**Typical Applications**

The HMC1113LP5E is ideal for:
- Point-to-Point and Point-to-Multi-Point Radios
- Military Radar, EW & ELINT
- Satellite Communications
- Maritime & Mobile Radios

**Features**

- Conversion Gain: 12 dB
- Image Rejection: 25 dBc
- LO to RF Isolation: 45 dB
- Noise Figure: 1.8 dB
- Input IP3: 1 dBm
- 32 Lead 5 x 5 mm SMT Package

**General Description**

The HMC1113LP5E is a compact GaAs MMIC I/Q downconverter in a leadless 5 x 5 mm low stress injection molded plastic surface mount package. This device provides a small signal conversion gain of 12 dB with a noise figure of 1.8 dB and 25 dBc of image rejection. The HMC1113LP5E utilizes an LNA followed by an image reject mixer which is driven by an LO buffer amplifier. The image reject mixer eliminates the need for a filter following the LNA, and removes thermal noise at the image frequency. I/Q mixer outputs are provided and an external 90° hybrid is needed to select the required sideband. The HMC1113LP5E is a much smaller alternative to hybrid style image reject mixer downconverter assemblies, and it eliminates the need for wire bonding by allowing the use of surface mount manufacturing techniques.

**Electrical Specifications, \( T_i = +25 \, ^\circ C \), \( IF = 500 \, MHz, \, LO = 6 \, dBm, \, VD1 = VD2 = 3V, \, VD3 = 4V, \, USB \) [1]**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>RF Frequency Range</td>
<td>10</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>16</td>
<td></td>
<td>GHz</td>
</tr>
<tr>
<td>IF Frequency Range</td>
<td>DC</td>
<td>3.5</td>
<td>DC</td>
<td>3.5</td>
<td></td>
<td></td>
<td>GHz</td>
</tr>
<tr>
<td>Conversion Gain</td>
<td>9</td>
<td>12</td>
<td>9</td>
<td>12</td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>Noise Figure</td>
<td>1.8</td>
<td>2.5</td>
<td>1.8</td>
<td>2.5</td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>Image Rejection</td>
<td>17</td>
<td>22</td>
<td>18</td>
<td>25</td>
<td></td>
<td></td>
<td>dBc</td>
</tr>
<tr>
<td>1 dB Compression (Input)</td>
<td>-7</td>
<td></td>
<td>-7</td>
<td></td>
<td></td>
<td></td>
<td>dBm</td>
</tr>
<tr>
<td>LO to RF Isolation</td>
<td>35</td>
<td>45</td>
<td>25</td>
<td>35</td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>LO to IF Isolation</td>
<td>22</td>
<td></td>
<td>15</td>
<td></td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>IP3 (Input)</td>
<td>0.5</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>dBm</td>
</tr>
<tr>
<td>Amplitude Balance [2]</td>
<td>±1</td>
<td></td>
<td>±1</td>
<td></td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>Phase Balance [2]</td>
<td>±6</td>
<td></td>
<td>±6</td>
<td></td>
<td></td>
<td></td>
<td>Deg</td>
</tr>
<tr>
<td>Supply Current (ID1 + ID2)</td>
<td>60</td>
<td>80</td>
<td>60</td>
<td>80</td>
<td></td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>Supply Current (ID3)</td>
<td>100</td>
<td>120</td>
<td>100</td>
<td>120</td>
<td></td>
<td></td>
<td>mA</td>
</tr>
</tbody>
</table>

[1] Unless otherwise noted all measurements performed as downconverter.

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COMPARABLE PARTS
View a parametric search of comparable parts.

