HMC463LP5 / 463LP5E
GaAs pHEMT MMIC LOW NOISE AGC AMPLIFIER, 2 - 20 GHz

Typical Applications
The HMC463LP5(E) is ideal for:
• Telecom Infrastructure
• Microwave Radio & VSAT
• Military EW, ECM & C3I
• Test Instrumentation
• Fiber Optics

Features
Gain: 13 dB
Noise Figure: 2.8 dB @ 10 GHz
P1dB Output Power: +18 dBm @ 10 GHz
Supply Voltage: ±5V @ 60mA
50 Ohm Matched Input/Output
32 Lead 5x5mm SMT Package: 25mm²

General Description
The HMC463LP5(E) is a GaAs MMIC pHEMT Low Noise AGC Distributed Amplifier packaged in a leadless 5x5 mm surface mount package which operates between 2 and 20 GHz. The amplifier provides 13 dB of gain, 2.8 dB noise figure and 18 dBm of output power at 1 dB gain compression while requiring only 60mA from a +5V supply. An optional gate bias (Vgg2) is provided to allow Adjustable Gain Control (AGC) of 8 dB typical. Gain flatness is excellent at ±0.5 dB from 6 - 18 GHz making the HMC463LP5(E) ideal for EW, ECM RADA and test equipment applications. The HMC463LP5(E) LNA I/Os are internally matched to 50 Ohms and are internally DC blocked.

Functional Diagram

Electrical Specifications, $T_A = +25^\circ\text{C}$, Vdd = 5V, Idd = 60 mA*

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Frequency Range</td>
<td>2 - 6</td>
<td>6 - 18</td>
<td></td>
<td>18 - 20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>GHz</td>
</tr>
<tr>
<td>Gain</td>
<td>10</td>
<td>13</td>
<td>9</td>
<td>12</td>
<td>8</td>
<td>11</td>
<td></td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>Gain Flatness</td>
<td>±0.5</td>
<td>±0.5</td>
<td>±0.5</td>
<td>±0.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>Gain Variation Over Temperature</td>
<td>0.010</td>
<td>0.015</td>
<td>0.010</td>
<td>0.015</td>
<td>0.010</td>
<td>0.015</td>
<td></td>
<td></td>
<td></td>
<td>dB/°C</td>
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<td>Noise Figure</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>5</td>
<td>5.5</td>
<td>6.5</td>
<td></td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>Input Return Loss</td>
<td>15</td>
<td>13</td>
<td>12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>Output Return Loss</td>
<td>13</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>Output Power for 1 dB Compression (P1dB)</td>
<td>16</td>
<td>19</td>
<td>11</td>
<td>16</td>
<td>10</td>
<td>12</td>
<td></td>
<td></td>
<td></td>
<td>dBm</td>
</tr>
<tr>
<td>Saturated Output Power (Psat)</td>
<td>21</td>
<td>19</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>dBm</td>
</tr>
<tr>
<td>Output Third Order Intercept (IP3)</td>
<td>30</td>
<td>24</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>dBm</td>
</tr>
<tr>
<td>Supply Current (Idd) (Vdd = 5V, Vgg1 = -0.9V Typ.)</td>
<td>60</td>
<td>80</td>
<td>60</td>
<td>80</td>
<td>60</td>
<td>80</td>
<td></td>
<td></td>
<td></td>
<td>mA</td>
</tr>
</tbody>
</table>

* Adjust Vgg1 between -2 to -0V to achieve Idd = 60 mA typical.
COMPARABLE PARTS
View a parametric search of comparable parts.

EVALUATION KITS
• HMC463LP5 Evaluation Board

DOCUMENTATION
Application Notes
• AN-1363: Meeting Biasing Requirements of Externally Biased RF/Microwave Amplifiers with Active Bias Controllers
• Broadband Biasing of Amplifiers General Application Note
• MMIC Amplifier Biasing Procedure Application Note
• Thermal Management for Surface Mount Components General Application Note
Data Sheet
• HMC463LP5: GaAs pHEMT MMIC Low Noise AGC Amplifier, 2 - 20 GHz Data Sheet

TOOLS AND SIMULATIONS
• HMC463LP5 S-Parameters

REFERENCE MATERIALS
Product Selection Guide
• RF, Microwave, and Millimeter Wave IC Selection Guide 2017
Quality Documentation
• Package/Assembly Qualification Test Report: LP5 & LPSG (QTR: 2014-00150 REV: 02)
• Package/Assembly Qualification Test Report: Plastic Encapsulated QFN (QTR: 05006 REV: 02)
• Semiconductor Qualification Test Report: PHEMT-F (QTR: 2013-00269)

DESIGN RESOURCES
• HMC463LP5 Material Declaration
• PCN-PDN Information
• Quality And Reliability
• Symbols and Footprints

DISCUSSIONS
View all HMC463LP5 EngineerZone Discussions.

