MAAP-010168

10 W Power Amplifier
0.5 - 3 GHz

Rev. V4

Features
- Saturated Output Power: 41 dBm
- Linear Gain: 24 dB
- Power Added Efficiency: 30% at \( P_{\text{SAT}} \)
- 50 Ω Input / Output Match
- Ceramic Flange Mount Package
- RoHS* Compliant and 260°C Re-flow Compatible

Description
The MAAP-010168 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 hermetic package for high volume manufacturing.

The MAAP-010168 is fabricated using a fully passivated high reliability pHEMT process. The device provides excellent power added efficiency and gain.

Ordering Information

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAAP-010168-000000</td>
<td>Bulk</td>
</tr>
<tr>
<td>MAAP-010168-001SMB</td>
<td>Sample Board</td>
</tr>
</tbody>
</table>

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

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* Restrictions on Hazardous Substances, compliant to current RoHS EU directive.
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Electrical Specifications:
Freq. = 0.5 - 3.0 GHz, V<sub>DD</sub> = 10 V, I<sub>DQ</sub> = 3.5 A, T<sub>A</sub> = 25°C, Z<sub>0</sub> = 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>Small signal</td>
<td>dB</td>
<td>19</td>
<td>24</td>
<td>—</td>
</tr>
<tr>
<td>Input Return Loss</td>
<td>—</td>
<td>dB</td>
<td>—</td>
<td>10</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&lt;sub&gt;1dB&lt;/sub&gt;</td>
<td>—</td>
<td>dBm</td>
<td>—</td>
<td>39</td>
<td>—</td>
</tr>
<tr>
<td>P&lt;sub&gt;SAT&lt;/sub&gt;</td>
<td>—</td>
<td>dBm</td>
<td>38</td>
<td>41</td>
<td>—</td>
</tr>
<tr>
<td>Current</td>
<td>I&lt;sub&gt;DQ&lt;/sub&gt;</td>
<td>A</td>
<td>—</td>
<td>3.5</td>
<td>5.5</td>
</tr>
<tr>
<td></td>
<td>P&lt;sub&gt;SAT&lt;/sub&gt;</td>
<td>%</td>
<td>—</td>
<td>30</td>
<td>—</td>
</tr>
<tr>
<td>Gate Bias</td>
<td>—</td>
<td>V</td>
<td>—</td>
<td>-0.7</td>
<td>—</td>
</tr>
<tr>
<td>Duty Cycle</td>
<td>—</td>
<td>%</td>
<td>—</td>
<td>—</td>
<td>100</td>
</tr>
</tbody>
</table>

Absolute Maximum Ratings<sup>4,5</sup>

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Absolute Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Power</td>
<td>24 dBm</td>
</tr>
<tr>
<td>Operating Supply Voltage</td>
<td>+11 V</td>
</tr>
<tr>
<td>Operating Gate Voltage</td>
<td>-2 V</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-40°C to +85°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>

Operating the MAAP-010168
The MAAP-010168 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<sub>GG</sub> pins should have the same voltage applied at all times.

1. Apply V<sub>GG</sub> (-1.5 V).
2. Apply V<sub>DD</sub> (10.0 V Typical).
3. Set I<sub>DQ</sub> by adjusting V<sub>GG</sub>.
4. Apply RF<sub>IN</sub>.

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.

<sup>4</sup> Exceeding any one or combination of these limits may cause permanent damage to this device.
<sup>5</sup> MACOM does not recommend sustained operation near these survivability limits.
<sup>6</sup> Operating at nominal conditions with T<sub>J</sub> ≤ 150°C will ensure MTTF > 1 x 10<sup>6</sup> hours.
<sup>7</sup> Junction Temperature (T<sub>J</sub>) = T<sub>C</sub> + Θ<sub>JC</sub> * ((V * I) - (P<sub>OUT</sub> - P<sub>IN</sub>))
Typical thermal resistance (Θ<sub>JC</sub>) = 2.0°C/W
 a) For T<sub>C</sub> = 25°C @ 1.5 GHz
   T<sub>J</sub> = +80°C @ +10 V, 4 A, P<sub>OUT</sub> = 41 dBm, P<sub>IN</sub> = 21 dBm
 b) For T<sub>C</sub> = 85°C @ 1.5 GHz
   T<sub>J</sub> = +138°C @ +10 V, 3.9 A, P<sub>OUT</sub> = 41 dBm, P<sub>IN</sub> = 21 dBm
Recommended Bias Configuration

