



MSW6T-6000-600

SP6T High Power Series Six Pole Switch Module - SMT

Features:

- Surface Mount SP6T Switch Module: 8 mm x 8 mm x 2.5mm
- Frequency Range: 30 MHz to 512 MHz
- High Average Power Handling: +50 dBm (CW)
- High Peak Power Handling: +53 dBm
- Low Insertion Loss: < 0.25 dB
- Return Loss (Ant-Tx): >18 dBm
- Isolation: > 30 dB
- RoHS Compliant

Description:

The MSW6T-6000-600 SP5T surface mount High Power silicon PIN Diode switch was designed for transmit/receive functions and switched filter bank applications operating in the 30 MHz to 512 MHz frequency range. The MSW6T-6000-600 high power switch leverages proven high reliability hybrid manufacturing processes which yield both superior RF and thermal characteristics performance when 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 factors (8mm x 8mm x 2.5mm) offer world class power handling, low insertion loss, and superior isolation performance in a single device. The MSW6T-6000-600 symmetrical switch is tailored to minimize Transmit to Antenna loss while maximizing Transmit to Receive isolation. The extremely low thermal resistance of the hybrid assembly permits reliably handling up to +50 dBm CW power and up to +53 dBm peak RF incident power while operating at the T_{amb} (MAX) = +85°C.

ESD and Moisture Sensitivity Rating

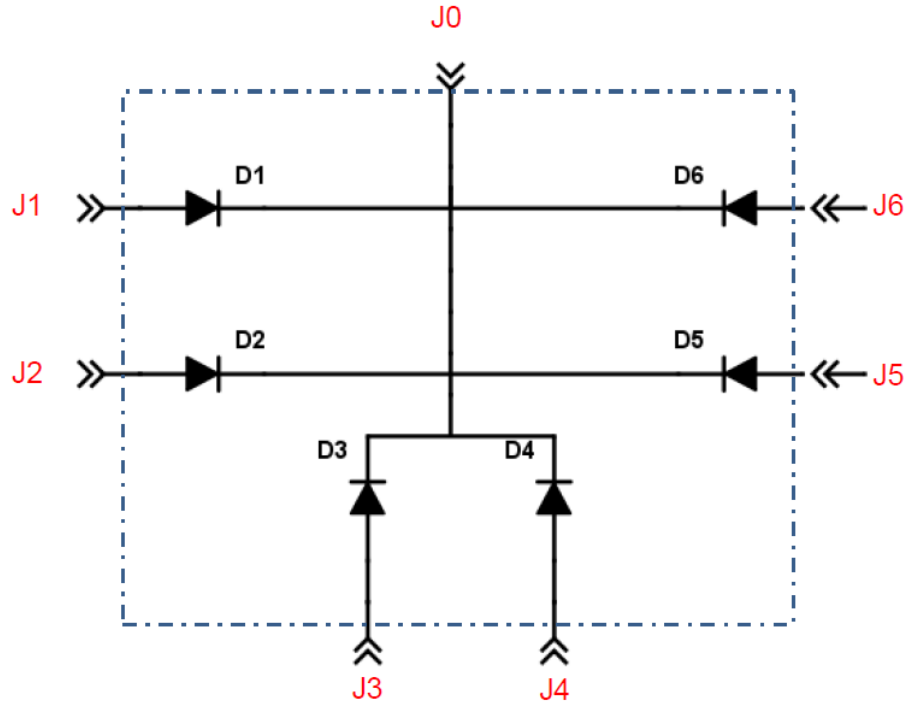
The MSW6T-6000-600 Switch Module carries a Class 1 ESD rating (HBM) and an MSL 1 moisture rating.

Thermal Management Features

A proprietary design methodology minimizes thermal resistance from the PIN Diode junction to base plate (RTHJ-A) to the customer's substrate and associated heat sink. This circuit topology coupled with the thermal characteristic of the substrate design enables reliably handling High Input RF Power up to 50 dBm CW and RF

Peak Power levels up to 53 dBm with the base plate temperature at 85°C. The MSW6T-6000-600 has been design to offer superior long term reliability in the customer’s application by utilizing ultra-thin Au plating to combat Au embrittlement concerns.

