Description
Avago Technologies’ ALM-1222 is a very low noise, high linearity balanced amplifier module operating in the 1.8 to 2.2GHz frequency range. The exceptional noise and linearity performances are achieved through the use of Avago Technologies’ proprietary 0.5um GaAs Enhancement-mode pHEMT process.

All matching components are fully integrated within the module and the 50Ω RF input and output pins are already internally AC-coupled. This makes the ALM-1222 extremely easy to use as the only external parts are DC supply bypass capacitors.

The ALM-1222 is housed in a miniature 5.0 x 6.0 x 1.1 mm³ 22-lead multiple-chips-on-board (MCOB) module package. The compact footprint and low profile makes this product an ideal choice for Wireless Infrastructure Basestation Tower-Mounted Amplifiers (TMA), Radiocards and Multi-Carrier Driver Amplifiers in the cellular/PCS/CDMA bands.

Component Image
5.0 x 6.0 x 1.1 mm³ 22-lead MCOB

Top View

Bottom View

Note:
Package marking provides orientation and identification
"ALM-1222" = Device Part Number
"YWWDD" = Year, work week and day of manufacture
"XXXX" = Assembly lot number

Features
- Low noise figure
- High linearity and P1dB
- GaAs E-pHEMT Technology[1]
- 50Ω internal matching
- Small package size: 5x6x1.1 mm³
- 5V supply
- Adjustable current for optimum NF or OIP3
- Excellent uniformity in product specifications
- Tape-and-Reel packaging option available
- MSL-2a and Lead-free
- Point MTTF > 300 years at 120°C channel temperature
- Shutdown function
- Specifications
  - 2GHz; 5V, 280mA (typ) per section
  - Vctrl typically at 2.3V
  - 31 dB Gain
  - 0.62 dB Noise Figure
  - 43.7 dBm Output IP3
  - 27.5 dBm Output Power at 1dB gain compression
  - 45dB Reverse Isolation

Applications
- Diversity Antenna, TMA & Front End LNA for EGSM/PCS/W-CDMA Base Stations.
- Driver amplifier.

Notes:
1. Enhancement mode technology employs positive gate voltage, thereby eliminating the need of negative gate voltage associated with conventional depletion mode devices.

Attention: Observe precautions for handling electrostatic sensitive devices.
ESD Machine Model = 50 V
ESD Human Body Model = 250 V
Refer to Avago Technologies Application Note A004R: Electrostatic Discharge, Damage and Control.
Absolute Maximum Rating \( T_A = 25^\circ C \)

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Units</th>
<th>Absolute Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vdd</td>
<td>Device Voltage, RF output to ground</td>
<td>V</td>
<td>5.5</td>
</tr>
<tr>
<td>Vctrl</td>
<td>Control Voltage</td>
<td>V</td>
<td>3.0</td>
</tr>
<tr>
<td>Pin,max</td>
<td>CW RF Input Power (Vdd = 5.0, Idd=280mA)</td>
<td>dBm</td>
<td>22</td>
</tr>
<tr>
<td>Pdiss</td>
<td>Total Power Dissipation (^{[4]})</td>
<td>W</td>
<td>5</td>
</tr>
<tr>
<td>TJ</td>
<td>Junction Temperature (^{[3]})</td>
<td>°C</td>
<td>150</td>
</tr>
<tr>
<td>TSTG</td>
<td>Storage Temperature</td>
<td>°C</td>
<td>-65 to 150</td>
</tr>
</tbody>
</table>

Notes:
2. Operation of this device in excess of any of these limits may cause permanent damage.
3. Thermal resistance measured using Infra-Red measurement technique.
4. Board (module belly) temperature \( T_B \) is 25 °C. Derate 50mW/°C for \( T_B > 95 \) °C.

