

20 W HMIC Silicon PIN Diode Terminated SPDT Switch 8.0 - 10.5 GHz

Rev. V1

Features

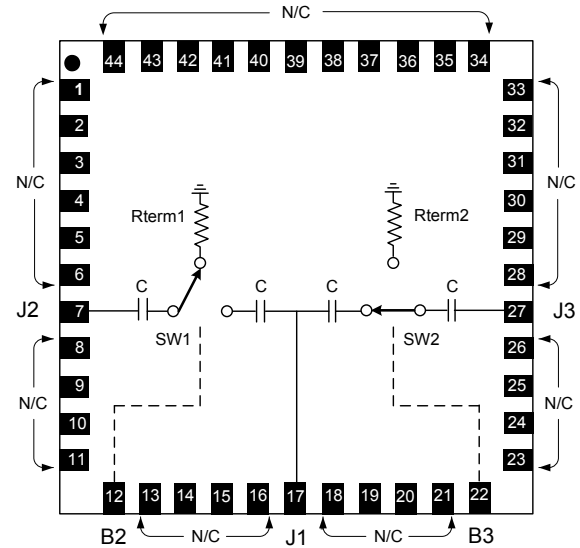
- Low Insertion Loss: 1 dB
- High Isolation: 38 dB
- Integrated Bias Network and Termination Circuit
- Greater than 20 W CW Power Handling @ +70°C
- Lead-Free 7 mm 44-lead PQFN Package
- Halogen-Free “Green” Mold Compound
- RoHS* Compliant

Description

The MASW-011071 is a terminated silicon PIN diode SPDT switch designed for X-Band high power, high performance applications. The switch is assembled in a lead-free 7 mm 44-lead PQFN plastic package and handles greater than 20 W of CW power over the 8.0 - 10.5 GHz frequency band.

The device is fabricated using MACOM's patented HMIC process, which allows for the integration of silicon pedestals that embed series and shunt diodes in low loss, low dispersion glass. The switch offers 1 dB insertion loss as well as 38 dB isolation performance. The device integrates a bias network to allow for simplified bias application and switch control.

Functional Diagram



Pin Configuration

| Pin | Port | Function |
|---------------------------------------|------|----------------------------|
| 7 | J2 | RF _{OUT} |
| 12 | B2 | Bias of J2 |
| 17 | J1 | RF _{COMMON} |
| 22 | B3 | Bias of J3 |
| 27 | J3 | RF _{OUT} |
| 1-6, 8-11, 13-16, 18-21, 23-26, 28-44 | N/C | No Connection ³ |
| 45 | Pad | Ground ⁴ |

Ordering Information^{1,2}

| Part Number | Package |
|--------------------|----------------|
| MASW-011071-TR0500 | 500 piece reel |
| MASW-011071-001SMB | Sample Board |

1. Reference Application Note M513 for reel size information.
2. All sample boards include 3 loose parts.

3. MACOM recommends connecting all No Connection (N/C) pins to ground.
4. The paddle on the package bottom must be connected to RF, DC and thermal ground.

* Restrictions on Hazardous Substances, European Union Directive 2011/65/EU.

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Electrical Specifications⁵: $T_A = +25^\circ\text{C}$, $Z_0 = 50 \Omega$, $P_{IN} = 0 \text{ dBm}$ (unless otherwise noted)

| Parameter | Test Conditions | Units | Min. | Typ. | Max. |
|------------------------------|---|-------|------|------|------|
| Insertion Loss | 8.0 GHz | dB | — | 0.9 | — |
| | 8.5 GHz | | | 1.0 | — |
| | 9.5 GHz | | | 1.0 | 1.4 |
| | 10.5 GHz | | | 1.2 | — |
| Input to Output Isolation | 8.0 GHz | dB | — | 36 | — |
| | 8.5 GHz | | — | 37 | |
| | 9.5 GHz | | 32 | 39 | |
| | 10.5 GHz | | — | 38 | |
| Input Return Loss | 8.0 GHz | dB | — | 26 | — |
| | 8.5 GHz | | | 26 | |
| | 9.5 GHz | | | 31 | |
| | 10.5 GHz | | | 19 | |
| Return Loss (Termination) | 8.0 GHz | dB | — | 12 | — |
| | 8.5 GHz | | — | 16 | |
| | 9.5 GHz | | 14 | 28 | |
| | 10.5 GHz | | — | 18 | |
| P0.1dB | 9.5 GHz (+5 V, -30 V) | dBm | — | 44.5 | — |
| Input IP3 | 10 GHz, +20 dBm, 10 MHz spacing | dBm | — | 60 | — |
| Switching Speed ⁶ | 10 GHz, +/- 4 V, PW 500 ns, 50% duty cycle | ns | — | 130 | — |

5. See Driver Connections table.

6. Typical switching speed measured from 10% to 90 % of detected RF signal driven by TTL compatible drivers. MACOM recommends the MADR-007097, Complementary Channel TTL PIN Diode Driver.

