**ALM-32320**
3.3GHz – 3.9GHz
2 Watt High Linearity Amplifier

**Data Sheet**

**Description**
Avago Technologies’ ALM-32320 is a high linearity 2 Watt PA with good OIP3 performance and exceptionally good PAE at 1dB gain compression point, achieved through the use of Avago Technologies’ proprietary 0.25um 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-32320 extremely easy to use as the only external parts are DC supply bypass capacitors.

The adjustable temperature-compensated internal bias circuit allows the device to be operated at either class A or class AB operation. The ALM-32320 is housed inside a miniature 7.0 x 10.0 x 1.1 mm³ 20-lead multiple-chips-on-board (MCOB) module package.

**Features**
- Fully matched, input and output
- High linearity and P1dB
- Unconditionally stable across load condition
- Built-in adjustable temperature compensated internal bias circuitry
- GaAs E-pHEMT Technology\(^1\)
- 5V supply
- Excellent uniformity in product specifications
- Tape-and-Reel packaging option available
- MSL-3 and Lead-free
- High MTTF for base station application

**Specifications**
3.5GHz; 5V, 810mA (typical)
- 12.6 dB Gain
- 51.0 dBm Output IP3
- 34.5 dBm Output Power at 1dB Gain Compression
- 46.6% PAE at P1dB
- 2.5dB Noise Figure

**Applications**
- Class A driver amplifier for WiMAX base stations.
- General purpose gain block.

**Note:**
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 = 80 V
ESD Human Body Model = 800 V
Refer to Avago Application Note A004R: Electrostatic Discharge, Damage and Control.

---

**Component Image**
7.0 x 10.0 x 1.1mm³ 20-Lead MCOB Package

[Component Diagram]

Note:
Package marking provides orientation and identification
"32320" = Device Part Number
"WWYY" = Work week and year of manufacture
"XXXX" = Last 4 digit of lot number

---
Absolute Maximum Rating\(^2\) \(T_A=25^\circ C\)

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Units</th>
<th>Absolute Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>(V_{dd,max})</td>
<td>Device Voltage, RF output to ground</td>
<td>V</td>
<td>5.5</td>
</tr>
<tr>
<td>(I_{ds,max})</td>
<td>Device Drain Current</td>
<td>mA</td>
<td>1500</td>
</tr>
<tr>
<td>(V_{ctrl,max})</td>
<td>Control Voltage</td>
<td>V</td>
<td>5.5</td>
</tr>
<tr>
<td>(P_{in,max})</td>
<td>CW RF Input Power</td>
<td>dBm</td>
<td>28</td>
</tr>
<tr>
<td>(P_{diss})</td>
<td>Total Power Dissipation (^4)</td>
<td>W</td>
<td>8.25</td>
</tr>
<tr>
<td>(T_{j, max})</td>
<td>Junction Temperature</td>
<td>°C</td>
<td>150</td>
</tr>
<tr>
<td>(T_{STG})</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. This is limited by maximum \(V_{dd}\) and \(I_{ds}\). Derate 66.7mW/\(^\circ C\) for \(T_c > 26.2^\circ C\).

Thermal Resistance\(^3\) \(\theta_{jc} = 15^\circ C/W\) (\(V_{dd} = 5V, I_{ds} = 810mA, T_c = 85^\circ C\))

Product Consistency Distribution Charts\(^5\)

- **Figure 1.** \(I_{ds}\); LSL = 690mA, nominal = 810mA, USL = 910mA
- **Figure 2.** OIP3; LSL = 48dBm, nominal = 51dBm
- **Figure 3.** P1dB; LSL = 33dBm, nominal = 34.5dBm
- **Figure 4.** PAE at P1dB; nominal = 46.6%

Note:
5. Distribution data sample size is 500 samples taken from 3 different wafer lots. \(T_A = 25^\circ C\), \(V_{dd} = 5V, V_{ctrl} = 5V\), RF performance at 3.5GHz unless otherwise specified. 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. Input trace losses have not been de-embedded from actual measurements.
**Electrical Specifications**[7]

$T_A = 25 \degree C$, $Vdd = 5V$, $Vctrl = 5V$, RF performance at 3.5GHz, measured on demo board (see Figure 7) 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>$I_{ds}$</td>
<td>Quiescent current</td>
<td>mA</td>
<td>810</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$I_{crl}$</td>
<td>Vctrl current</td>
<td>mA</td>
<td>28</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gain</td>
<td>Gain</td>
<td>dB</td>
<td>12.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OIP3[8]</td>
<td>Output Third Order Intercept Point</td>
<td>dBm</td>
<td>50.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OP1dB</td>
<td>Output Power at 1dB Gain Compression</td>
<td>dBm</td>
<td>34.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PAE</td>
<td>Power Added Efficiency</td>
<td>%</td>
<td>46.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NF</td>
<td>Noise Figure</td>
<td>dB</td>
<td>2.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S11</td>
<td>Input Return Loss, 50Ω source</td>
<td>dB</td>
<td>-9.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S22</td>
<td>Output Return Loss, 50Ω load</td>
<td>dB</td>
<td>-12.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S12</td>
<td>Reverse Isolation</td>
<td>dB</td>
<td>-26.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**