MSW6T-6000-600 Series SP6T Switch Module Schematic



Absolute Maximum Ratings

@ Zo=50Ω, TA= +25°C as measured on the base ground surface of the device.

| Parameter | Conditions | Absolute Maximum Value |
|--------------------------------|--|------------------------|
| Forward Current – ON ARM | | 250 mA |
| Reverse Voltage – OFF ARMS | | 300 V |
| Forward Diode Voltage | IF = 250 mA (TBD) | 1.2 V |
| Operating Temperature | | -65°C to 125°C |
| Storage Temperature | | -65°C to +125°C |
| Junction Temperature | | +175°C |
| Assembly Temperature | T = 10 sec | +260°C for 10 sec |
| CW Incident Power | Source VSWR: 3.5:1, Load VSWR: 1.1:1, T _{CASE} = +85°C, cold switching | +50 dBm |
| Peak Incident Power Handling | Source VSWR: 3.5:1, Load VSWR: 1.1:1, PW = 10 usec, DC = 1 %, T _{case} = 85°C | +53 dBm |
| Total Dissipated RF & DC Power | T _{case} = 85°C, cold switching | 3.0 W |

Note 1: T_{CASE} is defined as the temperature of the bottom ground surface of the device.

MSW6T-6000-600 Electrical Specifications

@ $Z_0=50\Omega$, $T_A=+25^\circ\text{C}$ as measured on the base ground surface of the device.

| Parameter | Symbol | Test Condition | Min Value | Typ Value | Max Value | Units |
|---|-------------------------|---|-----------|-----------|-----------|-------|
| Frequency | F | | 30 | | 512 | MHz |
| Insertion Loss | IL | ON ARM: $I_F = 100\text{ mA}$ OFF ARMS: $V_R = -28\text{V @ } 0\text{ mA}$ $P_{IN} = 0\text{ dBm}$ | | 0.25 | 0.4 | dB |
| Return Loss | RL | $P_{IN} = 0\text{ dBm}$ ON ARM: $I_F = 100\text{ mA}$ OFF ARMS: $V_R = -28\text{V @ } 0\text{ mA}$ | 18 | 20 | | dB |
| Isolation | ISO | $P_{IN} = 0\text{ dBm}$ ON ARM: $I_F = 100\text{ mA}$ OFF ARMS: $V_R = -28\text{V @ } 0\text{ mA}$ $F = 30\text{ MHz to } 88\text{ MHz}$ $F = 89\text{ MHz to } 512\text{ MHz}$ | 40 30 | 42 32 | | dB |
| CW Incident Power (note 1) | $P_{inc}\text{ (CW)}$ | ON ARM: $I_F = 100\text{ mA}$ OFF ARMS: $V_R = -200\text{V @ } 0\text{ mA}$ 3.5:1 Source VSWR & 1.1:1 Load VSWR | | 50 | | dBm |
| Peak Incident Power Note 1) | $P_{inc}\text{ (Peak)}$ | ON ARM: $I_F = 100\text{ mA}$ OFF ARMS: $V_R = -200\text{V @ } 0\text{ mA}$ 3.5:1 Source VSWR & 1.1:1 Load VSWR, $PW = 10\text{ usec}$, Duty Cycle = 1% | | 53 | | dBm |
| Switching Time (note 2) | t_{sw} | 10% to 90% RF Voltage | | 1 | 2 | usec |
| Input 3 rd Order Intercept Point | IIP3 | $F1 = 200\text{ MHz}$, $F2 = 210\text{ MHz}$, $P1 = P2 = 0\text{ dBm}$, ON ARM: $I_F=100\text{mA}$ OFF ARM: $V_R=-28\text{V @ } 0\text{ mA}$ | 60 | 65 | | dBm |

Conditions:

1. The PIN Diode minimum reverse DC Voltage (VHIGH) is used to maintain the High Resistance state in the OFF PIN Diode is determined by the RF Frequency, Incident power, duty cycle, characteristic impedance and VSWR in addition to the RF characteristics of the PIN Diodes.
2. Switching time defined to be from 50% TTL signal to 10/90% RF Voltage is controlled by the PIN Diode Driver circuit performance as well as the RF characteristics of the PIN Diode

Minimum Reverse Bias Voltage vs Frequency

| Frequency | 30 MHz | 88 MHz | 225 MHz | 512 MHz |
|----------------------|--------|--------|---------|---------|
| Reverse Bias Voltage | 160V | 150V | 110V | 60V |

Note: Signal conditions:

| | |
|--------------|-----------|
| Input Power: | 100W (CW) |
| Source VSWR: | 3.5 : 1 |
| Load VSWR: | 1.1 : 1 |