Thermal Resistance \(^{[3]}\)(Vdd = 5.0V, Vctrl=2.2V) \( \Thetajc = 20 \) °C/W

Product Consistency Distribution Charts \(^{[5,6]}\)

**Process Capability for NF**

- Nominal = 0.62, USL = 1.0
- Std dev = 0.014
- CPK > 2

**Process Capability for Gain**

- LSL = 29.5, Nominal = 31.0
- Std dev = 0.35
- CPK = 1.45

**Process Capability for OIP3**

- LSL = 39.0, Nominal = 43.7
- Std dev = 0.07
- CPK_L = 2.0
- CPK_U = 2.1

**Process Capability for Vctrl**

- LSL = 1.9, Nominal = 2.2, USL = 2.8
- Std dev = 0.07
- CPK_L = 2.0
- CPK_U = 2.1

Note:
5. Distribution data sample size is 500 samples taken from 3 different wafers and 3 different lots. Future wafers allocated to this product may have nominal values anywhere between the upper and lower limits.
6. Measurements are made on a production test board, which can show a variance of up to 1dB in gain and OIP3 compared to a soldered-down demo board. Input trace losses have been de-embedded from actual measurements.
Electrical Specifications [7], [10]

$T_A = 25 \, ^\circ C$, $V_{dd} = 5V @ 280mA$, RF performance at 2.0 GHz, given for each of the 2 RF paths, measured on demo board (see Fig. 5) unless otherwise specified.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter and Test Condition</th>
<th>Units</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vctrl</td>
<td>Control Voltage, $I_{dd}=280mA$</td>
<td></td>
<td>1.9</td>
<td>2.3</td>
<td>2.8</td>
</tr>
<tr>
<td>Gain</td>
<td>Gain</td>
<td>dB</td>
<td>29.5</td>
<td>31</td>
<td>32.5</td>
</tr>
<tr>
<td>OIP3 [8]</td>
<td>Output Third Order Intercept Point</td>
<td>dBm</td>
<td>39</td>
<td>43.7</td>
<td>-</td>
</tr>
<tr>
<td>NF [9]</td>
<td>Noise Figure (Typ.$V_{ctrl}=2.2V$)</td>
<td>dB</td>
<td>-</td>
<td>0.62</td>
<td>1.00</td>
</tr>
<tr>
<td>OP1dB</td>
<td>Output Power at 1dB Gain Compression</td>
<td>dBm</td>
<td>-</td>
<td>27.5</td>
<td>-</td>
</tr>
<tr>
<td>S11</td>
<td>Input Return Loss, 50Ω source</td>
<td>dB</td>
<td>-</td>
<td>-8</td>
<td>-</td>
</tr>
<tr>
<td>S22</td>
<td>Output Return Loss, 50Ω load</td>
<td>dB</td>
<td>-</td>
<td>-10</td>
<td>-</td>
</tr>
<tr>
<td>S12</td>
<td>Reverse Isolation</td>
<td>dB</td>
<td>-</td>
<td>45</td>
<td>-</td>
</tr>
<tr>
<td>ISO1-2</td>
<td>Isolation between RF Input 1 and RF Input 2</td>
<td>dB</td>
<td>-</td>
<td>22</td>
<td>-</td>
</tr>
</tbody>
</table>

Notes:
7. Measurements at 2GHz obtained using demo board described in Fig 5.
8. 2GHz OIP3 test condition: $f_{RF1} = 2.0$ GHz, $f_{RF2} = 2.01$ GHz with input power of -20dBm per tone measured at lower side band.
9. For NF data, board losses of 0.12dB at the input have been de-embedded.
10. Use proper bias, heatsink and derating to ensure maximum channel temperature is not exceeded. See absolute maximum ratings and application note for more details.
Demo Board Layout

<table>
<thead>
<tr>
<th>Circuit Symbol</th>
<th>Size</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1, C10</td>
<td>0805</td>
<td>2.2uF ceramic</td>
</tr>
<tr>
<td>C2, C7</td>
<td>0402</td>
<td>Not used</td>
</tr>
<tr>
<td>C3, C6</td>
<td>0402</td>
<td>0.1uF ceramic</td>
</tr>
<tr>
<td>C4, C9</td>
<td>0402</td>
<td>Not used</td>
</tr>
<tr>
<td>C5, C8</td>
<td>0402</td>
<td>0.1uF ceramic</td>
</tr>
</tbody>
</table>

Recommended PCB material is 10 mils Rogers RO4350.
Suggested component values may vary according to layout and PCB material.