7. Measurements at 3.5GHz obtained using demo board described in Figure 6 and 7.
8. OIP3 test condition: $|f_{RF1} - f_{RF2}| = 10MHz$ with input power of -5dBm per tone measured at worst side band.
9. Use proper biasing, heat sink and de-rating to ensure maximum channel temperature is not exceeded. See absolute maximum ratings and application note (if applicable) for more details.
Note:
To supply Vdd1 and Vdd2 individually, remove R4 and supply Vdd1 from pin 1,2 and Vdd2 from pin 19,20

Figure 6. Demo board application schematics and components table

<table>
<thead>
<tr>
<th>Circuit Symbol</th>
<th>Size</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1, C10</td>
<td>0805</td>
<td>2.2uF</td>
<td>Ceramic Chip Capacitor</td>
</tr>
<tr>
<td>C2, C4, C9</td>
<td>0402</td>
<td>0.1uF</td>
<td>Ceramic Chip Capacitor</td>
</tr>
<tr>
<td>C3, C5, C8</td>
<td>0402</td>
<td>10nF</td>
<td>Ceramic Chip Capacitor</td>
</tr>
<tr>
<td>C6, C7</td>
<td>0402</td>
<td>N/A</td>
<td>Not Used</td>
</tr>
<tr>
<td>R1, R2</td>
<td>1206</td>
<td>0 Ohm</td>
<td>Chip Resistor</td>
</tr>
<tr>
<td>R3</td>
<td>0402</td>
<td>N/A</td>
<td>Not Used</td>
</tr>
<tr>
<td>R4</td>
<td>0805</td>
<td>0 Ohm</td>
<td>Chip Resistor</td>
</tr>
<tr>
<td>Z1, Z2</td>
<td>0805</td>
<td>N/A</td>
<td>Zener Diode 5.6V (Optional)</td>
</tr>
</tbody>
</table>

Demo board layout

1. Recommended PCB material is 10 mils Rogers RO4350, with FR4 backing for mechanical strength.
2. Suggested component values may vary according to layout and PCB material.

Figure 7. Demo board layout diagram
ALM-32320 Typical Over-Temperature Performance

$V_{dd} = 5V$, $V_{ctrl} = 5V$, Input Signal = CW unless stated otherwise.

Figure 8. Over temperature $I_d$ vs Temperature

Figure 9. Over temperature $OIP3$ vs Frequency

Figure 10. Over temperature $P1dB$ vs Frequency

Figure 11. Over temperature Gain vs Frequency

Figure 12. Over temperature $S11$ vs Frequency

Figure 13. Over temperature $S22$ vs Frequency
Figure 14. Over temperature S12 vs Frequency

Figure 15. Over temperature WiMAX EVM vs Output Power @ 3.3GHz

Figure 16. Over temperature WiMAX EVM vs Output Power @ 3.5GHz

Figure 17. Over temperature WiMAX EVM vs Output Power @ 3.9GHz
PCB Layout and Stencil Design

C’fer 0.3X45°

PCB Land Pattern (Top View)

Stencil Outline

Combined PCB and stencil layout Land Pattern (Top View)

Note:
All dimensions are in millimeters.

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-32320-TR1G</td>
<td>1000</td>
<td>13&quot; Reel</td>
</tr>
<tr>
<td>ALM-32320-TR2G</td>
<td>3000</td>
<td>13&quot; Reel</td>
</tr>
<tr>
<td>ALM-32320-BLKG</td>
<td>100</td>
<td>antistatic bag</td>
</tr>
</tbody>
</table>
MCOB 7 x 10 Package Dimensions

**Notes:**
1. All dimensions are in millimeters
2. Dimensions are inclusive of plating
3. Dimensions are exclusive of mold flash and metal burr
Tape Dimensions

Device Orientation

USER FEED DIRECTION

REEL

CARRIER TAPE

USER FEED DIRECTION

COVER TAPE

TOP VIEW

END VIEW

A.  
K.  
B.  

MM [INCH]

8˚ MAX

7.11 ± .10
[.280 ± .004]

.330 ± .013
[.0130 ± .0005]

1.50 ± .05
[.059 ± .004]

2.00 ± .10
[.079 ± .004]

1.50 ± .10
[.059 ± .004]

4.00 ± .10
[.157 ± .004]

11.50 ± .10
[.453 ± .004]

24.00 ± .30 − .10
[.945 ± .012 − .004]

1.50 ± .25
[.059 ± .010]

7.11 ± .10
[.280 ± .004]

1.52 ± .10
[.060 ± .004]

10.08 ± .10
[.397 ± .004]