**RELEASED**

RFuW Engineering Pte. Ltd.

# MSW2T-020522-198
# 1KW PIN Diode Series-Shunt Switch

## Features:

- Wide Operating Frequency Band: 20 MHz to 520 MHz
- Power (CW): +60 dBm
- Low Insertion Loss: <0.5 dB
- Isolation: >40 dB
- High IIP3: 65 dBm
- Surface Mount SP2T Switch: 10.1mm x 6.2mm x 2.5mm
- High Linearity
- RoHS Compliant

## Description:

The MSW2T-020522-198 symmetrical SP2T surface mount High Power Series PIN Diode switch offers an exceptionally high power handling of 1KW (+60 dBm) average power over the over the 20 MHz to 520 MHz frequency band. The MSW2T-020522-198 high power switches leverage high reliability hybrid manufacturing processes which yield both superior RF and thermal characteristics performance compared to MMIC or Glass Carrier based technologies. The hybrid design approach permits precise PIN Diode selection to optimize RF performance while maintaining competitive cost targets. The small form factor (10.1mm x 6.2mm x 2.5mm) offers world class power handling, low insertion loss, and superior intermodulation performance exceeding all competitive technologies.

The MSW2T-020522-198 symmetrical switches is tailored to minimize Transmit to Antenna loss while maximizing Transmit to Receive isolation and to enable maximum flexibility as the designer can assign either port as Transmit Port and the other as the Receive Port. The extremely low thermal resistance of the hybrid assembly permits reliably handling up to +60 dBm CW power while operating at the $T_{amb\ (MAX)}$ = +55ºC.

## Typical Applications:

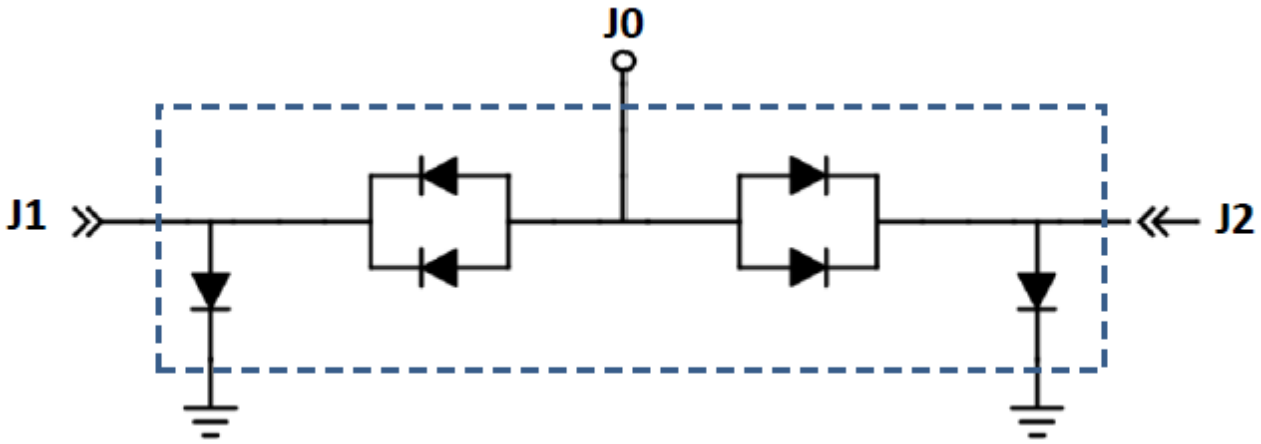
- High Power Transmit/Receive Switching
- EW Systems
- Switch Bank Filters
- Mil-Com Radios

The MSW2T-020522-198 series of High Power SP2T switches are intended for use in high power, high reliability, mission critical applications from 20 MHz to 520 MHz. The manufacturing process has been proven through decades of extensive use in high reliability applications.

## ESD and Moisture Sensitivity Level Rating:

The MSW2T-020522-198 SP2T switch is fully RoHS compliant and carries an ESD rating of Class 1C, Human Body Model (HBM) with a moisture sensitivity rating of MSL 1.

