HMC369LP3 / 369LP3E
SMT GaAs HBT MMIC x2 ACTIVE FREQUENCY MULTIPLIER, 9.9 - 12.7 GHz OUTPUT

**Typical Applications**
Active Multiplier for X Band Applications:
- OC-192 Clock Recovery
- Microwave Radio & VSAT
- Military Radios, Radar & ECM
- Test Instrumentation

**Features**
- Output Power: +4 dBm
- Sub-Harmonic Suppression: 30 dBc
- SSB Phase Noise: -142 dBc/Hz
- Single Supply: 5V@ 46 mA
- 16 Lead 3x3mm SMT Package: 9mm²

**General Description**
The HMC369LP3 & HMC369LP3E are active miniature x2 frequency multipliers utilizing InGaP GaAs HBT technology in 3x3 mm leadless QFN surface mount packages. Power output is +4 dBm typical from a single +5V supply and varies little vs. input power, temperature and supply voltage. Suppression of undesired fundamental and sub-harmonics is 30 dBc typical with respect to output signal level. The low additive SSB phase noise of -142 dBc/Hz at 100 kHz offset helps the user maintain good system noise performance. The HMC369LP3(E) is ideal for use in LO multiplier chains allowing reduced parts count versus traditional approaches. The HMC369LP3(E) are also useful for OC-192 clock recovery. The application of 10 GBPS data to the input generates a -7 dBm clock tone at the output with spurious signals suppressed by 25 dB.

**Functional Diagram**

**Electrical Specifications, \( T_A = +25^\circ \text{C}, \text{Vcc}=5V \)**

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency Range, Input</td>
<td>4.95</td>
<td>5.3</td>
<td>5.3</td>
<td>6.35</td>
<td></td>
<td></td>
<td>GHz</td>
</tr>
<tr>
<td>Frequency Range, Output</td>
<td>9.9</td>
<td>10.6</td>
<td>10.6</td>
<td>12.7</td>
<td></td>
<td></td>
<td>GHz</td>
</tr>
<tr>
<td>Input Power Range</td>
<td>-5</td>
<td>+5</td>
<td>-5</td>
<td>+5</td>
<td></td>
<td></td>
<td>dBm</td>
</tr>
<tr>
<td>Output Power</td>
<td>-1</td>
<td>3</td>
<td>0</td>
<td>4</td>
<td></td>
<td></td>
<td>dBm</td>
</tr>
<tr>
<td>Sub-Harmonic Suppression</td>
<td>30</td>
<td></td>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td>dBc</td>
</tr>
<tr>
<td>Input Return Loss</td>
<td>17</td>
<td></td>
<td>16</td>
<td></td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>Output Return Loss</td>
<td>5.5</td>
<td></td>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>SSB Phase Noise (100 kHz Offset)</td>
<td>-142</td>
<td></td>
<td>-142</td>
<td></td>
<td></td>
<td></td>
<td>dBc/Hz</td>
</tr>
<tr>
<td>Supply Current (Icc)</td>
<td>46</td>
<td>61</td>
<td>46</td>
<td>61</td>
<td></td>
<td></td>
<td>mA</td>
</tr>
</tbody>
</table>
COMPARABLE PARTS
View a parametric search of comparable parts.

EVALUATION KITS
• HMC369LP3 Evaluation Board

DOCUMENTATION
Data Sheet
• HMC369 Data Sheet

TOOLS AND SIMULATIONS
• HMC369 S-Parameter

REFERENCE MATERIALS
Product Selection Guide
• RF, Microwave, and Millimeter Wave IC Selection Guide 2017
Quality Documentation
• Package/Assembly Qualification Test Report: 16L 3x3mm QFN Package (QTR: 11003 REV: 02)
• Package/Assembly Qualification Test Report: Plastic Encapsulated QFN (QTR: 05006 REV: 02)
• Semiconductor Qualification Test Report: GaAs HBT-A (QTR: 2013-00228)

DESIGN RESOURCES
• HMC369 Material Declaration
• PCN-PDN Information
• Quality And Reliability
• Symbols and Footprints

DISCUSSIONS
View all HMC369 EngineerZone Discussions.

