K- & Ka-Band High Power Reflective SPDT PIN Switch Die
20 - 40 GHz

MASW-011144-DIE
Rev. V2

Features
- Broadband Performance, 20 - 40 GHz
- Low Loss: <1 dB, 30 - 40 GHz
- High Isolation: >30 dB, 20 - 40 GHz
- 40 dBm CW Power @ 35 GHz
- Die with G-S-G RF Pads and DC Bias Pads
- Includes DC blocking Capacitor at each RF input and Bias Low Pass filters with Series Resistor
- RoHS* Compliant

Applications
- K- and Ka-Band applications, including point-to-point radio and military products.

Description
The MASW-011144-DIE is a high power SPDT, reflective, broadband, high linearity, Aluminum Gallium Arsenide (AlGaAs) PIN diode switch for K- and Ka-Band applications, including point-to-point radio and military products.

The switch utilizes one shunt PIN diode per RF channel. The diode is controlled through an on-chip bias network that includes a current limiting resistor. These bias networks simplify the control of the switch; no external components are required.

The SPDT MMIC utilizes MACOM’s proven AlGaAs PIN diode technology. The switch is fully passivated with silicon nitride and has an added polymer layer for scratch protection. The protective coating prevents damage to the junctions and the anode air-bridges during handling and assembly. The die has backside metallization to facilitate an epoxy die attach process.

Ordering Information

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>MASW-011144-DIE</td>
<td>Die in Gel Pack</td>
</tr>
</tbody>
</table>

* Restrictions on Hazardous Substances, compliant to current RoHS EU directive.

For further information and support please visit:
https://www.macom.com/support
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Electrical Specifications: $T_A = +25^\circ C$, $Z_0 = 50 \, \Omega$, $V_F = 4.5 \, V / V_R = -9 \, V$, $P_{IN} = 0 \, dBm$

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Conditions</th>
<th>Units</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insertion Loss</td>
<td>26 GHz</td>
<td>dB</td>
<td>—</td>
<td>0.90</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>32 GHz</td>
<td></td>
<td>0.65</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>34 GHz</td>
<td></td>
<td>0.65</td>
<td>0.9</td>
<td></td>
</tr>
<tr>
<td></td>
<td>38 GHz</td>
<td></td>
<td>0.75</td>
<td>1.1</td>
<td></td>
</tr>
<tr>
<td>Insertion Loss</td>
<td>34 GHz, $P_{IN} = 30 , dBm$</td>
<td>dB</td>
<td>—</td>
<td>0.65</td>
<td>—</td>
</tr>
<tr>
<td>Isolation</td>
<td>26 GHz</td>
<td>dB</td>
<td>—</td>
<td>—</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>32 GHz</td>
<td></td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td></td>
<td>34 GHz</td>
<td></td>
<td>25</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td></td>
<td>38 GHz</td>
<td></td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>Input Return Loss</td>
<td>34 GHz</td>
<td>dB</td>
<td>14.5</td>
<td>22</td>
<td>—</td>
</tr>
<tr>
<td>Output Return Loss</td>
<td>34 GHz</td>
<td>dB</td>
<td>14.0</td>
<td>20</td>
<td>—</td>
</tr>
<tr>
<td>CW Input Power$^2$</td>
<td>-9 V @ 85°C, 29 GHz</td>
<td>dBm</td>
<td>—</td>
<td>39.0</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>-25 V @ 85°C, 29 GHz</td>
<td></td>
<td>41.2</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Switching Speed</td>
<td>10 dBm, 10 - 90% RF, 500 µs pulse, 26.5 GHz</td>
<td>ns</td>
<td>—</td>
<td>40</td>
<td>—</td>
</tr>
<tr>
<td>0.1 dB Compression Point</td>
<td>-9 V @ 85°C, 29 GHz</td>
<td>dBm</td>
<td>—</td>
<td>34</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>-25 V @ 85°C, 29 GHz</td>
<td></td>
<td>40</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>Forward Current</td>
<td>$V_F = 4.5 , V$</td>
<td>mA</td>
<td>6.0</td>
<td>8.5</td>
<td>11.0</td>
</tr>
</tbody>
</table>

2. Reverse bias voltage should be determined based on working conditions. For example, -25 V @ 40 dBm input power. For lower power applications, a less negative voltage can be used.

Absolute Maximum Ratings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Absolute Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>$T_x$, Incident CW Power</td>
<td>42 dBm @ 29 GHz</td>
</tr>
<tr>
<td>Reverse DC Bias Voltage</td>
<td>-50 V</td>
</tr>
<tr>
<td>Forward Bias Current</td>
<td>15 mA</td>
</tr>
<tr>
<td>Junction Temperature</td>
<td>+150°C</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-55°C to +85°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

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 HBM class 1A devices.
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Typical Performance Curves: $V_R = -9$ V

**Isolation over Temperature**

-30 dB over Temperature

**Insertion Loss over Temperature**

-0.8 dB over Temperature

**RF1, RF2 Return Loss over Temperature**

-20 dB over Temperature

**Common Return Loss over Temperature**

-20 dB over Temperature

**Output Power over Reverse Bias Voltage @ +85°C, 29 GHz**

(dBm)

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DC-0022676
Bias Diagrams & Tables

Functional Diagram
The Functional Diagram shows the switch in following state:
RF1 - Low Loss
RF2 - Isolation

![Functional Diagram]

Truth Table

<table>
<thead>
<tr>
<th>Pin</th>
<th>Bias 1</th>
<th>Bias 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>RF1 - Low Loss</td>
<td>$V_R = -9$ V</td>
<td>$V_F = 4.5$ V$^3$</td>
</tr>
<tr>
<td>RF2 - Isolation</td>
<td>$V_R = -9$ V</td>
<td>$V_F = 4.5$ V$^3$</td>
</tr>
</tbody>
</table>

3. Internal bias resistors (400 Ω) control the forward bias current ($I_F$).

Bias Control
Optimal operation is achieved by simultaneous application of negative $V_R$ voltage to the low loss switch path and positive $V_F$ voltage to the isolating switch path.

In the low loss path, the diodes are reverse biased.
In the isolating path, the diodes are forward biased.

Forward Bias Current over Forward Bias Voltage

![Graph of Forward Bias Current over Forward Bias Voltage]
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Outline Drawing

Dimensions indicated in μm.
Chip Thickness: 100 μm
RF Pads (1,4,5): 110 x 148 μm
DC Bias Pads (3 & 6): 113 x 118 μm
DC Pads (2 & 7): 93 x 207 μm
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