

Ka-Band High Power Terminated SPDT PIN Switch 20 - 44 GHz



MASW-011148

Rev. V4

Features

- Broadband Performance, 20 to 44 GHz
- Low Loss <0.9 dB
- High Isolation >36 dB
- Up to 13 W CW Power, +85°C
- Includes DC Blocks and RF Bias Networks
- 23 dBm power handling in terminated port
- Lead-Free 3 x 4 mm PQFN package
- RoHS* Compliant

Applications

- 5G
- Point-to-Point
- Radar
- Radiometers
- Test & Instrumentation
- High Frequency Applications

Description

The MASW-011148 is a high power SPDT PIN diode switch in 3 x 4 mm PQFN package. This broadband, high linearity, SPDT switch with 50 Ω terminated RF ports was developed for Ka-Band applications that require up to 13 Watts CW power handling at an environmental temperature of +85°C while maintaining low insertion loss and high isolation.

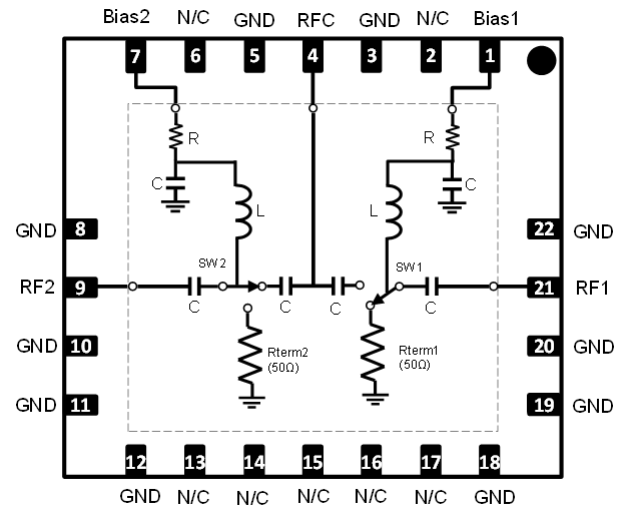
The SPDT MMIC utilizes MACOM's proven AlGaAs PIN diode technology.

Ordering Information¹

| Part Number | Package |
|--------------------|----------------|
| MASW-011148-TR0500 | 500 piece reel |
| MASW-011148-SMB | Sample Board |

1. Reference Application Note M513 for reel size information.

Functional Schematic



Pin Configuration²

| Pin # | Function |
|-------------------------------------|---------------------|
| 1 | BIAS 1 |
| 2, 6, 13, 14, 15, 16, 17 | N/C |
| 3, 5, 8, 10, 11, 12, 18, 19, 20, 22 | GND |
| 4 | RFC |
| 7 | BIAS 2 |
| 9 | RF2 |
| 21 | RF1 |
| 23 | Paddle ³ |

2. MACOM recommends connecting unused package pins to ground.

3. The exposed pad centered on the package bottom must be connected to RF, DC and thermal ground.

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

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Electrical Specifications:

Freq. = 20 - 44 GHz, $T_A = 25^\circ\text{C}$, $V_{CC} = +4\text{ V @ } 28\text{ mA} / -15\text{ V @ } 0\text{ mA}$, $Z_0 = 50\ \Omega$

| Parameter | Test Conditions | Units | Min. | Typ. | Max. |
|--|------------------|-------|------|------|------|
| Insertion Loss | 21 GHz | dB | — | 1.0 | 1.5 |
| | 28 GHz | | | 0.9 | 1.6 |
| | 37 GHz | | | 1.0 | 1.6 |
| | 41 GHz | | | 1.3 | — |
| Isolation ⁴ | 21 GHz | dB | 35 | 38 | — |
| | 28 GHz | | 35 | 43 | |
| | 37 GHz | | 35 | 43 | |
| | 41 GHz | | — | 38 | |
| Input / Output Return Loss On state | 21 GHz | dB | — | 16 | — |
| | 28 GHz | | | 18 | |
| | 37 GHz | | | 16 | |
| | 41 GHz | | | 13 | |
| RF1, 2 Return Loss, Off state | 21 GHz | dB | — | 4 | — |
| | 28 GHz | | | 9 | |
| | 37 GHz | | | 18 | |
| | 41 GHz | | | 16 | |
| Switching Speed-T _{ON} | 50% DC to 90% RF | ns | — | 26 | — |
| Switching Speed-T _{OFF} | 50% DC to 10% RF | ns | — | 27 | — |
| Rise Time -T _{RISE} | 10% to 90% RF | ns | — | 8 | — |
| Fall Time - T _{FALL} | 90% to 10% RF | ns | — | 11 | — |
| CW Input Power ⁵ | -25 V @ +85°C | dBm | — | 41.2 | — |
| DC Reverse Bias Voltage ⁵ | — | V | -32 | -15 | -5 |
| Reverse Bias Current ⁵ | -15 V | nA | — | 25 | 500 |
| Forward Bias Current | +4 V | mA | 18 | 28 | 33 |