Bias Control⁷

Optimal operation is achieved by simultaneous application of negative DC voltage to the low loss switch path and positive DC 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.

Minimum Reverse Bias Required:

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

However MACOM recommends 30 V of reverse bias to achieve optimal operating conditions.

Driver Connections

| DC Control Voltages (DC Currents) | | Condition of RF Output | |
|--------------------------------------|-----------------------------|---------------------------|-------------------|
| B2 | B3 | J1-J2 | J1-J3 |
| -5 V ⁷ (0 mA) | +5 V (55 mA typ.) | Insertion Loss | Isolation |
| +5 V (55 mA typ.) | -5 V ⁷ (0 mA) | Isolation | Insertion Loss |

7. R. Caverly and G. Hiller, "Establishing the Minimum Reverse Bias for a P-I-N Diode in a High Power Switch," IEEE Transactions on Microwave Theory and Techniques, Vol.38, No.12, December 1990.

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Absolute Maximum Ratings^{8,9}

| Parameter | Absolute Maximum |
|-------------------------------------|------------------|
| Applied Reverse Voltage | 100 V |
| Bias Current | 100 mA @ +70°C |
| RF CW Incident Power (Transmission) | 20 W @ +70°C |
| RF CW Incident Power (Termination) | 1 W @ +70°C |
| Junction Temperature | +175°C |
| Operating Temperature | -40°C to +70°C |
| Storage Temperature | -65°C to +150°C |

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

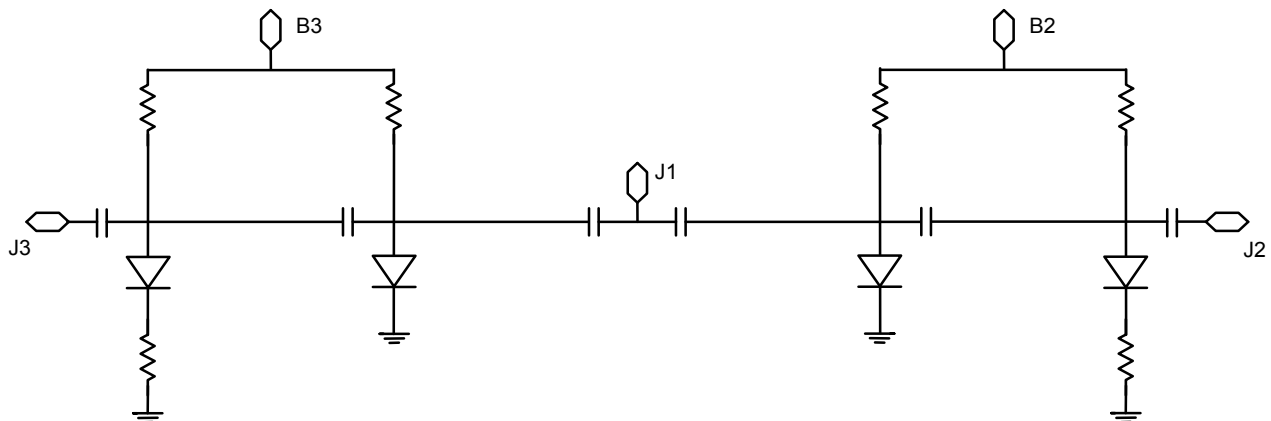
Handling Procedures

Please observe the following precautions to avoid damage:

Static Sensitivity

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 HBM Class 1A devices.

