## Features

- 200 W CW Incident Power @ $+85^{\circ} \mathrm{C}$
- Low Insertion Loss: 0.30 dB @ 500 MHz
- High Isolation: 48 dB @ 500 MHz
- Harmonics: -85 dBc @ 500 MHz
- Positive DC Bias
- Lead-Free 12 mm XHQFN 28-lead Package
- RoHS* Compliant


## Applications

## - Mil-Com/PS

## Description

The MASW-011077 is a high power PIN diode SP4T switch in a common anode configuration, operating from 50 to 1000 MHz . It features low insertion loss and excellent linearity. It includes two high power ports (RF1 and RF4) capable of handling up to 200 W CW, and two lower power ports (RF2 and RF3) capable of handling up to 100 W CW of incident power at a base plate temperature of $+85^{\circ} \mathrm{C}$.

This high power switch is ideal for use on land mobile radio and MIL-COM applications that require higher CW and pulsed power operation. This device operates with positive-only DC bias, making it suitable for switch-filter and power amplifier control circuits.

The MASW-011077 is manufactured using MACOM's hybrid manufacturing process featuring high voltage PIN diodes and passive devices integrated in a 12 mm XHQFN 28-lead plastic package.

The MASW-011077 is compatible with MACOM's MADR-011021 PIN diode Driver.

Ordering Information ${ }^{1}$

| Part \# | Package |
| :---: | :---: |
| MASW-011077-TR0500 | 500 Piece Reel |
| MASW-011077-SMB | Sample Test Board |

1. Reference Application Note M513 for reel size information.

## Functional Schematic



Pin Configuration ${ }^{2}$

| Pin | Function | Pin | Function |
| :---: | :---: | :---: | :---: |
| $1,2^{3}$ | RF1 Input / <br> V1 Bias | 14 | B6 Bias |
| $3-5$ | No Connection | $15,16^{3}$ | RF3 Input / <br> V3 Bias |
| $6^{3}$ | RF2 Input / <br> V2 Bias | $17-19$ | No Connection |
| 7 | No Connection | $20,21^{3}$ | RF4 Input / <br> V4 Bias |
| 8 | B3 Bias | 22 | B7 Bias |
| 9 | No Connection | 23 | B8 Bias |
| 10 | B4 Bias | 24,25 | RFC Input / <br> V5 Bias |
| 11 | No Connection | 26 | No Connection |
| 12 | B5 Bias | 27 | B1 Bias |
| 13 | No Connection | 28 | B2 Bias |
|  |  | Paddle ${ }^{4}$ | Ground |

2. MACOM recommends connecting unused package pins to ground.
3. RF1 and RF4 are high power ports ( 200 W ); RF2 is a receive port; RF3 is a low power port (100 W),
4. The exposed paddle centered on the package bottom must be connected to RF, DC and thermal ground.
[^0]Electrical Specifications: $\mathrm{T}_{\mathrm{A}}=25^{\circ} \mathrm{C}, \mathrm{P}_{\mathrm{IN}}=0 \mathrm{dBm}, \mathrm{Z}_{0}=50 \Omega$,
Bias $^{5}=8 \mathrm{~V} / 500 \mathrm{~mA}, 8 \mathrm{~V} / 75 \mathrm{~mA}, 150 \mathrm{~V}$ (unless otherwise defined)

