

20 W HMIC Silicon PIN Diode Terminated SPDT Switch

8.0 - 10.5 GHz



MASW-011071

Rev. V2

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
- RoHS* Compliant

Applications

- ISM / MM

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.

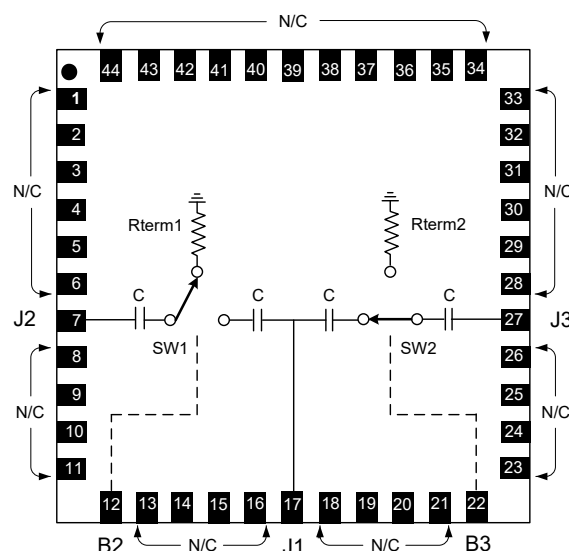
The device is fabricated using MACOM's patented HMIC process, which allows for the integration of silicon pedestals that embed series and shunt diodes in low loss, low dispersion glass. The switch offers 1 dB insertion loss as well as 38 dB isolation performance. The device integrates a bias network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

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.

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

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, compliant to current RoHS EU directive.

20 W HMIC Silicon PIN Diode Terminated SPDT Switch

8.0 - 10.5 GHz



MASW-011071

Rev. V2

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-011020, 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.

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



MASW-011071

Rev. V2

Absolute Maximum Ratings^{8,9}

Parameter	Absolute Maximum
DC Reverse Voltage	100 V
Bias Current	100 mA @ +70°C
RF CW Incident Power ¹⁰ Transmission Termination	20 W @ +70°C 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.
10. Maximum source or load VSWR 1.2:1.

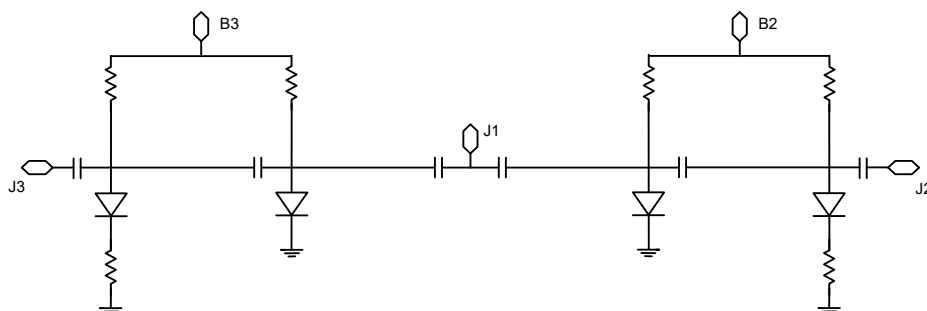
Handling Procedures

Please observe the following precautions to avoid damage:

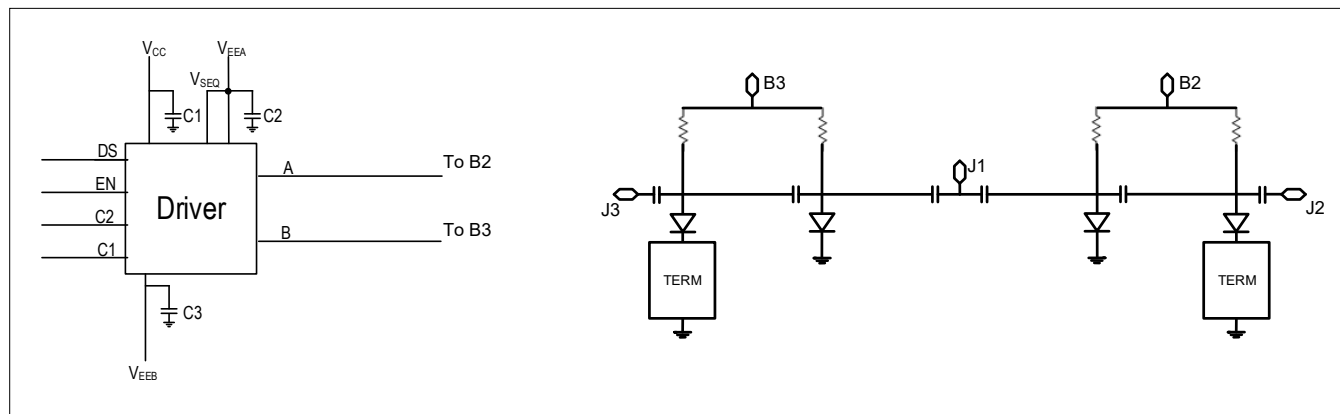
Static Sensitivity

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



MASW-011071 with MADR-011020 Driver Application Schematic¹¹



11. Recommended bias with this driver is $V_{CC} = 5\text{ V}$ and $V_{EEB} = -30\text{ V}$.

20 W HMIC Silicon PIN Diode Terminated SPDT Switch

8.0 - 10.5 GHz

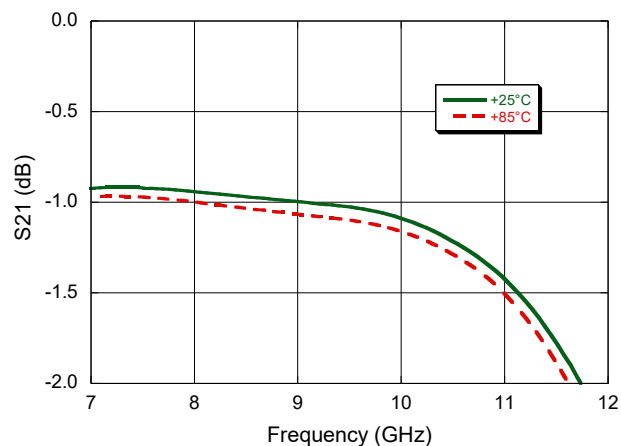


MASW-011071

