**Typical Applications**

The HMC894LP5E is ideal for:

- Test & Measurement Equipment
- Military RADAR & EW/ECM
- SATCOM & Space
- Industrial & Medical Equipment

**Functional Diagram**

The HMC894LP5E is a MMIC band pass filter which features a user selectable passband frequency. The 3 dB filter bandwidth is approximately 6%. The 20 dB filter bandwidth is approximately 16.5%. The center frequency can be varied between 5.9 and 11.2 GHz by applying an analog tune voltage between 0 and 14V. This tunable filter can be used as a much smaller alternative to physically large switched filter banks and cavity tuned filters. The HMC894LP5E has excellent microphonics due to the monolithic design, and provides a dynamically adjustable solution in advanced communications applications.

**Electrical Specifications, \( T_a = +25^\circ C, V_{fctl} = V_{bwctl} \)** Unless Otherwise Stated

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>F_{center} Tuning Range</td>
<td>5.9</td>
<td></td>
<td>11.2</td>
<td>GHz</td>
</tr>
<tr>
<td>3 dB Bandwidth</td>
<td>6</td>
<td></td>
<td></td>
<td>%</td>
</tr>
<tr>
<td>Low Side Rejection Frequency (Rejection &gt;20 dB)</td>
<td>0.92F_{center}</td>
<td></td>
<td></td>
<td>GHz</td>
</tr>
<tr>
<td>High Side Rejection Frequency (Rejection &gt;20 dB)</td>
<td>1.08F_{center}</td>
<td></td>
<td></td>
<td>GHz</td>
</tr>
<tr>
<td>Re-entry Frequency (Rejection &lt;30 dB)</td>
<td>25</td>
<td></td>
<td></td>
<td>GHz</td>
</tr>
<tr>
<td>3 dB Bandwidth Control (V_{bwctl})</td>
<td>±3</td>
<td></td>
<td></td>
<td>%</td>
</tr>
<tr>
<td>Insertion Loss</td>
<td>9</td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>Return Loss (2 dB Bandwidth)</td>
<td>7.5</td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>Maximum Input Power for Linear Operation</td>
<td>10</td>
<td></td>
<td></td>
<td>dBm</td>
</tr>
<tr>
<td>Frequency Control Voltage (V_{fctl})</td>
<td></td>
<td>14</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Source/Sink Current (I_{fctl})</td>
<td>±1</td>
<td></td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>Bandwidth Control Voltage (V_{bwctl})</td>
<td>0</td>
<td>14</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Source/Sink Current (I_{bwctl})</td>
<td>±1</td>
<td></td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>Residual Phase Noise [1] (1 MHz Offset)</td>
<td>-165</td>
<td></td>
<td></td>
<td>dBc/Hz</td>
</tr>
<tr>
<td>F_{center} Drift Rate</td>
<td>-0.86</td>
<td></td>
<td></td>
<td>MHz/°C</td>
</tr>
<tr>
<td>Tuning Characteristics [2]</td>
<td></td>
<td>200</td>
<td></td>
<td>ns</td>
</tr>
</tbody>
</table>

[2] Tuning speed is dependent on driver circuit. Data measured with a high speed op-amp driver and includes driver slew rate delay.
HMC894LP5E
FILTER - TUNABLE, BAND PASS SMT
5.9 - 11.2 GHz

Broadband Insertion Loss vs.
Control Voltages, Vfctl = Vbwctl

Insertion Loss vs.
Control Voltages, Vfctl = Vbwctl

Insertion Loss vs.
Temperature, Vfctl = Vbwctl = 7V

Return Loss vs.
Control Voltages, Vfctl = Vbwctl

Return Loss vs.
Temperature, Vfctl = Vbwctl = 7V

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www.BDTIC.com/Hittite/
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5.9 - 11.2 GHz

Broadband Insertion Loss vs. Vbwctl, Vfctl = 7V

Broadband Return Loss vs. Vbwctl, Vfctl = 7V

Insertion Loss vs. Vbwctl, Vfctl = 7V

Return Loss vs. Vbwctl, Vfctl = 7V

Center Frequency vs. Temperature, Vfctl = Vbwctl

Insertion Loss vs. Temperature, Vfctl = Vbwctl

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**HMC894LP5E**

**FILTER - TUNABLE, BAND PASS SMT**

5.9 - 11.2 GHz

### 3 dB Bandwidth vs. Temperature, Vfctl = Vbwctl

![Graph of 3 dB Bandwidth vs. Temperature](image)

### Maximum Return Loss in a 2 dB Bandwidth vs. Temperature, Vfctl = Vbwctl

![Graph of Maximum Return Loss](image)

