HMC863ALC4

GaAs pHEMT MMIC 1/2 WATT
POWER AMPLIFIER, 24 - 29.5 GHz

Typical Applications
The HMC863ALC4 is ideal for:
• Point-to-Point Radios
• Point-to-Multi-Point Radios
• VSAT
• Military & Space

Features
High P1dB Output Power: +27 dBm
High Psat Output Power: +28.5 dBm
High Gain: 24 dB
High Output IP3: +38.5 dBm
Supply Voltage: +5.5 V @ 350 mA
No External Matching Required
24 Lead 4x4 mm SMT Package: 16 mm²

General Description
The HMC863ALC4 is a three stage GaAs pHEMT MMIC 1/2 Watt Power Amplifier which operates between 24 and 29.5 GHz. The HMC863ALC4 provides 24 dB of gain, +28.5 dBm of saturated output power and 22.5% PAE from a +5.5V supply. High output IP3 makes the HMC863ALC4 ideal for point-to-point and point-to-multi-point radio systems as well as VSAT applications. The RF I/Os are DC blocked and matched to 50 Ohms for ease of integration into higher level assemblies. The HMC863ALC4 can be operated over a Vdd range of +4.0 to +6.0V.

Functional Diagram

Electrical Specifications, $T_a = +25^\circ$ C, $Vdd = +5.5$ V, $Idd = 350$ mA*

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency Range</td>
<td>24</td>
<td>24</td>
<td>29.5</td>
<td>24</td>
<td>24</td>
<td>29.5</td>
<td>GHz</td>
</tr>
<tr>
<td>Gain</td>
<td>20.5</td>
<td>24</td>
<td></td>
<td>24</td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>Gain Flatness</td>
<td>2</td>
<td>1.5</td>
<td></td>
<td>0.03</td>
<td>0.03</td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>Gain Variation Over Temperature</td>
<td></td>
<td>0.03</td>
<td></td>
<td></td>
<td>0.03</td>
<td></td>
<td>dB/°C</td>
</tr>
<tr>
<td>Input Return Loss</td>
<td>8</td>
<td>17.5</td>
<td></td>
<td>15</td>
<td>15</td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>Output Return Loss</td>
<td>13</td>
<td>15</td>
<td></td>
<td>27</td>
<td>27</td>
<td></td>
<td>dBm</td>
</tr>
<tr>
<td>Output Power for 1 dB Compression (P1dB)</td>
<td>24.5</td>
<td>27</td>
<td></td>
<td>28.5</td>
<td>28.5</td>
<td></td>
<td>dBm</td>
</tr>
<tr>
<td>Saturated Output Power (Psat)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>dBm</td>
</tr>
<tr>
<td>Output Third Order Intercept (IP3) *Pout/Tone = + 14 dBm</td>
<td>38.5</td>
<td>37.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>dBm</td>
</tr>
<tr>
<td>Noise Figure</td>
<td>4.5</td>
<td>6</td>
<td></td>
<td>5</td>
<td>5</td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>Supply Current (Idd)</td>
<td>350</td>
<td></td>
<td></td>
<td>350</td>
<td></td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>Supply Voltage (Vdd)</td>
<td>4</td>
<td>5.5</td>
<td>6</td>
<td>4</td>
<td>5.5</td>
<td>6</td>
<td>V</td>
</tr>
</tbody>
</table>

* Adjust Vgg1 between -2 to 0 V to achieve IDD = 350 mA; Typical Vgg1 = -0.75 V.
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Broadband Gain and Return Loss

Gain vs. Temperature

Gain vs. Vdd

Gain vs. Idd

Input Return Loss vs. Temperature

Input Return Loss vs. Vdd
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Input Return Loss vs. Idd

Output Return Loss vs. Temperature

Output Return Loss vs. Vdd

Output Return Loss vs. Idd

Reverse Isolation vs. Temperature

Noise Figure vs. Temperature
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- Noise Figure vs. Vdd
- Noise Figure vs. Idd
- P1dB vs. Temperature
- P1dB vs. Vdd
- P1dB vs. Idd
- Psat vs. Temperature
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Psat vs. Vdd

Psat vs. Idd

Power Compression @ 25 GHz

PAE @ Psat vs. Frequency

Power Dissipation @ 85°C

Gain and Power vs. Vdd @ 25 GHz

For price, delivery, and to place orders: Analog Devices, Inc., One Analog Way, Wilmington, MA 01887
Phone: 781-937-1428 • Order online at www.analog.com
Application Support: Phone: 1-800-ANALOG-D
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Gain and Power vs. Idd @ 25 GHz