SAMPLE AND BUY
Visit the product page to see pricing options.

TECHNICAL SUPPORT
Submit a technical question or find your regional support number.

DOCUMENT FEEDBACK
Submit feedback for this data sheet.
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P1dB vs. Temperature
![P1dB vs. Temperature graph](image)

Psat vs. Temperature
![Psat vs. Temperature graph](image)

Output IP3 vs. Temperature
![Output IP3 vs. Temperature graph](image)

Gain, Power & Noise Figure vs. Supply Voltage @ 10 GHz, Fixed Vgg1
![Gain, Power & Noise Figure vs. Supply Voltage graph](image)

Gain, P1dB & Output IP3 vs. Control Voltage @ 10 GHz
![Gain, P1dB & Output IP3 vs. Control Voltage graph](image)

Noise Figure & Supply Current vs. Control Voltage @ 10 GHz
![Noise Figure & Supply Current vs. Control Voltage graph](image)
**Absolute Maximum Ratings**

- Drain Bias Voltage (Vdd): +9V
- Gate Bias Voltage (Vgg1): -2 to 0V
- Gate Bias Current (Igg1): 2.5 mA
- Gate Bias Voltage (Vgg2)/(AGC): (Vdd - 9) Vdc to +2V
- RF Input Power (RFIN)/(Vdd = +5V): +18 dBm
- Channel Temperature: 150 °C
- Continuous Pdiss (T= 85 °C): 1.24 W
- Thermal Resistance (channel to ground paddle): 52.3 °C/W
- Storage Temperature: -65 to +150 °C
- Operating Temperature: -40 to +85 °C
- ESD Sensitivity (HBM): Class 0B - Passed 150V

**Typical Supply Current vs. Vdd**

<table>
<thead>
<tr>
<th>Vdd (V)</th>
<th>Idd (mA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>+4.5</td>
<td>58</td>
</tr>
<tr>
<td>+5.0</td>
<td>60</td>
</tr>
<tr>
<td>+5.5</td>
<td>62</td>
</tr>
</tbody>
</table>
**HMC463LP5 / 463LP5E**

**GaAs pHEMT MMIC LOW NOISE AGC AMPLIFIER, 2 - 20 GHz**

### Outline Drawing

![Outline Drawing](image)

**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>HMC463LP5</td>
<td>Low Stress Injection Molded Plastic</td>
<td>Sn/Pb Solder</td>
<td>MSL1 [1]</td>
<td>H463 XXXX</td>
</tr>
<tr>
<td>HMC463LP5E</td>
<td>RoHS-compliant Low Stress Injection Molded Plastic</td>
<td>100% matte Sn</td>
<td>MSL1 [2]</td>
<td>H463 XXXX</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Pin Number</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 3, 4, 6-14, 16-20, 22-29, 31, 32</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>
</tr>
<tr>
<td>2</td>
<td>Vgg2</td>
<td>Optional gate control if AGC is required. Leave Vgg2 open circuited if AGC is not required. Typical Vgg2 = -1.5V to 0V</td>
</tr>
<tr>
<td>5</td>
<td>RFIN</td>
<td>This pad is AC coupled and matched to 50 Ohms</td>
</tr>
<tr>
<td>15</td>
<td>Vgg1</td>
<td>Gate control for amplifier. Adjust to achieve Idd = 60mA.</td>
</tr>
<tr>
<td>21</td>
<td>RFOUT</td>
<td>This pad is AC coupled and matched to 50 Ohms</td>
</tr>
<tr>
<td>30</td>
<td>Vdd</td>
<td>Power supply voltage for the amplifier. External bypass capacitors are required</td>
</tr>
<tr>
<td>Ground Paddle</td>
<td>GND</td>
<td>Ground paddle must be connected to RF/DC ground.</td>
</tr>
</tbody>
</table>
### 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 package bottom 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 board should be mounted to an appropriate heat sink. The evaluation circuit board shown is available from Analog Devices upon request.

#### List of Materials for Evaluation PCB 108341

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>J1 - J2</td>
<td>SRI K Connector</td>
</tr>
<tr>
<td>J3 - J4</td>
<td>2 mm Molex Header</td>
</tr>
<tr>
<td>C1 - C3</td>
<td>100 pF Capacitor, 0402 Pkg.</td>
</tr>
<tr>
<td>C4 - C6</td>
<td>1000 pF Capacitor, 0603 Pkg.</td>
</tr>
<tr>
<td>C7 - C8</td>
<td>4.7 µF Capacitor, Tantalum</td>
</tr>
<tr>
<td>U1</td>
<td>HMC463LP5(E) Amplifier</td>
</tr>
<tr>
<td>PCB [2]</td>
<td>109949 Evaluation PCB</td>
</tr>
</tbody>
</table>

[1] Reference this number when ordering complete evaluation PCB