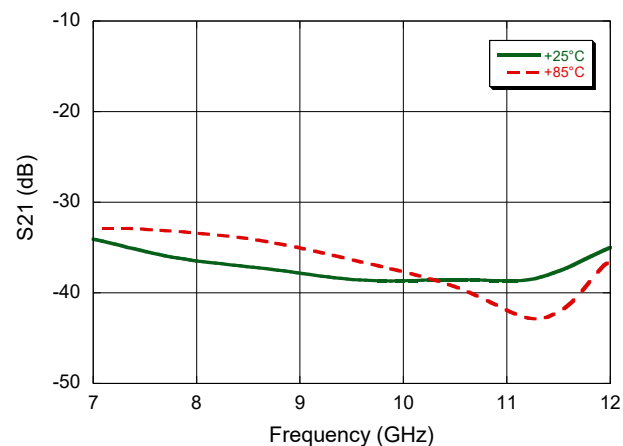
Rev. V2

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

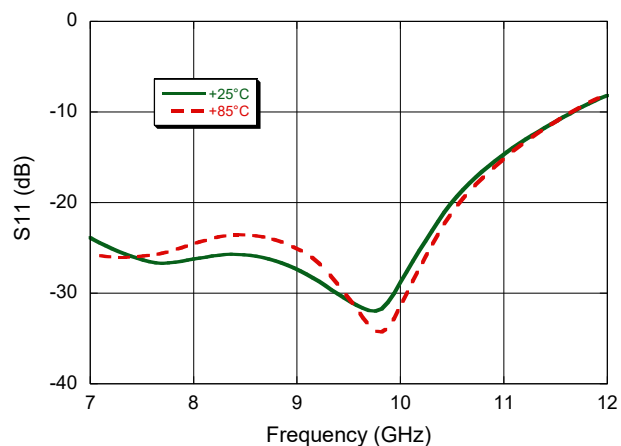
Insertion Loss vs. Frequency



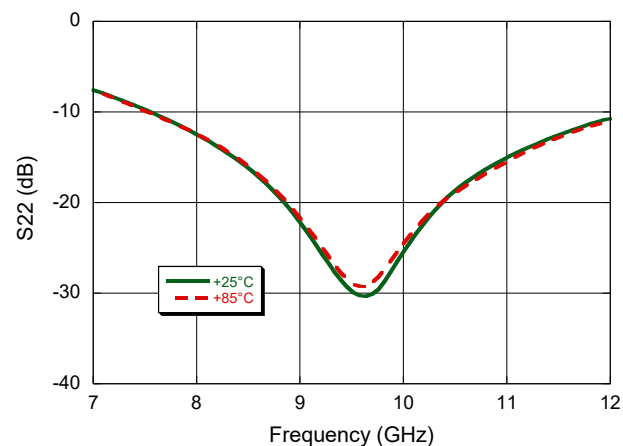
Isolation vs. Frequency



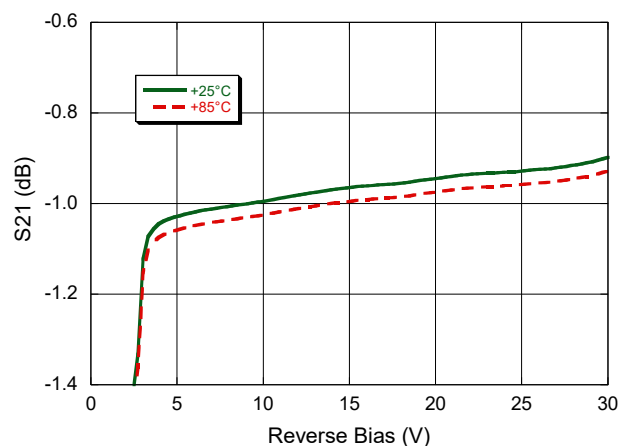
Input Return Loss vs. Frequency (Transmission)



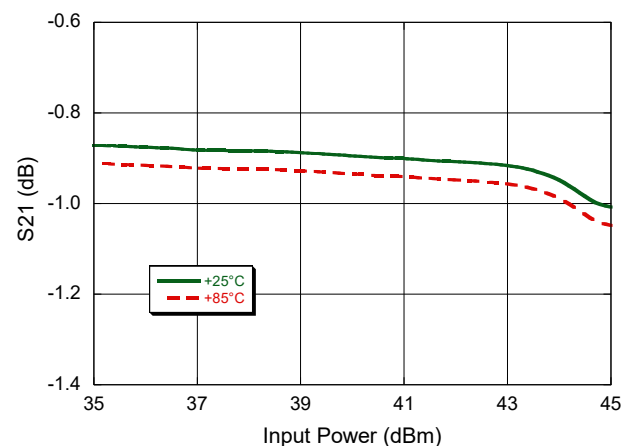
Output Return Loss vs. Frequency (Termination)