OIP3 vs. Temperature
@ Pout / Tone = +14 dBm

OIP3 vs. Vdd
@ Pout / Tone = +14 dBm

OIP3 vs. Idd
@ Pout / Tone = +14 dBm

OIP3 vs. Pout / Tone

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**Output IM3**

**Igd vs. Input Power**

**Output IM3 @ Vdd = +6.0 V, Idd = 350 mA**

**Idd vs. Vgg1,**
Representative of a Typical Device

**Output IM3**

**Igd vs. Input Power**

**Output IM3 @ Vdd = +6.0 V, Idd = 350 mA**

**Idd vs. Vgg1,**
Representative of a Typical Device

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**Absolute Maximum Ratings**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal Drain Supply to GND</td>
<td>+6.3 V</td>
</tr>
<tr>
<td>Gate Bias Voltage (V_{gg1})</td>
<td>-3.0 to 0 Vdc</td>
</tr>
<tr>
<td>Continuous Pdiss (T= 85 °C)</td>
<td>2.88 W</td>
</tr>
<tr>
<td>(derate 31.54 mW/°C above 85 °C)</td>
<td></td>
</tr>
<tr>
<td>RF Input Power</td>
<td>+26 dBm</td>
</tr>
<tr>
<td>Output Load VSWR</td>
<td>7:1</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>-65 to 150 °C</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-40 to +85 °C</td>
</tr>
<tr>
<td>Max Peak Reflow Temperature</td>
<td>260 °C</td>
</tr>
<tr>
<td>ESD Sensitivity (HBM)</td>
<td>Class 1A - Passed 350V</td>
</tr>
</tbody>
</table>

**Reliability Information**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Junction Temperature</td>
<td>175 °C</td>
</tr>
<tr>
<td>Nominal Junction Temperature (T=85 °C, Vdd = +5.5 V)</td>
<td>145.06 °C</td>
</tr>
<tr>
<td>Thermal Resistance (channel to ground paddle)</td>
<td>31.2 °C/W</td>
</tr>
</tbody>
</table>

Stresses at or above those listed under Absolute Maximum Ratings may cause permanent damage to the product. This is a stress rating only, functional operation of the product at these or any other conditions above those indicated in the operational section of this specification is not implied. Operation beyond the maximum operating conditions for extended periods may affect product reliability.

**Outline Drawing**

24-Terminal Ceramic Leadless Chip Carrier [LCC]
(E-24-1)
Dimensions shown in millimeters.

**Package Information**

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package Body Material</th>
<th>Lead Finish</th>
<th>MSL Rating</th>
<th>Package Marking</th>
</tr>
</thead>
</table>

[1] Max peak reflow temperature of 260 °C
### Pin Descriptions

<table>
<thead>
<tr>
<th>Pin Number</th>
<th>Function</th>
<th>Description</th>
<th>Interface Schematic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 2, 4 - 7, 12 - 15, 17 - 19, 24 Package Bottom</td>
<td>GND</td>
<td>These pins &amp; exposed ground paddle must be connected to RF/DC ground.</td>
<td><img src="image" alt="Interface Schematic for GND" /></td>
</tr>
<tr>
<td>3</td>
<td>RFIN</td>
<td>The pin is AC coupled and matched to 50 Ohms.</td>
<td><img src="image" alt="Interface Schematic for RFIN" /></td>
</tr>
<tr>
<td>8 - 11, 22, 21</td>
<td>N/C</td>
<td>These pins are not connected internally; however, all data shown herein was measured with these pins connected to RF/DC ground externally.</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>RFOUT</td>
<td>The pin is AC coupled and matched to 50 Ohms.</td>
<td><img src="image" alt="Interface Schematic for RFOUT" /></td>
</tr>
<tr>
<td>20</td>
<td>Vd</td>
<td>Drain bias for amplifier. External 100 pF, 0.1 uF and 4.7 uF bypass capacitors are required.</td>
<td><img src="image" alt="Interface Schematic for Vd" /></td>
</tr>
<tr>
<td>23</td>
<td>Vgg1</td>
<td>Gate control for amplifier. Adjust VGG to achieve recommended bias current. External 100 pF, 0.1 uF and 4.7 uF bypass capacitors are required.</td>
<td><img src="image" alt="Interface Schematic for Vgg1" /></td>
</tr>
</tbody>
</table>
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**Evaluation PCB**

![Evaluation PCB Diagram]

**Evaluation Order Information**

<table>
<thead>
<tr>
<th>Item</th>
<th>Contents</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaluation PCB only</td>
<td>HMC863ALC4 Evaluation PCB</td>
<td>EV1HMC863ALC4</td>
</tr>
</tbody>
</table>

**List of Materials for Evaluation Board**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>J1, J2</td>
<td>PCB Mount K Connectors</td>
</tr>
<tr>
<td>J3, J4</td>
<td>DC Pins</td>
</tr>
<tr>
<td>C1 - C2</td>
<td>100 pF Capacitor, 0402 Pkg.</td>
</tr>
<tr>
<td>C5 - C6</td>
<td>10 kµF Capacitor, 0402 Pkg.</td>
</tr>
<tr>
<td>C9 - C10</td>
<td>4.7 µF Capacitor, 0402 Pkg.</td>
</tr>
<tr>
<td>U1</td>
<td>HMC863ALC4 Power Amplifier</td>
</tr>
<tr>
<td>PCB [1]</td>
<td>08_046199</td>
</tr>
</tbody>
</table>

[1] Circuit Board Material: Rogers 4350 or Arlon FR4

The circuit board used in the application should use RF circuit design techniques. Signal lines should have 50 Ohm impedance while the package ground leads and exposed paddle should be connected directly to the ground plane similar to that shown. A sufficient number of via holes should be used to connect the top and bottom ground planes. The evaluation board should be mounted to an appropriate heat sink. The evaluation circuit board shown is available from Analog Devices, Inc.
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Application Circuit