MASW-00x102 Series

HMIC™ Silicon PIN Diode Switches with Integrated Bias Network

Rev. V7

Features
- Broad Bandwidth Specified 2 - 18 GHz
- Usable up to 26 GHz
- Integrated Bias Network
- Lower Insertion Loss / Higher Isolation
- Fully Monolithic, Glass Encapsulated Chip
- Up to 33 dBm CW Power Handling @ +25°C
- RoHS* Compliant

Description
The MASW-002102 (SP2T) and MASW-003102 (SP3T) are broadband switches with integrated bias networks utilizing MACOM’s HMIC (Heterolithic Microwave Integrated Circuit) process, US Patent 5,268,310. 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 circuit elements, this combination of silicon and glass gives HMIC devices low loss and high isolation performance with exceptional repeatability through low millimeter frequencies.

The top side of the chip is protected by a polymer coating for manual or automatic handling and large gold bond pads help facilitate connection of low inductance ribbons. The gold metallization on the backside of the chip allows for attachment via 80/20 (gold/tin) solder or conductive silver epoxy.

Functional Diagrams

MASW-002102 (SP2T)

MASW-003102 (SP3T)

Ordering Information

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package xx = 0G</th>
<th>Package xx = 0W</th>
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</thead>
<tbody>
<tr>
<td>MASW-002102-1358(xx)</td>
<td>Gel Pack</td>
<td>Waffle Pack</td>
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<tr>
<td>MASW-003102-1359(xx)</td>
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## Electrical Specifications: $T_A = 25^\circ$C, 20 mA

### MASW-002102 (SPDT)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test Conditions</th>
<th>Units</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
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<td>0.9</td>
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<td>1.2</td>
<td>1.2</td>
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<tr>
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<tr>
<td></td>
<td>6 GHz</td>
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<td>47</td>
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<td></td>
<td>18 GHz</td>
<td></td>
<td>36</td>
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<td>15</td>
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<tr>
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<td>6 GHz</td>
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<td>—</td>
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<tr>
<td></td>
<td>18 GHz</td>
<td></td>
<td>13</td>
<td></td>
<td>—</td>
</tr>
<tr>
<td>Switching Speed</td>
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### MASW-003102 (SP3T)

<table>
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<th>Min.</th>
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<tr>
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</tr>
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<td></td>
<td>18 GHz</td>
<td></td>
<td>1.3</td>
<td>1.9</td>
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</tr>
<tr>
<td>Isolation</td>
<td>2 GHz</td>
<td>dB</td>
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<td>59</td>
<td>—</td>
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<tr>
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<td>47</td>
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</tr>
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<td>—</td>
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<tr>
<td>Switching Speed</td>
<td>—</td>
<td>ns</td>
<td>50</td>
<td>—</td>
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</tr>
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</table>

1. Typical switching speed is measured from (10% to 90% and 90% to 10% of detected RF voltage), driven by TTL compatible drivers. In the modulating state, (the switching port is modulating, all other ports are in steady state isolation.) The switching speed is measured using an RC network using the following values: $R = 50 \text{ - } 200 \ \Omega$, $C = 390 \text{ - } 1000 \ \text{pF}$. Driver spike current, $I_C = C \frac{dV}{dt}$, ratio of spike current to steady state current, is typically 10:1.
Absolute Maximum Ratings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Absolute Maximum</th>
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<tbody>
<tr>
<td>RF CW Incident Power</td>
<td>+33 dBm</td>
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<tr>
<td>Reverse Voltage</td>
<td>-50 V</td>
</tr>
<tr>
<td>Bias Current per Port</td>
<td>±50 mA @ +25°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>
<tr>
<td>Junction Temperature</td>
<td>+175°C</td>
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</tbody>
</table>

3. Exceeding any one or combination of these limits may cause permanent damage to this device.
4. MACOM does not recommend sustained operation near these survivability limits.
5. Maximum operating conditions for a combination of RF power, DC bias and temperature: +33 dBm CW @ 15 mA (per diode) @ +85°C.