### MSW2T-020522-198 Schematic




### MSW2T-020522-198 Electrical Specifications @ Zo = 50Ω; Ta = +25°C

| Parameter | Symbol | Test Condition | Min Value | Typ Value | Max Value | Units | | |
|---|---|---|---|---|---|---|---|---|
| Frequency | F | | 20 | | 520 | MHz | | |
| Insertion Loss | IL | State 1: J0 to J1&State 2: J0 to J2 | | | 0.5 | dB | | |
| Return Loss | RL | 50 MHz to 1 GHz | 15 | | | dB | | |
| Isolation | ISO | State 1: J0 to J1&State 2: J0 to J2<br>50 MHz to 1 GHz | 40 | | | dB | | |
| CW Incident Power (Note 2) | $P_{inc}$(CW) | Source & Load; Baseplate < +55°C; VSWR = 1:1.25 | | | +60 | dBm | | |
| Switching Time | $t_{SW}$ | 10% to 90% RF Voltage, TTL rep rate = 100 kHz | | | 5 | usec | | |
| Input 3rd Order Intercept Point | IIP3 | $F_1$=500 MHz, $F_2$=510 MHz, $P_1$=$P_2$=10dBm<br>Measured on path biased to low loss state | 60 | 65 | | dBm | | |

## MSW2T-020522-198 Absolute Maximum Ratings @ $T_A$ = +25 °C(unless otherwise denoted)

| Parameters | Conditions | Absolute Maximum Value |
|---|---|---|
| Forward Current – Port | | 500mA |
| Reverse Voltage – Tx or Rx Port | | 250V |
| Forward Diode Voltage | $I_F$ = 400mA | 1.2V |
| Operating Temperature | | -65°C to + 125°C |
| Storage Temperature | | -65°C to + 150°C |
| Junction Temperature | | +175°C |
| Assembly Temperature | | 260°C for 10 sec |
| CW Incident Power Handling – J0-J1 or J0-J2 ( Note 1) | Source & Load VSWR = 1:1.25, $T_{CASE}$ = +55°C, cold switching | +60 dBm |

Notes:

**1)** Backside RF, DC and Thermal Ground area of device must be completely solder attached to RF circuit board vias for proper electrical and thermal circuit grounding.

## Control Truth Table for MSW2T-020522-198

$+V_{cc1}$ = +5V and $+V_e$ = -28V to -200V ( unless otherwise noted)

| Ant – Tx Path | Ant – Rx Path | J1 (notes 1 & 2) | J2 (notes 1 & 2) | J0 (notes 1 & 2) |
|---|---|---|---|---|
| Low Loss | Isolation | V = $V_{LOW}$, I = -150 mA | V = $V_{HIGH}$, I = +200 mA | Vcc ~ +5V I = +100mA |
| Isolation | Low Loss | V = $V_{HIGH}$, I = +200 mA | V = $V_{LOW}$, I = -150 mA | Vcc ~ +5V I = +100mA |

Notes:

