# AlGaAs SP2T Reflective PIN Diode Switch
# 20 - 55 GHz

**MASW-011173-DIE**
**Rev. V2**

## Features

- Low Loss: 1 dB, 22 to 45 GHz
- 30 dBm CW Power Handling @ +85°C, 40 GHz
- Switching Speed <30 ns
- Integrated DC Blocks and Bias Networks
- Die with GSG RF Pads and DC Bias Pads
- RoHS* Compliant

## Applications

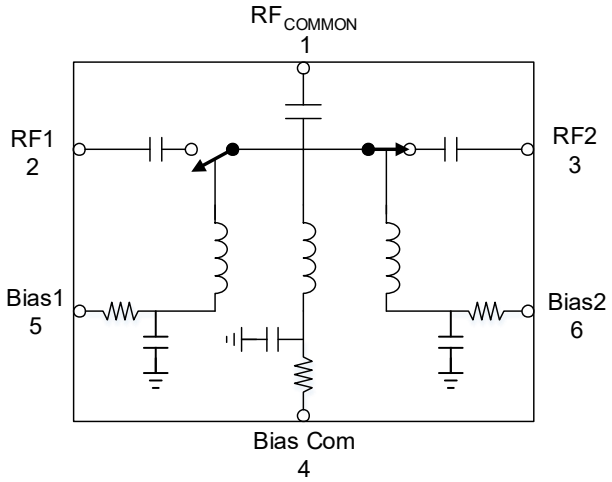
- Test Equipment
- Switching Arrays of Radar Systems
- Point-to-Point Communications
- Multi-Assembly Components

## Description

The MASW-011173-DIE is a high power SP2T switch with integrated bias networks. This broadband, reflective switch was developed for 20 - 55 GHz applications that require up to 30 dBm (1 W) power handling while maintaining low insertion loss, high isolation, and fast switching speed. These switches are suitable for multiple applications.

This SP2T 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 air-bridges during handling and assembly. The die has backside metallization designed to facilitate an epoxy die attach process.

## Functional Schematic




## Pin Configuration[1]

| Pin # | Function |
|---|---|
| 1 | RF Common |
| 2 | RF 1 |
| 3 | RF 2 |
| 4 | Bias Common |
| 5 | Bias 1 |
| 6 | Bias 2 |
| Backside | Ground[1] |

1. The entire exposed pad on the die bottom must be connected to RF, DC and thermal ground.

## Ordering Information

| Part Number | Package |
|---|---|
| MASW-011173-DIE | Gel-Pak |
| MASW-011173-DIEW | Waffle Pack |
| MASW-011173-SMB | Sample Board |

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

## Electrical Specifications: $T_A$ = +25 °C, $I_{ON}$ = -5 mA, $I_{OFF}$ = +5 mA, $Z_0$ = 50 Ω

| Parameter | Test Conditions | Units | Min. | Typ. | Max. |
|---|---|---|---|---|---|
| Insertion loss ($RF_{COMMON}$ to $RF_X$ ON state) | 20 GHz<br>40 GHz<br>50 GHz<br>55 GHz | dB | — | 1.3<br>0.8<br>1.1<br>1.5 | 1.7<br>1.2<br>1.5<br>— |
| Isolation ($RF_{COMMON}$ to $RF_X$ OFF state) | 20 GHz<br>40 GHz<br>50 GHz<br>55 GHz | dB | 35<br>25<br>23<br>— | 40<br>30<br>28<br>28 | — |
| Return loss ($RF_{COMMON}$) | 20 GHz<br>40 GHz<br>50 GHz<br>55 GHz | dB | — | 10<br>20<br>18<br>14 | — |
| Return loss ($RF_X$) | 20 GHz<br>40 GHz<br>50 GHz<br>55 GHz | dB | — | 10<br>20<br>16<br>13 | — |
| CW Power Handling (ON state) | 40 GHz, +85°C | dBm | — | 30 | — |
| P0.1dB | 40 GHz | dB | — | >30 | — |
| Switching Speed | $T_{RISE}$ / $T_{FALL}$ (10% - 90% RF)<br>$T_{ON}$ / $T_{OFF}$ (50% control to 90% RF) | ns | — | <30 | — |
| IIP3 | 30 GHz<br>40 GHz | dBm | — | >55<br>>48 | — |

## Absolute Maximum Ratings[2,3]

| Parameter | Absolute Maximum |
|---|---|
| Incident Power (ON path) @ Baseplate, 40 GHz<br>+85°C<br>+25°C | <br>31 dBm<br>33 dBm |
| $I_{ON}$ | 10 mA |
| $I_{OFF}$ | 10 mA |
| $V_R$ | 50 V |
| Junction Temperature[4] | +150°C |
| Operating Temperature | -40°C to +85°C |
| Storage Temperature | -55 °C to +150 °C |

2. Exceeding any one or combination of these limits may cause permanent damage to this device.
3. MACOM does not recommend sustained operation near these survivability limits.
4. Operating at nominal conditions with $T_J \leq +150°C$ will ensure MTTF > 1 x $10^6$ hours.