Cleanliness
The chips should be handled in a clean environment free of dust and organic contamination.

Wire / Ribbon Bonding
Thermo compression wedge bonding using 0.003” x 0.00025” ribbon or 0.001” diameter gold wire is recommended. A work stage temperature of 150°C - 200°C, tool tip temperature of 120°C - 150°C and a downward force of 18 to 22 grams should be used. If ultrasonic energy is necessary, it should be adjusted to the minimum level required to achieve a good bond. Excessive power or force will fracture the silicon beneath the bond pad causing it to lift. RF bond wires and ribbons should be kept as short as possible for optimum RF performance.

Handling Procedures
Please observe the following precautions to avoid damage:

Static Sensitivity
These electronic devices are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these Class 0 (HBM) and Class C1 (CDM) devices.

Chip Mounting
HMIC switches have Ti-Pt-Au backside metallization and can be mounted using a gold-tin eutectic solder or conductive epoxy. Mounting surface must be free of contamination and flat.

Eutectic Die Attachment
An 80/20, gold-tin, eutectic solder is recommended. Adjust the work surface temperature to 255°C and the tool tip temperature to 265°C. After placing the chip onto the circuit board re-flow the solder by applying hot forming gas (95/5 Ni/H) to the top surface of the chip. Temperature should be approximately 290°C and not exceed 320°C for more than 20 seconds. Typically no more than three seconds is necessary for attachment. Solders rich in tin should be avoided.

Epoxy Die Attachment
A minimum amount of epoxy, 1 - 2 mils thick, should be used to attach chip. A thin epoxy fillet should be visible around the outer perimeter of the chip after placement. Epoxy cure time is typically 1 hour at 150°C.
Typical RF Performance at $T_{AMB} = +25°C$, 20 mA Bias Current

**Isolation**

MASW-002102

**Isolation**

MASW-003102

**Insertion Loss**

**Return Loss**
MASW-002102 Series Junction Temperature vs. Incident Power @ 8 GHz

MASW-002102 Compression vs. Incident Power @ 8 GHz

6. The MASW-003102 contains the same PIN diodes and will have similar performance.
Operation of MASW-00x102 Series

Operation of the MASW-00x102 series PIN diode switches is achieved by simultaneous application of DC currents to the bias pads. The required levels for the different states are shown in the tables below. The control currents should be supplied by constant current sources. The nominal DC voltage at the BIAS\textsuperscript{IN} ports is approximately +1 V for 20 mA bias current and approximately -1.8 V to -2.2 V for -20 mA bias current.

### Driver / Bias Connections

<table>
<thead>
<tr>
<th>MASW-002102 (SP2T)</th>
<th>MASW-003102 (SP3T)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DC Control Current (mA)</strong></td>
<td><strong>RF Output States</strong></td>
</tr>
<tr>
<td>J4</td>
<td>J5</td>
</tr>
<tr>
<td>-20</td>
<td>+20</td>
</tr>
<tr>
<td>+20</td>
<td>-20</td>
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![MASW-002102 (SP2T) Diagram]

![MASW-003102 (SP3T) Diagram]
MASW-00x102 Series

HMIC™ Silicon PIN Diode Switches
with Integrated Bias Network

Chip Outline Drawings

MASW-002102 (SP2T)

MASW-003102 (SP3T)

<table>
<thead>
<tr>
<th>DIM</th>
<th>INCHES</th>
<th>MM</th>
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<tbody>
<tr>
<td></td>
<td>MIN.</td>
<td>MAX.</td>
</tr>
<tr>
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<td>0.070</td>
</tr>
<tr>
<td>B</td>
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<tr>
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</tr>
<tr>
<td>K</td>
<td>0.005</td>
<td>REF.</td>
</tr>
</tbody>
</table>

7. Topside and backside metallization is gold, 2.5 μm thick typical.
8. Yellow areas indicate ribbon/wire bonding pads

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