbody>
</table>

### Electrical Specifications

**Freq = 0.9 GHz, \( V_D = 4 \text{ V}, 25^\circ\text{C}, Z_0 = 50 \Omega \)**

<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>—</td>
<td>dB</td>
<td>18</td>
<td>21</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>27</td>
<td>—</td>
</tr>
<tr>
<td>Noise Figure</td>
<td>—</td>
<td>dB</td>
<td>—</td>
<td>0.7</td>
<td>—</td>
</tr>
<tr>
<td>Output IP3</td>
<td>( P_{\text{OUT}} = 5 \text{ dBm}, \text{Tone Spacing} = 1 \text{ MHz} )</td>
<td>dBm</td>
<td>—</td>
<td>33</td>
<td>—</td>
</tr>
<tr>
<td>Output P1dB</td>
<td>—</td>
<td>dBm</td>
<td>17.5</td>
<td>18.5</td>
<td>—</td>
</tr>
<tr>
<td>Total Current</td>
<td>( I_{\text{DD}} = I_D + I_{\text{BIAS}} )</td>
<td>mA</td>
<td>—</td>
<td>60</td>
<td>70</td>
</tr>
</tbody>
</table>

1. \( V_D \) and \( V_{\text{BIAS}} \) are connected together to 4 V, \( R_3 = 150 \Omega \) and \( R_4 = 240 \Omega \); reference recommended schematic on page 5.

### Absolute Maximum Ratings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Absolute Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>5.5 V</td>
</tr>
<tr>
<td>Current</td>
<td>100 mA</td>
</tr>
<tr>
<td>RF Input Power</td>
<td>20 dBm</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>-55°C to +150°C</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-40°C to +85°C</td>
</tr>
<tr>
<td>Junction Temperature (^5)</td>
<td>+150°C</td>
</tr>
</tbody>
</table>

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. Typical thermal resistance \((\Theta_c) = 45^\circ\text{C/W}\).

### 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.
Low Noise Amplifier
0.5 - 3 GHz

Typical Performance Curves: 4 V (over temperature)

**Gain**

- **S21 (dB)**
  - Frequency (GHz):
    - 0.5
    - 1.0
    - 1.5
    - 2.0
    - 2.5
    - 3.0
  - Temperature:
    - +25°C
    - -40°C
    - +85°C

**Reverse Isolation**

- **S12 (dB)**
  - Frequency (GHz):
    - 0.5
    - 1.0
    - 1.5
    - 2.0
    - 2.5
    - 3.0
  - Temperature:
    - +25°C
    - -40°C
    - +85°C

**Input Return Loss**

- **S11 (dB)**
  - Frequency (GHz):
    - 0.5
    - 1.0
    - 1.5
    - 2.0
    - 2.5
    - 3.0
  - Temperature:
    - +25°C
    - -40°C
    - +85°C

**Output Return Loss**

- **S22 (dB)**
  - Frequency (GHz):
    - 0.5
    - 1.0
    - 1.5
    - 2.0
    - 2.5
    - 3.0
  - Temperature:
    - +25°C
    - -40°C
    - +85°C

**Noise Figure**

- **Noise Figure (dB)**
  - Frequency (GHz):
    - 0.5
    - 1.0
    - 1.5
    - 2.0
    - 2.5
    - 3.0
  - Temperature:
    - +25°C
    - -40°C
    - +85°C
Typical Performance Curves @ 900 MHz, 4 V

**OIP3 High vs. Output Power**

-25°C, -40°C, +85°C

**OIP3 Low vs. Output Power**

-25°C, -40°C, +85°C

**Gain vs. Output Power**

-25°C, -40°C, +85°C

**P1dB vs. Frequency**

800 MHz to 900 MHz

**OIP3 vs. Frequency**

800 MHz to 900 MHz

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Low Noise Amplifier
0.5 - 3 GHz

Off-Chip Component Values

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>3.3 pF</td>
<td>0402</td>
</tr>
<tr>
<td>C7, C8, C10</td>
<td>1000 pF</td>
<td>0402</td>
</tr>
<tr>
<td>C12, C13</td>
<td>100 pF</td>
<td>0402</td>
</tr>
<tr>
<td>C2, C14</td>
<td>4.7 µF</td>
<td>Tantalum, 1210</td>
</tr>
<tr>
<td>L1</td>
<td>9 nH</td>
<td>0402</td>
</tr>
<tr>
<td>L2</td>
<td>15 nH</td>
<td>0402</td>
</tr>
<tr>
<td>R3</td>
<td>150 Ω</td>
<td>0402</td>
</tr>
<tr>
<td>R4</td>
<td>240 Ω</td>
<td>0402</td>
</tr>
</tbody>
</table>

Bias Information

$V_{\text{BIAS}}$ and $V_D$ are separate connections on the evaluation board to give the option of varying $I_D$ without changing $R4$. They can be connected together to a single voltage supply during the measurement and in the final layout implementation of the PCB. If two different voltage supplies are used then apply $V_D$ first and then $V_{\text{BIAS}}$ to turn on the LNA. To turn off the LNA disconnect $V_{\text{BIAS}}$ first and then $V_D$. $R3$ is varied to obtain different levels of gain. $R4$ is varied to change the drain current $I_D$. 

Schematic
Lead-Free Hermetic CR10 Package†

All dimensions are in inches.

† Reference Application Note S2083 for lead-free solder reflow recommendations.
Meets JEDEC moisture sensitivity level 1 requirements.
Plating is Au over Ni.