0.2 GHz to 8 GHz, GaAs, HBT MMIC, Divide by 8 Prescaler

FEATURES
- Ultralow SSB phase noise: −150 dBc/Hz typical
- Single-ended input/outputs
- Output power: −2 dBm typical
- Single supply operation: 3 V
- Ultrasmall, surface-mount, 2.90 mm × 2.80 mm, 6-lead SOT-23 package

APPLICATIONS
- DC to C band PLL prescalers
- Very small aperture terminal (VSAT) radios
- Unlicensed national information infrastructure (UNII) and point to point radios
- IEEE 802.11a and high performance radio local area network (HiperLAN) WLAN
- Fiber optics
- Cellular/3G infrastructure

GENERAL DESCRIPTION
The HMC434 is a low noise, static, divide by 8 prescaler monolithic microwave integrated circuit (MMIC) utilizing indium gallium phosphide/gallium arsenide (InGaP/GaAs) heterojunction bipolar transistor (HBT) technology in an ultrasmall surface-mount 6-lead SOT-23 package.

The HMC434 operates from near dc (square wave) or 200 MHz (sine wave) to 8 GHz input frequency with a single 3 V dc supply.

The HMC434 features single-ended inputs and outputs for reduced component count and cost. The low additive single sideband (SSB) phase noise of −150 dBc/Hz at 100 kHz offset helps the user maintain optimal system noise performance.
COMPARABLE PARTS
View a parametric search of comparable parts.

EVALUATION KITS
- HMC434 Evaluation Board

DOCUMENTATION
Application Notes
- AN-1463: Frequency Divider Operation and Compensation with No Input Signal
Data Sheet
- HMC434-DSCC: Military Data Sheet
- HMC434-EP: Enhanced Product Data Sheet
- HMC434: 0.2 GHz to 8 GHz, GaAs, HBT MMIC, Divide by 8 Prescaler Data Sheet

TOOLS AND SIMULATIONS
- ADIsimPLL™

REFERENCE MATERIALS
Quality Documentation
- HMC Legacy PCN: SOT26 and SOT26E packages - Relocation of pre-existing production equipment to new building
- Package/Assembly Qualification Test Report: Plastic Encapsulated SOT26 (QTR: 02017 REV: 01)
- PCN: MS, QS, SOT, SOIC Packages - Sn/Pb Plating Vendor Change
- Semiconductor Qualification Test Report: GaAs HBT-A (QTR: 2013-00228)

DESIGN RESOURCES
- HMC434 Material Declaration
- PCN-PDN Information
- Quality And Reliability
- Symbols and Footprints

DISCUSSIONS
View all HMC434 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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REVISION HISTORY

8/2017—Rev. E to Rev. F
Added Endnote 2, Table 1 ............................................ 3

This Hittite Microwave Products data sheet has been reformatted to meet the styles and standards of Analog Devices, Inc.

3/2017—Rev. 04.0410 to Rev. E
Updated Format ...................................................... Universal
Changes to Features Section, Figure 1, and General Description Section ................................................................. 1
Changes to Table 1 ..................................................... 3
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Added Figure 2; Renumbered Sequentially .................... 5
Changes to Table 4, Figure 4, Figure 5, and Figure 6 ....... 5
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Added Applications Information Section ..................... 7
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Added PCB Material Stackup Section and Figure 15 ........ 8
Updated Outline Dimensions ..................................... 9
Change to Ordering Guide .......................................... 9
### SPECIFICATIONS