Functional Schematic

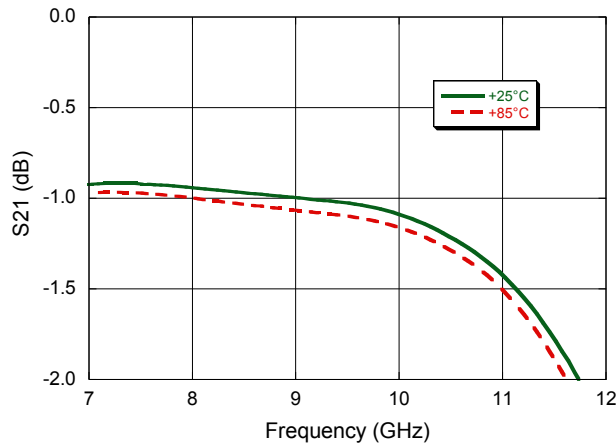


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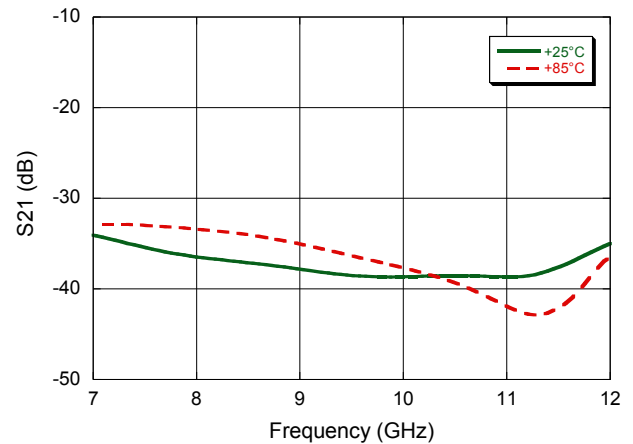
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Typical Performance: Bias = ± 5 V, $P_{IN} = 0$ dBm (Unless otherwise stated)

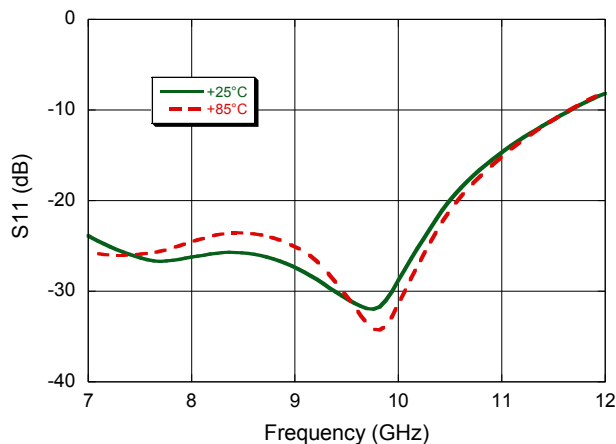
Insertion Loss vs. Frequency



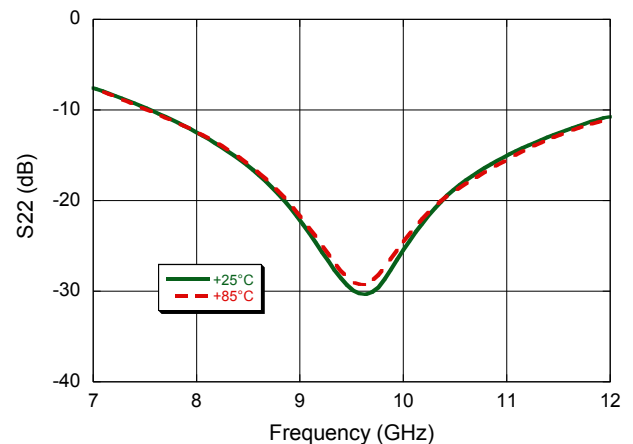
Isolation vs. Frequency



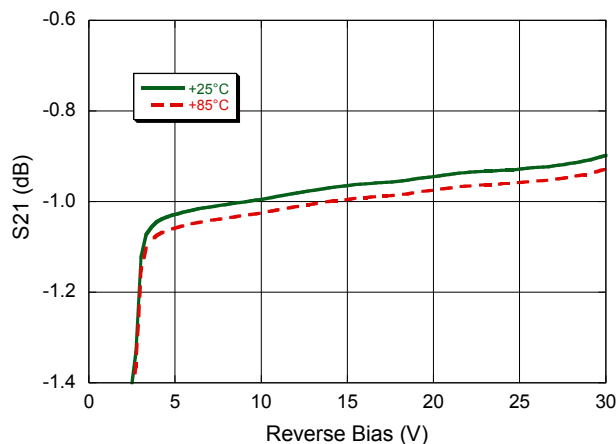
Input Return Loss vs. Frequency (Transmission)



