MASW-009588

GaAs SP2T Switch
DC - 4.0 GHz

Features
- Insertion Loss: 0.35 dB @ 1 GHz
- Lead-Free 1 mm 6-Lead PDFN Package
- Halogen-Free “Green” Mold Compound
- RoHS* Compliant and 260°C Reflow Compatible

Description
The MASW-009588 is a GaAs pHEMT MMIC single pole two throw (SP2T) switch in a miniature 1x1mm 6-lead PDFN package. The MASW-009588 is ideally suited for applications where low control voltage, low insertion loss, moderate isolation, and small size are required.

Typical applications are for filter and antenna switching in handset systems that connect separate receive functions to a common antenna, as well as other related handset and general purpose applications. This part can be used in all systems operating up to 4 GHz requiring high power at low control voltage.

The MASW-009588 is fabricated using a 0.5 micron gate length GaAs pHEMT process. The process features full passivation for performance and reliability.

Functional Diagram

Pin Configuration

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>RF1</td>
<td>RF Port 1</td>
</tr>
<tr>
<td>2</td>
<td>GND</td>
<td>Ground</td>
</tr>
<tr>
<td>3</td>
<td>RF2</td>
<td>RF Port 2</td>
</tr>
<tr>
<td>4</td>
<td>V2</td>
<td>Control 2</td>
</tr>
<tr>
<td>5</td>
<td>RFC</td>
<td>RF Common</td>
</tr>
<tr>
<td>6</td>
<td>V1</td>
<td>Control 1</td>
</tr>
</tbody>
</table>

Ordering Information 1,2

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>MASW-009588-000000</td>
<td>Bulk</td>
</tr>
<tr>
<td>MASW-009588-TR3000</td>
<td>3000 piece reel</td>
</tr>
<tr>
<td>MASW-009588-001SMB</td>
<td>Sample Board</td>
</tr>
</tbody>
</table>

Absolute Maximum Ratings 3,4

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Absolute Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max Input Power (0.5 - 4 GHz, 2.6V Control)</td>
<td>+33 dBm</td>
</tr>
<tr>
<td>Operating Voltage</td>
<td>+5 volts</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-40°C to +85°C</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>-65°C to +150°C</td>
</tr>
</tbody>
</table>

3. Exceeding any one or combination of these limits may cause permanent damage to this device.
4. M/A-COM Technology does not recommend sustained operation near these survivability limits.

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**Electrical Specifications:** $T_A = 25^\circ C$, $V_C = 2.6V$, $Z_0 = 50 \, \Omega$

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test Conditions</th>
<th>Units</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insertion Loss</td>
<td>1 GHz</td>
<td>dB</td>
<td>0.35</td>
<td>0.45</td>
<td>0.4</td>
</tr>
<tr>
<td></td>
<td>2 GHz</td>
<td></td>
<td>0.5</td>
<td>0.65</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td>3 GHz</td>
<td></td>
<td>0.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4 GHz</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isolation</td>
<td>1 GHz</td>
<td>dB</td>
<td>23</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 GHz</td>
<td></td>
<td>17</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3 GHz</td>
<td></td>
<td>13</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4 GHz</td>
<td></td>
<td>11</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>VSWR</td>
<td>DC - 4 GHz</td>
<td>dB</td>
<td>—</td>
<td>&lt;1.3</td>
<td>—</td>
</tr>
<tr>
<td>IP3</td>
<td>Two Tone +10 dBm, 5 MHz Spacing, &gt;500 MHz $P_{IN} = 10$ dBm $V_C = 0/2.6$ V</td>
<td>dBm</td>
<td>—</td>
<td>55</td>
<td>—</td>
</tr>
<tr>
<td>P0.1dB</td>
<td>$V_C = 0V/2.6V$</td>
<td>dBm</td>
<td>—</td>
<td>26</td>
<td>—</td>
</tr>
<tr>
<td>P1dB</td>
<td>$V_C = 0V/2.6V$</td>
<td>dBm</td>
<td>—</td>
<td>32</td>
<td>—</td>
</tr>
<tr>
<td>2nd Harmonic</td>
<td>1 GHz, +16 dBm</td>
<td>dBc</td>
<td>—</td>
<td>83</td>
<td>—</td>
</tr>
<tr>
<td>3rd Harmonic</td>
<td>1 GHz, +16 dBm</td>
<td>dBc</td>
<td>—</td>
<td>93</td>
<td>—</td>
</tr>
<tr>
<td>Trise, Tfall</td>
<td>10% to 90% RF, 90% to 10% RF</td>
<td>ns</td>
<td>—</td>
<td>15</td>
<td>—</td>
</tr>
<tr>
<td>Ton, Toff</td>
<td>50% control to 90% RF, and 50% control to 10% RF</td>
<td>ns</td>
<td>—</td>
<td>25</td>
<td>—</td>
</tr>
<tr>
<td>Transients</td>
<td>In Band</td>
<td>mV</td>
<td>—</td>
<td>30</td>
<td>—</td>
</tr>
<tr>
<td>Gate Leakage</td>
<td>$</td>
<td>V_C</td>
<td>= 2.6V$</td>
<td>µA</td>
<td>—</td>
</tr>
</tbody>
</table>

