MASW-011021

HMIC™ Silicon PIN Diode SPDT Switch 6 - 14 GHz

Rev. V2

Features

- Specified from 8 GHz to 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[5]
- Silicon Nitride Passivation
- Polymer Scratch Protection
- RoHS* Compliant

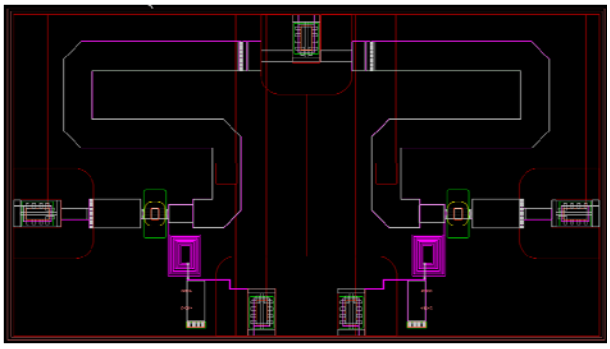
Description

This device is a Surmount™ X-Band monolithic SPDT switch designed for high power, high performance applications. This Surface Mount chipscale 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.

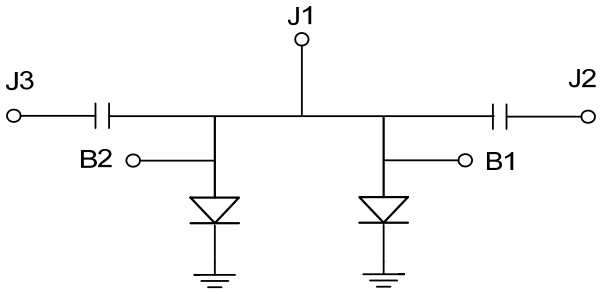
This device is fabricated using M/A-COM Technology Solutions' patented HMIC™ (Heterolithic Microwave Integrated Circuit) process, US Patent 5,268,310. This process allows the incorporation of silicon pedestals that form series and shunt diodes and/or vias by embedding them in low loss, low dispersion 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.

Die Bond Pad Layout



Functional Schematic



Pin Configuration [1]

Pin	Function
J1	RF C
J2	RF 1
J3	RF 2
B1	Bias 1
B2	Bias 2

1. The exposed pad centered on the chip bottom must be connected to RF and DC ground.

Ordering Information[2]

Part Number	Package
MASW-011021-14010G	25 piece gel pack
MASW-011021-001SMB	Sample Test Board

2. Reference Application Note M513 for reel size information.

*Restrictions on Hazardous Substances, European Union Directive 2002/95/EC.

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Electrical Specifications: Bias: -5 V, +30 mA, T_A = 25°C, P_{IN} = 0 dBm, Z_0 = 50 Ω

Parameter	Units	Min.	Typ.	Max.
Insertion Loss 8 GHz 10 GHz 12 GHz	dB	— — —	0.70 0.70 0.65	0.85 0.85 0.85
Input to Output Isolation 8 GHz 10 GHz 12 GHz	dB	30 30 30	34 36 34	— — —
Return Loss	dB	—	15	—
IIP3	dBm	—	60	—
Switching Speed [3]	ns	—	130	—
Voltage Rating [4]	V	—	200	—
CW Power Handling [5] (-30 V, +30 mA)	W	—	10	—

3. Typical Switching Speed measured for 10% to 90 % of detected RF signal driven by TTL compatible drivers.
4. Maximum reverse leakage current in either the shunt or series PIN diodes shall be 0.1 µA maximum.
5. 20 W up to 300 µs 40% Duty Cycle

Absolute Maximum Ratings[6,7]

Parameter	Absolute Maximum
Operating Temperature	-65°C to +125°C
Storage Temperature	-65°C to +150°C
Junction Temperature	+175°C
Applied Reverse Voltage	200 V
Bias Current +25°C	100 mA

6. Exceeding any one or combination of these limits may cause permanent damage to this device.
7. M/A-COM Technology Solutions does not recommend sustained operation near these survivability limits.

