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>$V_{\text{GG2}}$</td>
</tr>
<tr>
<td>2</td>
<td>$V_{\text{GG1}}$</td>
</tr>
<tr>
<td>3</td>
<td>RF Input</td>
</tr>
<tr>
<td>4</td>
<td>$V_{\text{GG1}}$</td>
</tr>
<tr>
<td>5</td>
<td>$V_{\text{GG2}}$</td>
</tr>
<tr>
<td>6</td>
<td>$V_{\text{DD1}}$</td>
</tr>
<tr>
<td>7</td>
<td>$V_{\text{DD2}}$</td>
</tr>
<tr>
<td>8</td>
<td>RF Output</td>
</tr>
<tr>
<td>9</td>
<td>$V_{\text{DD2}}$</td>
</tr>
<tr>
<td>10</td>
<td>$V_{\text{DD1}}$</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_{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>—</td>
<td>—</td>
</tr>
<tr>
<td>P1dB</td>
<td>—</td>
<td>dBm</td>
<td>38</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>P_{SAT}</td>
<td>—</td>
<td>dBm</td>
<td>40</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>PAE</td>
<td>P_{SAT}</td>
<td>%</td>
<td>30</td>
<td>—</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_{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}.
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Typical Performance Curves

**Gain**

- **S21 (dB)**
  - Frequency (GHz)

**Reverse Isolation**

- **S12 (dB)**
  - Frequency (GHz)

**Input Return Loss**

- **S11 (dB)**
  - Frequency (GHz)

**Output Return Loss**

- **S22 (dB)**
  - Frequency (GHz)

**Output Power (dBm)**

- Output Power (dBm)
  - Frequency (GHz)

**Output Power (W)**

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

**Power Gain**

- Frequency (GHz) vs. Power Gain (dBm)
- Temperature variation shown: +25 C, -40 C, +85 C

**Power Added Efficiency**

- Frequency (GHz) vs. PAE (%)
- Temperature variation shown: +25 C, -40 C, +85 C

**Drain Current**

- Frequency (GHz) vs. Drain Current (A)
- Temperature variation shown: +25 C, -40 C, +85 C

**Efficiency @ 2 GHz**

- Input Power (dBm) vs. Efficiency (%)
- Temperature variation shown: +25 C, -40 C, +85 C

**Efficiency @ 4 GHz**

- Input Power (dBm) vs. Efficiency (%)
- Temperature variation shown: +25 C, -40 C, +85 C

**Efficiency @ 6 GHz**

- Input Power (dBm) vs. Efficiency (%)
- Temperature variation shown: +25 C, -40 C, +85 C
Typical Performance Curves

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

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.
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