SURMOUNT™ Silicon PIN Diode SPDT Switch
6 - 14 GHz

Features

- Specified from 8 - 12 GHz
- Low Insertion Loss
- High Isolation
- Low Parasitic Capacitance and Inductance
- Surface Mountable, Fully Monolithic Die
- Glass Encapsulated Construction
- 20 W Pulsed Power Handling
- Silicon Nitride Passivation
- Polymer Scratch Protection
- RoHS* Compliant

Description

This device is a SURMOUNT™ X-Band monolithic SPDT switch designed for high power, high performance applications. This surface mount chip-scale configuration is designed with minimal parasitics usually associated with hybrid MIC designs incorporating beam lead and/or bondable PIN diodes that require chip and wire assembly.

This device is fabricated using MACOMs’ patented 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 and/or vias by embedding them in low loss, low dispersion glass.

Selective backside metalization is applied producing a surface mount device. The topside is fully encapsulated with silicon nitride and has an additional polymer layer for scratch and impact protection. These protective coatings prevent damage to the junction and the anode airbridge during handling and assembly.

Ordering Information

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>MASW-011021-14010G</td>
<td>25 piece gel pack</td>
</tr>
<tr>
<td>MASW-011021-001SMB</td>
<td>Sample Test Board</td>
</tr>
</tbody>
</table>

1. Reference Application Note M513 for reel size information.


For further information and support please visit: https://www.macom.com/support
Electrical Specifications: Bias: -5 V, +30 mA, $T_A = 25^\circ C$, $P_{IN} = 0$ dBm, $Z_0 = 50 \Omega$

<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>8 GHz, 10 GHz, 12 GHz</td>
<td>dB</td>
<td>0.70</td>
<td>0.70</td>
<td>0.85</td>
</tr>
<tr>
<td>Input to Output Isolation</td>
<td>8 GHz, 10 GHz, 12 GHz</td>
<td>dB</td>
<td>30</td>
<td>34</td>
<td>—</td>
</tr>
<tr>
<td>Return Loss</td>
<td>—</td>
<td>dB</td>
<td>—</td>
<td>15</td>
<td>—</td>
</tr>
<tr>
<td>IIP3</td>
<td>—</td>
<td>dBm</td>
<td>—</td>
<td>60</td>
<td>—</td>
</tr>
<tr>
<td>Voltage Rating$^3$</td>
<td>—</td>
<td>V</td>
<td>—</td>
<td>—</td>
<td>80</td>
</tr>
<tr>
<td>Switching Speed</td>
<td>10% to 90% of detected RF signal driven by TTL compatible drivers</td>
<td>ns</td>
<td>—</td>
<td>130</td>
<td>—</td>
</tr>
<tr>
<td>CW Power Handling$^4$</td>
<td>-30 V, +30 mA</td>
<td>W</td>
<td>—</td>
<td>10</td>
<td>—</td>
</tr>
</tbody>
</table>

3. Maximum reverse leakage current in the shunt PIN diodes shall be 0.1 µA maximum.
4. 20 W up to 300 µs 40% Duty Cycle

Absolute Maximum Ratings$^5,6$

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Absolute Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bias Current @ +25°C</td>
<td>100 mA</td>
</tr>
<tr>
<td>Applied Reverse Voltage</td>
<td>80 V</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>

5. Exceeding any one or combination of these limits may cause permanent damage to this device.
6. MACOM does not recommend sustained operation near these survivability limits.

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 1A HBM devices.
Typical Performance Curves (on wafer probed results): Bias: -30 V, +30 mA

**Insertion Loss**

![Insertion Loss Graph]

**Isolation**

![Isolation Graph]

**Input Return Loss**

![Input Return Loss Graph]

**Output Return Loss**

![Output Return Loss Graph]
Bias Control
Optimal operation is achieved by simultaneous application of negative DC voltage to the low loss switching arm and positive DC current to the isolating switching arm.

In the low loss state, the diode is reverse biased with voltage. In the isolated state, the shunt diode is forward biased with current.

Minimum Reverse Bias Required:
At X-Band, with a 1:1 match, 5 V of negative reverse bias is required. With a 4:1 match, 10 V of negative reverse bias is required.

However MACOM suggests a reverse bias voltage of -30 V to achieve optimal insertion loss.

Driver Connections

<table>
<thead>
<tr>
<th>Control Level (DC Currents and Voltages)</th>
<th>Condition of RF Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1</td>
<td>B2</td>
</tr>
<tr>
<td>-30 V</td>
<td>+30 mA</td>
</tr>
<tr>
<td></td>
<td>Low Loss</td>
</tr>
<tr>
<td>+30 mA</td>
<td>-30 V</td>
</tr>
<tr>
<td></td>
<td>Isolation</td>
</tr>
</tbody>
</table>

Handling Procedures
Attachment to a circuit board is made simple through the use of standard surface mount technology. Mounting pads are conveniently located on the bottom surface of these devices and are removed from the active junction locations. These devices are well suited for solder attachment onto hard and soft substrates. The use of 80Au/20Sn, or RoHS compliant solders is recommended. For applications where the average power is ≤1 W, conductive silver epoxy may also be used. Cure per manufacturers recommended time and temperature. Typically 1 hour at 150°C.

When soldering these devices to a hard substrate, a solder re-flow method is preferred. A vacuum tip pick-up tool and a force of 60 to 100 grams applied to the top surface of the device while placing the chip is recommended. When soldering to soft substrates, such as Duroid, it is recommended to use a soft solder at the circuit board to mounting pad interface to minimize stress due to any TCE mismatches that may exist. Position the die so that its mounting pads are aligned with the circuit board mounting pads. Solder reflow should not be performed by causing heat to flow through the top surface of the die to the back. Since the HMIC glass is transparent, the edges of the mounting pads can be visually inspected through the die after attachment is completed.

Typical re-flow profiles for Sn60/Pb40 and RoHS compliant solders is provided in Application Note M538 , “Surface Mounting Instructions” and can be viewed MACOM website.

Sample Board
Samples test boards are available upon request.
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Outline Drawing - Back Metal

All dimensions are in µm.

PWB for testing purposes

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