Handling Procedures

Please observe the following precautions to avoid damage:

Static Sensitivity

Silicon 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 Class 1A HBM devices.

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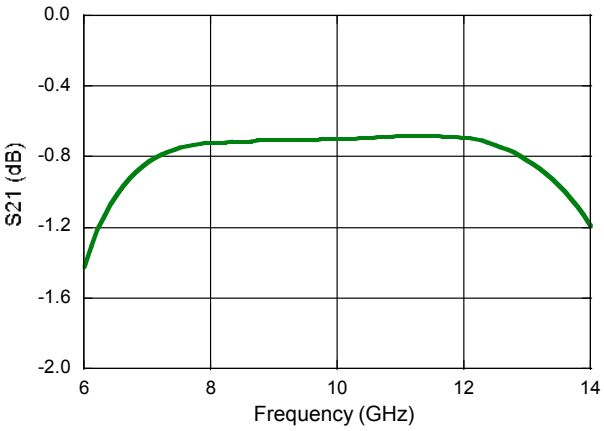
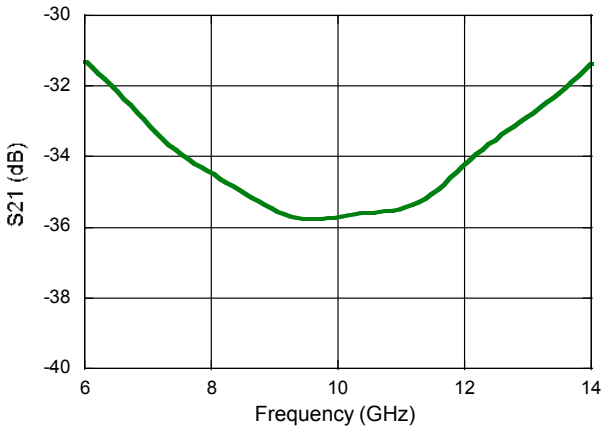
Typical Performance Curves (on wafer probed results): Bias: -30 V, +30 mA

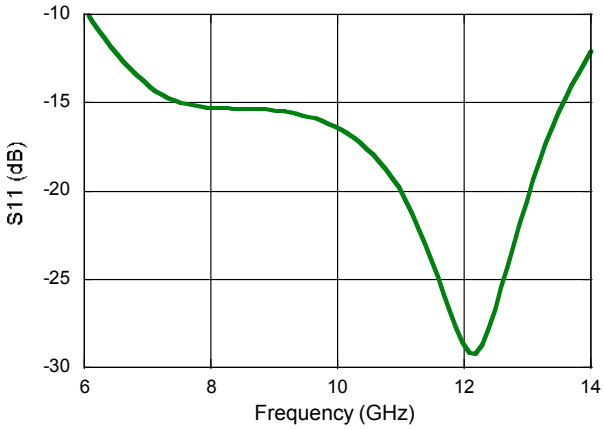
Insertion Loss



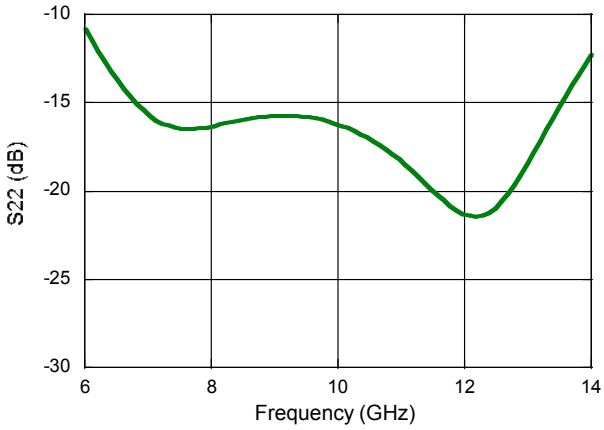
Isolation



Input Return Loss



Output Return Loss



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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, 5V of negative reverse bias is required. With a 4:1 match, 10 V of negative reverse bias is required[8].