4. Isolation defined with 1 port in low loss state.

5. DC Reverse bias voltage should be determined based on working conditions. For example, recommended min of -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 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^{6,7}

| Parameter | Absolute Maximum |
|---|--------------------------------------|
| DC Reverse Bias Voltage + RF Peak voltage | 80 V |
| DC Reverse Bias Voltage | 50 V |
| Forward Bias Current | 60 mA (6 V) |
| CW Incident Power (Low Loss Port) | 41.2 dBm @ +85°C 43.0 dBm @ +25°C |
| CW Incident Power (Terminated Port) | 23 dBm @ +85°C 26 dBm @ +25°C |
| Operating Temperature | -40°C to +85°C |
| Storage Temperature | -65°C to +150°C |

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

Truth Table

| RF _{COMMON} Path | Bias 1 | Bias 2 |
|-------------------------------------|---------------|---------------|
| RF1 Insertion Loss RF2 Isolation | -15 V (0 mA) | +4 V (+28 mA) |
| RF2 Insertion Loss RF1 Isolation | +4 V (+28 mA) | -15 V (0 mA) |

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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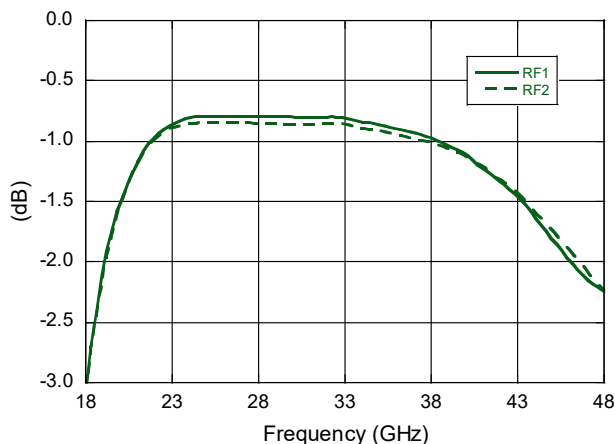


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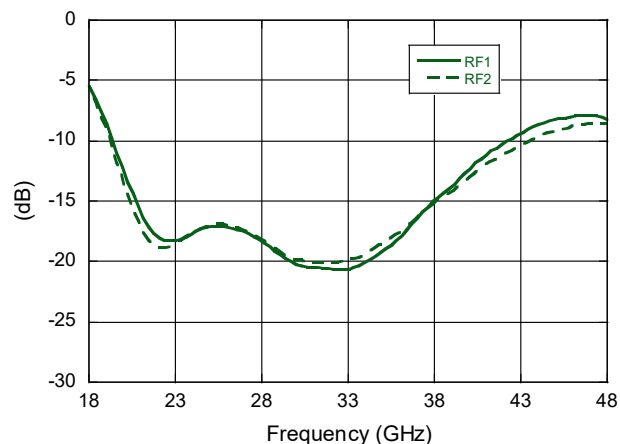
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Typical Performance Curves @ +25°C

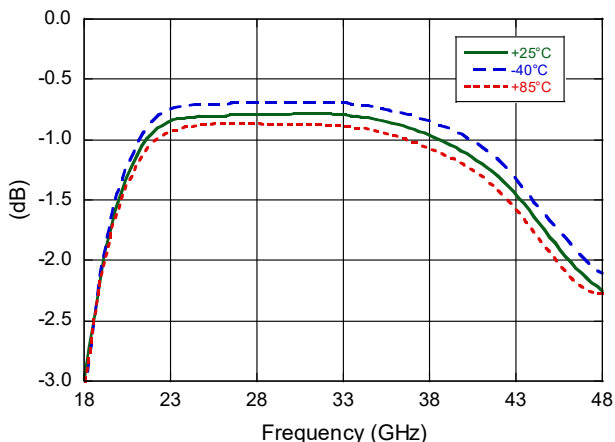
Insertion Loss (On State)



