MASW-011052

HMIC Silicon PIN Diode SP2T Switch with Integrated Bias Network
2 - 18 GHz

Features
- Broad Bandwidth Specified up to 18 GHz
- Usable up to 26 GHz
- Integrated Bias Network
- Low Insertion Loss / High Isolation
- Fully Monolithic
- Glass Encapsulate Construction
- RoHS Compliant* and 260°C Reflow Compatible

Description
The MASW-011052 device is a SP2T broad band switch with integrated bias networks utilizing MACOM's patented HMIC (Heterolithic Microwave Integrated Circuit) process. This process allows the incorporation of silicon pedestals that form series and shunt diodes or vias by imbedding them in low loss, low dispersion glass. By using small spacing between elements, this combination of silicon and glass gives HMIC devices low loss and high isolation performance with exceptional repeatability through low millimeter frequencies. Large bond pads facilitate the use of low inductance ribbon bonds, while gold backside metallization allows for manual or automatic chip bonding via 80/20 - Au/Sn, 62/36/2 - Sn/Pb/Ag solders or electrically conductive silver epoxy.

Ordering Information

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>MASW-011052-14220G</td>
<td>Die in Gel Pack</td>
</tr>
<tr>
<td>MASW-011052-14220W</td>
<td>Die in Waffle Pack</td>
</tr>
</tbody>
</table>

1. Die quantity varies.


For further information and support please visit: [https://www.macom.com/support](https://www.macom.com/support)
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**Rev. V3**

**MASW**

**MASW-011052**

**Electrical Specifications:**

\[ T_A = +25°C, \ Z_0 = 50 \ \Omega, \ P_{IN} = 0 \ dBm, \ DC \ Control \ Current = 20 \ mA \ (unless \ otherwise \ noted) \]

<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>2 GHz  6 GHz  12 GHz  18 GHz</td>
<td>dB</td>
<td>—</td>
<td>1.20</td>
<td>1.80</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.55</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.80</td>
<td>1.20</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1.15</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>Input to Output Isolation</td>
<td>2 GHz  6 GHz  12 GHz  18 GHz</td>
<td>dB</td>
<td>55  47  40  36</td>
<td>70  64  59  48</td>
<td></td>
</tr>
<tr>
<td>Input Return Loss</td>
<td>2 GHz  6 GHz  12 GHz  18 GHz</td>
<td>dB</td>
<td>—</td>
<td>15  23  18  15</td>
<td></td>
</tr>
<tr>
<td>Input/Output IP3 @ 5 dBm</td>
<td>2 GHz  6 GHz  9 GHz  12 GHz  15 GHz  18 GHz</td>
<td>dBm</td>
<td>—</td>
<td>42.2  41.6  44.6  44.5  43.4  40.5</td>
<td></td>
</tr>
<tr>
<td>Input/Output IP2 @ 5 dBm</td>
<td>2 GHz  6 GHz  9 GHz  12 GHz  15 GHz  18 GHz</td>
<td>dBm</td>
<td>—</td>
<td>75.0  68.1  67.2  66.6  76.3  80.3</td>
<td></td>
</tr>
<tr>
<td>Switching Speed (^3)</td>
<td>—</td>
<td>ns</td>
<td>—</td>
<td>50</td>
<td>—</td>
</tr>
</tbody>
</table>

3. Typical switching speed measured from 10% to 90% of detected RF signal driven by TTL compatible drivers using RC output spiking network, \( R = 50 – 200 \ \Omega \), \( C = 390 – 560 \ pF \).

**Absolute Maximum Ratings\(^4,5\)**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Absolute Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forward Bias Current</td>
<td>60 mA</td>
</tr>
<tr>
<td>Reverse Bias Voltage</td>
<td>50 V</td>
</tr>
<tr>
<td>RF Incident Power</td>
<td>33 dBm CW</td>
</tr>
<tr>
<td>Junction Temperature</td>
<td>+175°C</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-65°C to +125°C</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>-65°C to +150°C</td>
</tr>
</tbody>
</table>

**Handling Procedures**

Please observe the following precautions to avoid damage:

**Static Sensitivity**

HMIC 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.

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\(^3\) Handling Procedures

\(^4\) Absolute Maximum Ratings

\(^5\) Static Sensitivity
Truth Table

<table>
<thead>
<tr>
<th>DC Control Current</th>
<th>Condition of RF Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>J4</td>
<td>J5</td>
</tr>
<tr>
<td>-20 mA</td>
<td>+20 mA</td>
</tr>
<tr>
<td>+20 mA</td>
<td>-20 mA</td>
</tr>
</tbody>
</table>

6. The forward diode voltage drop between:
   J6 to J4 or J6 to J5 is 1.0 V typical.
   J4 to GND or J5 to GND is 0.9 V typical.

Circuit Schematic
Typical Performance Curves

**Isolation @ 5 V, +25°C**

![Graph showing isolation at 5 V, +25°C for 5 mA and 40 mA over frequency (GHz).]

**Isolation @ 5 V, 5 mA**

![Graph showing isolation at 5 V, 5 mA for +25°C and +85°C over frequency (GHz).]

**Insertion Loss @ 5 V, +25°C**

![Graph showing insertion loss at 5 V, +25°C for 5 mA, 10 mA, 20 mA, and 40 mA over frequency (GHz).]

**Insertion Loss @ 5 V, 20 mA**

![Graph showing insertion loss at 5 V, 20 mA for +25°C and +85°C over frequency (GHz).]

**Input Return Loss @ 5 V, +25°C**

![Graph showing input return loss at 5 V, +25°C for 5 mA, 10 mA, 20 mA, and 40 mA over frequency (GHz).]

**Output Return Loss @ 5 V, +25°C**

![Graph showing output return loss at 5 V, +25°C for 5 mA, 10 mA, 20 mA, and 40 mA over frequency (GHz).]
Typical Performance Curves

IP3

IP2

Junction Temperature

Compression Power
Wire/Ribbon and Die Attachment Recommendations

Wire Bonding:
Thermosonic wedge wire bonding using 0.00025” x 0.003” ribbon or 0.001” diameter gold wire is recommended. A heat stage temperature of 150°C and a force of 18 to 22 grams should be used. Ultrasonic energy should be adjusted to the minimum required to achieve a good bond. RF bond wires should be kept as short and straight as possible.

Mounting
The HMIC switches have Ti-Pt-Au back metal. They can be die mounted with a gold-tin eutectic solder preform or conductive epoxy. Mounting surface must be clean and flat.

Eutectic Die Attachment:
An 80/20, gold-tin, eutectic solder preform is recommended with a work surface temperature of 255°C and a tool tip temperature of 265°C. When hot gas is applied, the tool tip temperature should be 290°C. The chip should not be exposed to temperatures greater than 320°C for more than 20 seconds. No more than three seconds should be required for attachment. Solders containing tin should not be used.

Epoxy Die Attachment:
A minimum amount of epoxy should be used. A thin epoxy fillet should be visible around the perimeter of the chip after placement. Cure epoxy per manufacturer’s schedule (typically 125-150°C).

Outline Drawing

7. Unless otherwise specified, all dimensions shown as μm, with tolerance ±5 μm.
8. Die thickness is 125 ±10 μm.
9. Topside and backside metallization is gold, 2.5 μm thick typical.
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