8 – 12GHz 10 Watt High Power Amplifier

Features
- Frequency Range: 8 – 12GHz
- 40 dBm Psat
- 25 dB Small Signal Gain
- 28% PAE
- High IP3
- DC decoupled input and output
- InGaAs pHEMT Technology
- Chip dimension: 4.8 x 4.1 x 0.1 mm

Typical Applications
- RADAR
- Military & space
- LMDS, VSAT

Description
The ASL4039 is X-band Power amplifier operates in 8 – 12GHz frequency range with 40dBm output power over entire bandwidth. The PA uses 3 stages of amplification featuring 25 dB of Small Signal Gain with input & output return losses better than 10dB and 28% PAE over the operating frequency. The chip operates with dual bias supply voltage. The die is fabricated using a reliable 0.25µm InGaAs pHEMT technology. The Circuit grounds are provided through vias to the backside metallization.

Absolute Maximum Ratings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Absolute Maximum</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drain bias voltage ( V_{d1} = V_{d2} = V_{d3} @ I_d = 3.5A )</td>
<td>+9</td>
<td>volts</td>
</tr>
<tr>
<td>Drain Current ( I_d = I_{d1} + I_{d2} + I_{d3} ) at ( V_d = 8.5V )</td>
<td>5.5</td>
<td>A</td>
</tr>
<tr>
<td>Gate Bias Voltage ( V_g = V_{g1} = V_{g2} = V_{g3} )</td>
<td>(-2.2 &lt; V_g &lt; -0.6 )</td>
<td>V</td>
</tr>
<tr>
<td>RF input power (RFin at ( V_d = 8.5V ))</td>
<td>23</td>
<td>dBm</td>
</tr>
<tr>
<td>Operating temperature</td>
<td>-50 to +85</td>
<td>°C</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>-65 to +150</td>
<td>°C</td>
</tr>
</tbody>
</table>

1. Operation beyond these limits may cause permanent damage to the component
Electrical Specifications\(^{(1)}\) @ \( T_A = 25 \, ^\circ C \), \( V_d = V_{d1} = V_{d2} = V_{d3} = 8.5 \text{V} \),

\( \text{Total Current (} I_{dq} \text{)} = I_{dq1} + I_{dq2} + I_{dq3} = 3.5 \text{A}, \ Z_o = 50 \, \Omega \), Pulse Duty Cycle = 10%

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency Range</td>
<td>8</td>
<td>25</td>
<td>12</td>
<td>GHz</td>
</tr>
<tr>
<td>Small Signal Gain</td>
<td>-</td>
<td>25</td>
<td>-</td>
<td>dB</td>
</tr>
<tr>
<td>Gain Flatness</td>
<td>-</td>
<td>+/-3</td>
<td>-</td>
<td>dB</td>
</tr>
<tr>
<td>Input Return Loss</td>
<td>-</td>
<td>&lt;-10</td>
<td>-</td>
<td>dB</td>
</tr>
<tr>
<td>Output Return Loss</td>
<td>-</td>
<td>&lt;-15</td>
<td>-</td>
<td>dB</td>
</tr>
<tr>
<td>Saturated output power (Psat)</td>
<td>-</td>
<td>40</td>
<td>-</td>
<td>dBm</td>
</tr>
<tr>
<td>Power Added Efficiency (PAE)(^2)</td>
<td>-</td>
<td>28%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Gate Voltage ((V_g=V_{g1}=V_{g2}=V_{g3}))(^3)</td>
<td>-1</td>
<td>-0.75</td>
<td>-0.6</td>
<td>V</td>
</tr>
<tr>
<td>Supply Current((I_{dq}))</td>
<td>-</td>
<td>3.5</td>
<td>-</td>
<td>A</td>
</tr>
</tbody>
</table>

Note:

