MAAP-010169

10 W Power Amplifier
2 - 6 GHz

Features
• +41 dBm Saturated Output Power
• Linear Gain: 18 dB
• Power Added Efficiency: 30% at $P_{\text{SAT}}$
• 50 $\Omega$ 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 $\Omega$ 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.

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Electrical Specifications: Freq. = 2 - 6 GHz, V\textsubscript{DD} = 10 V, I\textsubscript{DQ} = 3.5 A, T\textsubscript{A} = +25 °C, Z\textsubscript{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></td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Output Return Loss</td>
<td></td>
<td>dB</td>
<td></td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>P\textsubscript{1dB}</td>
<td></td>
<td>dBm</td>
<td></td>
<td>38</td>
<td></td>
</tr>
<tr>
<td>P\textsubscript{SAT}</td>
<td></td>
<td>dBm</td>
<td></td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>PAE</td>
<td>P\textsubscript{SAT}</td>
<td>%</td>
<td></td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Duty Cycle</td>
<td></td>
<td>%</td>
<td></td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Gate Bias</td>
<td>Voltage</td>
<td>V</td>
<td></td>
<td>-0.56</td>
<td></td>
</tr>
<tr>
<td>Current</td>
<td>I\textsubscript{DQ} P\textsubscript{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\textsubscript{GG} &lt; 0 V</td>
</tr>
<tr>
<td>Operating Temperature\textsuperscript{6}</td>
<td>-40°C to +25°C</td>
</tr>
<tr>
<td>Channel Temperature\textsuperscript{7}</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\textsubscript{J} ≤ +150°C will ensure MTTF > 1 x 10\textsuperscript{6} hours.
6. Operating temperatures >25°C will require regulation of dissipated power to maintain T\textsubscript{J} ≤ 150°C. Refer to the Max. Power Dissipation vs. Base Plate Temperature curve on page 6.
7. Junction Temperature (T\textsubscript{J}) = T\textsubscript{C} + Θ\textsubscript{JC} * ((V * I) - (P\textsubscript{OUT} - P\textsubscript{IN}))
   Typical thermal resistance (Θ\textsubscript{JC}) = 2.8°C/W
   a) For T\textsubscript{C} = 25°C, 4 GHz
      T\textsubscript{J} = +130°C @ +10 V, 5.3 A, P\textsubscript{OUT} = 42 dBm, P\textsubscript{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\textsubscript{GG} pins should have the same voltage applied at all times.
1. Apply V\textsubscript{GG} (-1.5 V).
2. Apply V\textsubscript{DD} (10 V Typical).
3. Set I\textsubscript{DQ} by adjusting V\textsubscript{GG}.
4. Apply RF\textsubscript{IN}.
Typical Performance Curves

**Gain**

- $S_{21}$ (dB) vs. Frequency (GHz)
- Gain vs. Frequency (GHz)

**Reverse Isolation**

- $S_{12}$ (dB) vs. Frequency (GHz)

**Input Return Loss**

- $S_{11}$ (dB) vs. Frequency (GHz)

**Output Return Loss**

- $S_{22}$ (dB) vs. Frequency (GHz)

**Output Power (dBm)**

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

**Output Power (W)**

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

**Power Gain**

![Power Gain Graph](image)

**Power Added Efficiency**

![Power Added Efficiency Graph](image)

**Drain Current**

![Drain Current Graph](image)

**Efficiency @ 2 GHz**

![Efficiency @ 2 GHz Graph](image)

**Efficiency @ 4 GHz**

![Efficiency @ 4 GHz Graph](image)

**Efficiency @ 6 GHz**

![Efficiency @ 6 GHz Graph](image)
Typical Performance Curves

**Power Gain @ 2 GHz**

![Power Gain @ 2 GHz Graph](image)

**Output Power Sweep @ 2 GHz**

![Output Power Sweep @ 2 GHz Graph](image)

**Power Gain @ 4 GHz**

![Power Gain @ 4 GHz Graph](image)

**Output Power Sweep @ 4 GHz**

![Output Power Sweep @ 4 GHz Graph](image)

**Power Gain @ 6 GHz**

![Power Gain @ 6 GHz Graph](image)

**Output Power Sweep @ 6 GHz**

![Output Power Sweep @ 6 GHz Graph](image)
Typical Performance Curves

**Max. Power Dissipation vs. Base Plate Temperature**

![Graph showing max. power dissipation vs. base plate temperature.]

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

![Graph showing junction temperature vs. base plate temperature.]

8. Power dissipation should not exceed the maximum plot shown above to maintain $T_J < 150^\circ C$. 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.
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