## Handling Procedures

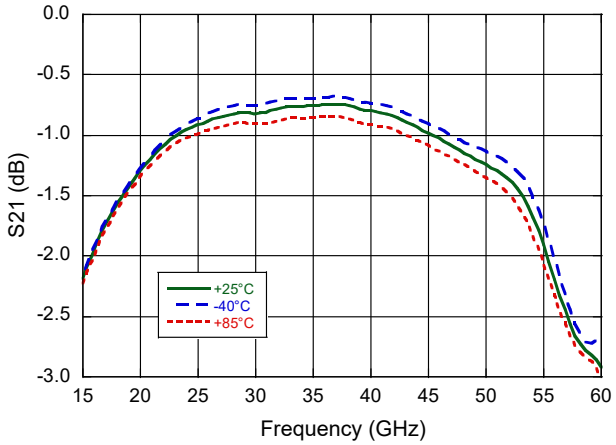
Please observe the following precautions to avoid damage:

## Static Sensitivity

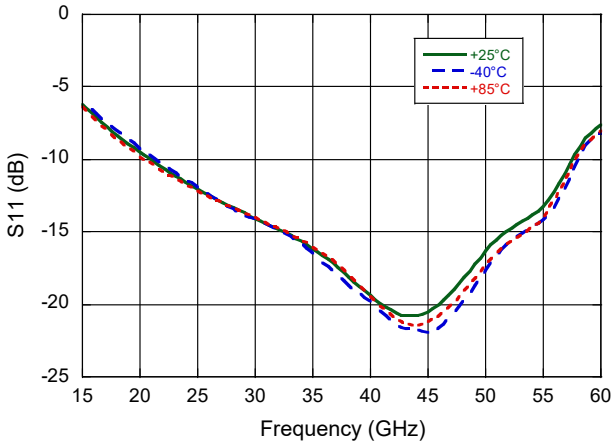
These HBM Class 1A electronic devices are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these devices.

