HMC973ALP3E

GAAS MMIC VOLTAGE VARIABLE ATTENUATOR, 0.5 - 5.0 GHz

**Typical Applications**
The HMC973ALP3E is ideal for:
- Point-to-Point Radio
- Cellular/3G & WiMAX/4G Infrastructure
- Test Instrumentation
- Microwave Sensors
- Military, ECM & Radar

**Features**
- Wide Attenuation Range: 26 dB
- Single Positive Voltage Control: 0 to +5V
- Absorptive Topology
- 16 Lead 3x3mm SMT Package: 9 mm²

**General Description**
The HMC973ALP3E is an absorptive Voltage Variable Attenuator (VVA) which operates from 0.5 to 5 GHz and is ideal in designs where an analog DC control signal must be used to control RF signal levels over a 26 dB amplitude range. It features a shunt-type attenuator controlled by an analog voltage, Vctrl. The HMC973ALP3E is an unidirectional device with optimum linearity performance achieved when the RF input signal is applied to the RFIN package lead. The HMC973ALP3E is housed in a RoHS compliant 3x3 mm QFN leadless package.

**Functional Diagram**

![Functional Diagram](image)

**Electrical Specifications, \( T_A = +25^\circ \text{C} \), 50 Ohm system, \( Vdd = +5V \)**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Frequency</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insertion Loss</td>
<td>0.5 - 2.0 GHz</td>
<td></td>
<td></td>
<td>3.3</td>
<td>dB</td>
</tr>
<tr>
<td></td>
<td>2.0 - 4.0 GHz</td>
<td></td>
<td></td>
<td>4.2</td>
<td>dB</td>
</tr>
<tr>
<td></td>
<td>4.0 - 5.0 GHz</td>
<td></td>
<td></td>
<td>5.6</td>
<td>dB</td>
</tr>
<tr>
<td>Attenuation Range</td>
<td>0.5 - 2.0 GHz</td>
<td></td>
<td></td>
<td>26</td>
<td>dB</td>
</tr>
<tr>
<td></td>
<td>2.0 - 4.0 GHz</td>
<td></td>
<td></td>
<td>28</td>
<td>dB</td>
</tr>
<tr>
<td></td>
<td>4.0 - 5.0 GHz</td>
<td></td>
<td></td>
<td>31</td>
<td>dB</td>
</tr>
<tr>
<td>Input Return Loss</td>
<td>0.5 - 2.0 GHz</td>
<td></td>
<td></td>
<td>10</td>
<td>dB</td>
</tr>
<tr>
<td></td>
<td>2.0 - 5.0 GHz</td>
<td></td>
<td></td>
<td>13</td>
<td>dB</td>
</tr>
<tr>
<td>Output Return Loss</td>
<td>0.5 - 2.0 GHz</td>
<td></td>
<td></td>
<td>8</td>
<td>dB</td>
</tr>
<tr>
<td></td>
<td>2.0 - 5.0 GHz</td>
<td></td>
<td></td>
<td>9</td>
<td>dB</td>
</tr>
<tr>
<td>Input Power for 1 dB Compression</td>
<td>0.5 - 5.0 GHz</td>
<td></td>
<td></td>
<td>25</td>
<td>dBm</td>
</tr>
<tr>
<td>Input Third Order Intercept (All Control Voltages) (Two-tone Input Power = +5 dBm Each Tone)</td>
<td>0.5 - 5.0 GHz</td>
<td></td>
<td></td>
<td>30</td>
<td>dBm</td>
</tr>
<tr>
<td>Supply Current (Idd)</td>
<td>0.5 - 5.0 GHz</td>
<td></td>
<td></td>
<td>600</td>
<td>( \mu \text{A} )</td>
</tr>
</tbody>
</table>

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**HMC973ALP3E**

**Gaas Mmic Voltage Variable Attenuator, 0.5 - 5.0 GHz**

**Insertion Loss vs. Frequency Over Temperature @ VDD=5 V**

**Attenuation vs. Frequency Over Vctrl @ VDD=5 V**

**Attenuation vs. Vctrl Over Temperature @ 0.5 GHz and VDD=5 V**

**Attenuation vs. Vctrl Over Temperature @ 2 GHz and VDD=5 V**

**Attenuation vs. Vctrl Over Temperature @ 4 GHz and VDD=5 V**

**Attenuation vs. Vctrl Over Temperature @ 5 GHz and VDD=5 V**

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HMC973ALP3E

GAAS MMIC VOLTAGE VARIABLE
ATTENUATOR, 0.5 - 5.0 GHz

Input Return Loss Over Temperature (Vctrl = 0) @ VDD=5 V

Output Return Loss Over Temperature (Vctrl = 0) @ VDD=5 V

Input IP3 Vs Frequency Over Vctrl @ VDD=5 V

Output Return Loss Over Vctrl @ VDD=5 V

Input IP3 Over Temperature (Vctrl = 0V) @ VDD=5 V

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**Insertion Loss vs. Frequency Over Temperature @ 3 V**

