MAAL-011136

75 Ω CATV, FTTx Low Noise Amplifier
45 - 1218 MHz

Features
- Single Stage, Single Ended
- 3 to 5 V Operation
- Low Current, 50 mA
- 20 dB Flat Gain
- 1.2 dB NF Noise
- Low Distortion Performance
- Lead-Free SOT-89 Plastic Package
- Halogen-Free “Green” Mold Compound
- RoHS* Compliant

Description
The MAAL-011136 is an RF amplifier assembled in a SOT-89 plastic package. This amplifier provides 20 dB of flat gain while biased from 3 to 5 volts. The amplifier provides excellent noise figure.

The MAAL-011136 provides high gain, low noise and low distortion making it ideally suited as input stage for fiber-to-the-home (FTTh) applications and other 75 Ω infrastructure applications.

The MAAL-011136 is fabricated using GaAs pHEMT technology.

Ordering Information

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAAL-011136-TR1000</td>
<td>1000 Part Reel</td>
</tr>
<tr>
<td>MAAL-011136-TR3000</td>
<td>3000 Part Reel</td>
</tr>
<tr>
<td>MAAL-011136-001SMB</td>
<td>Sample Board</td>
</tr>
</tbody>
</table>

1. Reference Application Note M513 for reel size information.
2. All sample boards include 5 loose parts.

Electrical Specifications: $T_A = 25^\circ C$, $V_{DD} = 5 \, V$, $Z_0 = 75 \, \Omega$

<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>45 - 1218 MHz</td>
<td>dB</td>
<td>19</td>
<td>20.5</td>
<td>22</td>
</tr>
<tr>
<td>Gain Flatness</td>
<td>45 - 1218 MHz</td>
<td>dB</td>
<td>—</td>
<td>+/- 0.2</td>
<td>—</td>
</tr>
<tr>
<td>Reverse Isolation</td>
<td>45 - 1218 MHz</td>
<td>dB</td>
<td>—</td>
<td>25</td>
<td>—</td>
</tr>
<tr>
<td>Input Return Loss</td>
<td>45 - 1218 MHz</td>
<td>dB</td>
<td>—</td>
<td>10</td>
<td>—</td>
</tr>
<tr>
<td>Output Return Loss</td>
<td>45 - 1218 MHz</td>
<td>dB</td>
<td>—</td>
<td>16</td>
<td>—</td>
</tr>
<tr>
<td>Noise Figure</td>
<td>45 - 1218 MHz</td>
<td>dB</td>
<td>—</td>
<td>1.2</td>
<td>1.6</td>
</tr>
<tr>
<td>Output IP2</td>
<td>45 - 1200 MHz, tone spacing 6 MHz, $P_{OUT}$ per tone = 4 dBm</td>
<td>dBm</td>
<td>—</td>
<td>43</td>
<td>—</td>
</tr>
<tr>
<td>Output IP3</td>
<td>45 - 1200 MHz, tone spacing 6 MHz, $P_{OUT}$ per tone = 4 dBm</td>
<td>dBm</td>
<td>—</td>
<td>32</td>
<td>—</td>
</tr>
<tr>
<td>$P_{1dB}$</td>
<td>45 - 1218 MHz</td>
<td>dBm</td>
<td>—</td>
<td>17.5</td>
<td>—</td>
</tr>
<tr>
<td>Composite Triple Beat, CTB</td>
<td>79 channels, 0 dB Tilt, 18 dBmV per channel output, QAM to 1000 MHz</td>
<td>dBc</td>
<td>—</td>
<td>-79</td>
<td>—</td>
</tr>
<tr>
<td>Composite Second Order, CSO</td>
<td>79 channels, 0 dB Tilt, 18 dBmV per channel output, QAM to 1000 MHz</td>
<td>dBc</td>
<td>—</td>
<td>-62</td>
<td>—</td>
</tr>
<tr>
<td>$I_{DD}$</td>
<td>$V_{DD} = 5 , V$</td>
<td>mA</td>
<td>—</td>
<td>53</td>
<td>62</td>
</tr>
</tbody>
</table>

Absolute Maximum Ratings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Absolute Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Power</td>
<td>10 dBm</td>
</tr>
<tr>
<td>Operating Voltage</td>
<td>6 volts</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-40°C to +85°C</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>-65°C to +150°C</td>
</tr>
</tbody>
</table>

Handling Procedures
Please observe the following precautions to avoid damage:

Static Sensitivity
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 1A.

