

# Ka-Band High Power Reflective SPDT PIN Switch Die

## 26 - 40 GHz



**MASW-010646**

Rev. V6

### Features

- Broadband Performance, 26 to 40 GHz
- Low Loss: 0.6 dB
- High Isolation: 32 dB
- Up to 13 W CW Power, +85°C
- Die with G-S-G RF Pads and DC Bias Pads
- Includes DC Blocks and RF Bias Networks
- RoHS\* Compliant

### Applications

- Aerospace & Defense

### Description

The MASW-010646 is a high power, broadband, reflective, high linearity, SPDT switch die. This switch was developed for Ka-Band applications that require up to 13 W of power handling while maintaining low insertion loss and high isolation.

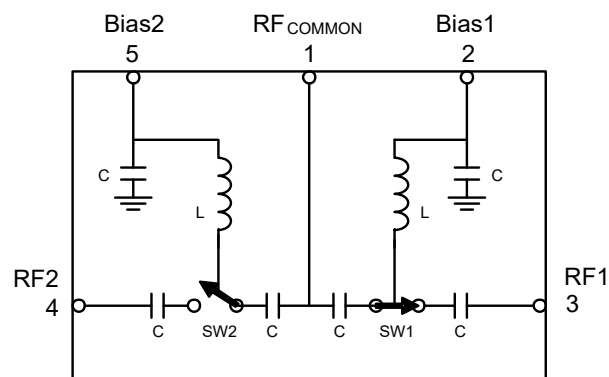
The SPDT MMIC utilizes MACOM's proven AlGaAs PIN diode technology. The switch is fully passivated with silicon nitride and has an added polymer layer for scratch protection. The protective coating prevents damage to the junction and the anode air-bridge during handling and assembly. The die has backside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

### Ordering Information<sup>1</sup>

Part Number	Package
MASW-010646-13940G	Die in Gel Pack
MASW-010646-13940W	Die in Waffle Pack

1. Die quantity varies.

### Functional Diagram



### Pad Configuration:

(Back Metal is RF, DC, and Thermal Ground)

Pad #	Function
1	RF <sub>COMMON</sub>
2	BIAS 1
3	RF1
4	RF2
5	BIAS 2

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

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### Electrical Specifications:

Freq. = 28 - 38 GHz,  $T_A = +25^\circ\text{C}$ ,  $I_F^2 = +25\text{ mA}$ ,  $V_R^3 = -15\text{ V}$ ,  $Z_0 = 50\ \Omega$

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Insertion Loss (RF <sub>COMMON</sub> to RFx ON state)	26 GHz	dB	—	0.60	—
	28 GHz			0.60	0.90
	35 GHz			0.60	0.90
	38 GHz			0.60	0.90
	40 GHz			0.70	—
Isolation (RF <sub>COMMON</sub> to RFx OFF state) <sup>4</sup>	26 GHz	dB	—	34	—
	28 GHz		29	35	
	35 GHz		33	39	
	38 GHz		35	41	
	40 GHz		—	42	
Return Loss (RF <sub>COMMON</sub> )	26 GHz	dB	—	16	—
	28 GHz			18	
	35 GHz			16	
	38 GHz			16	
	40 GHz			16	
Return Loss (RFx ON state)	26 GHz	dB	—	16	—
	28 GHz			18	
	35 GHz			16	
	38 GHz			16	
	40 GHz			16	
CW Power Handling (ON state) <sup>3</sup>	-25 V, +85°C	dBm	—	41.2	—
Switching Speed $T_{ON} / T_{OFF}$ $T_{RISE} / T_{FALL}$	50% DC to 90% RF / 50% DC to 10% RF 10% to 90% RF / 90% to 10% RF	ns	—	25 / 23 9 / 9	—
Reverse Bias Voltage <sup>3</sup>	—	V	-32	-15	-5
Reverse Bias Current <sup>3</sup>	-15 V	nA	—	25	—

- Forward bias current ( $I_F$ ) is set using external bias resistors ( $R_{BIAS}$ ) placed at pins Bias1 and Bias2, where  $R_{BIAS} = (V_{CC} - 1.32\text{ V}) / I_F$ .
- Reverse bias voltage should be determined based on working conditions. For example, -25 V @ 41.2 dBm input power. For lower power applications, a less negative voltage can be used. R. Caverly and G. Hiller, "Establishing the Minimum Reverse Bias for a PIN Diode in a High Power Switch," IEEE Transactions on Microwave Theory and Techniques, Vol.38, No.12, December 1990.
- Isolation defined with 1 port in low loss state.

