Features
- 15 dB Gain
- 50 Ω Input / Output Match
- 20 dBm Output Power
- 5 V DC, 190 mA
- Die size: 1.97 x 1.30 x 0.1 mm
- Gold-Plated Contact Pads, Backside
- 100% On-Wafer DC & RF Tested
- RoHS* Compliant

Description
The MAAM-011109-DIE is an easy-to-use, wideband amplifier that operates from DC - 50 GHz. This device features 15 dB gain and +20 dBm of output power. Matching is 50 Ω with typical return loss better than 15 dB. This amplifier requires dual DC power supplies: 5V (190 mA) and a low current negative VG1 (< 1 mA).

Features include gate bias adjust to change current setting for power or temperature, gain trim control that allows 15 dB of gain control (0 to -1 V), and a temperature-compensated detector that provides a DC voltage in relation to the output power.

The MAAM-011109-DIE is ideally suited for any application that requires 50 Ω gain from DC to 50 GHz. It is useful in circuits where the incoming signal varies over a broad bandwidth such as laboratory, instrumentation, and defense applications.

Ordering Information

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAAM-011109-DIE</td>
<td>Die in Gel Pack</td>
</tr>
</tbody>
</table>

1. Die quantity varies.

* Restrictions on Hazardous Substances, compliant to current RoHS EU directive.

For further information and support please visit: https://www.macom.com/support
Wideband Amplifier
DC - 50 GHz

Electrical Specifications⁴:
\[ T_A = +25^\circ C, +5 \text{ V (applied to OUT)}, \text{VG1} = -0.4 \text{ V}, \text{VC} = \text{Open}, Z_{\text{IN}} = Z_{\text{OUT}} = 50 \Omega \]

<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>10 KHz - 2 GHz</td>
<td>dB</td>
<td>14.0</td>
<td>15.5</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>2 - 40 GHz</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>50 GHz</td>
<td></td>
<td>12</td>
<td></td>
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<tr>
<td>Isolation</td>
<td>DC - 50 GHz</td>
<td>dB</td>
<td>—</td>
<td>22</td>
<td>—</td>
</tr>
<tr>
<td>Input Return Loss</td>
<td>DC - 50 GHz</td>
<td>dB</td>
<td>—</td>
<td>15</td>
<td>—</td>
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<tr>
<td>Output Return Loss</td>
<td>DC - 20 GHz</td>
<td>dB</td>
<td>—</td>
<td>15</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>20 - 50 GHz</td>
<td></td>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Noise Figure</td>
<td>DC - 40 GHz</td>
<td>dB</td>
<td>—</td>
<td>3.5</td>
<td>—</td>
</tr>
<tr>
<td>P1dB</td>
<td>0.1 GHz</td>
<td>dBm</td>
<td>—</td>
<td>21</td>
<td>—</td>
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<tr>
<td></td>
<td>10 GHz</td>
<td></td>
<td>21</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>40 GHz</td>
<td></td>
<td>15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output IP3</td>
<td>0.1 GHz</td>
<td>dBm</td>
<td>—</td>
<td>29</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>10 GHz</td>
<td></td>
<td>29</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>40 GHz</td>
<td></td>
<td>19</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bias Current</td>
<td>—</td>
<td>mA</td>
<td>—</td>
<td>190</td>
<td>—</td>
</tr>
</tbody>
</table>

4. See Application Information for biasing details.

Absolute Maximum Ratings⁵,⁶

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Absolute Maximum</th>
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</thead>
<tbody>
<tr>
<td>Input Power</td>
<td>17 dBm</td>
</tr>
<tr>
<td>Drain Voltage</td>
<td>7.5 V</td>
</tr>
<tr>
<td>Drain Current</td>
<td>240 mA</td>
</tr>
<tr>
<td>Control Voltage</td>
<td>-1 V ≤ VC ≤ 1.2 V</td>
</tr>
<tr>
<td>Junction Temperature⁷,⁸</td>
<td>+150°C</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>

5. Exceeding any one or combination of these limits may cause permanent damage to this device.
6. MACOM does not recommend sustained operation near these survivability limits.
7. Operating at nominal conditions with \( T_J \leq +150^\circ C \) will ensure MTTF > 1 x 10⁶ hours.
8. Junction Temperature (\( T_J \)) = \( T_C + \Theta_{jc} \ast (V \ast I) \)
   Typical thermal resistance (\( \Theta_{jc} \)) = 17.8°C/W.
   a) For \( T_C = 25^\circ C \),
      \[ T_J = 47^\circ C \text{ @ 6.5V, 190mA} \]
   b) For \( T_C = 85^\circ C \),
      \[ T_J = 107^\circ C \text{ @ 6.5V, 190mA} \]

Handling Procedures
Please observe the following precautions to avoid damage:

Static Sensitivity
These electronic devices are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these Class 1A devices.
Biasing Schematic

Application Schematic (recommended biasing)

Parts List

Application Information (DC & Pads)

Biasing voltage and current affect both the bandwidth (response flatness), power available, noise figure, and linearity of the amplifier. Higher currents and lower bias voltage increase high frequency gain but reduce the P1dB and the OIP3 numbers. If the device is driven to P1dB and on into Psat the bias current will naturally reduce. The device will return to the quiescent current value once the input power is reduced. Finally, higher bias current values increase the device noise figure.

