HMC1056LP4BE
GaAs MMIC I/Q Mixer
8 - 12 GHz

**Typical Applications**
The HMC1056LP4BE is ideal for:
- Point-to-Point and Point-to-Multi-Point Radio
- Military Radar, EW & ELINT
- Satellite Communications
- Sensors

**Features**
- Wide IF Bandwidth: DC - 4 GHz
- Image Rejection: 25 dBc
- LO to RF isolation: 40 dB
- High Input IP3: 18 dBm
- 20 Lead 4x4 mm SMT Package: 16 mm²

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**General Description**
The HMC1056LP4BE is a compact I/Q MMIC mixer in a leadless “Pb free” SMT package, which can be used as either an Image Reject Mixer or a Single Sideband Upconverter. The mixer utilizes two standard Hittite double balanced mixer cells and a 90 degree hybrid fabricated in a GaAs Schottky diode process. A low frequency quadrature hybrid was used to produce a 100MHz LSB IF output. This product is a much smaller alternative to hybrid style Image Reject Mixers and Single Sideband Upconverter assemblies. The HMC1056LP4BE eliminates the need for wire bonding and allows the use of surface mount manufacturing techniques.

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**Functional Diagram**

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**Electrical Specifications, \( T_A = +25°C, IF = 100 MHz, \) LSB, LO = +10 dBm**

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Frequency Range, RF/LO</td>
<td>8 - 10</td>
<td></td>
<td></td>
<td>10 - 12</td>
<td></td>
<td></td>
<td>GHz</td>
</tr>
<tr>
<td>Frequency Range, IF</td>
<td>DC - 4</td>
<td></td>
<td></td>
<td>DC - 4</td>
<td></td>
<td></td>
<td>GHz</td>
</tr>
<tr>
<td>Conversion Loss</td>
<td>8</td>
<td>11</td>
<td></td>
<td>8</td>
<td>11</td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>Image Rejection</td>
<td>18</td>
<td>25</td>
<td></td>
<td>12</td>
<td>18</td>
<td></td>
<td>dBc</td>
</tr>
<tr>
<td>LO to RF isolation</td>
<td>33</td>
<td>40</td>
<td></td>
<td>33</td>
<td>40</td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>LO to IF isolation</td>
<td>35</td>
<td></td>
<td></td>
<td>40</td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>IP3 (input)</td>
<td>18</td>
<td></td>
<td></td>
<td>18</td>
<td></td>
<td></td>
<td>dBm</td>
</tr>
<tr>
<td>Amplitude Balance (^{[2]})</td>
<td>+0.5</td>
<td></td>
<td></td>
<td>+1.5</td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>Phase Balance (^{[2]})</td>
<td>+2.5</td>
<td></td>
<td></td>
<td>-2.5</td>
<td></td>
<td></td>
<td>Deg</td>
</tr>
</tbody>
</table>

\(^{[1]}\) Unless otherwise noted all measurements performed as downconverter.

\(^{[2]}\) Data taken without external 90° hybrid.

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HMC1056LP4BE
GaAs MMIC I/Q Mixer
8 - 12 GHz

Data Taken as SSB Downconverter with External IF 90° Hybrid, IF = 100 MHz

Conversion Gain, LSB vs. Temperature

Conversion Gain, LSB vs. LO Drive

Image Rejection, LSB vs. Temperature

Image Rejection, LSB vs. LO Drive

Return Loss

Input P1dB, LSB vs. Temperature

[1] Data taken without external IF 90° hybrid

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HMC1056LP4BE
GaAs MMIC I/Q Mixer
8 - 12 GHz

Data Taken as SSB Downconverter with External IF 90° Hybrid, IF = 100 MHz

Input IP3, LSB vs. Temperature

Input IP3, LSB vs. LO Drive

Isolations

IF Bandwidth*

Amplitude Balance, LSB vs. LO Drive

Phase Balance, LSB vs. LO Drive

* Conversion gain data taken with external IF hybrid.

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Data Taken as SSB Downconverter with External IF 90° Hybrid, IF = 100 MHz

**Upconverter Performance, Conversion Gain, LSB vs. LO Drive**

**Conversion Gain, USB vs. Temperature**

**Image Rejection, USB vs. Temperature**

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8 - 12 GHz

Data Taken as SSB Downconverter with External IF 90° Hybrid, IF = 100 MHz

Input P1dB, USB vs. Temperature

Input IP3, USB vs. Temperature

Input IP3, USB vs. LO Drive

Amplitude Balance, USB vs. LO Drive

Phase Balance, USB vs. LO Drive

Upconverter Performance, Conversion Gain, USB vs. LO Drive
GaAs MMIC I/Q Mixer
8 - 12 GHz

