The HMC890LP5E is a MMIC band pass filter which features a user selectable passband frequency. The 3 dB filter bandwidth is approximately 11%. The 20 dB filter bandwidth is approximately 33%. The center frequency can be varied between 1 and 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 HMC890LP5E has excellent microphonics due to the monolithic design, and provides a dynamically adjustable solution in advanced communications applications.

**General Description**

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**Electrical Specifications, T_A = +25°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>1</td>
<td>2</td>
<td></td>
<td>GHz</td>
</tr>
<tr>
<td>3 dB Bandwidth</td>
<td>11</td>
<td>2</td>
<td></td>
<td>%</td>
</tr>
<tr>
<td>Low Side Rejection Frequency (Rejection &gt;20 dB)</td>
<td>0.86*F_{center}</td>
<td></td>
<td>GHz</td>
<td></td>
</tr>
<tr>
<td>High Side Rejection Frequency (Rejection &gt;20 dB)</td>
<td>1.19*F_{center}</td>
<td></td>
<td>GHz</td>
<td></td>
</tr>
<tr>
<td>Re-entry Frequency (Rejection &lt;30 dB)</td>
<td>9</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</td>
<td>10</td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>Maximum Input Power for Linear Operation</td>
<td></td>
<td></td>
<td>10</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></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>-155</td>
<td></td>
<td></td>
<td>dBc/Hz</td>
</tr>
<tr>
<td>F_{center} Drift Rate</td>
<td>0</td>
<td></td>
<td></td>
<td>MHz/°C</td>
</tr>
<tr>
<td>Tuning Characteristics [2]</td>
<td></td>
<td></td>
<td>200</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.
FILTER - TUNABLE, BAND PASS SMT
1 - 2 GHz

Broadband Insertion Loss vs. Control Voltages, Vfctl = Vbwctl

Broadband Return Loss vs. Control Voltages, Vfctl = Vbwctl

Insertion Loss vs. Control Voltages, Vfctl = Vbwctl

Return Loss vs. Control Voltages, Vfctl = Vbwctl

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

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

-70 -60 -50 -40 -30 -20 -10 0
0 5 10 15 20 25 30
FREQUENCY (GHz)
INTRACTION LOSS (dB)

0V 7V 14V

S11 S22
0V 7V 14V

S11 S22

-18 -16 -14 -12 -10 -8 -6 -4 -2 0
0 0.5 1 1.5 2 2.5 3
FREQUENCY (GHz)
RETURN LOSS (dB)

14V 7V 0V

14V 7V 0V

-40C +25C +85C

+25C +85C -40C

-35 -30 -25 -20 -15 -10 -5 0
0 0.5 1 1.5 2 2.5 3
FREQUENCY (GHz)
RETURN LOSS (dB)

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

Return Loss vs. Temperature, Vfctl = Vbwctl = 7V
FILTER - TUNABLE, BAND PASS SMT

1 - 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
3 dB Bandwidth vs. Temperature, $V_{fctl} = V_{bwctl}$

Maximum Return Loss in a 2 dB Bandwidth vs. Temperature, $V_{fctl} = V_{bwctl}$

Low Side Rejection Ratio vs. Temperature, $V_{fctl} = V_{bwctl}$ [1]

High Side Rejection Ratio vs. Temperature, $V_{fctl} = V_{bwctl}$ [1]

Tuning Sensitivity vs. Temperature, $V_{fctl} = V_{bwctl}$

Group Delay

[1] Rejection ratio is defined as the ratio of the frequency at which the relative insertion loss is 20 dB to $f_{center}$
**FILTER - TUNABLE, BAND PASS SMT**

**1 - 2 GHz**

---

**3 dB Bandwidth vs. Bandwidth Control**

![Graph 1](image1)

**Insertion Loss vs. Bandwidth Control**

![Graph 2](image2)

**Low Side Rejection Ratio vs. Bandwidth Control** [1]

![Graph 3](image3)

**High Side Rejection Ratio vs. Bandwidth Control** [1]

![Graph 4](image4)

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

![Graph 5](image5)

---

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

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**Absolute Maximum Ratings**

- Frequency Control Voltage (Vfctl) -0.5 to +15V
- Bandwidth Control Voltage (Vbwctl) -0.5 to +15V
- RF Power Input 27 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

**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 (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMC890LP5E</td>
<td>RoHS-compliant Low Stress Injection Molded Plastic</td>
<td>100% matte Sn</td>
<td>MSL1 (2)</td>
<td>H890 XXXX</td>
</tr>
</tbody>
</table>

(1) 4-Digit lot number XXXX  
(2) Max peak reflow temperature of 260 °C
### 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></td>
</tr>
<tr>
<td>12</td>
<td>Vfctl</td>
<td>Center frequency control voltage.</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Vbwctl</td>
<td>Bandwidth control voltage.</td>
<td></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></td>
</tr>
</tbody>
</table>

### Application Circuit

![Application Circuit Diagram](image)

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**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.

### List of Materials for Evaluation PCB 128531

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>J1 - J4</td>
<td>SMA - SRI</td>
</tr>
<tr>
<td>C1, C2</td>
<td>100 pf Capacitor, 0402 Pkg.</td>
</tr>
<tr>
<td>U1</td>
<td>HMC890LP5E Filter</td>
</tr>
<tr>
<td>PCB [2]</td>
<td>127338 Evaluation PCB</td>
</tr>
</tbody>
</table>

[1] Reference this number when ordering complete evaluation PCB


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