1) $V_{LOW} \leq$ -200V and VHIGH ≤+5V

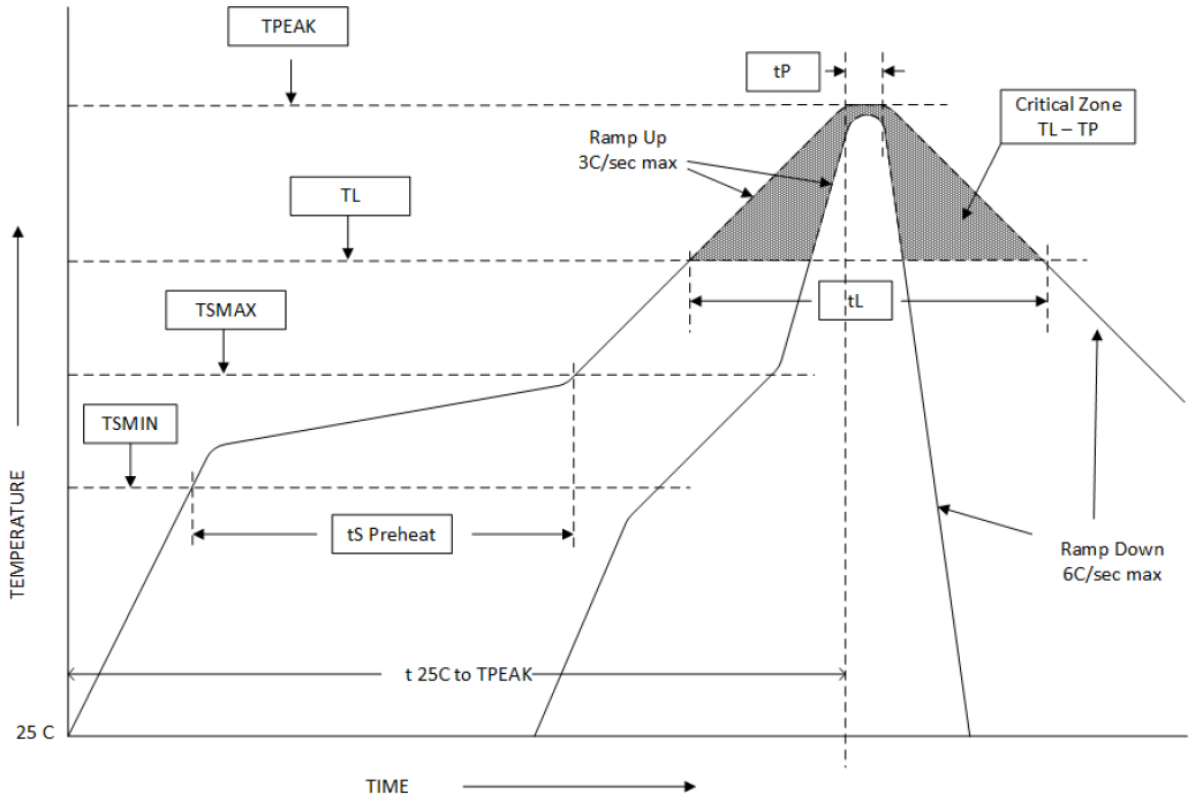
2) PIN diode min reverse DC voltage ($V_{HIGH}$) to maintain high resistance state in the OFF PIN diode is determined by RF frequency. Incident power, duty cycle, characteristic impedance and VSWR as well as by characteristics of the diode.

## Assembly Instructions

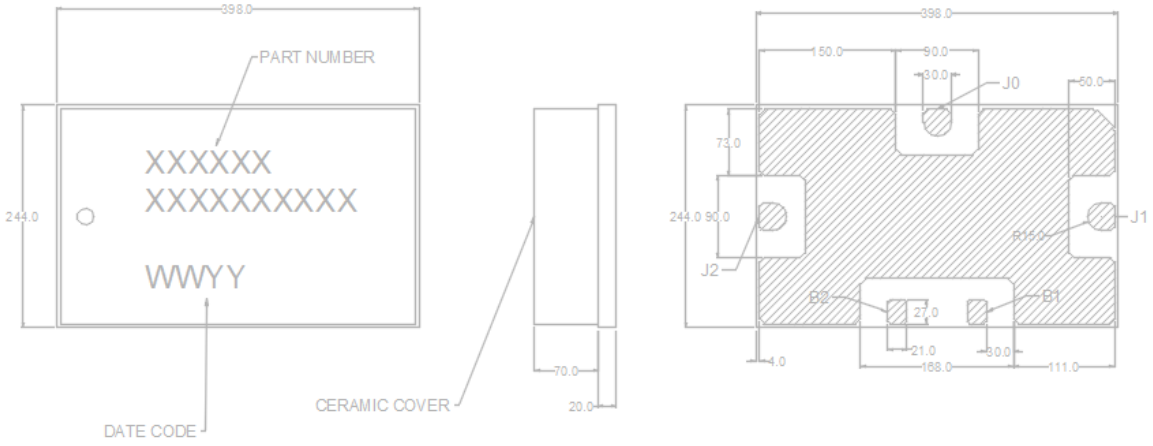
The MSW2T-204X-193 may be attached to the printed circuit card using solder reflow procedures using either RoHS or Sn63/ Pb37 type solders per the Table and Temperature Profile Graph shown below:

