MAAP-010169

10 W Power Amplifier
2 - 6 GHz

Features
- +41 dBm Saturated Output Power
- Linear Gain: 18 dB
- Power Added Efficiency: 30% at P_{SAT}
- 50 Ω Input / Output Match
- Ceramic Flange Mount Package
- RoHS* Compliant and 260°C Re-flow Compatible

Description
The MAAP-010169 is a two stage MMIC power amplifier designed for broadband high power applications. It can be used as either a driver or an output stage amplifier. This device is fully matched input and output to 50 Ω which eliminates any sensitive external RF tuning components.

The device is packaged in a lead free 10-lead flanged package for high volume manufacturing.

The MAAP-010169 is fabricated using a high reliability pHEMT process, to realize good power added efficiency and gain. The pHEMT process features full passivation for high performance and reliability.

Ordering Information

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAAP-010169-000000</td>
<td>Bulk</td>
</tr>
</tbody>
</table>

1. Reference Application Note M567 for package handling and mounting procedure.

Functional Schematic

Pin Configuration

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>V_{GG2}</td>
</tr>
<tr>
<td>2</td>
<td>V_{GG1}</td>
</tr>
<tr>
<td>3</td>
<td>RF Input</td>
</tr>
<tr>
<td>4</td>
<td>V_{GG1}</td>
</tr>
<tr>
<td>5</td>
<td>V_{GG2}</td>
</tr>
<tr>
<td>6</td>
<td>V_{DD1}</td>
</tr>
<tr>
<td>7</td>
<td>V_{DD2}</td>
</tr>
<tr>
<td>8</td>
<td>RF Output</td>
</tr>
<tr>
<td>9</td>
<td>V_{DD2}</td>
</tr>
<tr>
<td>10</td>
<td>V_{DD1}</td>
</tr>
</tbody>
</table>

2. Flange is DC and RF ground.

Handling Procedures

Please observe the following precautions 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.

10 W Power Amplifier
2 - 6 GHz

Electrical Specifications: Freq. = 2 - 6 GHz, V_{DD} = 10 V, I_{DQ} = 3.5 A, T_{A} = +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>14</td>
<td>18</td>
<td>—</td>
</tr>
<tr>
<td>Input Return Loss</td>
<td></td>
<td>dB</td>
<td>8</td>
<td>10</td>
<td>—</td>
</tr>
<tr>
<td>Output Return Loss</td>
<td></td>
<td>dB</td>
<td>10</td>
<td>38</td>
<td>—</td>
</tr>
<tr>
<td>P_{1dB}</td>
<td></td>
<td>dBm</td>
<td>38</td>
<td>40</td>
<td>—</td>
</tr>
<tr>
<td>P_{SAT}</td>
<td></td>
<td>dBm</td>
<td>38</td>
<td>40</td>
<td>—</td>
</tr>
<tr>
<td>PAE</td>
<td>P_{SAT}</td>
<td>%</td>
<td>30</td>
<td>100</td>
<td>—</td>
</tr>
<tr>
<td>Duty Cycle</td>
<td></td>
<td>%</td>
<td></td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>Gate Bias Voltage</td>
<td></td>
<td>V</td>
<td>-0.56</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Current</td>
<td>I_{DQ}, P_{SAT}</td>
<td>A</td>
<td>3.5</td>
<td>5.5</td>
<td>—</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>+26 dBm</td>
</tr>
<tr>
<td>Operating Supply Voltage</td>
<td>+11 Volts</td>
</tr>
<tr>
<td>Operating Gate Voltage</td>
<td>-2 V &lt; V_{GG} &lt; 0 V</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-40°C to +25°C</td>
</tr>
<tr>
<td>Channel Temperature</td>
<td>+150 °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 Solutions does not recommend sustained operation near these survivability limits.
5. Operating at nominal conditions with T_{J} ≤ +150°C will ensure MTTF > 1 x 10^6 hours.
6. Operating temperatures >25°C will require regulation of dissipated power to maintain T_{J} ≤ 150°C. Refer to the Max. Power Dissipation vs. Base Plate Temperature curve on page 6.
7. Junction Temperature (T_{J}) = T_{C} + Θ_{JC} * ((V * I) - (P_{OUT} - P_{IN}))
   Typical thermal resistance (Θ_{JC}) = 2.8°C/W
   a) For T_{C} = 25°C, 4 GHz
      T_{J} = +130°C @ +10 V, 5.3 A, P_{OUT} = 42 dBm, P_{IN} = 24 dBm

Recommended Bias Configuration

Operating the MAAP-010169

The MAAP-010169 is static sensitive. Please handle with care. To operate the device, follow these steps. Ramp down or shutdown in reverse order (gate bias on first and off last). All V_{GG} pins should have the same voltage applied at all times.
1. Apply V_{GG} (-1.5 V).
2. Apply V_{DD} (10 V Typical).
3. Set I_{DQ} by adjusting V_{GG}.
4. Apply RF_{IN}.
Typical Performance Curves

**Gain**

- **S21 (dB)**
  - Frequency (GHz) vs. Gain

**Reverse Isolation**

- **S12 (dB)**
  - Frequency (GHz) vs. Reverse Isolation

**Input Return Loss**

- **S11 (dB)**
  - Frequency (GHz) vs. Input Return Loss

**Output Return Loss**

- **S22 (dB)**
  - Frequency (GHz) vs. Output Return Loss

**Output Power (dBm)**

- **Output Power (dBm)**
  - Frequency (GHz) vs. Output Power (dBm)

**Output Power (W)**

- **Output Power (W)**
  - Frequency (GHz) vs. Output Power (W)
Typical Performance Curves

**Power Gain**

![Power Gain Graph]

**Power Added Efficiency**

![Power Added Efficiency Graph]

**Drain Current**

![Drain Current Graph]

**Efficiency @ 2 GHz**

![Efficiency Graph @ 2 GHz]

**Efficiency @ 4 GHz**

![Efficiency Graph @ 4 GHz]

**Efficiency @ 6 GHz**

![Efficiency Graph @ 6 GHz]
Typical Performance Curves

**Power Gain @ 2 GHz**

![Graph showing power gain at 2 GHz]

**Output Power Sweep @ 2 GHz**

![Graph showing output power sweep at 2 GHz]

**Power Gain @ 4 GHz**

![Graph showing power gain at 4 GHz]

**Output Power Sweep @ 4 GHz**

![Graph showing output power sweep at 4 GHz]

**Power Gain @ 6 GHz**

![Graph showing power gain at 6 GHz]

**Output Power Sweep @ 6 GHz**

![Graph showing output power sweep at 6 GHz]
Typical Performance Curves

Max. Power Dissipation vs. Base Plate Temperature

Junction Temperature vs. Base Plate Temperature with 45 W Power Dissipation

8. Power dissipation should not exceed the maximum plot shown above to maintain $T_J < 150°C$. It is recommended to monitor power dissipation and decrease power dissipation in the device as required.

Ceramic Flange Mount Package†

† Reference Application Note M538 for lead-free solder reflow recommendations.

This is a high frequency, low thermal resistance package. The package consists of a cofired ceramic construction with a copper-tungsten base and iron-nickel-cobalt leads. The finish consists of electrolytic gold over nickel plate.
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.

M/A-COM Technology Solutions Inc. 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.

- North America  Tel: 800.366.2266 / Fax: 978.366.2266
- Europe  Tel: 44.1908.574.200 / Fax: 44.1908.574.300
- Asia/Pacific  Tel: 81.44.844.8296 / Fax: 81.44.844.8298