### Low Side Rejection Ratio vs. Temperature, Vfctl = Vbwctl [1]

![Graph of Low Side Rejection Ratio](image)

### High Side Rejection Ratio vs. Temperature, Vfctl = Vbwctl [1]

![Graph of High Side Rejection Ratio](image)

### Tuning Sensitivity vs. Temperature, Vfctl = Vbwctl

![Graph of Tuning Sensitivity](image)

### Group Delay, Vctl = Vbwctl

![Graph of Group Delay](image)

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[1] Rejection ratio is defined as the ratio of the frequency at which the relative insertion loss is 20 dB to fcenter

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Group Delay vs. Fcenter vs. Temperature

3 dB Bandwidth vs. Bandwidth Control

Insertion Loss vs. Bandwidth Control

Low Side Rejection Ratio vs. Bandwidth Control

High Side Rejection Ratio vs. Bandwidth Control

Maximum Return Loss in a 2 dB Bandwidth vs. Bandwidth Control

[1] Rejection ratio is defined as the ratio of the frequency at which the relative insertion loss is 20 dB to $f_{center}$.
HMC894LP5E

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5.9 - 11.2 GHz

Input IP3 vs. Power Input
Vfctl = Vbwctl

Residual Phase Noise
Vfctl = Vbwctl

Absolute Maximum Ratings
- Frequency Control Voltage (Vfctl): -0.5 to +15V
- Bandwidth Control Voltage (Vbwctl): -0.5 to +15V
- RF Power Input: 26 dBm
- Storage Temperature: -65 to +150 °C
- ESD Rating (HBM): Class 1B

Reliability Information
- Junction Temperature to Maintain 1 Million Hour MTTF: 150 °C
- Nominal Junction Temperature (T= 85 °C and Pin = 10 dBm): 90 °C
- Operating Temperature: -40 to +85 °C

Electrostatic Sensitive Device
Observe Handling Precautions

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5.9 - 11.2 GHz

Outline Drawing

NOTES:
1. LEADFRAME MATERIAL: COPPER ALLOY
2. DIMENSIONS ARE IN INCHES [MILLIMETERS]
3. LEAD SPACING TOLERANCE IS NON-CUMULATIVE.
4. Pin BURR LENGTH SHALL BE 0.15mm MAXIMUM.
   Pin BURR HEIGHT SHALL BE 0.05mm 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 [1]</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMC894LP5E</td>
<td>RoHS-compliant Low Stress Injection Molded Plastic</td>
<td>100% matte Sn</td>
<td>MSL1 [2]</td>
<td>H894 XXXX</td>
</tr>
</tbody>
</table>

[1] 4-Digit lot number XXXX
### 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 - 4, 7 - 11, 13 15 - 18, 21 - 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>
<td></td>
</tr>
<tr>
<td>5, 20</td>
<td>GND</td>
<td>These pins and exposed paddle must be connected to RF/DC ground.</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>RFIN</td>
<td>This pin is DC coupled and matched to 50 Ohms. External voltage must not be applied to this pin.</td>
<td>![RFIN Interface Schematic]</td>
</tr>
<tr>
<td>12</td>
<td>Vfctl</td>
<td>Center frequency control voltage.</td>
<td>![Vfctl Interface Schematic]</td>
</tr>
<tr>
<td>14</td>
<td>Vbwctl</td>
<td>Bandwidth control voltage.</td>
<td>![Vbwctl Interface Schematic]</td>
</tr>
<tr>
<td>19</td>
<td>RFOUT</td>
<td>This pin is DC coupled and matched to 50 Ohms. External voltage must not be applied to this pin.</td>
<td>![RFOUT Interface Schematic]</td>
</tr>
</tbody>
</table>

### Application Circuit

![Application Circuit Diagram]
Evaluation PCB

List of Materials for Evaluation PCB 128531

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>J1, J2</td>
<td>SMA - SRI</td>
</tr>
<tr>
<td>J3, J4</td>
<td>SMA - Johnson</td>
</tr>
<tr>
<td>C1, C2</td>
<td>100 pF Capacitor, 0402 Pkg.</td>
</tr>
<tr>
<td>U1</td>
<td>HMC894LP5E Filter - Tunable</td>
</tr>
<tr>
<td>PCB [2]</td>
<td>127338 Evaluation PCB</td>
</tr>
</tbody>
</table>

[1] Reference this number when ordering complete evaluation PCB

The circuit board used in the application should use RF circuit design techniques. Signal lines should have 50 Ohms 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.