Features

- Gain: 24.5 dB
- P_{1dB}: 29 dBm
- P_{SAT}: 30 dBm
- PAE at P_{SAT}: 40%
- OIP3: 40 dBm
- Typical bias conditions: 9 V, 265 mA
- Fully matched output
- Lead-Free 3 mm 16-LD PQFN package
- Halogen-Free “Green” Mold Compound
- RoHS* Compliant

Description

The MAAP-011232 is a 2-stage power amplifier with gain shut off, operating from 100 MHz to 3 GHz. For operation in the 100 MHz to 1 GHz frequency range no I/O matching is required. Internal DC blocking is provided at the input, while the RF output port is DC coupled through an external bias-tee. Bias current, RF gain and output power are controlled with a gate bias voltage (V_G). Typical current consumption is less than 300 mA at maximum output power.

The MAAP-011232 is well suited to both power and driver requirements for multiple applications such as LMR, Milcom, Sensors & Telemetry, Test & Measurement and Satcom.

The MAAP-011232 is fabricated using a GaAs D-mode high breakdown process which features full passivation for increased performance and reliability.

Ordering Information

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAAP-011232</td>
<td>Bulk</td>
</tr>
<tr>
<td>MAAP-011232-TR0500</td>
<td>500 Piece Reel</td>
</tr>
<tr>
<td>MAAP-011232-TR1000</td>
<td>1000 Piece Reel</td>
</tr>
<tr>
<td>MAAP-011232-001SMB</td>
<td>Sample Board Type A</td>
</tr>
<tr>
<td>MAAP-011232-002SMB</td>
<td>Sample Board Type B</td>
</tr>
</tbody>
</table>

1. Reference Application Note M513 for reel size information.
2. All sample boards include 5 loose parts.
3. MACOM recommends connecting unused package pins to ground.
4. The exposed pad centered on the package bottom must be connected to RF, DC and thermal ground.

1 W Driver Amplifier with VG Enable
0.1 - 3.0 GHz

Electrical Specifications:
Freq. = 1 GHz, $T_A = +25^\circ$C, $V_D1 = V_D2 = 9$ V, $I_{DO2} = 200$ mA, $Z_0 = 50$ $\Omega$,
$V_G$ pulsed with 1 ms pulse width and 10% duty cycle

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Test Conditions</th>
<th>Units</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small-Signal Gain</td>
<td>SSG</td>
<td>-10 dBm input drive level</td>
<td>dB</td>
<td>23</td>
<td>24.5</td>
<td>—</td>
</tr>
<tr>
<td>Output Power at 1dB compression</td>
<td>$P_{1dB}$</td>
<td>—</td>
<td>dBm</td>
<td>—</td>
<td>29</td>
<td>—</td>
</tr>
<tr>
<td>Saturated Output Power</td>
<td>$P_{SAT}$</td>
<td>3 dB Gain compression</td>
<td>dBm</td>
<td>28.5</td>
<td>30</td>
<td>—</td>
</tr>
<tr>
<td>Power Added Efficiency</td>
<td>PAE</td>
<td>3 dB Gain compression</td>
<td>%</td>
<td>35</td>
<td>40</td>
<td>—</td>
</tr>
<tr>
<td>Reverse Isolation</td>
<td>S12</td>
<td>-10 dBm input drive level</td>
<td>dB</td>
<td>—</td>
<td>50</td>
<td>—</td>
</tr>
<tr>
<td>Input Return Loss</td>
<td>IRL</td>
<td>-10 dBm input drive level</td>
<td>dB</td>
<td>—</td>
<td>8</td>
<td>—</td>
</tr>
<tr>
<td>Output Return Loss</td>
<td>ORL</td>
<td>-10 dBm input drive level</td>
<td>dB</td>
<td>—</td>
<td>12</td>
<td>—</td>
</tr>
<tr>
<td>Output Third Order Intercept</td>
<td>OIP3</td>
<td>-13 dBm/tone, $F_1-F_2 = 6$ MHz</td>
<td>dBm</td>
<td>—</td>
<td>40</td>
<td>—</td>
</tr>
<tr>
<td>Gate Bias Voltage</td>
<td>$V_G$</td>
<td>—</td>
<td>V</td>
<td>—</td>
<td>-0.55</td>
<td>—</td>
</tr>
<tr>
<td>Quiescent Drain Current</td>
<td>$I_{DO1}$</td>
<td>—</td>
<td>mA</td>
<td>—</td>
<td>65</td>
<td>—</td>
</tr>
</tbody>
</table>