| Profile Parameter | Sn-Pb Assembly Technique | RoHS Assembly Technique |
|---|---|---|
| Average ramp-up rate ($T_L$ to $T_P$) | 3°C/sec (max) | 3°C/sec (max) |
| Preheat<br>Temp Min ($T_{smin}$)<br>Temp Max ($T_{smax}$)<br>Time ( min to max) ($t_s$) | <br>100°C<br>150°C<br>60 – 120 sec | <br>100°C<br>150°C<br>60 – 120 sec |
| $T_{smax}$ to $T_L$<br>Ramp up Rate | | 3°C/sec (max) |
| Peak Temp ($T_P$) | 225°C +0°C / -5°C | 245°C +0°C / -5°C |
| Time within 5°C of Actual Peak Temp ($T_P$) | 10 to 30 sec | 20 to 40 sec |
| Time Maintained Above:<br>Temp ($T_L$)<br>Time ($t_L$) | <br>183°C<br>60 to 150 sec | <br>217°C<br>60 to 150 sec |
| Ramp Down Rate | 6°C/sec (max) | 6°C/sec (max) |
| Time 25°C to $T_P$ | 6 minutes (max) | 8 minutes (max) |

### Solder Re-Flow Time-Temperature Profile



## MSW2T-020522-198 SP2T Package Outline Drawing



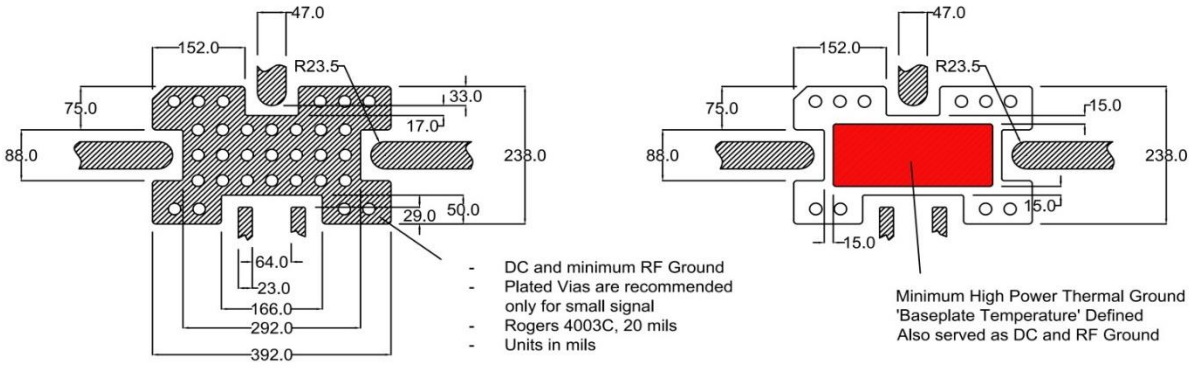

Note:

- Metalized area on backside is the RF, DC and Thermal ground. In user's end application this surface temperature must be managed to meet the power handling requirements.
- **B1 & B2 ports – no connection**

