MAAL-010200

Miniature Broadband Gain Stage
70 - 3000 MHz

Features
- Low Noise Figure
- High IP₃
- Single Supply +3 V, +5 V
- RoHS* Compliant SOT-89 Package

Description
M/A-COM Technology’s MAAL-010200 broadband gain stage is a GaAs MMIC amplifier in a lead-free SOT-89 surface mount plastic package. The MAAL-010200 employs a monolithic 1-stage self-biased design featuring a convenient 50 Ω input/output impedance that minimizes the number of external components required. Its broadband design provides usable performance from 500 to 3000 MHz. For operation below 500 MHz contact M/A-COM Technology’s application group for support.

Ordering Information

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAAL-010200-TR3000</td>
<td>3000 piece reel</td>
</tr>
<tr>
<td>MAAL-010200-001SMB</td>
<td>Sample Test Board</td>
</tr>
</tbody>
</table>

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

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>RF In</td>
<td>RF Input</td>
</tr>
<tr>
<td>2</td>
<td>GND</td>
<td>Ground</td>
</tr>
<tr>
<td>3</td>
<td>RF Out/V_DD</td>
<td>RF Output &amp; Voltage Bias</td>
</tr>
</tbody>
</table>

Absolute Maximum Ratings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Absolute Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gain Compression</td>
<td>6 dB</td>
</tr>
<tr>
<td>Voltage</td>
<td>5.5 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>

3. Exceeding any one or combination of these limits may cause permanent damage to this device.
4. M/A-COM Technology does not recommend sustained operation near these survivability limits.
5. Operating at 5 volts with no drain resistor will require the RF output power to be no greater than 10 dBm.

Miniature Broadband Gain Stage
70 - 3000 MHz

Electrical Specifications: Freq. = 500 - 3000 MHz, $T_A = 25^\circ$C, $Z_0 = 50 \, \Omega$

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test Conditions</th>
<th>Units</th>
<th>Bias Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>3 Volts</td>
</tr>
<tr>
<td>Gain</td>
<td>F = 0.9 GHz</td>
<td>dB</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>F = 1.9 GHz</td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>Noise Figure</td>
<td>F = 0.9 GHz</td>
<td>dB</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>F = 1.9 GHz</td>
<td></td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>F = 3.0 GHz</td>
<td></td>
<td>—</td>
</tr>
<tr>
<td>Input Return Loss</td>
<td>F = 0.9 GHz</td>
<td>dB</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>F = 1.9 GHz</td>
<td></td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>F = 3.0 GHz</td>
<td></td>
<td>—</td>
</tr>
<tr>
<td>Output Return Loss</td>
<td>F = 0.9 GHz</td>
<td>dB</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>F = 1.9 GHz</td>
<td></td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>F = 3.0 GHz</td>
<td></td>
<td>—</td>
</tr>
<tr>
<td>Output P1dB</td>
<td>500 – 3000 MHz</td>
<td>dBm</td>
<td>17.5</td>
</tr>
<tr>
<td>Output IP3</td>
<td>500 – 3000 MHz</td>
<td>dBm</td>
<td>36</td>
</tr>
<tr>
<td>Current</td>
<td>—</td>
<td>mA</td>
<td>50</td>
</tr>
</tbody>
</table>

Baseline Application Schematic @ 3V, 5V

Component List @ 3V, 5V

<table>
<thead>
<tr>
<th>Part</th>
<th>Value</th>
<th>Case Style</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1,C2</td>
<td>39 pF</td>
<td>0402</td>
<td>DC Block</td>
</tr>
<tr>
<td>C3</td>
<td>0.1 µF</td>
<td>0402</td>
<td>RF Bypass</td>
</tr>
<tr>
<td>L1</td>
<td>12 nH</td>
<td>0402</td>
<td>RF Choke/Tuning</td>
</tr>
</tbody>
</table>

Handling Procedures

The following precautions should be observed 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.
Miniature Broadband Gain Stage
70 - 3000 MHz

Typical Performance Curves: $V_{DD} = 3\, V$

**Gain**

- $S_{21}$ (dB) vs Frequency (GHz)
- +25°C, -40°C, +85°C

**Input Return Loss**

- $S_{11}$ (dB) vs Frequency (GHz)
- +25°C, -40°C, +85°C

**Output Return Loss**

- $S_{22}$ (dB) vs Frequency (GHz)
- +25°C, -40°C, +85°C

**Noise Figure**

- Noise Figure (dB) vs Frequency (GHz)
- +25°C, -40°C, +85°C

Visit www.macom.com for additional data sheets and product information.