MACOM MAAP-010168

VGG1  VGG2

GATE 2

1

MACOM

MAAP-010168

GATE 1

2

RF IN

3

GATE 1

4

GATE 2

5

DRAIN 1

10

DRAIN 2

9

RF OUT

8

DRAIN 2

7

DRAIN 1

6

Cx = 1000 pF
Cy = 1 µF
Cz = 10 µF

Sample Board Layout

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MAAP-010168 Recommended Layout

Below is the recommended layout for the MAAP-010168. For optimal stability MACOM recommends adding bias decoupling capacitors of 10 µF at the entry point of $V_G$ and $V_{DD}$ (At the DC connections Header PIN). It is also recommended to add shunt decoupling capacitors of 1 µF & 1000 pF at the gate and drain pins of MAAP-010168 as shown in the details A below.

MACOM can provide gerber files of the sample board layout upon request.

MAAP-010168 Sample Board Layout

![Sample Board Layout](image)

### Parts List

<table>
<thead>
<tr>
<th>Item #</th>
<th>Component / Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>Test Board, RO4350, ½ Oz copper, 10 mil thick</td>
</tr>
<tr>
<td>20</td>
<td>SMA Edge Mount Connectors</td>
</tr>
<tr>
<td>30</td>
<td>2x15 Right Angle Connector, 0.1 Grid</td>
</tr>
<tr>
<td>40</td>
<td>Capacitor, 10 µF, 10%, 16 V, 1210, X5R</td>
</tr>
<tr>
<td>50</td>
<td>Capacitor, 1 µF, 10%, 16 V, 0402, X5R</td>
</tr>
<tr>
<td>60</td>
<td>Capacitor, 1000 pF, 10 %, 25 V, 0402, X5R</td>
</tr>
</tbody>
</table>
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Typical Performance Curves

**Gain**

[S21 (dB)]

**Input Return Loss**

[S11 (dB)]

**Output Return Loss**

[S22 (dB)]

**Reverse Isolation**

[S12 (dB)]

**Output Power (dBm)**

Output Power (dBm)

**Output Power (W)**

Output Power (W)

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Typical Performance Curves

**Power Gain**

- Frequency (GHz) vs. Power Gain (dBm)
- Three temperature conditions: +25°C, -40°C, +85°C

**Output Power Sweep @ 0.7 GHz**

- Input Power (dBm) vs. Output Power (dBm)
- Three temperature conditions: +25°C, -40°C, +85°C

**Power Added Efficiency**

- Frequency (GHz) vs. PAE (%)
- Three temperature conditions: +25°C, -40°C, +85°C

**Output Power Sweep @ 1.5 GHz**

- Input Power (dBm) vs. Output Power (dBm)
- Three temperature conditions: +25°C, -40°C, +85°C

**Drain Current**

- Frequency (GHz) vs. Drain Current (A)
- Three temperature conditions: +25°C, -40°C, +85°C

**Output Power Sweep @ 2.5 GHz**

- Input Power (dBm) vs. Output Power (dBm)
- Three temperature conditions: +25°C, -40°C, +85°C
Typical Performance Curves

Power Gain vs. Input Power @ 0.7 GHz

Power Gain vs. Output Power @ 0.7 GHz

Power Gain vs. Input Power @ 1.5 GHz

Power Gain vs. Output Power @ 1.5 GHz

Power Gain vs. Input Power @ 2.5 GHz

Power Gain vs. Output Power @ 2.5 GHz
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Typical Performance Curves

Max. Power Dissipation vs. Base Plate Temperature

Junction Temperature vs. Base Plate Temperature with 50 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.
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