EVALUATION KITS
• HMC1113LP5 Evaluation Board

DOCUMENTATION
Data Sheet
• HMC1113LP5E: GaAs MMIC I/Q Mixer Downconverter, 10 - 16 GHz Data Sheet

TOOLS AND SIMULATIONS
• HMC1113 S-Parameters

REFERENCE MATERIALS
Quality Documentation
• Package/Assembly Qualification Test Report: LP3, LP4, LP5 & LP5G (QTR: 2014-00145)
• Semiconductor Qualification Test Report: PHEMT-A (QTR: 2013-00267)

Technical Articles
• The Changing Landscape of Frequency Mixing Components

DESIGN RESOURCES
• HMC1113 Material Declaration
• PCN-PDN Information
• Quality And Reliability
• Symbols and Footprints

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HMC1113LP5E
GaAs MMIC I/Q MIXER
DOWNCONVERTER, 10 - 16 GHz

Data Taken as SSB Downconverter with External IF 90° Hybrid, IF = 500 MHz, USB

Conversion Gain vs. Temperature

Conversion Gain vs. LO Drive

Image Rejection vs. Temperature

Image Rejection vs. LO Drive

Input IP3 vs. Temperature

Input IP3 vs. LO Power

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HMC1113LP5E

GaAs MMIC I/Q MIXER
DOWNCONVERTER, 10 - 16 GHz

Data Taken as SSB Downconverter with External IF 90° Hybrid, IF = 500 MHz, USB

Input P1dB vs. Temperature

Input P1dB vs. LO Power

Noise Figure vs. Temperature

IF = 500 MHz

Noise Figure vs. LO Power

IF = 500 MHz

Noise Figure vs. Temperature

LO = 12 GHz

Noise Figure vs. LO Power

LO = 12 GHz

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**HMC1113LP5E**

**GaAs MMIC I/Q MIXER**

**DOWNCONVERTER, 10 - 16 GHz**

**Data Taken as SSB Downconverter with External IF 90° Hybrid, IF = 500 MHz, USB**

**Noise Figure vs. IF Frequency**

**Isolations [1]**

**Amplitude Balance vs. LO Power [1]**

**Phase Balance vs. LO Power [1]**

**IF Bandwidth**

**Return Loss [1]**


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GaAs MMIC I/Q MIXER
DOWNCONVERTER, 10 - 16 GHz

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

Conversion Gain vs. Temperature

Conversion Gain vs. LO Drive

Image Rejection vs. Temperature

Image Rejection vs. LO Drive

Input IP3 vs. Temperature

Input IP3 vs. LO Power
Data Taken as SSB Downconverter with External IF 90° Hybrid, IF = 1800 MHz, USB
Noise Figure vs. Temperature
IF = 1800 MHz

![Graph showing noise figure vs. temperature for HMC1113LP5E GaAs MMIC I/Q mixer downconverter.]
GaAs MMIC I/Q MIXER
DOWNCONVERTER, 10 - 16 GHz

Data Taken as SSB Downconverter with External IF 90° Hybrid, IF = 3500 MHz, USB

Conversion Gain vs. Temperature

Conversion Gain vs. LO Drive

Image Rejection vs. Temperature

Image Rejection vs. LO Drive

Input IP3 vs. Temperature

Input IP3 vs. LO Power

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GaAs MMIC I/Q MIXER
DOWNCONVERTER, 10 - 16 GHz

Data Taken as SSB Downconverter with External IF 90° Hybrid, IF = 3500 MHz, USB

Noise Figure vs. Temperature
IF = 3500 MHz

Noise Figure vs. LO Power
IF = 3500 MHz

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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, 7, 8, 9, 13, 14, 15, 16, 22, 23, 24, 25, 26, 27, 30, 31, 32</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, 10, 12, 17, 19, 21</td>
<td>GND</td>
<td>These pins and the exposed ground paddle must be connected to RF/DC ground.</td>
<td>GND</td>
</tr>
<tr>
<td>3</td>
<td>RF</td>
<td>This pin is AC coupled and matched to 50 Ohms.</td>
<td>RF</td>
</tr>
<tr>
<td>6</td>
<td>VD3</td>
<td>Power Supply for LO amplifier.</td>
<td>VD3</td>
</tr>
<tr>
<td>11</td>
<td>LO</td>
<td>This pin is AC coupled and matched to 50 Ohms.</td>
<td>LO</td>
</tr>
<tr>
<td>18</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 3 mA of current or part non function and possible part failure will result.</td>
<td>IF1, IF2</td>
</tr>
<tr>
<td>20</td>
<td>IF1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>28, 29</td>
<td>VD2, VD1</td>
<td>Voltage bias for LNA.</td>
<td>VD1, VD2</td>
</tr>
</tbody>
</table>