## Typical Performance: On-Wafer Probe, $I_{ON}$ = -5 mA, $I_{OFF}$ = +5 mA, $Z_0$ = 50 Ω

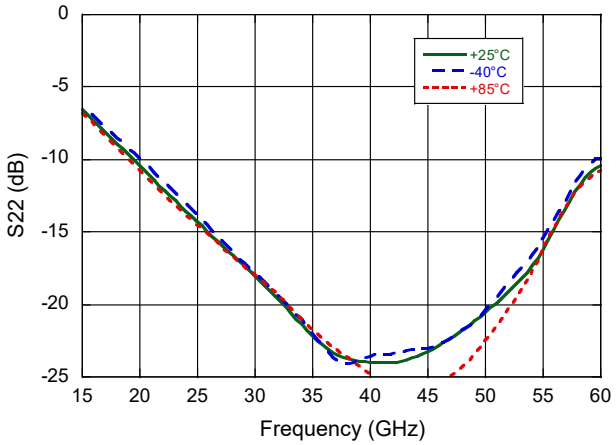
***Insertion Loss***



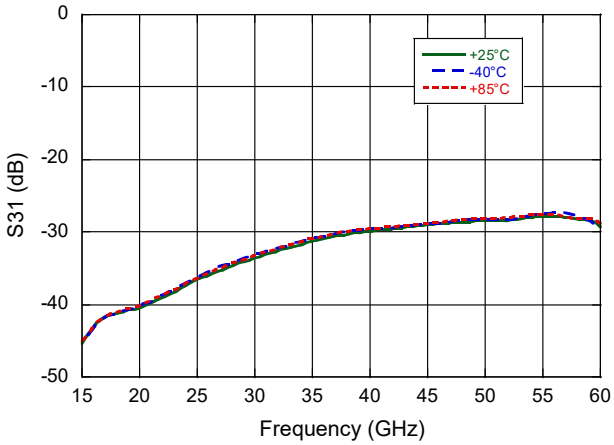

***$RF_{COMMON}$ Return Loss***



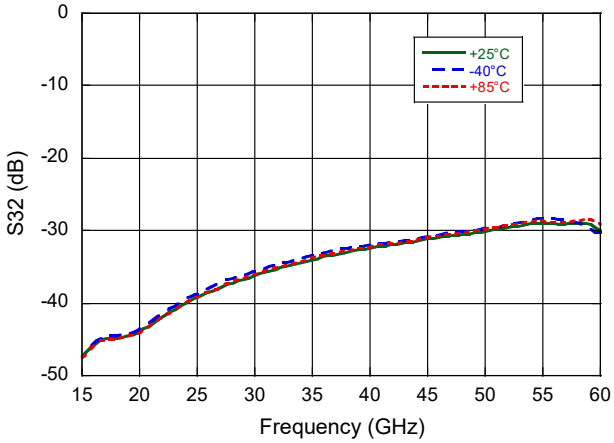

***RF1, RF2 Return Loss***



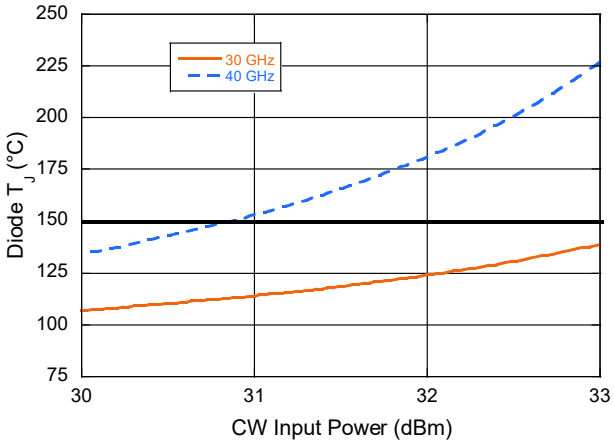

***Isolation $RF_{COM}$ to RF1, RF2***




***Isolation RF1 to RF2***




***Diode Junction Temperature with +85°C Baseplate[5,6]***

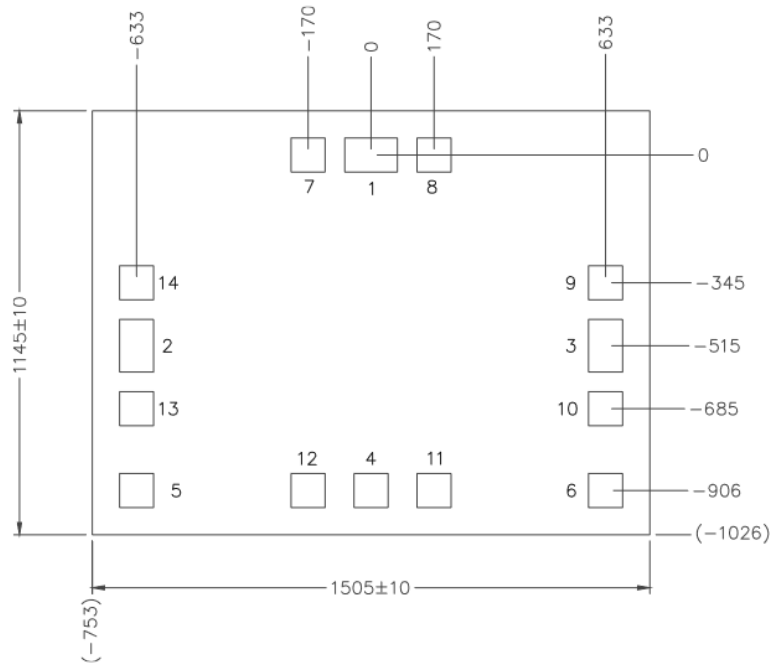



5. The die is mounted to the SMB with high thermal conductivity epoxy.
6. Operating with Diode Junction Temperature ≤ +150°C will ensure MTTF > 1 x $10^6$ hours.

## Truth Table

| State | $R_{COMMON}$ | B1 | B2 |
|---|---|---|---|
| $RF_{COM}$ to RF1 ON | ≥ 1.6 kΩ to Ground | -5 mA | +5 mA |
| $RF_{COM}$ to RF2 ON | | +5 mA | -5 mA |

## Outline Drawing




| BOND PAD DIM. (μm) | | | |
|---|---|---|---|
| PAD | X | Y | PIN LABEL |
| 1 | 142 | 92 | $RF_{COM}$ |
| 2 | 92 | 142 | RF1 |
| 3 | 92 | 142 | RF2 |
| 4 | 92 | 92 | $B_{COM}$ |
| 5 | 92 | 92 | B1 |
| 6 | 92 | 92 | B2 |
| 7–14 | 92 | 92 | GND |

NOTES:
1. UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS SHOWN ARE μm WITH A TOLERANCE OF ±5μm.
2. DIE THICKNESS IS 100 ±10μm
3. BOND PAD/BACKSIDE METALLIZATION: GOLD.