Schematic of the Production Test Board

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Absolute Maximum Ratings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Absolute Maximum</th>
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<tbody>
<tr>
<td>RF Input Power</td>
<td>20 dBm</td>
</tr>
<tr>
<td>Gate Voltage</td>
<td>-4 V to 0 V</td>
</tr>
<tr>
<td>Drain Voltage VD1</td>
<td>10 V</td>
</tr>
<tr>
<td>Drain Voltage VD2</td>
<td>10 V</td>
</tr>
<tr>
<td>Junction Temperature</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>-55°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 $T_J \leq +150°C$ will ensure $MTTF > 1 \times 10^6$ hours.
8. Junction Temperature ($T_J$) = $T_C + \Theta_{JC} \times [(V \times I) - (P_{OUT} - P_{IN})]
   Typical thermal resistance ($\Theta_{JC}$) = 29°C/W.

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 (HBM) Class 1A devices.

Operating the MAAP-011232

To operate the device, follow these steps:

1. Set VG to -2 V.
2. Turn on VD1 and VD2 to 5-9 V.
3. Adjust VG to set $I_{DQ2}$ ($I_{DQ1}$ varies).
4. Turn off in reverse order with VG last.
Typical Electrical Specifications: Test Board A: 100 - 1600 MHz Input Tuning

\[ T_A = +25^\circ C, \ V_{D1} = V_{D2} = 9 \ V, \ I_{DQ1} = 200 \ mA, \ Z_0 = 50 \ \Omega, \ CW \]

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Sym-</th>
<th>Test Conditions</th>
<th>Units</th>
<th>Typical Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>F</td>
<td></td>
<td>MHz</td>
<td>100 700 1100 1600</td>
</tr>
<tr>
<td>Small-Signal Gain</td>
<td>SSG</td>
<td>-10 dBm input drive level</td>
<td>dB</td>
<td>16 26 25 21</td>
</tr>
<tr>
<td>Output Power at 1dB compression</td>
<td>P1dB</td>
<td>1 dB Gain compression</td>
<td>dBm</td>
<td>29 29 30 29</td>
</tr>
<tr>
<td>Saturated Output Power</td>
<td>PSAT</td>
<td>3 dB Gain compression</td>
<td>dBm</td>
<td>30 30 30.5 30</td>
</tr>
<tr>
<td>Power Added Efficiency</td>
<td>PAE</td>
<td>3 dB Gain compression</td>
<td>%</td>
<td>32 40 45 37</td>
</tr>
<tr>
<td>Reverse Isolation</td>
<td>S12</td>
<td>-10 dBm input drive level</td>
<td>dB</td>
<td>79 56 55 53</td>
</tr>
<tr>
<td>Input Return Loss</td>
<td>IRL</td>
<td>-10 dBm input drive level</td>
<td>dB</td>
<td>4 17 28 7</td>
</tr>
<tr>
<td>Output Return Loss</td>
<td>ORL</td>
<td>-10 dBm input drive level</td>
<td>dB</td>
<td>17 16 15 14</td>
</tr>
<tr>
<td>Output Third Order Intercept</td>
<td>OIP3</td>
<td>-13 dBm/tone, F1-F2 = 6 MHz</td>
<td>dBm</td>
<td>41 44 43 40</td>
</tr>
<tr>
<td>Gate Bias Voltage</td>
<td>V_G</td>
<td></td>
<td>V</td>
<td>-0.55</td>
</tr>
<tr>
<td>Quiescent Drain Current</td>
<td>I_DQ</td>
<td></td>
<td>mA</td>
<td>65</td>
</tr>
</tbody>
</table>

Schematic of the Test Board Type A: 100-1600 MHz Input Tuning

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Test Board Type A: 100 - 1600 MHz Input Tuning