| Parameter | Test Conditions | Units | Min. | Typ. | Max. |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Insertion Loss RFC - RF1 \& RFC - RF4 | $\begin{aligned} & 170 \mathrm{MHz} \\ & 500 \mathrm{MHz} \\ & 870 \mathrm{MHz} \end{aligned}$ | dB | - | $\begin{aligned} & 0.25 \\ & 0.30 \\ & 0.35 \end{aligned}$ | $\begin{aligned} & 0.40 \\ & 0.55 \end{aligned}$ |
| Insertion Loss RFC - RF2 \& RFC - RF3 | $\begin{aligned} & 170 \mathrm{MHz} \\ & 500 \mathrm{MHz} \\ & 870 \mathrm{MHz} \end{aligned}$ | dB | - | $\begin{aligned} & \hline 0.30 \\ & 0.35 \\ & 0.40 \end{aligned}$ | $\begin{aligned} & 0.45 \\ & 0.60 \end{aligned}$ |
| $\begin{gathered} \text { Isolation } \\ \text { RFC - RF1 \& RFC - RF4 } \end{gathered}$ | $\begin{aligned} & 170 \mathrm{MHz} \\ & 500 \mathrm{MHz} \\ & 870 \mathrm{MHz} \end{aligned}$ | dB | $\frac{50}{37}$ | $\begin{aligned} & 55 \\ & 48 \\ & 41 \end{aligned}$ | - |
| $\begin{gathered} \text { Isolation } \\ \text { RFC - RF2 \& RFC - RF3 } \end{gathered}$ | $\begin{aligned} & 170 \mathrm{MHz} \\ & 500 \mathrm{MHz} \\ & 870 \mathrm{MHz} \end{aligned}$ | dB | $\frac{53}{42}$ | $\begin{aligned} & 58 \\ & 52 \\ & 47 \end{aligned}$ | - |
| Input Return Loss RFC - All Ports | 50-1000 MHz | dB | - | >14 | - |
| CW Input Power RFC - RF1 \& RFC - RF4 | $85^{\circ} \mathrm{C}$ base plate, 500 MHz | $\mathrm{dBm}$ W | - | $\begin{gathered} 53 \\ 200 \end{gathered}$ | - |
| CW Input Power RFC - RF2 \& RFC - RF3 | $85^{\circ} \mathrm{C}$ base plate, 870 MHz | $\mathrm{dBm}$ W | - | $\begin{gathered} 50 \\ 100 \end{gathered}$ | - |
| $\begin{gathered} \text { P0.1dB } \\ \text { RFC - RF1 \& RFC - RF4 } \end{gathered}$ | $85^{\circ} \mathrm{C}$ base plate, 500 MHz | $\mathrm{dBm}$ W | - | $\begin{gathered} 53 \\ 200 \end{gathered}$ | - |
| $\begin{gathered} \text { P0.1dB } \\ \text { RFC - RF2 \& RFC - RF3 } \end{gathered}$ | $85^{\circ} \mathrm{C}$ base plate, 870 MHz | $\begin{gathered} \mathrm{dBm} \\ \mathrm{~W} \end{gathered}$ | - | $\begin{gathered} \hline 51 \\ 125 \end{gathered}$ | - |
| 2nd Harmonics | $\begin{aligned} & P_{\text {IN }}=51 \mathrm{dBm}, \mathrm{~F}_{\mathrm{O}}=150 \mathrm{MHz} \\ & \mathrm{P}_{\mathrm{IN}}=51 \mathrm{dBm}, \mathrm{~F}_{\mathrm{O}}=500 \mathrm{MHz} \\ & \mathrm{P}_{\mathrm{IN}}=51 \mathrm{dBm}, \mathrm{~F}_{\mathrm{O}}=870 \mathrm{MHz} \end{aligned}$ | dBc | - | $\begin{aligned} & -85 \\ & -85 \\ & -80 \end{aligned}$ | - |
| 3rd Harmonics | $\begin{aligned} & \mathrm{P}_{\mathrm{IN}}=51 \mathrm{dBm}, \mathrm{~F}_{\mathrm{O}}=150 \mathrm{MHz} \\ & \mathrm{P}_{\mathrm{IN}}=51 \mathrm{dBm}, \mathrm{~F}_{\mathrm{O}}=500 \mathrm{MHz} \\ & \mathrm{P}_{\mathrm{IN}}=51 \mathrm{dBm}, \mathrm{~F}_{\mathrm{O}}=870 \mathrm{MHz} \end{aligned}$ | dBc | - | $\begin{aligned} & -85 \\ & -90 \\ & -90 \end{aligned}$ | - |
| Ton, Toff | 50\% Control - 90\% RF and 10\% RF 100 Hz Rep. Rate in Commutating Mode | $\mu \mathrm{s}$ | - | 10 | - |
| $\mathrm{T}_{\text {RISE }}, \mathrm{T}_{\text {FALL }}$ | 10-90\% RF Voltage 100 Hz Rep. Rate in Commutating Mode | $\mu \mathrm{s}$ | - | 4 | - |
| Reverse Bias Leakage Current | $\mathrm{Vr}=150 \mathrm{~V}$ | $\mu \mathrm{A}$ | - | 0.3 | 1.0 |