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. These operating conditions will ensure MTTF > 1 x 10^6 hours.
6. Junction Temperature ($T_J$) = Case Temperature ($T_C$) + $\Theta_{JC}(V^I)$
   Typical thermal resistance ($\Theta_{JC}$) = 67°C/W.
   a) For $T_C = 25^\circ C$,
      $T_J = 42^\circ C @ 5 \, V, 53 \, mA$
   b) For $T_C = 85^\circ C$,
      $T_J = 103^\circ C @ 5 \, V, 53 \, mA$
Schematic Including Off-Chip Components

Parts List, \( V_{DD} = 5 \, \text{V} \)

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1-C4</td>
<td>10 nF</td>
<td>0402</td>
</tr>
<tr>
<td>C5</td>
<td>1.5 pF</td>
<td>0402</td>
</tr>
<tr>
<td>C6</td>
<td>1000 pF</td>
<td>0402</td>
</tr>
<tr>
<td>C7</td>
<td>1.0 pF</td>
<td>0402</td>
</tr>
<tr>
<td>L1</td>
<td>6.2 nH</td>
<td>0402</td>
</tr>
<tr>
<td>L2</td>
<td>6.8 nH</td>
<td>0402</td>
</tr>
<tr>
<td>L3</td>
<td>Ferrite Bead(^7)</td>
<td>0402</td>
</tr>
<tr>
<td>L4</td>
<td>68 nH(^8)</td>
<td>0402</td>
</tr>
<tr>
<td>R1</td>
<td>8.06 k(\Omega)</td>
<td>0402</td>
</tr>
<tr>
<td>R2</td>
<td>931 (\Omega)</td>
<td>0402</td>
</tr>
<tr>
<td>R3</td>
<td>464 (\Omega)</td>
<td>0402</td>
</tr>
<tr>
<td>R4</td>
<td>1.54 k(\Omega)</td>
<td>0402</td>
</tr>
<tr>
<td>R5</td>
<td>8.06 k(\Omega)</td>
<td>0402</td>
</tr>
<tr>
<td>R6</td>
<td>19.1 (\Omega)</td>
<td>0402</td>
</tr>
</tbody>
</table>

7. Murata, part number BLM15HD182SN.
8. Coilcraft, part number 0402CS-68NXJLW

Recommended PCB Layout

Recommended PCB Land Pattern

60 vias beneath package
0.012 in. via diameter
75 Ω CATV, FTTx Low Noise Amplifier
45 - 1218 MHz

Typical Performance Curves: $V_{DD} = 5$ V

**Gain to 1.218 GHz**

![Gain to 1.218 GHz graph]

**Noise Figure to 1.218 GHz**

![Noise Figure to 1.218 GHz graph]

**Gain to 3 GHz**

![Gain to 3 GHz graph]

**Output Return Loss to 1.218 GHz**

![Output Return Loss to 1.218 GHz graph]

**Reverse Isolation to 3 GHz**

![Reverse Isolation to 3 GHz graph]

**Input Return Loss to 1.218 GHz**

![Input Return Loss to 1.218 GHz graph]
**75 Ω CATV, FTTx Low Noise Amplifier**

**45 - 1218 MHz**

**Typical Performance Curves: V_{DD} = 5 V**

### CTB

- 79 analog channels + QAM, 0 dB tilt,
- $P_{OUT} = 18 \text{ dBmV per channel}$

### CSO Lower

- 79 analog channels + QAM, 0 dB tilt,
- $P_{OUT} = 18 \text{ dBmV per channel}$

### CSO Upper

- 79 analog channels + QAM, 0 dB tilt,
- $P_{OUT} = 18 \text{ dBmV per channel}$

---

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](http://www.macom.com) for additional data sheets and product information.

For further information and support please visit: [https://www.macom.com/support](https://www.macom.com/support)
**75 Ω CATV, FTTx Low Noise Amplifier**

**45 - 1218 MHz**

---

**Lead Free SOT-89†**

† 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

3 V Application
The MAAL-011136 may also be operated from 3 V $V_{DD}$ supply with adjustment of two bias resistors: $R4 = 4.64 \, k\Omega$ to set current at nominal 53 mA; and $R6 = 0 \, \Omega$.