PCB Material: R4003C LoPro, 0.008” THICK, Solid Copper filled vias

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
<th>Value</th>
<th>Size</th>
<th>Manufacturer</th>
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</thead>
<tbody>
<tr>
<td>C1</td>
<td>Capacitor</td>
<td>0.6 pF</td>
<td>0402</td>
<td>Murata</td>
</tr>
<tr>
<td>C2, C4</td>
<td>Capacitor</td>
<td>0.1 µF</td>
<td>0402</td>
<td>Murata</td>
</tr>
<tr>
<td>C3</td>
<td>Capacitor</td>
<td>100 pF</td>
<td>0402</td>
<td>Murata</td>
</tr>
<tr>
<td>C5</td>
<td>Capacitor</td>
<td>10 nF</td>
<td>0402</td>
<td>Murata</td>
</tr>
<tr>
<td>L1</td>
<td>Inductor</td>
<td>7.5 nH</td>
<td>0402</td>
<td>0402CS, Coilcraft</td>
</tr>
<tr>
<td>L2</td>
<td>Inductor</td>
<td>560 nH</td>
<td>0402</td>
<td>0402AF, Coilcraft</td>
</tr>
<tr>
<td>L3</td>
<td>Inductor</td>
<td>110 nH</td>
<td>0603</td>
<td>0603HP, Coilcraft</td>
</tr>
<tr>
<td>J1, J2</td>
<td>SMA Connector</td>
<td>—</td>
<td>—</td>
<td>142-0701-881 Emerson</td>
</tr>
</tbody>
</table>
Test Board Type A: S-parameters over Temperature
Test Conditions: $T_A = +25^\circ C$, $V_{D1} = V_{D2} = 9\, V$, $I_{DQ1} = 65\, mA$, $I_{DQ2} = 200\, mA$, $Z_0 = 50\, \Omega$, CW

**Insertion Gain vs. Frequency**

**Isolation vs. Frequency**

**Input Return Loss vs. Frequency**

**Output Return Loss vs. Frequency**
1 W Driver Amplifier with VG Enable
0.1 - 3.0 GHz

Test Board Type A - Power Performance @ Room Temperature
Test Conditions: $T_A = +25^\circ C$, $V_{D1} = V_{D2} = 9$ V, $I_{DQ1} = 65$ mA, $I_{DQ2} = 200$ mA, $Z_0 = 50$ $\Omega$, CW

$P_{OUT}$, Gain and Efficiency vs. $P_{IN}$ @ 700 MHz

Bias Current vs. $P_{IN}$ @ 700 MHz

$P_{OUT}$, Gain and Efficiency vs. $P_{IN}$ @ 1100 MHz

Bias Current vs. $P_{IN}$ @ 1100 MHz

$P_{OUT}$, Gain and Efficiency vs. $P_{IN}$ @ 1600 MHz

Bias Current vs. $P_{IN}$ @ 1600 MHz
MAAP-011232

1 W Driver Amplifier with VG Enable
0.1 - 3.0 GHz

Test Board Type A - Power Performance over Temperature
Test Conditions: TA = +25°C, VD1 = VD2 = 9 V, Ibo1 = 65 mA, Ibo2 = 200 mA, Zo = 50 Ω, CW

Saturated Power vs. Frequency

P1dB vs. Frequency

PAE vs. Frequency

Output IP3 vs. Frequency

Gain Control Range vs. Frequency

P_N = -13 dBm/tone, tone separation = 6 MHz

Measured for VG between -0.4 V and -1.4 V

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1 W Driver Amplifier with VG Enable
0.1 - 3.0 GHz