### Absolute Maximum Ratings<sup>5,6</sup>

Parameter	Absolute Maximum
DC Reverse Bias Voltage	50 V
Forward Bias Current	40 mA
CW Incident Power	43 dBm @ 85°C
Operating Temperature	-40°C to +85°C
Storage Temperature	-65°C to +150°C

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

### Truth Table

RF <sub>COMMON</sub> Path	Bias 1	Bias 2
RF1 Insertion Loss RF2 Isolation	-15 V	25 mA
RF2 Insertion Loss RF1 Isolation	25 mA	-15 V

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## Minimum Reverse Bias Voltage<sup>7</sup>

Frequency (GHz)	DC Voltage (V)
26	16
30	14
35	12
40	11

7. Minimum DC bias voltage to maintain low loss under 41.2 dBm of power with 1.5:1 VSWR.

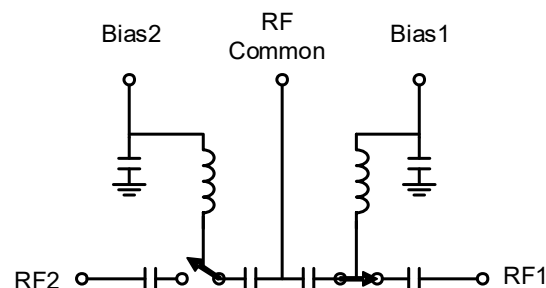
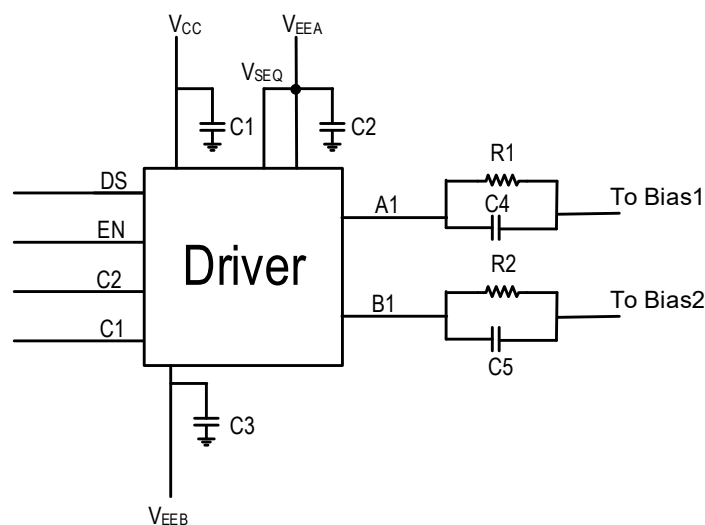
## Handling Procedures

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.

## MASW-010646 with MADR-011020 Driver Application Schematic



## Parts List<sup>8</sup>

Part	Value
C1, C3	0.1 $\mu$ F
C2	47 pF
C4, C5	470 pF
R1, R2	150 $\Omega$

8. Resistor values calculated to provide 25 mA of bias current given  $V_{CC} = 5$  V.

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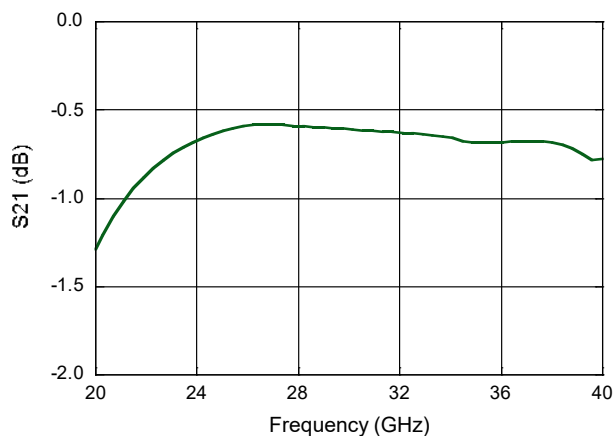


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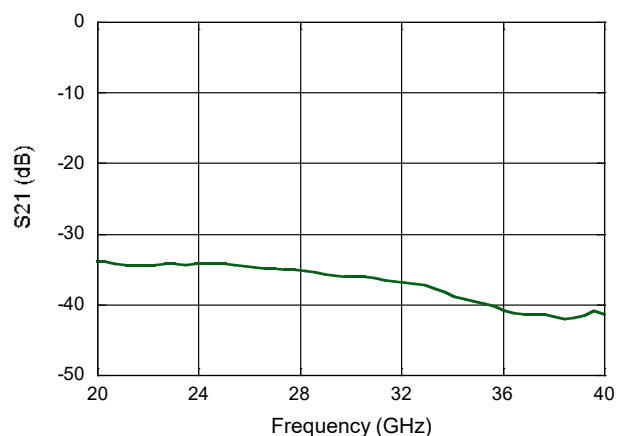
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Typical Performance:  $T_A = +25^\circ\text{C}$ ,  $+25\text{ mA}$ ,  $-15\text{ V}$ ,  $Z_0 = 50\ \Omega$