Temperature also affects the bandwidth, gain and noise figure of the device. Lower temperatures increase gain and bandwidth but reduce the noise figure. Temperature has little effect on power and linearity.
Typical Performance Curves over Temperature, 5 V / 190 mA

**Gain**

- S21 (dB) vs Frequency (GHz)
- +25°C, -40°C, +85°C

**Noise Figure**

- Noise Figure (dB) vs Frequency (GHz)
- +25°C, -40°C, +85°C

**Input Return Loss**

- S11 (dB) vs Frequency (GHz)
- +25°C, -40°C, +85°C

**Output Return Loss**

- S22 (dB) vs Frequency (GHz)
- +25°C, -40°C, +85°C

**Output P1dB**

- P1dB (dBm) vs Frequency (GHz)
- +25°C, -40°C, +85°C

**Output IP3**

- OIP3 (dBm) vs Frequency (GHz)
- +25°C, -40°C, +85°C
Typical Performance Curves over Current and Voltage (5 V unless otherwise noted)

**Gain over Current**

![Gain over Current Graph]

**Noise Figure over Current**

![Noise Figure over Current Graph]

**Input Return Loss over Current**

![Input Return Loss over Current Graph]

**Output Return Loss over Current**

![Output Return Loss over Current Graph]

**Output P1dB over Voltage and Current**

![Output P1dB over Voltage and Current Graph]

**Output IP3 over Voltage and Current**

![Output IP3 over Voltage and Current Graph]
Typical Performance Curves, 5 V / 190 mA unless otherwise noted

Gain vs. Frequency over voltage

Gain vs. Frequency, VC from -0.9 to +1.1 V

Output Saturated Power over Temperature

Output Saturated Power over Bias

Isolation over Temperature
Typical Performance Curves, 5 V / 190 mA unless otherwise noted

**VDET vs. Output Power**

**VDET vs. Output Power at 2 GHz over Temperature**

**Current vs. VG1**

**Gain vs. VD1 Bypass with 0.22 µF 0201 capacitors**

**Current vs. VC**

**Gain at 5 GHz vs. VC**
Wideband Amplifier
DC - 50 GHz

Outline Drawing

Bond Pad Detail in µm

<table>
<thead>
<tr>
<th>Pad</th>
<th>Size (x)</th>
<th>Size (y)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>85</td>
<td>65</td>
</tr>
<tr>
<td>B</td>
<td>85</td>
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</tr>
<tr>
<td>C</td>
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<td>D</td>
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<td>105</td>
</tr>
<tr>
<td>K</td>
<td>85</td>
<td>135</td>
</tr>
<tr>
<td>GND</td>
<td>78</td>
<td>91</td>
</tr>
</tbody>
</table>

Notes:
1. All units are in µm, unless otherwise noted, with a tolerance of ±5 µm.
2. Die thickness is 100 ±10 µm.
**Broadband Amplifier Applications**

The MAAM-011109-DIE also has a low enough noise figure to be used in instrumentation front ends and buffer applications. It also has very flat response with low group delay distortion so it can be used in pulse applications. For higher gains multiple amplifiers may be cascaded. It also makes a very good low cost optical driver capable of delivering up to 8 V p-p into 50 ohms.

**Variable Gain/Limiting Applications**

The gain of the MAAM-011109-DIE can be easily controlled with the VC pin. The gain reduction is almost linear with VC between 0.1 V to -0.8 V. Below -0.7 V internal ESD protection diodes will draw increasing current (50 mA at -1.0 V). The VC pad should not be driven below -1 V or above 1.2 V. The nominal open circuit voltage at the VC pad is 0.8 V.

Reducing VC below 0.8 V will also reduce the bias current. Gain, P1dB, and PSAT will all be reduced as the voltage on VC is lowered. Limiting applications and zero crossing adjustment can be done by adjusting the VG1 and VC pads together.

**Internal Detector**

The VDET pad is connected to an internal diode detector. This pad should be connected to a high impedance (>50 kΩ) or left unconnected. The detector is internally connected so that it responds predominately to the power generated by the amplifier and is temperature compensated. The detector has a low pass characteristic which rolls off gradually above 1 GHz. Finally, even with zero output power the detector has a DC output voltage proportional to the bias voltage (nominally 2.8 V for 5 V at the OUT pad).
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