5. See Bias table.

## Bias Tables ${ }^{6}$

| RF State | V1 | V2 | V3 | V4 | V5 |
| :---: | :---: | :---: | :---: | :---: | :---: |
| ```RFC - RF1 Insertion Loss RFC - RF2 Isolation RFC - RF3 Isolation RFC - RF4 Isolation``` | 8 V @ <1.0 $\mu \mathrm{A}$ | 8 V @ 75 mA | 8 V @ 75 mA | 8 V @ 75 mA | 8 V @ 500 mA |
| RFC - RF2 Insertion Loss <br> RFC - RF1 Isolation <br> RFC - RF3 Isolation <br> RFC - RF4 Isolation | 8 V @ 75 mA | 8 V @ <1.0 $\mu \mathrm{A}$ | 8 V @ 75 mA | 8 V @ 75 mA | 8 V @ 500 mA |
| RFC - RF3 Insertion Loss <br> RFC - RF1 Isolation <br> RFC - RF2 Isolation <br> RFC - RF4 Isolation | 8 V @ 75 mA | 8 V @ 75 mA | 8 V @ <1.0 $\mu \mathrm{A}$ | 8 V @ 75 mA | 8 V @ 500 mA |
| RFC - RF4 Insertion Loss <br> RFC - RF1 Isolation <br> RFC - RF2 Isolation <br> RFC - RF3 Isolation | 8 V @ 75 mA | 8 V @ 75 mA | 8 V @ 75 mA | 8 V @ <1.0 $\mu \mathrm{A}$ | 8 V @ 500 mA |