1. The above electrical specifications are on carrier measurements with 50 Ohms probes.
2. PAE is measured at 2dB Gain Compression Point.
3. Gate Bias Voltage "\( V_g \)" needs to be adjusted over the range mentioned in the above table in order to set the required value of "\( I_{dq} \)."
On Carrier Measurements with 50 Ohms Probes:

\[ V_{d1} = V_{d2} = V_{d3} = 8.5\, \text{V}, \; \text{Total Current (I_{dq})} = 3.5\, \text{A}, \; T_A = 25\, \text{^\circ C}, \; \text{Pulse Duty Cycle} = 10\% \]
On Carrier Measurements with 50 Ohms Probes:

\[ V_{d1} = V_{d2} = V_{d3} = 8.5V, \quad \text{Total Current} (I_{dq}) = 3.5A, \quad T_A = 25^\circ C, \quad \text{Pulse Duty Cycle} = 10\% \]
On Carrier Measurements with 50 Ohms Probes:

\[ V_{d1} = V_{d2} = V_{d3} = 8.5V, \quad \text{Total Current} \ (I_{dq}) = 3.5A, \quad T_A = 25 \, ^\circ C, \quad \text{Pulse Duty Cycle} = 10\% \]
On Carrier Measurements with 50 Ohms Probes:

\[ V_{d1}=V_{d2}=V_{d3}=8.5\text{V}, \text{ Total Current (I}_{dq})=3.5\text{A}, T_A=25^\circ\text{C}, \text{ Pulse Duty Cycle}=10\% \]
Bond Pad Details:

**Units:** millimeters (inches)

**Note:**

1. RF and DC bond pads are 100µm x 100µm
2. Pad no. 1: RF IN
3. Pad no. 14: RF Output
4. Pad no. 3,25: 1st stage gate voltage \( V_{g1} \)
5. Pad no. 5,23: 1st stage drain voltage \( V_{d1} \)
6. Pad no. 7,21: 2nd stage gate voltage \( V_{g2} \)
7. Pad no. 8,20: 2nd stage drain voltage \( V_{d2} \)
8. Pad no. 10,18: 3rd stage gate voltage \( V_{g3} \)
9. Pad no. 12,16: 3rd stage drain voltage \( V_{d3} \)
10. Pad no. 2,4,6,9,11,13,15,17,19,22,24: GND

All the dimensions shown above are measured taking bottom left corner as reference.

### Off Chip Components used for On Carrier Assembly:

<table>
<thead>
<tr>
<th>Component Name</th>
<th>Part Number/Description</th>
<th>Vendor</th>
</tr>
</thead>
<tbody>
<tr>
<td>47pF SLC Capacitors (C1)</td>
<td>CAP DI SL 47PF±10% 50V - D20BJ470K5PX or Equivalent</td>
<td>DLI</td>
</tr>
<tr>
<td>10kF MLC Capacitor (C2)</td>
<td>04023C1013KAT2A±10%:25V or Equivalent</td>
<td>AVX Corp.</td>
</tr>
<tr>
<td>1uF MLC Capacitor (C4)</td>
<td>0402YC105KAT2A±10%;16V or Equivalent</td>
<td>AVX Corp.</td>
</tr>
<tr>
<td>220kF MLC Capacitor (C3)</td>
<td>0402Y224KAT2A±10%;16V or Equivalent</td>
<td>AVX Corp.</td>
</tr>
</tbody>
</table>

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Recommended Assembly Diagram

Note:

1. Two 1 mil (0.0254mm) bond wires of minimum length should be used for RF input and output.
2. Two 1 mil (0.0254mm) bond wires of minimum length should be used from chip bond pad to 47pF single layer bypass capacitors.
3. Input and output 50 ohm lines are preferably on 5 mil RT Duroid substrate.
4. 47pF single layer bypass capacitors mentioned above need to be placed at closest possible distance to the corresponding DC bond pads.
5. The RF input & output ports are DC decoupled on-chip.
6. This chip is not preferred to be operated under continuous DC voltages, unless it is applied with considerably low drain voltage level (Vd ≤ 5V).
7. Proper heat sink like Copper tungsten or copper molybdenum to be used for better reliability of chip.

Die attach: Eutectic attachment using flux less AuSn (80/20) 1-2 mil thick preform solder is recommended. Use of AuGe preform should be strictly avoided.

Wire bonding: For DC pad connections use either ball or wedge bonds. For best RF performance, use of 150 to 200µm length of wedge bonds is advised. Single Ball bonds of 250-300µm though acceptable, may cause a deviation in RF performance.

GaAs MMIC devices are susceptible to Electrostatic discharge. Proper precautions should be observed during handling, assembly & testing

All information and Specifications are subject to change without prior notice. Before using the product, please download and refer to latest datasheet from website.