## Solder Die Attach

All die attach and bonding methods should be compatible with gold metal. Solder which does not scavenge gold, such as 80 Au/20 Sn or Indalloy #2, is recommended. Do not expose die to a temperature greater than 300°C for more than 10 seconds.

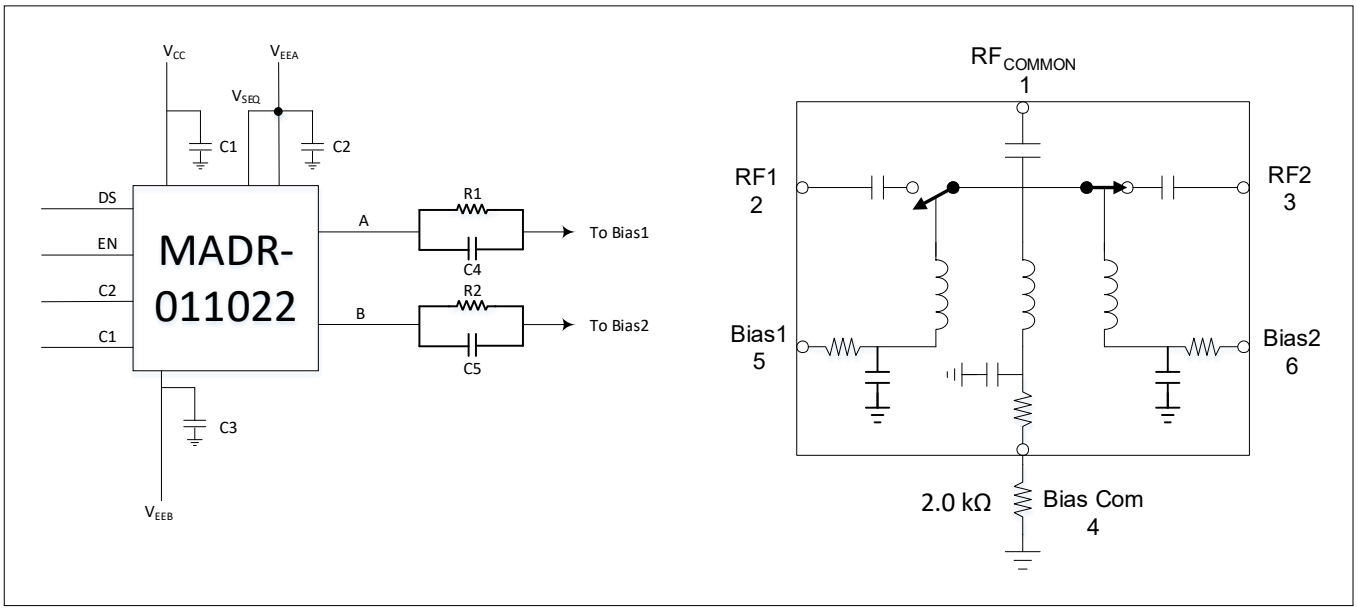
## Electrically Conductive Epoxy Die Attach

Assembly can be preheated to approximately 125°C. Use a controlled thickness of approximately 1 mils for best electrical conductivity and lower thermal resistance. A thin epoxy fillet should be visible around the perimeter of the chip after placement. Cure epoxy per manufacturer's schedule. For extended cure times, temperatures should be kept below 150°C.

## Wire / Ribbon Bonding

Wedge thermo compression bonding may be used to attach ribbons to the RF bonding pads. Gold ribbons should be at least 1/2 by 3 mil for lowest inductance. The same gold ribbon or 1 mil dia. gold wire is recommended for all DC pads.

## MASW-011173-DIE with MADR-011022 Driver Application Schematic




## Parts List

| Part | Value |
|---|---|
| C1, C3 | 0.1 µF |
| C2 | 47 pF |
| C4, C5 | 470 pF |
| R1, R2 | 723 Ω |
| $R_{COMMON}$ | 2 kΩ |

| MADR-011022 | Voltage |
|---|---|
| VCC | +5 V |
| VEEA and VEEB | -15 V |
| Logic “0” | 0 V |
| Logic “1” | +5 V |

### Application Control Table

| State | EN | DS | C2 | C1 | A Output | B Output |
|---|---|---|---|---|---|---|
| RFCOM to RF1 | 0 | 0 | 0 | 0 | -15 V @ -5 mA | +5 V @ +5 mA |
| RFCOM to RF2 | 0 | 0 | 0 | 1 | +5 V @ +5 mA | -15 V @ -5 mA |

*Full logic truth table can be found on MADR-011022 datasheet.