Demo Board Schematic

Figure 5. Demo Board Layout Diagram

Figure 6. Demo Board Schematic Diagram
Balanced Amplifier Demo Board Layout

<table>
<thead>
<tr>
<th>Circuit Symbol</th>
<th>Size</th>
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<tbody>
<tr>
<td>C1, C10</td>
<td>0805</td>
<td>2.2uF ceramic</td>
</tr>
<tr>
<td>C2, C7</td>
<td>0402</td>
<td>Not used</td>
</tr>
<tr>
<td>C3, C6</td>
<td>0402</td>
<td>0.1uF ceramic</td>
</tr>
<tr>
<td>C4, C9</td>
<td>0402</td>
<td>Not used</td>
</tr>
<tr>
<td>C5, C8</td>
<td>0402</td>
<td>0.1uF ceramic</td>
</tr>
<tr>
<td>R1, R4</td>
<td>0402</td>
<td>Not used</td>
</tr>
<tr>
<td>R2, R3</td>
<td>0402</td>
<td>49.9 ohms</td>
</tr>
<tr>
<td>Coupler</td>
<td>14.22x5.08 mm²</td>
<td>Anaren Xinger II XC1600E-03 or equiv</td>
</tr>
</tbody>
</table>

Figure 7. Suggested Balanced Amplifier Demo Board Layout

Recommended PCB material is 10 mils Rogers RO4350.

Suggested component values may vary according to layout and PCB material.

Balanced Demo Board Schematic

Figure 8. Application Schematic for Balanced Amplifier
ALM-1222 Typical Performance I

$T_A = +25 \, ^\circ C, \, V_{dd} = 5V, \, I_{dd} = 280mA$ Input Signal=CW unless stated otherwise.

Figure 9. NF vs Frequency and channel

Figure 10. Gain vs Frequency and channel

Figure 11. S11 vs Frequency and channel

Figure 12. S22 vs Frequency and channel

Figure 13. Isolation vs Frequency and channel

Figure 14. NF vs Frequency and temperature

Figure 15. Gain vs Frequency and temperature

Figure 16. OIP3 vs Frequency and temperature

Figure 17. OP1dB vs Frequency and temperature
ALM-1222 Typical Performance II

$T_A = +25 \, ^\circ C, V_{dd} = 5V, I_{dd} = 280mA, Frequency = 2GHz$. Input Signal=CW unless stated otherwise.

**Figure 18. NF vs Idd and temperature**

**Figure 19. Gain vs Idd and temperature**

**Figure 20. OIP3 vs Idd and temperature**

**Figure 21. OP1dB vs Vctrl and temperature**

**Figure 22. S11 vs Idd and temperature**

**Figure 23. S22 vs Idd and temperature**

**Figure 24. Stability over frequency**
Package Dimensions

Device Orientation

Tape Dimensions
Reel Dimensions

![Reel Dimensions Diagram]

Part Number Ordering Information

<table>
<thead>
<tr>
<th>Part Number</th>
<th>No. of Devices</th>
<th>Container</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALM-1222-BLKG</td>
<td>100</td>
<td>Antistatic bag</td>
</tr>
<tr>
<td>ALM-1222-TR1G</td>
<td>1000</td>
<td>7” Reel</td>
</tr>
<tr>
<td>ALM-1222-TR2G</td>
<td>3000</td>
<td>13” Reel</td>
</tr>
</tbody>
</table>

For product information and a complete list of distributors, please go to our web site:  www.avagotech.com

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