**Attenuation vs. Frequency Over Vctrl @ 3 V**

**Attenuation vs. Vctrl Over Temperature @ 0.5 GHz and 3 V**

**Attenuation vs. Vctrl Over Temperature @ 2 GHz and 3 V**

**Attenuation vs. Vctrl Over Temperature @ 4 GHz and 3 V**

**Attenuation vs. Vctrl Over Temperature @ 5 GHz and 3 V**

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Input Return Loss Over Temperature (Vctrl = 0) @ VDD=3 V

Output Return Loss Over Temperature (Vctrl = 0) @ VDD=3 V

Input IP3 Vs Frequency Over Vctrl @ VDD=3 V

Input IP3 Over Temperature (Vctrl = 0V) @ VDD=3 V

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### Absolute Maximum Ratings

- **RF Input Power**: +29 dBm
- **Vdd**: 5.5V
- **Control Voltage Range**: -0.5V to Vdd
- **Channel Temperature**: 150 °C
- **Continuous Pdiss (T = 85 °C)**: 0.8W
- **Thermal Resistance (Channel to ground paddle)**: 35°C/W
- **Storage Temperature**: -65 to +150 °C
- **Operating Temperature**: -40 to +85 °C
- **ESD Sensitivity (HBM)**: Class 1A

### Voltages & Currents

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vdd</td>
<td>5V @ 600 µA</td>
<td></td>
</tr>
<tr>
<td>Vctrl</td>
<td>0 to +5V @ 2.6mA</td>
<td></td>
</tr>
</tbody>
</table>

### 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 [1]</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMC973ALP3E</td>
<td>RoHS-compliant Low Stress Injection Molded Plastic</td>
<td>100% matte Sn</td>
<td>MSL3 [2]</td>
<td>973A XXXX</td>
</tr>
</tbody>
</table>

[1] 4-Digit lot number XXXX

Pin Descriptions

<table>
<thead>
<tr>
<th>Pin Number</th>
<th>Function</th>
<th>Description</th>
<th>Interface Schematic</th>
</tr>
</thead>
<tbody>
<tr>
<td>GND Paddle</td>
<td>GND</td>
<td>The exposed ground paddle must be connected to RF/DC ground.</td>
<td>![GND Interface Schematic]</td>
</tr>
<tr>
<td>3</td>
<td>RFOUT</td>
<td>This pin is DC coupled and matched to 50 Ohms. A blocking capacitor is required if RF line potential is not equal to 0V.</td>
<td>![RFOUT Interface Schematic]</td>
</tr>
<tr>
<td>5</td>
<td>Vdd</td>
<td>Supply Voltage</td>
<td>![Vdd Interface Schematic]</td>
</tr>
<tr>
<td>1,2,4,6, 8, 9, 11-16</td>
<td>N/C</td>
<td>The pins are not connected internally; however, all data shown herein was measured with these pins connected to RF/DC ground externally.</td>
<td>![N/C Interface Schematic]</td>
</tr>
<tr>
<td>7</td>
<td>Vctrl</td>
<td>Control Voltage</td>
<td>![Vctrl Interface Schematic]</td>
</tr>
<tr>
<td>10</td>
<td>RFIN</td>
<td>This pin is DC coupled and matched to 50 Ohms. A blocking capacitor is required if RF line potential is not equal to 0V. The HMC973ALP3E is a unidirectional device with optimum linearity performance achieved with RF input signal applied to RFIN package lead.</td>
<td>![RFIN Interface Schematic]</td>
</tr>
</tbody>
</table>

Application Circuit

![Application Circuit Diagram]

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**Evaluation PCB**

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 circuit board shown is available from Analog Devices upon request.

**List of Materials for Evaluation PCB EV1HMC973ALP3**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>J1, J2</td>
<td>PCB Mount SMA RF Connector</td>
</tr>
<tr>
<td>J3 - J5</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>10000 pF Capacitor, 0402 Pkg.</td>
</tr>
<tr>
<td>U1</td>
<td>HMC973ALP3E Voltage Variable Attenuator</td>
</tr>
<tr>
<td>PCB [2]</td>
<td>131550 Evaluation PCB</td>
</tr>
</tbody>
</table>

[1] Reference this number when ordering complete evaluation PCB

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