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



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



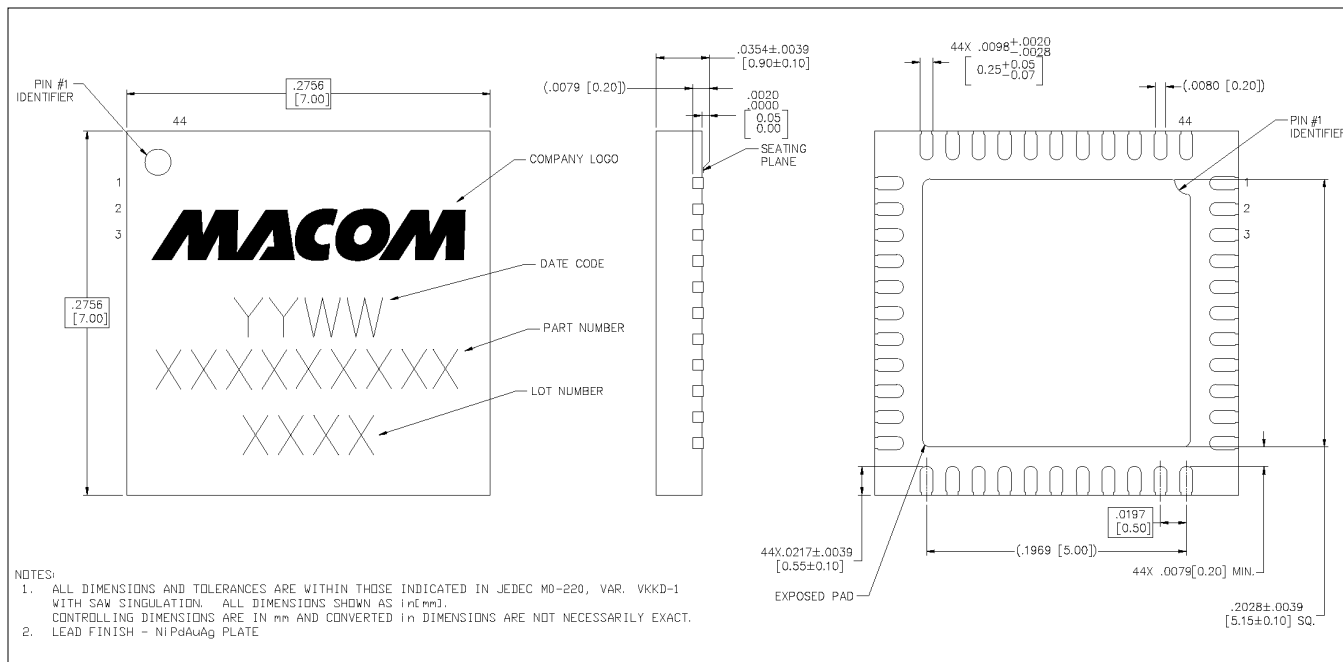
20 W HMIC Silicon PIN Diode Terminated SPDT Switch 8.0 - 10.5 GHz



MASW-011071

Rev. V2

Outline Drawing



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

20 W HMIC Silicon PIN Diode Terminated SPDT Switch

8.0 - 10.5 GHz



MASW-011071

Rev. V2

MACOM Technology Solutions Inc. ("MACOM"). All rights reserved.

These materials are provided in connection with MACOM's products as a service to its customers and may be used for informational purposes only. Except as provided in its Terms and Conditions of Sale or any separate agreement, MACOM assumes no liability or responsibility whatsoever, including for (i) errors or omissions in these materials; (ii) failure to update these materials; or (iii) conflicts or incompatibilities arising from future changes to specifications and product descriptions, which MACOM may make at any time, without notice. These materials grant no license, express or implied, to any intellectual property rights.

THESE MATERIALS ARE PROVIDED "AS IS" WITH NO WARRANTY OR LIABILITY, EXPRESS OR IMPLIED, RELATING TO SALE AND/OR USE OF MACOM PRODUCTS INCLUDING FITNESS FOR A PARTICULAR PURPOSE, MERCHANTABILITY, INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHT, ACCURACY OR COMPLETENESS, OR SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES WHICH MAY RESULT FROM USE OF THESE MATERIALS.

MACOM products are not intended for use in medical, lifesaving or life sustaining applications. MACOM customers using or selling MACOM products for use in such applications do so at their own risk and agree to fully indemnify MACOM for any damages resulting from such improper use or sale.