HMC689LP4 / 689LP4E

BiCMOS MMIC MIXER W/ INTEGRATED LO AMPLIFIER, 2.0 - 2.7 GHz

**Typical Applications**
The HMC689LP4(E) is Ideal for:
- Cellular/3G & LTE/WiMAX/4G
- Basestations & Repeaters
- GSM, CDMA & OFDM
- Transmitters and Receivers

**Features**
- High Input IP3: +32 dBm
- Low Conversion Loss: 7.5 dB
- Low LO Drive: 0 dBm
- Optimized for High Side LO Input
- Upconversion & Downconversion Applications
- 24 Lead 4x4mm SMT Package: 16mm²

**General Description**
The HMC689LP4(E) is a high dynamic range passive MMIC mixer with integrated LO amplifier in a 4x4 SMT QFN package covering 2.0 - 2.7 GHz. Excellent input IP3 performance of +32 dBm for down conversion is provided for 3G & 4G GSM/CDMA applications at an LO drive of 0 dBm. With an input 1 dB compression of +23 dBm, the RF port will accept a wide range of input signal levels. Conversion loss is 7.5 dB typical. The DC to 800 MHz IF frequency response will satisfy GSM/CDMA transmit or receive frequency plans. The HMC689LP4(E) is pin for pin compatible with the HMC688LP4(E) which is a 2.0 - 2.7 MHz mixer with LO amplifier, amplifier is optimized for low side LO applications.

**Electrical Specifications,**

\[ T_A = +25^\circ \text{C}, \ IF = 300 \text{ MHz}, \ LO = 0 \text{ dBm}, \ Vcc = Vcc1, 2, 3 = +5V, \ G\_Bias = +2.8V^* \]

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency Range, RF</td>
<td>2.0 - 2.7</td>
<td></td>
<td></td>
<td>GHz</td>
</tr>
<tr>
<td>Frequency Range, LO</td>
<td>2 - 3</td>
<td></td>
<td></td>
<td>GHz</td>
</tr>
<tr>
<td>Frequency Range, IF</td>
<td>DC - 800</td>
<td></td>
<td></td>
<td>MHz</td>
</tr>
<tr>
<td>Conversion Loss</td>
<td>7.5</td>
<td>11</td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>Noise Figure (SSB)</td>
<td>7.5</td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>LO to RF Isolation</td>
<td>26</td>
<td>34</td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>LO to IF Isolation</td>
<td>20</td>
<td>26</td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>RF to IF Isolation</td>
<td>24</td>
<td>30</td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>IP3 (Input)</td>
<td>32</td>
<td></td>
<td></td>
<td>dBm</td>
</tr>
<tr>
<td>1 dB Compression (Input)</td>
<td>23</td>
<td></td>
<td></td>
<td>dBm</td>
</tr>
<tr>
<td>LO Drive Input Level (Typical)</td>
<td>-3 to +3</td>
<td></td>
<td></td>
<td>dBm</td>
</tr>
<tr>
<td>Supply Current (Icc total)</td>
<td>152</td>
<td>185</td>
<td></td>
<td>mA</td>
</tr>
</tbody>
</table>

* Unless otherwise noted all measurements performed as downconverter with high side LO & IF = 300 MHz.
**HMC689LP4 / 689LP4E**

**BiCMOS MMIC MIXER W/ INTEGRATED LO AMPLIFIER, 2.0 - 2.7 GHz**

### Conversion Gain vs. Temperature

![Conversion Gain vs. Temperature Graph](image)

### Isolation

![Isolation Graph](image)

### Conversion Gain vs. LO Drive

![Conversion Gain vs. LO Drive Graph](image)

### Return Loss

![Return Loss Graph](image)

### IF Bandwidth (LO = 2.8 GHz)

![IF Bandwidth Graph](image)

### Input P1dB vs. Temperature

![Input P1dB Graph](image)