Typical Performance: $T_A = 25^\circ C$, $V_{DD} = 3 \, V$, $Z_0 = 75 \, \Omega$

<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>45 - 1218 MHz</td>
<td>dB</td>
<td>—</td>
<td>20.5</td>
<td>—</td>
</tr>
<tr>
<td>Gain Flatness</td>
<td>45 - 1218 MHz</td>
<td>dB</td>
<td>—</td>
<td>+/− 0.2</td>
<td>—</td>
</tr>
<tr>
<td>Reverse Isolation</td>
<td>45 - 1218 MHz</td>
<td>dB</td>
<td>—</td>
<td>25</td>
<td>—</td>
</tr>
<tr>
<td>Input Return Loss</td>
<td>45 - 1218 MHz</td>
<td>dB</td>
<td>—</td>
<td>10</td>
<td>—</td>
</tr>
<tr>
<td>Output Return Loss</td>
<td>45 - 1218 MHz</td>
<td>dB</td>
<td>—</td>
<td>16</td>
<td>—</td>
</tr>
<tr>
<td>Noise Figure</td>
<td>45 - 100 MHz, 100 - 1218 MHz</td>
<td>dB</td>
<td>—</td>
<td>1.2</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.2</td>
<td>—</td>
</tr>
<tr>
<td>Output IP2</td>
<td>45 - 1200 MHz, tone spacing 6 MHz, $P_{OUT}$ per tone = 4 dBm</td>
<td>dBm</td>
<td>—</td>
<td>42</td>
<td>—</td>
</tr>
<tr>
<td>Output IP3</td>
<td>45 - 1200 MHz, tone spacing 6 MHz, $P_{OUT}$ per tone = 4 dBm</td>
<td>dBm</td>
<td>—</td>
<td>32</td>
<td>—</td>
</tr>
<tr>
<td>P1dB</td>
<td>45 - 1218 MHz</td>
<td>dBm</td>
<td>—</td>
<td>16.5</td>
<td>—</td>
</tr>
<tr>
<td>Composite Triple Beat, CTB</td>
<td>79 channels, 0 dB Tilt, 18 dBmV per channel output, QAM to 1000 MHz</td>
<td>dBc</td>
<td>—</td>
<td>-79</td>
<td>—</td>
</tr>
<tr>
<td>Composite Second Order, CSO</td>
<td>79 channels, 0 dB Tilt, 18 dBmV per channel output, QAM to 1000 MHz</td>
<td>dBc</td>
<td>—</td>
<td>-62</td>
<td>—</td>
</tr>
<tr>
<td>$I_{DD}$</td>
<td>$V_{DD} = 3 , V$</td>
<td>mA</td>
<td>—</td>
<td>53</td>
<td>—</td>
</tr>
</tbody>
</table>
Typical Performance Curves: \( V_{DD} = 3 \) V

**Gain to 1.218 GHz**

\[
\begin{align*}
S_{21} (\text{dB}) & \quad \text{Frequency (GHz)} \\
22 & \quad 1.218 \\
21 & \quad 0.8 \\
20 & \quad 0.4 \\
19 & \quad 0.2 \\
18 & \quad 0 \\
17 & \quad 1.2 \\
\end{align*}
\]

**Noise Figure to 1.218 GHz**

\[
\begin{align*}
\text{Noise Figure (dB)} & \quad \text{Frequency (GHz)} \\
+25^\circ C & \quad 1.218 \\
& \quad 0.8 \\
& \quad 0.4 \\
& \quad 0.2 \\
& \quad 0 \\
& \quad 1.2 \\
\end{align*}
\]

**Gain to 3 GHz**

\[
\begin{align*}
S_{21} (\text{dB}) & \quad \text{Frequency (GHz)} \\
25 & \quad 3.0 \\
20 & \quad 2.5 \\
15 & \quad 2.0 \\
10 & \quad 1.5 \\
5 & \quad 1.0 \\
0 & \quad 0.5 \\
\end{align*}
\]

**Output Return Loss to 1.218 GHz**

\[
\begin{align*}
S_{22} (\text{dB}) & \quad \text{Frequency (GHz)} \\
+25^\circ C & \quad 1.218 \\
& \quad 0.8 \\
& \quad 0.4 \\
& \quad 0.2 \\
& \quad 0 \\
& \quad 1.2 \\
\end{align*}
\]

**Reverse Isolation to 3 GHz**

\[
\begin{align*}
S_{12} (\text{dB}) & \quad \text{Frequency (GHz)} \\
+25^\circ C & \quad 3.0 \\
& \quad 2.5 \\
& \quad 2.0 \\
& \quad 1.5 \\
& \quad 1.0 \\
& \quad 0.5 \\
& \quad 0 \\
\end{align*}
\]

**Input Return Loss to 1.218 GHz**

\[
\begin{align*}
S_{11} (\text{dB}) & \quad \text{Frequency (GHz)} \\
+25^\circ C & \quad 1.218 \\
& \quad 0.8 \\
& \quad 0.4 \\
& \quad 0.2 \\
& \quad 0 \\
& \quad 1.2 \\
\end{align*}
\]
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.