| RF State | B1 | B2 | B3 | B4 | B5 | B6 | B7 | B8 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| RFC - RF1 Insertion Loss <br> RFC - RF2 Isolation <br> RFC - RF3 Isolation <br> RFC - RF4 Isolation | $\begin{gathered} 0 \mathrm{~V} @ \\ 500 \mathrm{~mA} \end{gathered}$ | $\begin{aligned} & 150 \mathrm{~V} @ \\ & <1.0 \mu \mathrm{~A} \end{aligned}$ | $\begin{aligned} & 0 \mathrm{~V} \text { @ } \\ & 75 \mathrm{~mA} \end{aligned}$ | $\begin{aligned} & 150 \mathrm{~V} @ \\ & <1.0 \mu \mathrm{~A} \end{aligned}$ | $\begin{aligned} & 150 \mathrm{~V} @ \\ & <1.0 \mu \mathrm{~A} \end{aligned}$ | $\begin{aligned} & 0 \mathrm{~V} \text { @ } \\ & 75 \mathrm{~mA} \end{aligned}$ | $\begin{aligned} & 0 \mathrm{~V} \text { @ } \\ & 75 \mathrm{~mA} \end{aligned}$ | $\begin{aligned} & 150 \mathrm{~V} @ \\ & <1.0 \mu \mathrm{~A} \end{aligned}$ |
| RFC - RF2 Insertion Loss <br> RFC - RF1 Isolation <br> RFC - RF3 Isolation <br> RFC - RF4 Isolation | $\begin{aligned} & 150 \mathrm{~V} @ \\ & <1.0 \mu \mathrm{~A} \end{aligned}$ | $\begin{aligned} & 0 \mathrm{~V} \text { @ } \\ & 75 \mathrm{~mA} \end{aligned}$ | $\begin{aligned} & 150 \mathrm{~V} @ \\ & <1.0 \mu \mathrm{~A} \end{aligned}$ | $\begin{gathered} 0 \text { V @ } \\ 500 \text { mA } \end{gathered}$ | $\begin{aligned} & 150 \mathrm{~V} @ \\ & <1.0 \mu \mathrm{~A} \end{aligned}$ | $\begin{aligned} & 0 \mathrm{~V} \text { @ } \\ & 75 \mathrm{~mA} \end{aligned}$ | $\begin{aligned} & 0 \mathrm{~V} @ \\ & 75 \mathrm{~mA} \end{aligned}$ | $\begin{aligned} & 150 \mathrm{~V} @ \\ & <1.0 \mu \mathrm{~A} \end{aligned}$ |
| RFC - RF3 Insertion Loss <br> RFC - RF1 Isolation <br> RFC - RF2 Isolation <br> RFC - RF4 Isolation | $\begin{aligned} & 150 \mathrm{~V} @ \\ & <1.0 \mu \mathrm{~A} \end{aligned}$ | $\begin{aligned} & 0 \mathrm{~V} \text { @ } \\ & 75 \mathrm{~mA} \end{aligned}$ | $\begin{aligned} & 0 \mathrm{~V} \text { @ } \\ & 75 \mathrm{~mA} \end{aligned}$ | $\begin{aligned} & 150 \mathrm{~V} @ \\ & <1.0 \mu \mathrm{~A} \end{aligned}$ | $\begin{gathered} 0 \vee @ \\ 500 \mathrm{~mA} \end{gathered}$ | $\begin{aligned} & 150 \mathrm{~V} @ \\ & <1.0 \mu \mathrm{~A} \end{aligned}$ | $\begin{aligned} & 0 \mathrm{~V} \text { @ } \\ & 75 \mathrm{~mA} \end{aligned}$ | $\begin{aligned} & 150 \mathrm{~V} @ \\ & <1.0 \mu \mathrm{~A} \end{aligned}$ |
| RFC - RF4 Insertion Loss <br> RFC - RF1 Isolation <br> RFC - RF2 Isolation <br> RFC - RF3 Isolation | $\begin{aligned} & 150 \mathrm{~V} @ \\ & <1.0 \mathrm{uA} \end{aligned}$ | $\begin{aligned} & 0 \mathrm{~V} \text { @ } \\ & 75 \mathrm{~mA} \end{aligned}$ | $\begin{aligned} & 0 \text { V @ } \\ & 75 \mathrm{~mA} \end{aligned}$ | $\begin{aligned} & 150 \mathrm{~V} @ \\ & <1.0 \mu \mathrm{~A} \end{aligned}$ | $\begin{aligned} & 150 \mathrm{~V} @ \\ & <1.0 \mu \mathrm{~A} \end{aligned}$ | $\begin{aligned} & 0 \mathrm{~V} \text { @ } \\ & 75 \mathrm{~mA} \end{aligned}$ | $\begin{aligned} & 150 \mathrm{~V} @ \\ & <1.0 \mu \mathrm{~A} \end{aligned}$ | $\begin{gathered} 0 \mathrm{~V} @ \\ 500 \mathrm{~mA} \end{gathered}$ |

6. This device requires positive DC voltage to operate the PIN diodes under both the forward and reverse bias conditions. For safe operation of a reverse biased PIN diode at high power, the minimum DC bias voltage, applied to B1-B8, is dependent on RF frequency, incident power, and VSWR. See the High Power DC Bias Voltage table for high power operation.