MSW6T-000-600 Operating Truth Table: $P_{IN} = 0$ dBm, $Z_o = 50\Omega$

| State | J1 Bias | J2 Bias | J3 Bias | J4 Bias | J5 Bias | J6 Bias |
|--|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| State 1 J0-J1 Low Loss J2-J6 Isolation | +5V @ +100mA | -28V @ 0 mA | -28V @ 0 mA | -28V @ 0 mA | -28V @ 0 mA | -28V @ 0 mA |
| State 2 J0-J2 Low Loss J1, J3-J6 Isolation | -28V @ 0 mA | +5V @ +100mA | -28V @ 0 mA | -28V @ 0 mA | -28V @ 0 mA | -28V @ 0 mA |
| State 3 J0-J3 Low Loss J1, J2, J4-J6 Isolation | -28V @ 0 mA | -28V @ 0 mA | +5V @ +100mA | -28V @ 0 mA | -28V @ 0 mA | -28V @ 0 mA |
| State 4 J0-J4 Low Loss J1-J3, J5, J6 Isolation | -28V @ 0 mA | -28V @ 0 mA | -28V @ 0 mA | +5V @ +100mA | -28V @ 0 mA | -28V @ 0 mA |
| State 5 J0-J5 Low Loss J1-J4, J6 Isolation | -28V @ 0 mA | -28V @ 0 mA | -28V @ 0 mA | -28V @ 0 mA | +5V @ +100mA | -28V @ 0 mA |
| State 6 J0-J6 Low Loss J1-J5 Isolation | -28V @ 0 mA | -28V @ 0 mA | -28V @ 0 mA | -28V @ 0 mA | -28V @ 0 mA | +5V @ +100mA |

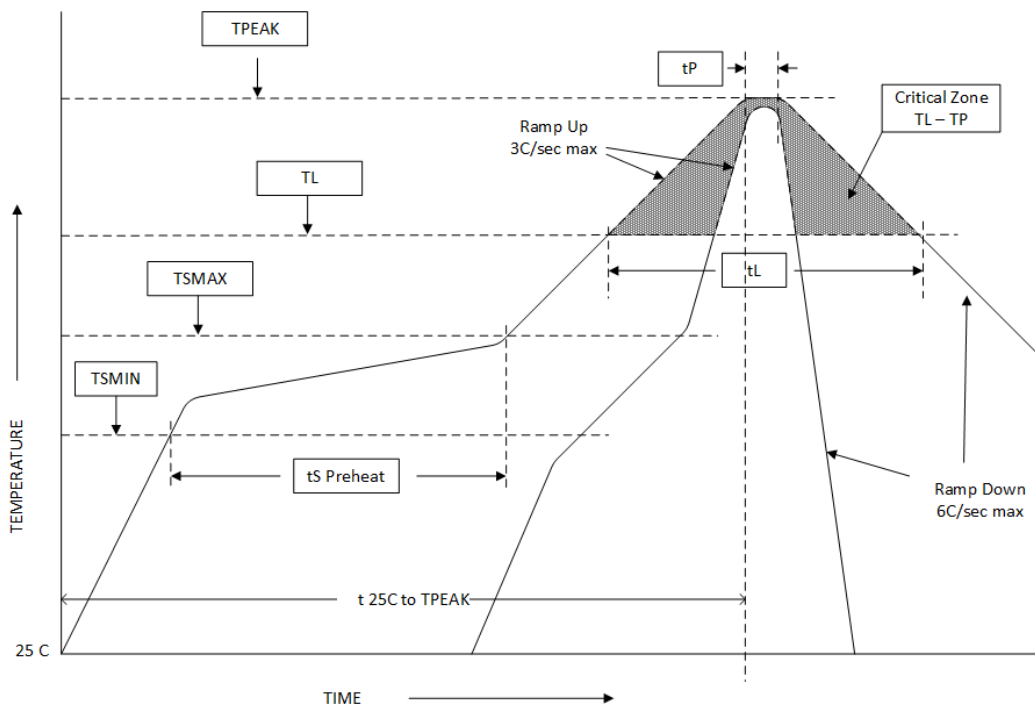
Note: 1) Refer to the Minimum Reverse Bias Voltage vs Frequency table to determine the required biasing voltage as various frequencies and power levels.

Assembly Instructions

The MSW6T-6000-600 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 | | |
| Temp Min (T_{smin}) | 100°C | 100°C |
| Temp Max (T_{smax}) | 150°C | 150°C |
| Time (min to max) (t_s) | 60 – 120 sec | 60 – 180 sec |
| T_{smax} to T_L | | |
| Ramp up Rate | | 3°C/sec (max) |
| Peak Temp (T_P) | 225°C +0°C / -5°C | 260°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: | | |
| Temp (T_L) | 183°C | 217°C |
| Time (t_L) | 60 to 150 sec | 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