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Input IP3 vs. LO Drive \(^{[1]}\)

![Input IP3 vs. LO Drive graph]

Input IP3 vs. Temperature \(^{[1]}\)

![Input IP3 vs. Temperature graph]

-2RF +2LO Response vs. Temperature \(^{[2]}\)

![-2RF +2LO Response vs. Temperature graph]

-2RF +2LO Response vs. LO Drive \(^{[2]}\)

![-2RF +2LO Response vs. LO Drive graph]

-3RF +3LO Response vs. Temperature \(^{[2]}\)

![-3RF +3LO Response vs. Temperature graph]

-3RF +3LO Response vs. LO Drive \(^{[2]}\)

![-3RF +3LO Response vs. LO Drive graph]

\(^{[1]}\) Two-tone input power = +9 dBm each tone, 1 MHz spacing.  \(^{[2]}\) Referenced to RF input power at 0 dBm
**HMC689LP4 / 689LP4E**

**BiCMOS MMIC Mixer w/ Integrated LO Amplifier, 2.0 - 2.7 GHz**

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**Upconverter Performance**

**Conversion Gain vs. LO Drive**

- Conversion Gain (dB) vs. Frequency (GHz)
  - 1.8 to 3 GHz
  - 0 dB to -15 dB

**Input IP3 vs. LO Drive [1]**

- IP3 (dBm) vs. Frequency (GHz)
  - 1.8 to 3 GHz
  - 2.5 GHz
  - 2.8 GHz

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**Absolute Maximum Ratings**

- RF / IF Input (Vcc1, 2, 3 = +5V) +23 dBm
- LO Drive (Vcc1, 2, 3 = +5V) +10 dBm
- Vcc1, 2, 3 = +5.5V
- Channel Temperature 125 °C
- Continuous Pdiss (T = 85°C) (derate 36.23 mW/°C above 85°C) 1.45 W
- Thermal Resistance (channel to ground paddle) 27.6 °C/W
- Storage Temperature -65 to 150 °C
- Operating Temperature -40 to +85 °C

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**MxN Spurious @ IF Port**

- RF Freq. = 2.5 GHz @ 0 dBm
- LO Freq. = 2.8 GHz @ 0 dBm
- All values in dBc below IF power level (-1RF + 1LO).

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**Typical Supply Current vs. Vcc**

- Vcc1, 2, 3 (V) Icc total (mA)
  - 4.75 140
  - 5.00 152
  - 5.25 164

- Downconverter will operate over full voltage range shown above.

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**Harmonics of LO**

- LO Freq. (GHz) 1 2 3 4
  - 2.1 32 26 55 29
  - 2.2 30 26 51 30
  - 2.3 29 27 42 29
  - 2.4 28 26 44 29
  - 2.5 26 25 41 26
  - 2.6 25 24 42 26
  - 2.7 24 23 42 22
  - 2.8 25 24 40 26
  - 2.9 26 22 38 34

- LO = 0 dBm
- All values in dBc below input LO level measured at RF port.

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**ELECTROSTATIC SENSITIVE DEVICE**

**OBSERVE HANDLING PRECAUTIONS**

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[1] Two-tone input power = +9 dBm each tone, 1 MHz spacing.
**BiCMOS MMIC MIXER W/ INTEGRATED LO AMPLIFIER, 2.0 - 2.7 GHz**

**Outline Drawing**

**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 [2]</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMC689LP4</td>
<td>Low Stress Injection Molded Plastic</td>
<td>Sn/Pb Solder</td>
<td>MSL1 [1]</td>
<td>H689 XXXX</td>
</tr>
<tr>
<td>HMC689LP4E</td>
<td>RoHS-compliant Low Stress Injection Molded Plastic</td>
<td>100% matte Sn</td>
<td>MSL1 [2]</td>
<td>H689 XXXX</td>
</tr>
</tbody>
</table>