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**HMC1113LP5E**

**GaAs MMIC I/Q MIXER**
**DOWNCONVERTER, 10 - 16 GHz**

---

### Absolute Maximum Ratings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>RF Input</td>
<td>+8 dBm</td>
</tr>
<tr>
<td>LO Input</td>
<td>+10 dBm</td>
</tr>
<tr>
<td>VD1, VD2</td>
<td>+4.5 V</td>
</tr>
<tr>
<td>Channel Temperature</td>
<td>175 °C</td>
</tr>
<tr>
<td>Continuous Pdiss (T = 85 °C) (derate 11.84 mW/°C above 85 °C)</td>
<td>1.066 W</td>
</tr>
<tr>
<td>Thermal Resistance (channel to ground paddle)</td>
<td>84.64 °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 150 V</td>
</tr>
</tbody>
</table>

---

### Outline Drawing

- **Top View**
- **Bottom View**

---

### Package Information

<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>HMC1113LP5E</td>
<td>RoHS-compliant Low Stress Injection Molded Plastic</td>
<td>100% matte Sn</td>
<td>MSL3</td>
<td>H1113 XXXX</td>
</tr>
</tbody>
</table>

---

[1] 4-Digit lot number XXXX


---

**NOTES:**
1. PACKAGE BODY MATERIAL: LOW STRESS INJECTION MOLDED PLASTIC SILICA AND SILICON IMPREGNATED.
2. LEAD AND GROUND PADDLE MATERIAL: COPPER ALLOY.
3. LEAD AND GROUND PADDLE PLATING: 100% Matte Tin.
4. DIMENSIONS ARE IN INCHES [MILLIMETERS].
5. LEAD SPACING TOLERANCE IS NON-CUMULATIVE.
6. CHARACTERS TO BE HELVETICA MEDIUM, 0.25 HIGH, WHITE INK, OR LASER MARK LOCATED APPROX. AS SHOWN.
7. PAD BURN LENGTH SHALL BE 0.15mm MAX. PAD BURN HEIGHT SHALL BE 0.25mm MAX.
8. PACKAGE WARP SHALL NOT EXCEED 0.05m.
9. ALL GROUND LEADS AND GROUND PADDLE MUST BE SOLDERED TO PCB BY GROUND.
10. REFER TO HITTITE APPLICATION NOTE FOR SUGGESTED PCB LAYOUT PATTERN.

---

**ELECTROSTATIC SENSITIVE DEVICE**

**OBSERVE HANDLING PRECAUTIONS**

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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.

**List of Materials for Evaluation PCB EV1HMC1113LP5[1]**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>J1 - J2</td>
<td>SCD, COMP, SMA Connector, SRI</td>
</tr>
<tr>
<td>J3 - J4</td>
<td>SCD, COMP, SMA Connector, JOHNSON</td>
</tr>
<tr>
<td>C1 - C3</td>
<td>100 pF Capacitor, 0402 Pkg.</td>
</tr>
<tr>
<td>C4 - C6</td>
<td>10000 pF Capacitor, 0402 Pkg.</td>
</tr>
<tr>
<td>C7 - C9</td>
<td>2.2 uF Capacitor, CAP TANT.</td>
</tr>
<tr>
<td>R1 - R2</td>
<td>0 Ohm Resistor, 0402 Pkg.</td>
</tr>
<tr>
<td>U1</td>
<td>HMC1113LP5E</td>
</tr>
<tr>
<td>PCB[1]</td>
<td>111225 Evaluation Board</td>
</tr>
</tbody>
</table>

[1] Circuit Board Material: Rogers 4350 or Arlon 25FR