Typical Electrical Specifications: Test Board B: 1600 - 3000 MHz Input Tuning

\( T_A = +25^\circ C, V_{D1} = V_{D2} = 9 V, I_{DD2} = 200 mA, Z_0 = 50 \Omega, CW \)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Test Conditions</th>
<th>Units</th>
<th>Typical Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>( F )</td>
<td>—</td>
<td>MHz</td>
<td>2000 2500 3000</td>
</tr>
<tr>
<td>Small-Signal Gain</td>
<td>( SSG )</td>
<td>-10 dBm input drive level</td>
<td>dB</td>
<td>24 24 17</td>
</tr>
<tr>
<td>Output Power @ 1 dB compression</td>
<td>( P_{1,dB} )</td>
<td>1 dB Gain compression</td>
<td>dBm</td>
<td>29 29 30</td>
</tr>
<tr>
<td>Saturated Output Power</td>
<td>( P_{SAT} )</td>
<td>3 dB Gain compression</td>
<td>dBm</td>
<td>30 30 30.5</td>
</tr>
<tr>
<td>Power Added Efficiency</td>
<td>PAE</td>
<td>3 dB Gain compression</td>
<td>%</td>
<td>37 40.5 37</td>
</tr>
<tr>
<td>Reverse Isolation</td>
<td>( S12 )</td>
<td>-10 dBm input drive level</td>
<td>dB</td>
<td>51 52 54</td>
</tr>
<tr>
<td>Input Return Loss</td>
<td>( IRL )</td>
<td>-10 dBm input drive level</td>
<td>dB</td>
<td>9 11 2</td>
</tr>
<tr>
<td>Output Return Loss</td>
<td>( ORL )</td>
<td>-10 dBm input drive level</td>
<td>dB</td>
<td>10 9 9</td>
</tr>
<tr>
<td>Output Third Order Intercept</td>
<td>( OIP3 )</td>
<td>-13 dBm/tone, F1-F2 = 6 MHz</td>
<td>dBm</td>
<td>40 42 40</td>
</tr>
<tr>
<td>Gate Bias Voltage</td>
<td>( V_G )</td>
<td>—</td>
<td>V</td>
<td>-0.55</td>
</tr>
<tr>
<td>Quiescent Drain Current</td>
<td>( I_{DD1} )</td>
<td>—</td>
<td>mA</td>
<td>65</td>
</tr>
</tbody>
</table>

Schematic of the Test Board Type B: 1600-3000 MHz Input Tuning
1 W Driver Amplifier with VG Enable
0.1 - 3.0 GHz

Test Board Type B: 1600 - 3000 MHz Input Tuning

PCB Material: R4003C LoPro, 0.008" THICK, Solid Copper filled vias

Parts List

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
<th>Value</th>
<th>Size</th>
<th>Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>Capacitor</td>
<td>1.2 pF</td>
<td>0402</td>
<td>PPI</td>
</tr>
<tr>
<td>C4, C5</td>
<td>Capacitor</td>
<td>10 nF</td>
<td>0402</td>
<td>Murata</td>
</tr>
<tr>
<td>C2, C6</td>
<td>Capacitor</td>
<td>0.1 µF</td>
<td>0402</td>
<td>Murata</td>
</tr>
<tr>
<td>C3</td>
<td>Capacitor</td>
<td>100 pF</td>
<td>0402</td>
<td>Murata</td>
</tr>
<tr>
<td>L1</td>
<td>Inductor</td>
<td>5.6 nH</td>
<td>0402</td>
<td>0402HP, Coilcraft</td>
</tr>
<tr>
<td>L2</td>
<td>Inductor</td>
<td>560 nH</td>
<td>0402</td>
<td>0402AF, Coilcraft</td>
</tr>
<tr>
<td>L3</td>
<td>Inductor</td>
<td>110 nH</td>
<td>0603</td>
<td>0603HP, Coilcraft</td>
</tr>
<tr>
<td>L4</td>
<td>Inductor</td>
<td>10 nH</td>
<td>0402</td>
<td>0402HP, Coilcraft</td>
</tr>
<tr>
<td>L5</td>
<td>Inductor</td>
<td>3.3 nH</td>
<td>0402</td>
<td>0402HP, Coilcraft</td>
</tr>
<tr>
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<td>SMA Connector</td>
<td>—</td>
<td>—</td>
<td>142-0701-881 Emerson</td>
</tr>
</tbody>
</table>
**MAAP-011232**

**1 W Driver Amplifier with VG Enable**  
**0.1 - 3.0 GHz**  
Rev. V2

**Test Board Type B: S-parameters over Temperature**  
Test Conditions: $T_A = +25°C$, $V_{D1} = V_{D2} = 9$ V, $I_{DQ1} = 65$ mA, $I_{DQ2} = 200$ mA, $Z_0 = 50$ Ω, CW

**Insertion Gain vs. Frequency**

**Isolation vs. Frequency**

**Input Return Loss vs. Frequency**

**Output Return Loss vs. Frequency**
1 W Driver Amplifier with VG Enable
0.1 - 3.0 GHz

Test Board Type B - Power Performance @ Room Temperature
Test Conditions: $T_A = +25^\circ C$, $V_{D1} = V_{D2} = 9$ V, $I_{DQ1} = 65$ mA, $I_{DQ2} = 200$ mA, $Z_0 = 50$ $\Omega$, CW