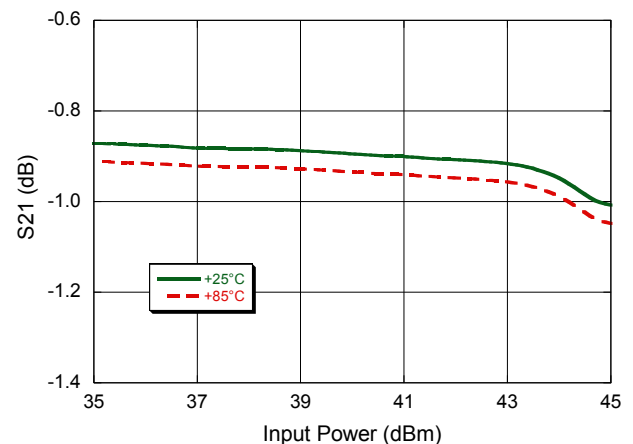
Output Return Loss vs. Frequency (Termination)



Insertion Loss vs. Bias Voltage, 9.5 GHz, 43 dBm CW



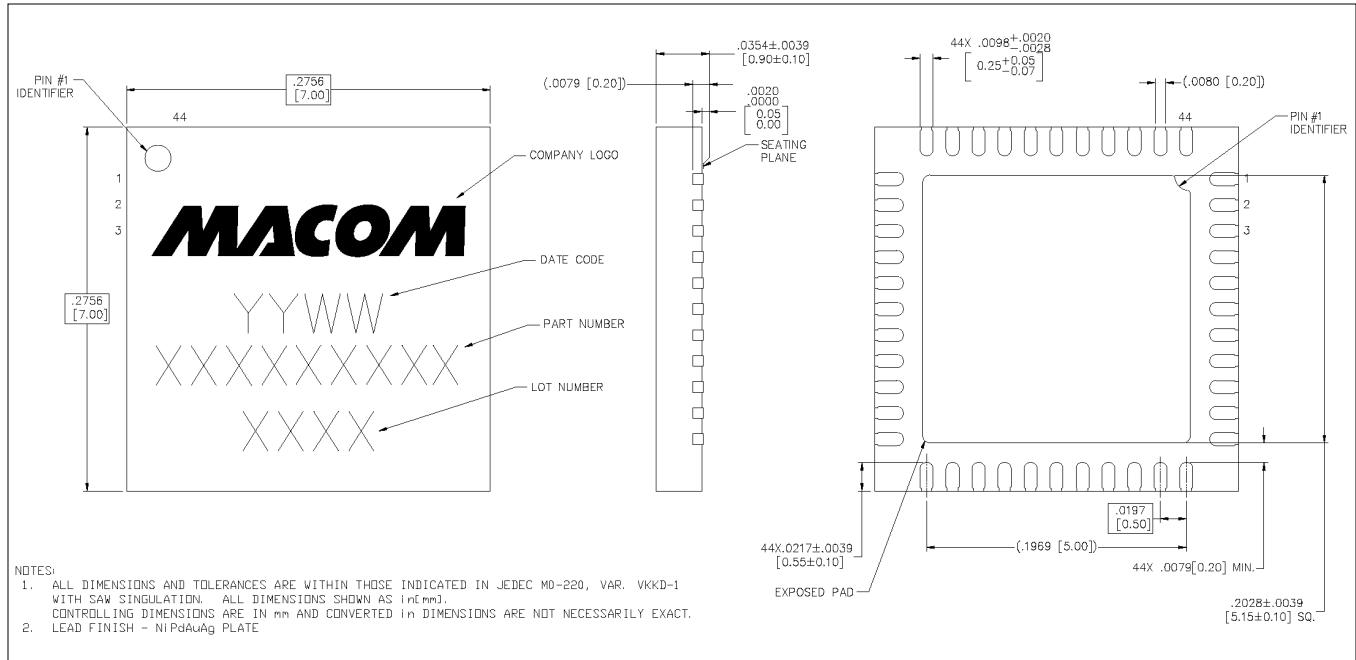
Insertion Loss vs. CW Power, 9.5 GHz, -30 V



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Outline Drawing



- † Reference Application Note S2083 for lead-free solder reflow recommendations.
 Meets JEDEC moisture sensitivity level 1 requirements.
 Plating is NiPdAuAg.

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