$V_{CC} = 3\ V, T_a = 25^\circ C, 50\ \Omega$ system, unless otherwise noted. $P_{IN}$ is input power.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
<th>Test Conditions / Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RADIO FREQUENCY (RF) INPUT</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency $^{1,2}$</td>
<td>0.2</td>
<td>0</td>
<td>8</td>
<td>GHz</td>
<td>$f_{IN} = 1.0\ \text{GHz}$ to $3.0\ \text{GHz}$</td>
</tr>
<tr>
<td>Power</td>
<td>−10</td>
<td>0</td>
<td>+10</td>
<td>dBm</td>
<td>$f_{IN} = 3.0\ \text{GHz}$ to $8.0\ \text{GHz}$</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>0</td>
<td>10</td>
<td>dBm</td>
<td></td>
</tr>
<tr>
<td><strong>RF OUTPUT</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SSB Phase Noise</td>
<td>−150</td>
<td></td>
<td></td>
<td>dBc/Hz</td>
<td>100 kHz offset, $P_{IN} = 0\ \text{dBm}$, $f_{IN} = 4.0\ \text{GHz}$</td>
</tr>
<tr>
<td>Power</td>
<td>−5</td>
<td>−2</td>
<td></td>
<td>dBm</td>
<td>$f_{IN} = 1.0\ \text{GHz}$ to $8.0\ \text{GHz}$</td>
</tr>
<tr>
<td><strong>REVERSE LEAKAGE</strong></td>
<td>−25</td>
<td></td>
<td></td>
<td>dBm</td>
<td>$P_{IN} = 0\ \text{dBm}$, $f_{IN} = 4.0\ \text{GHz}$, output terminated</td>
</tr>
<tr>
<td><strong>SUPPLY</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voltage ($V_{CC}$)</td>
<td>2.85</td>
<td>3</td>
<td>3.15</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Current ($I_{CC}$)</td>
<td>62</td>
<td>83</td>
<td></td>
<td>mA</td>
<td></td>
</tr>
</tbody>
</table>

$^{1}$ Below $200\ \text{MHz}$, a square wave input is required.

$^{2}$ For stable operation without an input signal, refer to AN-1463.
ABSOLUTE MAXIMUM RATINGS

Table 2.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Voltage (VCC)</td>
<td>−0.3 V to +3.5 V</td>
</tr>
<tr>
<td>RF Input Power (VCC = 3 V)</td>
<td>13 dBm</td>
</tr>
<tr>
<td>Temperature</td>
<td></td>
</tr>
<tr>
<td>Operating</td>
<td>−40°C to +85°C</td>
</tr>
<tr>
<td>Storage</td>
<td>−65°C to +125°C</td>
</tr>
<tr>
<td>Junction, TJ</td>
<td>135°C</td>
</tr>
<tr>
<td>Nominal (T_A = 85°C)</td>
<td>99°C</td>
</tr>
<tr>
<td>Reflow</td>
<td>260°C</td>
</tr>
<tr>
<td>ESD Sensitivity</td>
<td></td>
</tr>
<tr>
<td>Human Body Model (HBM)</td>
<td>Class 0</td>
</tr>
</tbody>
</table>

Stresses at or above those listed under Absolute Maximum Ratings may cause permanent damage to the product. This is a stress rating only; functional operation of the product at these or any other conditions above those indicated in the operational section of this specification is not implied. Operation beyond the maximum operating conditions for extended periods may affect product reliability.

THERMAL RESISTANCE

Thermal performance is directly linked to printed circuit board (PCB) design and operating environment. Careful attention to PCB thermal design is required.

\( \theta_{JA} \) is the natural convection junction to ambient thermal resistance measured in a one cubic foot sealed enclosure. \( \theta_{JC} \) is the junction to case thermal resistance.

Table 3. Thermal Resistance

<table>
<thead>
<tr>
<th>Package Type</th>
<th>( \theta_{JA} )</th>
<th>( \theta_{JC} )</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>RJ-6</td>
<td>359</td>
<td>70</td>
<td>°C/W</td>
</tr>
</tbody>
</table>

1 Simulated values per JEDEC JESD51-12 standards.
2 Junction to GND package pin.

ESD CAUTION

ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.
PIN CONFIGURATION AND FUNCTION DESCRIPTIONS

Table 4. Pin Function Descriptions

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Mnemonic</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 4</td>
<td>NIC</td>
<td>Not Internally Connected. These pins can be connected to RF and dc ground without affecting performance. The NIC pins are typically tied to GND for enhanced thermal performance (but not required).</td>
</tr>
<tr>
<td>2</td>
<td>GND</td>
<td>Ground. This pin must be connected to both RF and dc ground.</td>
</tr>
<tr>
<td>3</td>
<td>IN</td>
<td>RF Input. This pin must be dc blocked.</td>
</tr>
<tr>
<td>5</td>
<td>VCC</td>
<td>Supply Voltage (3 V).</td>
</tr>
<tr>
<td>6</td>
<td>OUT</td>
<td>RF Output. This pin must be dc blocked.</td>
</tr>
</tbody>
</table>

INTERFACE SCHEMATICS

Figure 2. Pin Configuration

Figure 3. GND Interface Schematic

Figure 4. IN Interface Schematic

Figure 5. OUT Interface Schematic

Figure 6. VCC Interface Schematic
TYPICAL PERFORMANCE CHARACTERISTICS

In Figure 9, $P_{\text{FEEDTHROUGH}}$ is the power of the output spectrum at the input frequency.