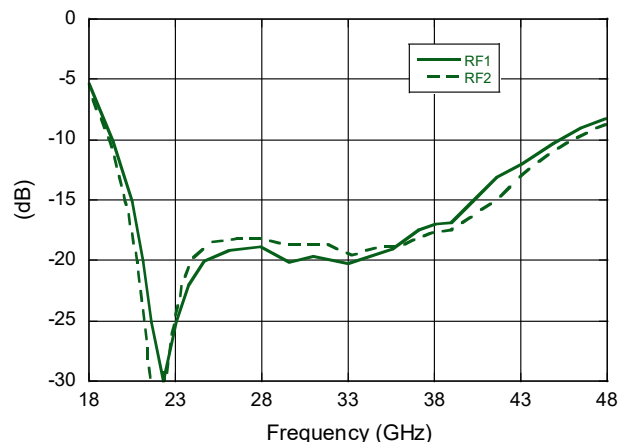
RF_{COMMON} Return Loss (On State)



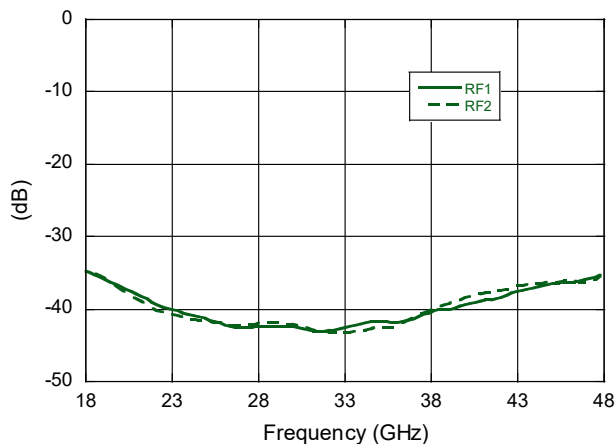
Insertion Loss (On State) over Temp



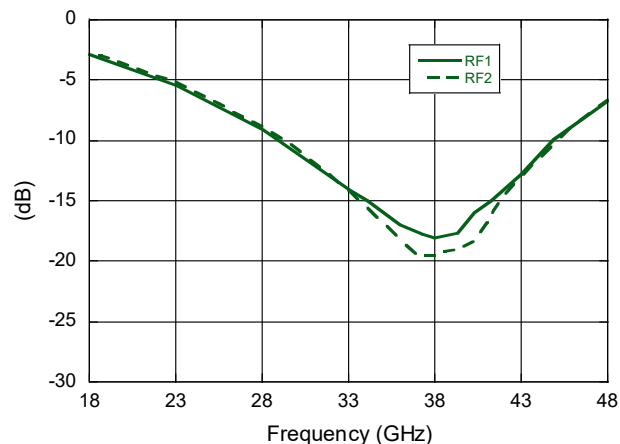
RF1, 2 Return Loss (On State)



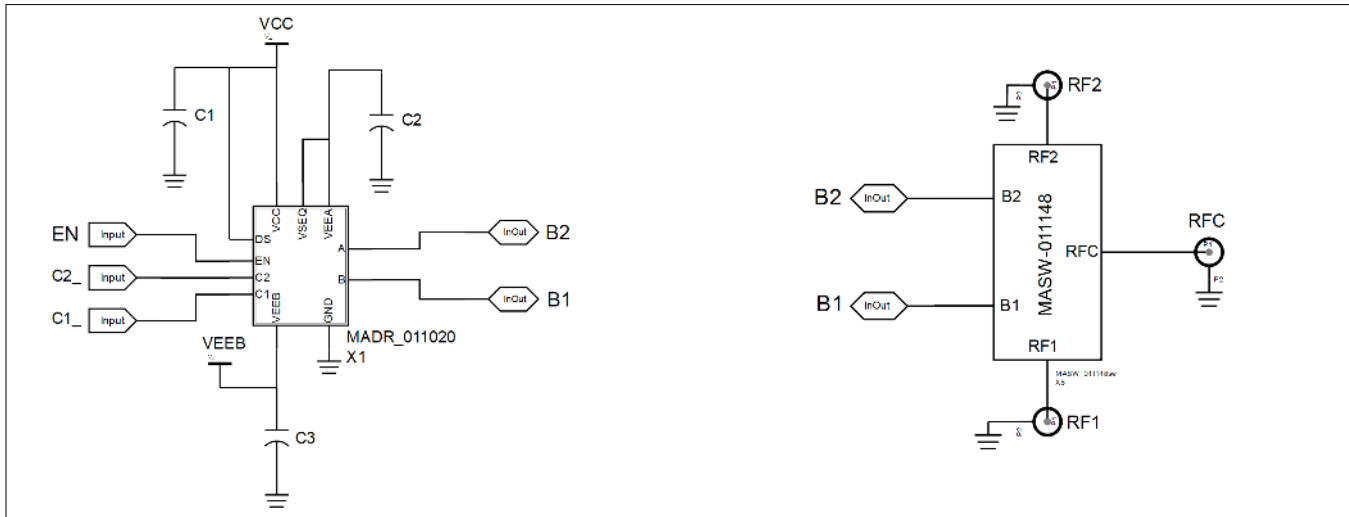
Isolation (Off State)