Data Taken as SSB Upconverter with External IF 90° Hybrid, IF = 100 MHz

Upconverter Performance, Sideband Rejection, USB vs. LO Drive,
HMC1056LP4BE

GaAs MMIC I/Q Mixer
8 - 12 GHz

Data Taken as SSB Downconverter with External IF 90° Hybrid, IF = 1000 MHz

Conversion Gain, LSB vs. Temperature

Conversion Gain, LSB vs. LO Drive

Image Rejection, LSB vs. Temperature

Image Rejection, LSB vs. LO Drive

Input IP3, LSB vs. Temperature

Input IP3, LSB vs. LO Drive

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8 - 12 GHz

Data Taken as SSB Downconverter with External IF 90° Hybrid, IF = 1000 MHz

Upconverter Performance, Conversion Gain, LSB vs. LO Drive

Upconverter Performance, Sideband Rejection, LSB vs. LO Drive

Conversion Gain, USB vs. Temperature

Conversion Gain, USB vs. LO Drive

Image Rejection, USB vs. Temperature

Image Rejection, USB vs. LO Drive

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HMC1056LP4BE

GaAs MMIC I/Q Mixer
8 - 12 GHz

Data Taken as SSB Downconverter with External IF 90° Hybrid, IF = 1000 MHz

Input IP3, USB vs. Temperature

Input IP3, USB vs. LO Drive

Upconverter Performance, Conversion Gain, USB vs. LO Drive

Upconverter Performance, Sideband Rejection, USB vs. LO Drive,

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Data Taken as SSB Downconverter with External IF 90° Hybrid, IF = 2000 MHz

Conversion Gain, LSB vs. Temperature

Conversion Gain, LSB vs. LO Drive

Image Rejection, LSB vs. Temperature

Image Rejection, LSB vs. LO Drive

Input IP3, LSB vs. Temperature

Input IP3, LSB vs. LO Drive
GaAs MMIC I/Q Mixer
8 - 12 GHz

Data Taken as SSB Downconverter with External IF 90° Hybrid, IF = 2000 MHz

Upconverter Performance, Conversion Gain, LSB vs. LO Drive

Upconverter Performance, Sideband Rejection, LSB vs. LO Drive,

Conversion Gain, USB vs. Temperature

Conversion Gain, USB vs. LO Drive

Image Rejection, USB vs. Temperature

Image Rejection, USB vs. LO Drive

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Input IP3, USB vs. Temperature

Input IP3, USB vs. LO Drive

Upconverter Performance, Conversion Gain, USB vs. LO Drive

Upconverter Performance, Sideband Rejection, USB vs. LO Drive

Harmonics of LO

MxN Spurious Outputs

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**Absolute Maximum Ratings**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>IF Input (At LO = 10 dBm and RF = -10 dBm)</td>
<td>+15.5 dBm</td>
</tr>
<tr>
<td>RF Input (At 10 dBm LO power)</td>
<td>+16 dBm</td>
</tr>
<tr>
<td>LO Input (At -10 dBm RF power)</td>
<td>+17 dBm</td>
</tr>
<tr>
<td>Channel Temperature</td>
<td>175 °C</td>
</tr>
<tr>
<td>Continuous Pdiss (T = 85°C) (derate 8.9 mW/°C above 85°C)</td>
<td>800 mW</td>
</tr>
<tr>
<td>Thermal Resistance (channel to ground paddle)</td>
<td>112 °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>

**Outline Drawing**

**Package Information**

<table>
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<tr>
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</thead>
<tbody>
<tr>
<td>HMC1056LP4BE</td>
<td>RoHS-compliant Low Stress Injection Molded Plastic</td>
<td>100% matte Sn</td>
<td>MSL1</td>
<td>H1056 XXXX</td>
</tr>
</tbody>
</table>

[1] 4-Digit lot number XXXX

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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, 5-8, 10-12, 16, 18-20</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>2, 4, 13, 15</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>3</td>
<td>LO</td>
<td>This pin is AC coupled and matched to 50 Ohms.</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>IF2</td>
<td>Differential IF input pins. For applications not requiring operation to DC, an off chip DC blocking capacitor should be used. For operation to DC this pin must not source/sink more than 3mA of current or part non function and possible part failure will result.</td>
<td><img src="image" alt="IF1, IF2" /></td>
</tr>
<tr>
<td>17</td>
<td>IF1</td>
<td></td>
<td><img src="image" alt="IF1, IF2" /></td>
</tr>
<tr>
<td>14</td>
<td>RF</td>
<td>This pin is matched to 50 Ohms.</td>
<td><img src="image" alt="RF" /></td>
</tr>
</tbody>
</table>
Evaluation PCB

List of Materials for Evaluation PCB EVAL01-HMC1056LP4B[1]

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>J1, J2</td>
<td>PCB Mount SMA RF Connector, SRI</td>
</tr>
<tr>
<td>J3 - J4</td>
<td>PCB Mount SMA Connector, Johnson</td>
</tr>
<tr>
<td>U1</td>
<td>HMC1056LP4BE</td>
</tr>
<tr>
<td>PCB [2]</td>
<td>600-00487-00-1 Evaluation Board</td>
</tr>
</tbody>
</table>

[1] Reference this number when ordering complete 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 Hittite upon request.
HMC1056LP4BE

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Notes: