Low Noise Amplifier
0.5 - 3 GHz

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.

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\textsuperscript{2}: Freq = 0.9 GHz, \(V_D = 4\) 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>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_{OUT} = 5) dBm, Tone Spacing = 1 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_{DD} = I_D + I_{BIAS})</td>
<td>mA</td>
<td>—</td>
<td>60</td>
<td>70</td>
</tr>
</tbody>
</table>

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

Absolute Maximum Ratings\textsuperscript{3,4}

<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 Temp.</td>
<td>-55°C to +150°C</td>
</tr>
<tr>
<td>Operating Temp.</td>
<td>-40°C to +85°C</td>
</tr>
<tr>
<td>Junction Temp.\textsuperscript{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°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.
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Typical Performance Curves: 4 V (over temperature)

**Gain**

![Gain Graph]

**Reverse Isolation**

![Reverse Isolation Graph]

**Input Return Loss**

![Input Return Loss Graph]

**Output Return Loss**

![Output Return Loss Graph]

**Noise Figure**

![Noise Figure Graph]
Typical Performance Curves @ 900 MHz, 4 V

**OIP3 High vs. Output Power**

-20°C
-40°C
+85°C

**OIP3 Low vs. Output Power**

-20°C
-40°C
+85°C

**Gain vs. Output Power**

-20°C
-40°C
+85°C

**P1dB vs. Frequency**

-20°C
-40°C
+85°C

**OIP3 vs. Frequency**

800 820 840 860 880 900

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Recommended Layout

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†

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