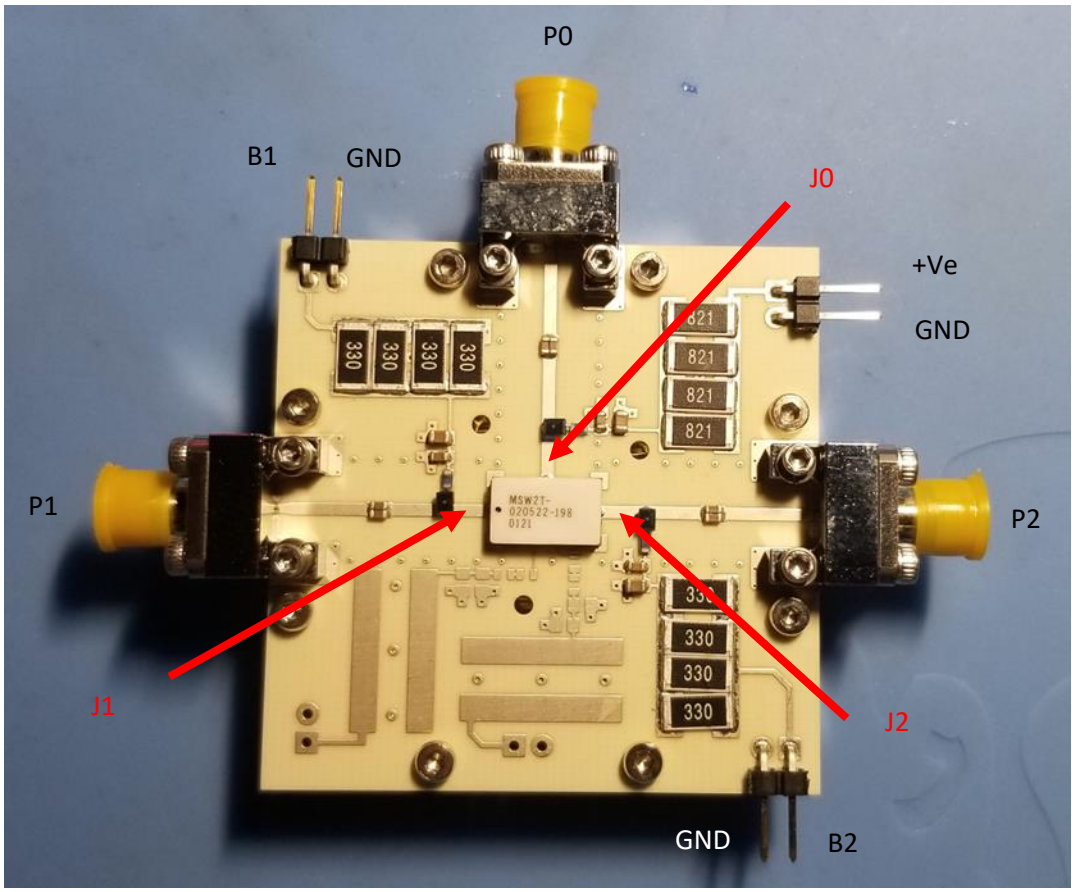
## Thermal Design Considerations:

The design of the MSW2T-020522-198 High Power Switches permits the maximum efficiency in thermal management of the PIN Diodes while maintaining extremely high reliability. Optimum switch performance and reliability of the switch can be achieved by the maintaining the base ground surface temperature of less than +55°C.

## Recommended RF Circuit Solder Footprint for the MSW2T-020522-198



# MSW2T-0202522-198 High Power Evaluation Board




- This Evaluation Board picture was taken without the heatsink.
- P0, P1 and P2 are the Port Designations of the evaluation board.
- The DUT (MSW2T-020522-198) has four ports: J0, J1, J2 and ground (beneath the device).
- This switch (MSW2T-020522-198) works with +ve and –ve bias voltage. Depending on the application and linearity requirements, a target minimum forward bias current of 200 mA must be budgeted for.
- When Return Loss or Isolation were measured, the RF Coupling Caps and Inductors are not de-embedded. Hence usually this is referred to RL or Isolation of P0-P1 and P0-P2.
- For Insertion Loss, usually a THRU with the biasing components was measured separately (not shown here). Hence a good approximate of the Device IL can be measured. As such, we designate this as J0-J1 or J0-J2 insertion loss.

## Part Number Ordering Details:

The MSW2T-020522-198 High Power Switch is available in the following format.

| Part Number | Packaging |
|---|---|
| MSW2T-020522-198 | Gel-Pack |
| MSW2T-020522-198 Small Signal Eval Board | Box |
| MSW2T-020522-198 High Power Eval Board | Box |