[1] Max peak reflow temperature of 235 °C
[3] 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, 6, 7, 11 - 14, 18, 20, 23</td>
<td>N/C</td>
<td>No connection. These pins may be connected to RF ground. Performance will not be affected.</td>
<td></td>
</tr>
<tr>
<td>2, 5, 15, 17</td>
<td>GND</td>
<td>Package bottom must be connected to RF/DC ground.</td>
<td>![GND Diagram]</td>
</tr>
<tr>
<td>3</td>
<td>RF</td>
<td>This pin is matched single-ended to 50 Ohms and DC shorted to ground through a balun.</td>
<td>![RF Diagram]</td>
</tr>
<tr>
<td>4</td>
<td>TAP</td>
<td>Center tap of secondary side of the internal RF balun. Short to ground with zero ohms close to the IC.</td>
<td>![TAP Diagram]</td>
</tr>
<tr>
<td>8, 10, 24</td>
<td>Vcc1, Vcc2, Vcc3</td>
<td>Power supply voltage. See application circuit for required external components.</td>
<td>![Vcc Diagram]</td>
</tr>
<tr>
<td>9</td>
<td>LO_BIAS</td>
<td>Adjust the LO buffer current through an external resistor. See application circuit for required external components.</td>
<td>![LO_BIAS Diagram]</td>
</tr>
<tr>
<td>16</td>
<td>LO</td>
<td>This pin is matched single-ended to 50 Ohms and DC shorted to ground through a balun.</td>
<td>![LO Diagram]</td>
</tr>
<tr>
<td>19</td>
<td>G_BIAS</td>
<td>External optional bias. See application circuit for required external components. Apply +2.8V for nominal performance</td>
<td>![G_BIAS Diagram]</td>
</tr>
<tr>
<td>21, 22</td>
<td>IFN, IFP</td>
<td>Differential IF input / output pins matched to differential 50 Ohms. For applications not requiring operation to DC, an off chip DC blocking capacitor should be used.</td>
<td>![IFN, IFP Diagram]</td>
</tr>
</tbody>
</table>

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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 Hittite upon request.

### List of Materials for Evaluation PCB 120974 [1]

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>J1 - J3</td>
<td>SMA Connector</td>
</tr>
<tr>
<td>J4 - J7</td>
<td>DC Pin</td>
</tr>
<tr>
<td>C1, C4</td>
<td>1.5 pF Capacitor, 0402 Pkg.</td>
</tr>
<tr>
<td>C7, C8, C13</td>
<td>10 nF Capacitor, 0402 Pkg.</td>
</tr>
<tr>
<td>C10, C12, C16, C18</td>
<td>0.1 µF Capacitor, 0402 Pkg.</td>
</tr>
<tr>
<td>C11, C15, C17, C21</td>
<td>1 nF Capacitor, 0402 Pkg.</td>
</tr>
<tr>
<td>C14, C19</td>
<td>22 pF Capacitor, 0402 Pkg.</td>
</tr>
<tr>
<td>L1</td>
<td>7.5 nH Inductor, 0402 Pkg</td>
</tr>
<tr>
<td>L2</td>
<td>8.2 nH Inductor, 0402 Pkg</td>
</tr>
<tr>
<td>C20</td>
<td>4.7 µF Case A, Tantalum</td>
</tr>
<tr>
<td>R3, R4</td>
<td>0 Ohm Resistor, 0402 Pkg</td>
</tr>
<tr>
<td>R9</td>
<td>215 Ohm Resistor, 0603 Pkg</td>
</tr>
<tr>
<td>T1</td>
<td>1:1 Transformer - Tyco MABACT0039</td>
</tr>
<tr>
<td>U1</td>
<td>HMC689LP4(E) Downconverter</td>
</tr>
<tr>
<td>PCB [2]</td>
<td>118162 Evaluation PCB</td>
</tr>
</tbody>
</table>

[1] Reference this number when ordering complete evaluation PCB


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Application Circuit

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