Figure 7. Input Sensitivity Window

Figure 8. Output Power vs. Frequency at Various Temperatures

Figure 9. Output Harmonic Content ($P_{\text{IN}} = 0$ dBm)

Figure 10. Input Sensitivity Window at Various Temperatures

Figure 11. SSB Phase Noise ($P_{\text{IN}} = 0$ dBm)

Figure 12. Reverse Leakage ($P_{\text{IN}} = 0$ dBm)
APPLICATIONS INFORMATION

EVALUATION BOARD PCB

Use RF circuit design techniques for the PCB used in the application. Ensure that signal lines have 50 Ω impedance when the package ground leads are connected directly to the ground plane (see Figure 14). Use a sufficient number of via holes to connect the top and bottom ground planes.

The evaluation board has two connectors, as shown in Figure 14. The RF input connector (J1) and the RF output connector (J2) are PCB mount SMA connectors.

The evaluation board is powered from a single 3 V supply; connect this supply using the J3 (VCC) and J4 (GND) test points.

See Figure 13 and Table 5 for the evaluation board schematic and the bill of materials, respectively.

Table 5. List of Materials for Evaluation PCB 105675-HMC434

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>J1, J2</td>
<td>PCB mount SMA RF connectors</td>
</tr>
<tr>
<td>J3, J4</td>
<td>DC pins</td>
</tr>
<tr>
<td>C1, C2</td>
<td>100 pF capacitors, 0402 package</td>
</tr>
<tr>
<td>C3</td>
<td>1000 pF capacitors, 0402 package</td>
</tr>
<tr>
<td>C4</td>
<td>10 μF tantalum capacitors, 1206 package</td>
</tr>
<tr>
<td>U1</td>
<td>HMC434/HMC434E, divide by 8</td>
</tr>
<tr>
<td>PCB1</td>
<td>105199 evaluation board</td>
</tr>
</tbody>
</table>

1 105199 is the raw bare PCB identifier. Reference 105675-HMC434 when ordering the complete evaluation PCB.

2 Circuit board material: Arlon 25FR or Rogers RO4350B.
PCB MATERIAL STACKUP

The evaluation board is built using Arlon 25FR or Rogers RO4350B and standard FR4 materials. RF trace widths are designed to achieve a controlled 50 Ω characteristic impedance. The complete PCB stackup is shown in Figure 15.

![Figure 15. Evaluation Board PCB Stackup](image-url)
OUTLINE DIMENSIONS

Figure 16. 6-Lead Small Outline Transistor Package [SOT-23] (RJ-6)
Dimensions shown in millimeters

ORDERING GUIDE

<table>
<thead>
<tr>
<th>Model</th>
<th>Temperature Range</th>
<th>Package Description</th>
<th>Package Option</th>
<th>Branding</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMC434</td>
<td>−40°C to +85°C</td>
<td>6-Lead Small Outline Transistor Package [SOT-23]</td>
<td>RJ-6</td>
<td>H434</td>
</tr>
<tr>
<td>HMC434TR</td>
<td>−40°C to +85°C</td>
<td>6-Lead Small Outline Transistor Package [SOT-23]</td>
<td>RJ-6</td>
<td>H434</td>
</tr>
<tr>
<td>HMC434E</td>
<td>−40°C to +85°C</td>
<td>6-Lead Small Outline Transistor Package [SOT-23]</td>
<td>RJ-6</td>
<td>434E</td>
</tr>
<tr>
<td>HMC434ETR</td>
<td>−40°C to +85°C</td>
<td>6-Lead Small Outline Transistor Package [SOT-23]</td>
<td>RJ-6</td>
<td>434E</td>
</tr>
<tr>
<td>105675-HMC434</td>
<td></td>
<td>Evaluation Board</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 The HMC434E and HMC434ETR are RoHS compliant parts.