HMC812ALC4
GaAs MMIC VOLTAGE-VARIABLE ATTENUATOR, 5 - 30 GHz

**Typical Applications**
The HMC812ALC4 is ideal for:
- Point-to-Point Radio
- VSAT Radio
- Test Instrumentation
- Microwave Sensors
- Military, ECM & Radar

**Features**
- Wide Bandwidth: 5 - 30 GHz
- High Power Handling: +25 dBm Input P1dB
- Excellent Linearity: +28 dBm Input IP3
- Wide Attenuation Range: 30 dB
- 24 Lead Ceramic 4x4 mm SMT Package: 16mm²

**General Description**
The HMC812ALC4 is an absorptive Voltage Variable Attenuator (VVA) which operates from 5 - 30 GHz and is ideal in designs where an analog DC control signal must be used to control RF signal levels over a 30 dB amplitude range. It features two shunt-type attenuators which are controlled by two analog voltages, Vctrl1 and Vctrl2. Optimum linearity performance of the attenuator is achieved by first varying Vctrl1 of the 1st attenuation stage from -5V to 0V with Vctrl2 fixed at -5V. The control voltage of the 2nd attenuation stage, Vctrl2, should then be varied from -5V to 0V, with Vctrl1 fixed at 0V. The HMC812ALC4 is housed in a RoHS compliant 4x4 mm QFN leadless ceramic package.

Furthermore, if the Vctrl1 and Vctrl2 pins are connected together it is possible to achieve the full analog attenuation range with only a small degradation in input IP3 performance. Applications include AGC circuits and temperature compensation of multiple gain stages in microwave point-to-point and VSAT radios.

**Electrical Specifications, \( T_A = +25^\circ C \), 50 Ohm system**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insertion Loss</td>
<td></td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>5 - 16 GHz</td>
<td>1.8</td>
<td>2.2</td>
<td>2.5</td>
<td>dB</td>
</tr>
<tr>
<td>16 - 24 GHz</td>
<td></td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>24 - 30 GHz</td>
<td></td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>Attenuation Range</td>
<td>35</td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>Input Return Loss</td>
<td>10</td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>Output Return Loss</td>
<td>10</td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>Input Power for 1 dB Compression (any attenuation)</td>
<td>25</td>
<td></td>
<td></td>
<td>dBm</td>
</tr>
<tr>
<td>Input Third Order Intercept (Two-tone Input Power = 10 dBm Each Tone)</td>
<td>28</td>
<td></td>
<td></td>
<td>dBm</td>
</tr>
</tbody>
</table>

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EVALUATION KITS
• Evaluation board for the HMC812A.

DOCUMENTATION
Data Sheet
• HMC812ALC4: GaAs MMIC Voltage-Variable Attenuator, 5 - 30 GHz Data Sheet

TOOLS AND SIMULATIONS
• HMC812A S-Parameters

DESIGN RESOURCES
• hmc812a Material Declaration
• PCN-PDN Information
• Quality And Reliability
• Symbols and Footprints

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**HMC812ALC4**

**GaAs MMIC VOLTAGE-VARIABLE ATTENUATOR, 5 - 30 GHz**

**Attenuation vs. Frequency over Vctrl**

*Vctrl1 = Variable, Vctrl2 = -5V*

- **Over Temperature @ 10 GHz, Vctrl2 = -5V**
- **Input Return Loss**

**Attenuation vs. Vctrl1**

*Vctrl2 = Variable, Vctrl2 = -5V*

- **Over Temperature @ 10 GHz, Vctrl2 = -5V**
- **Input Return Loss**

**Attenuation vs. Pin @ 10 GHz**

*Vctrl1 = Variable, Vctrl2 = -5V*

- **Input Return Loss**

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**Input Return Loss**
*Vctrl1 = 0V, Vctrl2 = Variable*

