MAAL-009120

Miniature Broadband Gain Stage
70 - 3000 MHz

Features
- Low Noise Figure
- High IP3
- Single Supply +3 V, +5 V
- RoHS* Compliant SC70-6LD Package

Description
M/A-COM Technology’s MAAL-009120 broadband gain stage is a GaAs MMIC amplifier in a lead-free SC70-6LD (SOT-363) surface mount plastic package. The MAAL-009120 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 Tech’s application group for support.

Ordering Information

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAAL-009120 -TR1000</td>
<td>1000 piece reel</td>
</tr>
<tr>
<td>MAAL-009120 -TR3000</td>
<td>3000 piece reel</td>
</tr>
<tr>
<td>MAAL-009120 -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.

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>3 Volts</th>
<th></th>
<th>5 Volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gain</td>
<td>$F = 0.9 , \text{GHz}$</td>
<td>dB</td>
<td>—</td>
<td>10.4</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>$F = 1.9 , \text{GHz}$</td>
<td>dB</td>
<td>8</td>
<td>1.4</td>
<td>1.4</td>
</tr>
<tr>
<td></td>
<td>$F = 3.0 , \text{GHz}$</td>
<td>dB</td>
<td>—</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Noise Figure</td>
<td>$F = 0.9 , \text{GHz}$</td>
<td>dB</td>
<td>—</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>$F = 1.9 , \text{GHz}$</td>
<td>dB</td>
<td>—</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>$F = 3.0 , \text{GHz}$</td>
<td>dB</td>
<td>—</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>Input Return Loss</td>
<td>$F = 0.9 , \text{GHz}$</td>
<td>dB</td>
<td>—</td>
<td>22</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>$F = 1.9 , \text{GHz}$</td>
<td>dB</td>
<td>—</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>$F = 3.0 , \text{GHz}$</td>
<td>dB</td>
<td>—</td>
<td>15.5</td>
<td>15.5</td>
</tr>
<tr>
<td>Output Return Loss</td>
<td>$F = 0.9 , \text{GHz}$</td>
<td>dB</td>
<td>—</td>
<td>18.5</td>
<td>18.5</td>
</tr>
<tr>
<td></td>
<td>$F = 1.9 , \text{GHz}$</td>
<td>dB</td>
<td>—</td>
<td>35</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>$F = 3.0 , \text{GHz}$</td>
<td>dB</td>
<td>—</td>
<td>35</td>
<td>35</td>
</tr>
</tbody>
</table>

Baseline Application Schematic @ 3V, 5V

<table>
<thead>
<tr>
<th>Component List @ 3V, 5V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part</td>
</tr>
<tr>
<td>------</td>
</tr>
<tr>
<td>C1</td>
</tr>
<tr>
<td>C2</td>
</tr>
<tr>
<td>C3</td>
</tr>
<tr>
<td>L1</td>
</tr>
</tbody>
</table>

Recommended PCB Configuration @ 3V, 5V

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**

![Gain Graph]

**Input Return Loss**

![Input Return Loss Graph]

**Output Return Loss**

![Output Return Loss Graph]

**Noise Figure**

![Noise Figure Graph]
Typical Performance Curves: $V_{DD} = 3$ V

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

$P1dB$

Current

Output Power (dBm)
Typical Performance Curves: $V_{DD} = 5\ V$

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 SC70-6LD (SOT-363)†

† 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

6. The addition of a 24.9 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>470 pF</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>24.9 Ω</td>
<td>0402</td>
<td>Voltage Drop</td>
</tr>
</tbody>
</table>

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

5 Volt Application Section for operation above 10 dBm output power

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

**Gain**

\[
\begin{align*}
S_21 \ (\text{dB}) & \quad \text{Frequency (GHz)} \\
0 & \quad 0.5 \quad 1.0 \quad 1.5 \quad 2.0 \quad 2.5 \quad 3.0
\end{align*}
\]

**Input Return Loss**

\[
\begin{align*}
S_{11} \ (\text{dB}) & \quad \text{Frequency (GHz)} \\
0 & \quad 0.5 \quad 1.0 \quad 1.5 \quad 2.0 \quad 2.5 \quad 3.0
\end{align*}
\]

**Output Return Loss**

\[
\begin{align*}
S_{22} \ (\text{dB}) & \quad \text{Frequency (GHz)} \\
0 & \quad 0.5 \quad 1.0 \quad 1.5 \quad 2.0 \quad 2.5 \quad 3.0
\end{align*}
\]

**Noise Figure**

\[
\begin{align*}
\text{Noise Figure (dB)} & \quad \text{Frequency (GHz)} \\
0.5 & \quad 0.5 \quad 1.0 \quad 1.5 \quad 2.0 \quad 2.5 \quad 3.0
\end{align*}
\]
Miniature Broadband Gain Stage
70 - 3000 MHz

5 Volt Application Section for operation above 10 dBm output power

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

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

![Output IP3 vs Frequency](image1)

**P1dB**

![P1dB vs Frequency](image2)

**Current**

![Current vs Output Power](image3)
Miniature Broadband Gain Stage
70 - 3000 MHz

3 Volt Application Section @ 70 MHz

Application Layout Schematic @ 3V

Component List @ 3V

<table>
<thead>
<tr>
<th>Part</th>
<th>Value</th>
<th>Case Style</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1 - C3</td>
<td>0.1 µF</td>
<td>0402</td>
</tr>
<tr>
<td>L1</td>
<td>80 nH</td>
<td>0805</td>
</tr>
<tr>
<td>L2</td>
<td>220 nH</td>
<td>0603</td>
</tr>
<tr>
<td>R1</td>
<td>3 Ω</td>
<td>0402</td>
</tr>
</tbody>
</table>

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

S-Parameter Response @ 3 Volts

Noise Figure

$P_{1dB}$

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