5. Insertion Loss can be optimized by varying the DC Blocking Capacitor value, ie. 1000 pF for 100 - 500 MHz, 39 pF for 0.5 - 4.0 GHz

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**Recommended PCB**

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**Off-Chip Component Values**

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1, C4</td>
<td>100 pF</td>
<td>0201</td>
</tr>
<tr>
<td>C2, C3, C5</td>
<td>39 pF</td>
<td>0201</td>
</tr>
<tr>
<td>R1, R2</td>
<td>0 Ω</td>
<td>0201</td>
</tr>
</tbody>
</table>

---

**Truth Table**

<table>
<thead>
<tr>
<th>V1</th>
<th>V2</th>
<th>RFC - RF1</th>
<th>RFC - RF2</th>
</tr>
</thead>
<tbody>
<tr>
<td>+1.6 to 3.5 V</td>
<td>0 ± 0.2 V</td>
<td>On</td>
<td>Off</td>
</tr>
<tr>
<td>0 ± 0.2 V</td>
<td>+1.6 to 3.5 V</td>
<td>Off</td>
<td>On</td>
</tr>
</tbody>
</table>

6. External DC blocking capacitors are required on all RF ports
7. Minimum Control Voltage Delta of 1.6V required
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DC - 4.0 GHz

Typical Performance Curves, \( V_{\text{CTL}} = 0/\pm 2.6 \text{ V}_{\text{DC}} \)

**Insertion Loss**

\[
\begin{array}{c|c|c|c|c|c|c|c|c}
\hline
\text{Frequency (GHz)} & \text{+25°C} & \text{-40°C} & \text{+85°C} \\
0.5 & -0.8 & -0.7 & -0.6 \\
1.0 & -0.7 & -0.6 & -0.5 \\
1.5 & -0.6 & -0.5 & -0.4 \\
2.0 & -0.5 & -0.4 & -0.3 \\
2.5 & -0.4 & -0.3 & -0.2 \\
3.0 & -0.3 & -0.2 & -0.1 \\
3.5 & -0.2 & -0.1 & 0.0 \\
4.0 & -0.1 & 0.0 & 0.1 \\
\hline
\end{array}
\]

**Isolation**

\[
\begin{array}{c|c|c|c|c|c|c|c|c}
\hline
\text{Frequency (GHz)} & \text{+25°C} & \text{-40°C} & \text{+85°C} \\
0.5 & -25 & -20 & -15 \\
1.0 & -20 & -15 & -10 \\
1.5 & -15 & -10 & -5 \\
2.0 & -10 & -5 & 0 \\
2.5 & -5 & 0 & 5 \\
3.0 & 0 & 5 & 10 \\
3.5 & 5 & 10 & 15 \\
4.0 & 10 & 15 & 20 \\
\hline
\end{array}
\]

**Input Return Loss**

\[
\begin{array}{c|c|c|c|c|c|c|c|c}
\hline
\text{Frequency (GHz)} & \text{+25°C} & \text{-40°C} & \text{+85°C} \\
0.5 & -35 & -30 & -25 \\
1.0 & -30 & -25 & -20 \\
1.5 & -25 & -20 & -15 \\
2.0 & -20 & -15 & -10 \\
2.5 & -15 & -10 & -5 \\
3.0 & -10 & -5 & 0 \\
3.5 & -5 & 0 & 5 \\
4.0 & 0 & 5 & 10 \\
\hline
\end{array}
\]

**Output Return Loss**

\[
\begin{array}{c|c|c|c|c|c|c|c|c}
\hline
\text{Frequency (GHz)} & \text{+25°C} & \text{-40°C} & \text{+85°C} \\
0.5 & -40 & -35 & -30 \\
1.0 & -35 & -30 & -25 \\
1.5 & -30 & -25 & -20 \\
2.0 & -25 & -20 & -15 \\
2.5 & -20 & -15 & -10 \\
3.0 & -15 & -10 & -5 \\
3.5 & -10 & -5 & 0 \\
4.0 & -5 & 0 & 5 \\
\hline
\end{array}
\]

**Output Power vs. Input Power @ 2.5 GHz**

\[
\begin{array}{c|c|c|c|c|c|c|c|c}
\hline
\text{Input Power (dBm)} & 10 & 12 & 14 & 16 & 18 & 20 & 22 & 24 & 26 & 28 & 30 & 32 \\
\text{Output Power (dBm)} & 10 & 12 & 14 & 16 & 18 & 20 & 22 & 24 & 26 & 28 & 30 & 32 \\
\hline
\end{array}
\]
PCB Land Pattern

Qualification

Handling Procedures
Please observe the following precautions to avoid damage:

Static Sensitivity
Gallium Arsenide Integrated Circuits are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these devices.

Lead-Free 1 mm 6-Lead PDFN†

†Reference Application Note S2083 for lead-free solder reflow recommendations.
Meets JEDEC moisture sensitivity level 1 requirements.
Plating is 100% matte tin over copper.
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