However M/A-COM Technology Solutions suggests a reverse bias voltage of –30V to achieve optimal insertion loss.

8. 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

Driver Connections

Control Level (DC Currents and Voltages)		Condition of RF Output	
B1	B2	J1-J2	J1-J3
-30 V	+30 mA	Low Loss	Isolation
+30 mA	-30 V	Isolation	Low Loss

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 ≤ 1W, 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 to100 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 on the MA-COM Technology Solutions website @ www.macomtech.com

Sample Board

Samples test boards are available upon request

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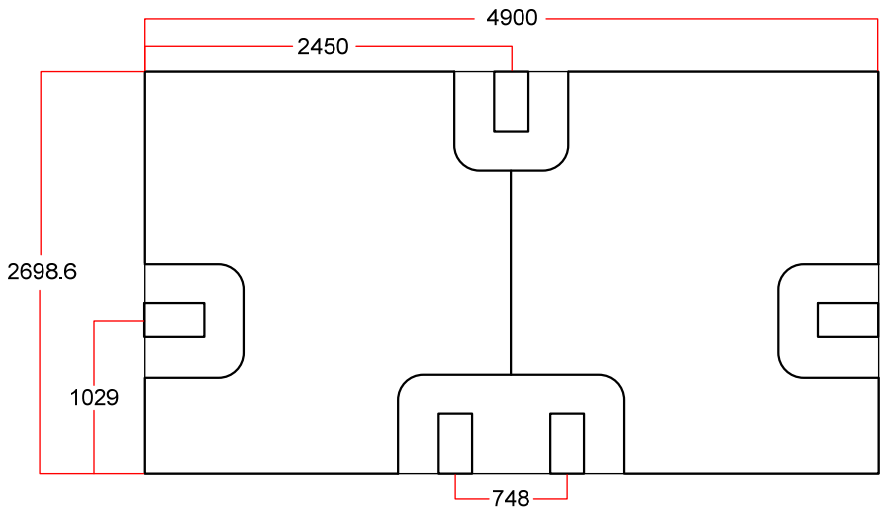
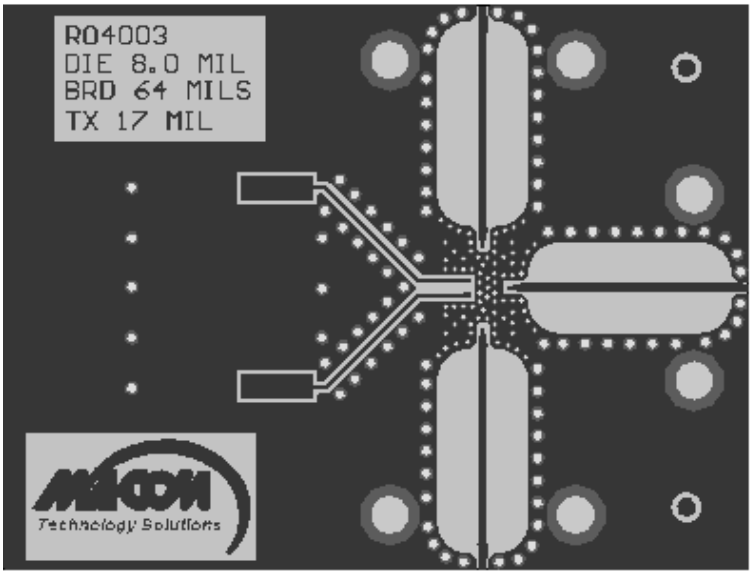
Outline Drawing - Back Metal



ALL DIMENTIONS ARE IN µm

PWB for testing purposes



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