$P_{OUT}$, Gain and Efficiency vs. $P_{IN}$ @ 2 GHz

Bias Current vs. $P_{IN}$ @ 2 GHz

$P_{OUT}$, Gain and Efficiency vs. $P_{IN}$ @ 2.5 GHz

Bias Current vs. $P_{IN}$ @ 2.5 GHz

$P_{OUT}$, Gain and Efficiency vs. $P_{IN}$ @ 3 GHz

Bias Current vs. $P_{IN}$ @ 3 GHz
1 W Driver Amplifier with VG Enable
0.1 - 3.0 GHz

Test Board Type B - Power Performance over Temperature
Test Conditions: $T_A = +25^\circ C$, $V_{D1} = V_{D2} = 9\, V$, $I_{DQ1} = 65\, mA$, $I_{DQ2} = 200\, mA$, $Z_0 = 50\, \Omega$, CW

_Saturated Power vs. Frequency_  

<table>
<thead>
<tr>
<th>Frequency (GHz)</th>
<th>+25°C</th>
<th>-40°C</th>
<th>+85°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>29</td>
<td>26</td>
<td>28</td>
</tr>
<tr>
<td>1.5</td>
<td>31</td>
<td>28</td>
<td>30</td>
</tr>
<tr>
<td>2.0</td>
<td>33</td>
<td>30</td>
<td>32</td>
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<tr>
<td>2.5</td>
<td>35</td>
<td>32</td>
<td>34</td>
</tr>
<tr>
<td>3.0</td>
<td>34</td>
<td>31</td>
<td>33</td>
</tr>
<tr>
<td>3.5</td>
<td>33</td>
<td>30</td>
<td>32</td>
</tr>
</tbody>
</table>

_PA E vs. Frequency_  

<table>
<thead>
<tr>
<th>Frequency (GHz)</th>
<th>+25°C</th>
<th>-40°C</th>
<th>+85°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>10</td>
<td>8</td>
<td>12</td>
</tr>
<tr>
<td>1.5</td>
<td>15</td>
<td>13</td>
<td>15</td>
</tr>
<tr>
<td>2.0</td>
<td>20</td>
<td>18</td>
<td>20</td>
</tr>
<tr>
<td>2.5</td>
<td>25</td>
<td>23</td>
<td>25</td>
</tr>
<tr>
<td>3.0</td>
<td>30</td>
<td>28</td>
<td>30</td>
</tr>
<tr>
<td>3.5</td>
<td>35</td>
<td>33</td>
<td>35</td>
</tr>
</tbody>
</table>

_Output IP3 vs. Frequency_  

<table>
<thead>
<tr>
<th>Frequency (GHz)</th>
<th>+25°C</th>
<th>-40°C</th>
<th>+85°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1.5</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>2.0</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>2.5</td>
<td>30</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>3.0</td>
<td>40</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>3.5</td>
<td>50</td>
<td>50</td>
<td>50</td>
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</tbody>
</table>

_Gain Control Range vs. Frequency_  

<table>
<thead>
<tr>
<th>Frequency (GHz)</th>
<th>+25°C</th>
<th>-40°C</th>
<th>+85°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>30</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>1.5</td>
<td>25</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>2.0</td>
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</tr>
<tr>
<td>2.5</td>
<td>15</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>3.0</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>3.5</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

Measured for $V_G$ between -0.4 V and -1.4 V

PN = -13 dBm/tone, tone separation = 6 MHz
Recommended Landing Pattern $^9,^{10}$

9. All dimensions are in inches.
10. Landing pattern indicates solder mask opening. Cu-filled via-holes under the ground are used for optimal thermal performance. Recommended pattern: 8-mil diameter, 8-mil spacing.

Lead-Free 3 mm 16-Lead PQFN†

† Reference Application Note M538 for lead-free solder reflow recommendations.
Meets JEDEC moisture sensitivity level 1 requirements.
Plating is 100% matte tin over copper.
1 W Driver Amplifier with VG Enable
0.1 - 3.0 GHz

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