**Output Return Loss**
*Vctrl1 = Variable, Vctrl2 = -5V*

**Input IP3 vs. Input Power Over Frequency**
*Vctrl1 = -3.2V, Vctrl2 = -5V (Worst Case IP3)*

**Input IP3 vs. Input Power Over Temperature**
*10 GHz, Vctrl1 = -3.2V, Vctrl2 = -5V*
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Attenuation vs. Frequency over Vctrl
Vctrl1 = Vctrl2

Attenuation vs. Vctrl over Temperature
@ 10 GHz, Vctrl1 = Vctrl2

Attenuation vs. Input Power over Vctrl
Vctrl1 = Vctrl2

Input Return Loss, Vctrl1 = Vctrl2

Output Return Loss, Vctrl1 = Vctrl2

Input IP3 vs. Input Power Over
Vctrl @ 10 GHz, Vctrl1 = Vctrl2

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**Absolute Maximum Ratings**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>RF Input Power</td>
<td>+30 dBm</td>
</tr>
<tr>
<td>Control Voltage Range</td>
<td>+0.3 to -6 V</td>
</tr>
<tr>
<td>Channel Temperature</td>
<td>175 °C</td>
</tr>
<tr>
<td>Continuous Pdiss (T = 85 °C) (derate 16.4 mW/ °C above 85 °C)</td>
<td>1.07 W</td>
</tr>
<tr>
<td>Thermal Resistance (Channel to ground paddle)</td>
<td>61 °C/W</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>ESD Sensitivity (HBM)</td>
<td>Class 0 (Passed 150V)</td>
</tr>
</tbody>
</table>

**Control Voltages**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vctrl1</td>
<td>-5 to 0 V @ 10 µA</td>
</tr>
<tr>
<td>Vctrl2</td>
<td>-5 to 0 V @ 10 µA</td>
</tr>
</tbody>
</table>

**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>
<tbody>
<tr>
<td>HMC812ALC4</td>
<td>Alumina, White</td>
<td>Gold over Nickel</td>
<td>MSL3</td>
<td>812A XXXX</td>
</tr>
</tbody>
</table>

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**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, 6 - 8, 11 - 13, 17 - 24</td>
<td>N/C</td>
<td>These pins are not connected internally, however these pins must be connected to RF/DC ground externally.</td>
<td></td>
</tr>
<tr>
<td>3, 5, 14, 16</td>
<td>GND</td>
<td>These pins and the exposed ground paddle must be connected to RF/DC ground.</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>RFIN</td>
<td>This pad is DC coupled and matched to 50 Ohms. A blocking capacitor is required if RF line potential is not equal to 0V.</td>
<td><img src="image" alt="Interface Schematic" /></td>
</tr>
<tr>
<td>15</td>
<td>RFOUT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Vctrl1</td>
<td>Control Voltage 1</td>
<td><img src="image" alt="Interface Schematic" /></td>
</tr>
<tr>
<td>10</td>
<td>Vctrl2</td>
<td>Control Voltage 2</td>
<td><img src="image" alt="Interface Schematic" /></td>
</tr>
</tbody>
</table>
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Application Circuit

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Evaluation PCB

List of Materials for EV1HMC812ALC4 [1]

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>J1, J2</td>
<td>2.9 mm PC Mount RF Connector</td>
</tr>
<tr>
<td>J3, J4</td>
<td>DC Pin</td>
</tr>
<tr>
<td>C1, C2</td>
<td>100 pF Capacitor, 0402 Pkg.</td>
</tr>
<tr>
<td>C3, C4</td>
<td>1000 pF Capacitor, 0402 Pkg.</td>
</tr>
<tr>
<td>C5, C6</td>
<td>4.7 µF Capacitor, CASE A</td>
</tr>
<tr>
<td>U1</td>
<td>HMC812ALC4 Analog VVA</td>
</tr>
<tr>
<td>PCB</td>
<td>123766 Evaluation PCB</td>
</tr>
</tbody>
</table>

[1] Reference this number when ordering complete evaluation PCB

The circuit board used in the final 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 circuit board shown is available from Analog Devices upon request.