For further information and support please visit:
https://www.macom.com/support
Typical Performance Curves: $V_{DD} = 3$ V

**Output IP3, Input Power @ -12 dBm**

-25°C, -40°C, +85°C

**P1dB**

15°C, -40°C, +85°C

**Current**

50°C, -40°C, +85°C

For further information and support please visit:
https://www.macom.com/support
Typical Performance Curves: \( V_{DD} = 5 \text{ V} \)

6. This device can run from a single 5 volt supply, but for 1M hour MTTF the output power must be no greater than 10 dBm unless using a series resistor on the drain. See Application note 7 on page 7.
Lead-Free SOT-89†

† Reference Application Note M538 for lead-free solder reflow recommendations.
Meets JEDEC moisture sensitivity level 1 requirements.
Plating is 100% matte tin over copper.
5 Volt Application Section for operation above 10 dBm output power

7. The addition of a 27 Ω series resistor on the drain line allows for 5 volt operation above 10 dBm output power, but no greater than 22 dBm of output power.

Component List @ 5V

<table>
<thead>
<tr>
<th>Part</th>
<th>Value</th>
<th>Case Style</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>39 pF</td>
<td>0402</td>
<td>Input DC Block</td>
</tr>
<tr>
<td>C2</td>
<td>39 pF</td>
<td>0402</td>
<td>Output DC Block</td>
</tr>
<tr>
<td>C3</td>
<td>0.1 µF</td>
<td>0402</td>
<td>RF Bypass</td>
</tr>
<tr>
<td>L1</td>
<td>12 nH</td>
<td>0805</td>
<td>RF Choke/Tuning</td>
</tr>
<tr>
<td>R1</td>
<td>27 Ω</td>
<td>0402</td>
<td>Voltage Drop</td>
</tr>
</tbody>
</table>

Application Schematic @ 5V
Miniature Broadband Gain Stage
70 - 3000 MHz

5 Volt Application Section for operation above 10 dBm output power

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

**Gain**

![Gain Curve](image1)

**Input Return Loss**

![Input Return Loss Curve](image2)

**Output Return Loss**

![Output Return Loss Curve](image3)

**Noise Figure**

![Noise Figure Curve](image4)
Miniature Broadband Gain Stage
70 - 3000 MHz

5 Volt Application Section for operation above 10 dBm output power

Typical Performance Curves: \( V_{DD} = 5 \) V

Output IP3, Input Power @ -12 dBm

\[
\begin{array}{c|c|c|c|c|c|c|c|c}
\text{Frequency (GHz)} & 0.5 & 1.0 & 1.5 & 2.0 & 2.5 & 3.0 \\
\text{OP3 (dBm)} & \text{25} & \text{30} & \text{35} & \text{40} & \text{45} & \\
\text{+25 C} & \text{30} & \text{35} & \text{40} & \text{45} & \\
\text{-40 C} & \text{25} & \text{30} & \text{35} & \text{40} & \\
\text{+85 C} & \text{20} & \text{25} & \text{30} & \text{35} & \\
\end{array}
\]

\[
\begin{array}{c|c|c|c|c|c|c|c|c}
\text{Frequency (GHz)} & 15 & 20 & 25 & 30 & 35 & 40 & 45 \\
\text{Output Power (dBm)} & \text{0} & \text{5} & \text{10} & \text{15} & \text{20} & \\
\text{+25 C} & \text{12} & \text{14} & \text{16} & \text{18} & \\
\text{-40 C} & \text{8} & \text{10} & \text{12} & \text{14} & \\
\text{+85 C} & \text{4} & \text{6} & \text{8} & \text{10} & \\
\end{array}
\]

P1dB

\[
\begin{array}{c|c|c|c|c|c|c|c|c}
\text{Frequency (GHz)} & 0.5 & 1.0 & 1.5 & 2.0 & 2.5 & 3.0 \\
\text{P1dB (dBm)} & \text{15} & \text{16} & \text{17} & \text{18} & \text{19} & \text{20} \\
\text{+25 C} & \text{10} & \text{12} & \text{14} & \text{16} & \text{18} & \\
\text{-40 C} & \text{5} & \text{7} & \text{9} & \text{11} & \text{13} & \\
\text{+85 C} & \text{0} & \text{2} & \text{4} & \text{6} & \text{8} & \\
\end{array}
\]

Current

\[
\begin{array}{c|c|c|c|c|c|c|c}
\text{Output Power (dBm)} & 0 & 2 & 4 & 6 & 8 & 10 & 12 \\
\text{Drain Current (mA)} & \text{50} & \text{55} & \text{60} & \text{65} & \text{70} & \text{75} & \text{80} & \text{85} & \text{90} \\
\text{+25 C} & \text{50} & \text{55} & \text{60} & \text{65} & \text{70} & \text{75} & \text{80} & \text{85} & \text{90} \\
\text{-40 C} & \text{45} & \text{50} & \text{55} & \text{60} & \text{65} & \text{70} & \text{75} & \text{80} & \text{85} \\
\text{+85 C} & \text{40} & \text{45} & \text{50} & \text{55} & \text{60} & \text{65} & \text{70} & \text{75} & \text{80} \\
\end{array}
\]

M/A-COM 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 for additional data sheets and product information.

For further information and support please visit: https://www.macom.com/support
Miniature Broadband Gain Stage
70 - 3000 MHz

M/A-COM Technology Solutions Inc. All rights reserved.

Information in this document is provided in connection with M/A-COM 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.

For further information and support please visit: https://www.macom.com/support