## Maximum Operating / Storage Ratings ${ }^{7}$

| Parameter | Maximum |
| :---: | :---: |
| RF Input Power <br> 1:1 VSWR Load @ +85 <br> RFC-RF1, RFC-RF4 <br> RFC-RF2, RFC-RF3 | $\left.\begin{array}{c}53.5 \mathrm{dBm}, 500 \mathrm{MHz} \\ 51.0 \mathrm{dBm}, 870 \mathrm{MHz} \\ \hline \text { Forward Current }\end{array}\right] 600 \mathrm{~mA}$ |
| Reverse DC Voltage | 200 V |
| Junction Temperature | $+175^{\circ} \mathrm{C}$ |
| Operating Temperature | $-40^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$ |
| Storage Temperature | $-55^{\circ} \mathrm{C}$ to $+150^{\circ} \mathrm{C}$ |

7. Operating at nominal conditions with $\mathrm{T}_{J} \leq+175^{\circ} \mathrm{C}$ will ensure MTBF > $1 \times 10^{6}$ hours.
Absolute Maximum Ratings ${ }^{\mathbf{8 , 9 , 1 0}}$

| Parameter | Absolute Maximum |
| :---: | :---: |
| RF Input Power <br> 1:1 VSWR Load @ $+85^{\circ} \mathrm{C}$ <br> RFC-RF1, RFC-RF4 <br> RFC-RF2, RFC-RF3 | $54.5 \mathrm{dBm}, 500 \mathrm{MHz}$ <br> $52.0 \mathrm{dBm}, 870 \mathrm{MHz}$ |
| Forward Current | 750 mA |
| Reverse DC Voltage | 400 V |
| Junction Temperature | $+250^{\circ} \mathrm{C}$ |

8. Operating at nominal conditions with $\mathrm{T}_{j} \leq+250^{\circ} \mathrm{C}$ will ensure MTBF > $3 \times 10^{4}$ hours.
9. MACOM does not recommend sustained operation near these survivability limits.
10. Exceeding any one or combination of these limits may cause permanent damage to this device.
Absolute Maximum Ratings ${ }^{8,9,10}$

High Power DC Bias Voltage ${ }^{11}$

| Frequency (MHz) | DC Voltage (V) |
| :---: | :---: |
| 50 | 80 |
| 100 | 50 |
| 200 | 30 |
| 500 | 20 |
| 1000 | 15 |

11. Minimum DC bias voltage, applied to $\mathrm{B} 1-\mathrm{B} 8$ as shown on the Bias Table, to maintain low loss under 200 W of incident power with 1.5:1 VSWR.

## Application Schematic



Off-Chip Component Values ${ }^{12}$

| Component | Value |
| :---: | :---: |
| C1, C2, C5, C6, C7 |  |
| C8, C11, C12, C13 | 1000 pF |
| C3,C4,C9,C10,C14 | 270 pF |
| C15 | 1 pF |
| L1 - L9 ${ }^{13}$ | 520 nH |
| R1 - R4 | $100 \Omega$ |
| R5 | $10 \Omega$ |

12. Off-chip components must be rated appropriately to ensure safe performance under DC and high RF power operation.
13. Air core inductors supplied by Microwave Components, Inc. part \# 22-6042-CCPAS-27-42-48.

## 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 devices. The device has an ESD rating for HBM Class 1C ( 1000 V ), and CDM Class C3 (1000 V).

## Typical Performance Curves

Isolation RFC - RF1


Isolation RFC - RF3


Isolation RFC - RF2


Isolation RFC - RF4


Rev. V3

## Typical Performance Curves

## Input Return Loss



Output Return Loss


Insertion Loss


## Lead Free 12 mm XHQFN 28-Lead ${ }^{\dagger}$



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[^0]:    * Restrictions on Hazardous Substances, compliant to current RoHS EU directive.

[^1]:    ${ }^{\dagger}$ Reference Application Note S2083 for lead-free solder reflow recommendations.
    Meets JEDEC moisture sensitivity level 3 requirements.
    Plating is NiPdAuAg.