MSW6T-6000-600 Switch Module Package Outline Drawing

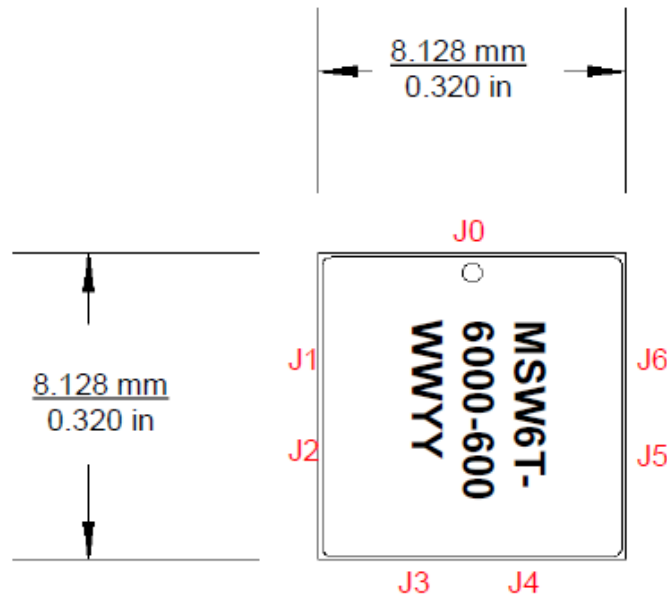


Figure 1 Module Outline and Markings; Units in mils

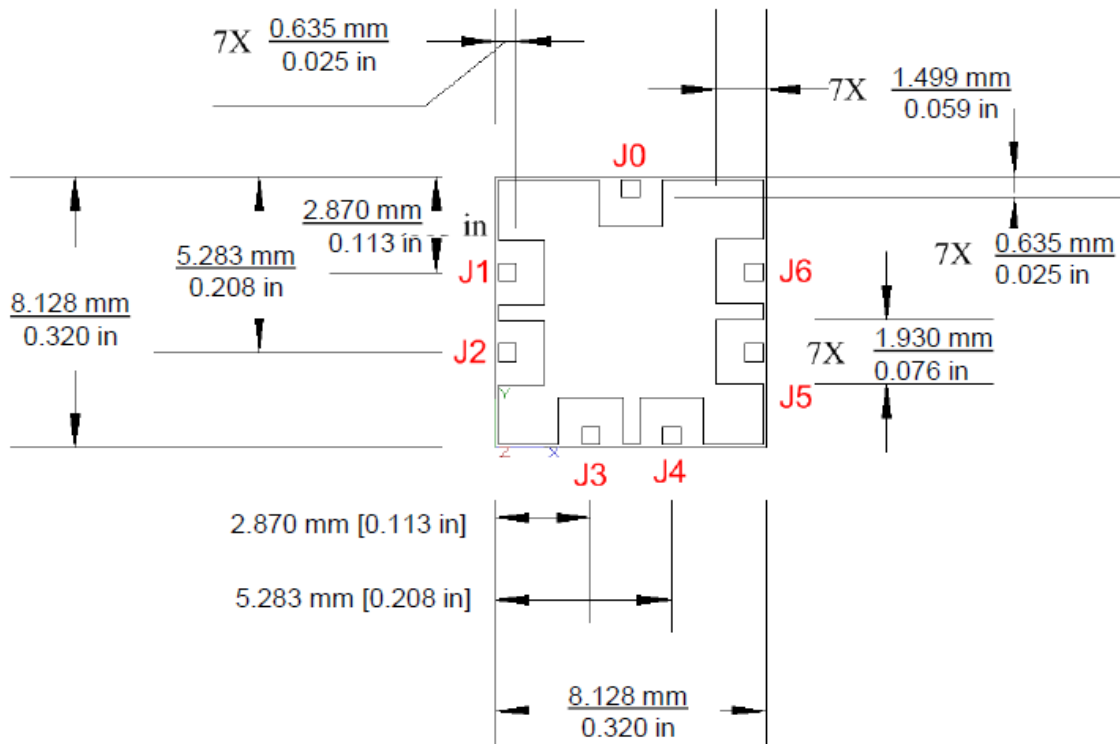


Figure 2 Module Backside / RF Ports and Ground; Units in mils

Notes:

- 1) 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.
- 2) Back side metallization 10 – 20 Micro Inches (typ) Au termination plating to combat Au embrittlement (Au plated over Cu).
- 3) RF Cover: White Ceramic
- 4) Substrate Material: 20 mils Aluminum Nitride (AlN)

Thermal Design Considerations:

The design of the MSW6T-6000-600 Switch Module permits the maximum efficiency in thermal management of the PIN Diodes while maintaining extremely high reliability. Optimum switch performance and reliability of the device can be achieved by the maintaining the base ground surface temperature of less than 85°C.

There must be a minimal thermal and electrical resistance between the limiter bottom surface and ground. Adequate thermal management is required to maintain a T_{JC} at less than +175°C and thereby avoid adversely affecting the semiconductor reliability. Special care must be taken to assure that minimal voiding occurs in the solder connection beneath the device.

Part Number Ordering Detail:

The MSW6T-6000-600 Switch Modules is available in the following format:

| Part Number | Description | Packaging |
|----------------|---------------------------------|-----------|
| MSW6T-6000-600 | SP6T 30 MHz – 512 MHz 8mm x 8mm | Gel Pack |