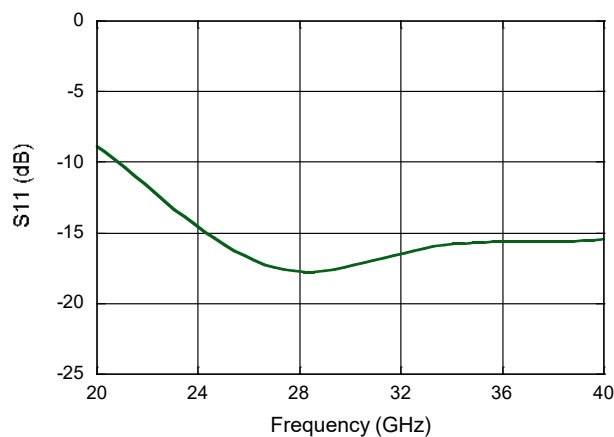
**Insertion Loss (On State)**



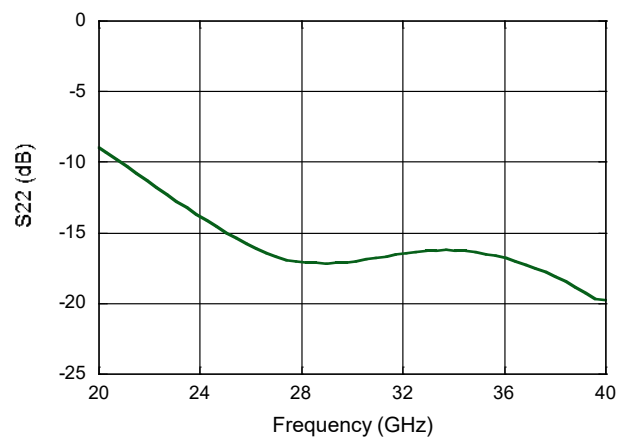
**Isolation (Off State)**



**RF<sub>COMMON</sub> Return Loss ((On State)**



**RF1, 2 Return Loss (On State)**



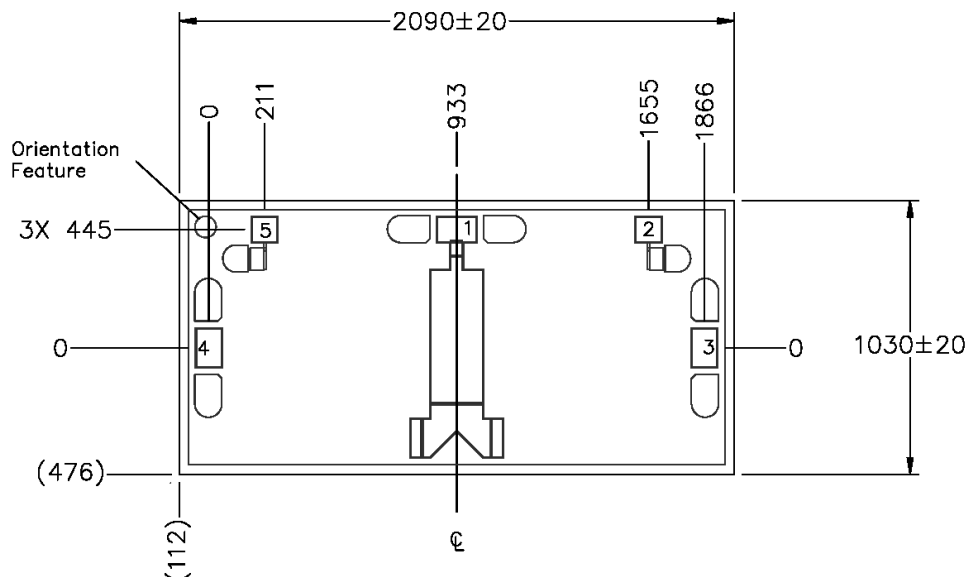
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## Die Outline<sup>†</sup>



<sup>†</sup> Dimensions indicated in  $\mu\text{m}$ .  
 Die Thickness : 100  $\mu\text{m}$   
 RF Pads (1, 3 & 4) are 100 x 150  $\mu\text{m}$ .  
 DC Bias Pads (2 & 5) are 100 x 100  $\mu\text{m}$ .  
 Meets JEDEC moisture sensitivity level 1 requirements.

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