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SMT GaAs HBT MMIC x2 ACTIVE
FREQUENCY MULTIPLIER, 9.9 - 12.7 GHz OUTPUT

Output Power vs.
Temperature @ 0 dBm Drive Level

Output Power vs. Drive Level

Output Power vs.
Supply Voltage @ 0 dBm Drive Level

Input Return Loss vs. Temperature

Output Return Loss vs. Temperature

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Downloaded from Arrow.com.
**Output Spectrum**

- **Frequency (GHz)**: 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26
- **Output Power (dBm)**: -60, -50, -40, -30, -20, -10, 0, 10, 20, 30, 40, 50, 60

**SSB Phase Noise**

- **Performance, Fout= 10.66 GHz, Input Power= 0 dBm**

- **Offset Frequency (Hz)**: 10^2, 10^3, 10^4, 10^5, 10^6
- **SSB Phase Noise (dBc/Hz)**: -140, -120, -100, -80, -60, -40, -20, 0, 20

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Absolute Maximum Ratings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>RF Input (Vcc = +5V)</td>
<td>+20 dBm</td>
</tr>
<tr>
<td>Vcc</td>
<td>+5.5V</td>
</tr>
<tr>
<td>Channel Temperature</td>
<td>135 °C</td>
</tr>
<tr>
<td>Continuous Pdiss (T=85 °C)</td>
<td>440 mW</td>
</tr>
<tr>
<td>Thermal Resistance (Rth)</td>
<td>147.8 °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>
</tbody>
</table>

Typical Supply Current vs. Vcc

<table>
<thead>
<tr>
<th>Vcc (V)</th>
<th>Icc (mA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.5</td>
<td>45</td>
</tr>
<tr>
<td>5.0</td>
<td>46</td>
</tr>
<tr>
<td>5.5</td>
<td>47</td>
</tr>
</tbody>
</table>

Note: Multiplier will operate over full voltage range shown above.

ELECTROSTATIC SENSITIVE DEVICE
OBSERVE HANDLING PRECAUTIONS

Outline Drawing

Bottom View

EXPOSED GROUND PADDLE
MUST BE CONNECTED TO
RF/DC GROUND

NOTES:
1. LEADFRAME MATERIAL: COPPER ALLOY
2. DIMENSIONS ARE IN INCHES [MILLIMETERS]
3. LEAD SPACING TOLERANCE IS NON-CUMULATIVE.
4. PAD BURR LENGTH SHALL BE 0.15mm MAXIMUM.
5. PACKAGE WARP SHALL NOT EXCEED 0.05mm.
6. ALL GROUND LEADS AND GROUND PADDLE MUST BE
   SOLDERED TO PCB RF GROUND.
7. REFER TO HITTITE APPLICATION NOTE FOR SUGGESTED
   LAND PATTERN.

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>HMC369LP3</td>
<td>Low Stress Injection Molded Plastic</td>
<td>Sn/Pb Solder</td>
<td>MSL1 [1]</td>
<td>369 XXXX</td>
</tr>
<tr>
<td>HMC369LP3E</td>
<td>RoHS-compliant Low Stress Injection Molded Plastic</td>
<td>100% matte Sn</td>
<td>MSL1 [2]</td>
<td>369 XXXX</td>
</tr>
</tbody>
</table>

[1] Max peak reflow temperature of 235 °C
[3] 4-Digit lot number XXXX
## Pin Description

<table>
<thead>
<tr>
<th>Pin Number</th>
<th>Function</th>
<th>Description</th>
<th>Interface Schematic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 2, 5 - 8, 11 - 13, 15, 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></td>
</tr>
<tr>
<td>3</td>
<td>RFIN</td>
<td>RF input needs to be DC blocked only if there is an external DC voltage applied to RFIN.</td>
<td><img src="image" alt="Interface Schematic" /></td>
</tr>
<tr>
<td>4, 9</td>
<td>GND</td>
<td>All ground leads and ground paddle must be soldered to PCB RF/DC ground.</td>
<td><img src="image" alt="Interface Schematic" /></td>
</tr>
<tr>
<td>10</td>
<td>RFOUT</td>
<td>Multiplied Output. AC coupled. No external DC blocks necessary.</td>
<td><img src="image" alt="Interface Schematic" /></td>
</tr>
<tr>
<td>14</td>
<td>Vcc</td>
<td>Supply voltage 5V ± 0.5V.</td>
<td></td>
</tr>
</tbody>
</table>
**Evaluation PCB**

![Diagram of Evaluation PCB]

**List of Materials for Evaluation PCB 107712 \(^{(1)}\)**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>J1, J2</td>
<td>PCB Mount SMA Connector</td>
</tr>
<tr>
<td>J3, J4</td>
<td>DC Pin</td>
</tr>
<tr>
<td>C1</td>
<td>0.01 μF Capacitor, 0603 Pkg.</td>
</tr>
<tr>
<td>U1</td>
<td>HMC369LP3 / HMC369LP3E x2 Active Multiplier</td>
</tr>
<tr>
<td>PCB</td>
<td>107710 Eval Board</td>
</tr>
</tbody>
</table>

\(^{(1)}\) Reference this number when ordering complete evaluation PCB

\(^{(2)}\) Circuit Board Material: Rogers 4350

The circuit board used in the final application should be generated with proper 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. The evaluation circuit board shown is available from Hittite upon request.

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For price, delivery, and to place orders: Hittite Microwave Corporation
20 Alpha Road, Chelmsford, MA 01824
Phone: 978-250-3343  Fax: 978-250-3373
Order On-line at www.hittite.com

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