RF1, 2 Return Loss (Off State)



MASW-011048 with MADR-011020 / MADR-011022 Driver Application Schematic⁸



8. V_{CC} at the driver should be 0.5 V higher than the required forward bias voltage 4 V at the bias switch input B1/B2.

Parts List

| Part | Value |
|--------|-------------|
| C1, C3 | 0.1 μ F |
| C2 | 47 pF |

Minimum DC Reverse Bias Voltage⁹ with MADR-011022 Driver

| Frequency (GHz) | DC Voltage (V) Bias1 & Bias2 |
|-----------------|------------------------------|
| 26 | -16 |
| 30 | -14 |
| 34 | -12 |
| 38 | -11 |
| 40 | -11 |

9. Calculated (see note 6) minimum DC reverse bias voltage to maintain low loss under 41.2 dBm of power with 1.5:1 VSWR.

Logic Truth Table MADR-011020 / MADR-011022

| Inputs | | | | Outputs | |
|--------|----|----|----|---------|-----|
| EN | DS | C2 | C1 | RF1 | RF2 |
| 1 | X | X | X | OFF | OFF |
| 0 | 1 | 0 | 0 | OFF | OFF |
| 0 | 1 | 0 | 1 | OFF | OFF |
| 0 | 1 | 1 | 0 | OFF | ON |
| 0 | 1 | 1 | 1 | ON | OFF |

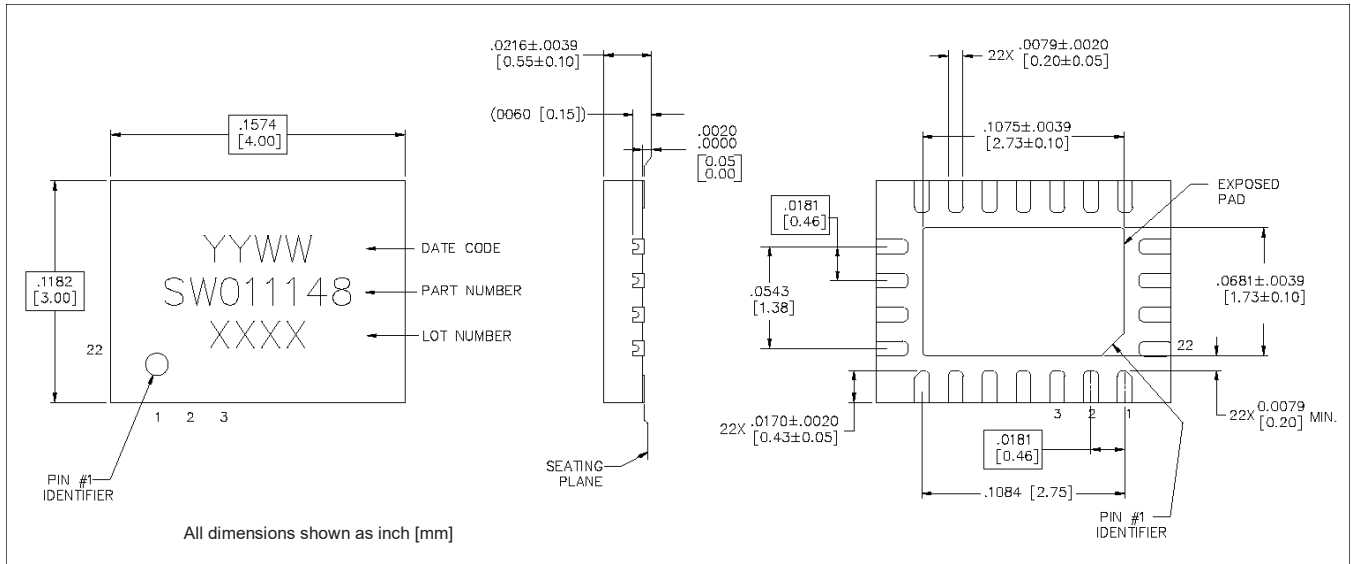
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Lead-Free 3 x 4 mm, 22-Lead PQFN[†]



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

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