PRELIMINARY

RFuW Engineering Ltd.

MSW6T-6000-600

SP6T High Power Series Six Pole Switch Module - SMT

Features:

- Surface Mount SP6T Switch Module: 8mm x 8mm 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^{o}C.

ESD and Moisture Sensitivity Rating

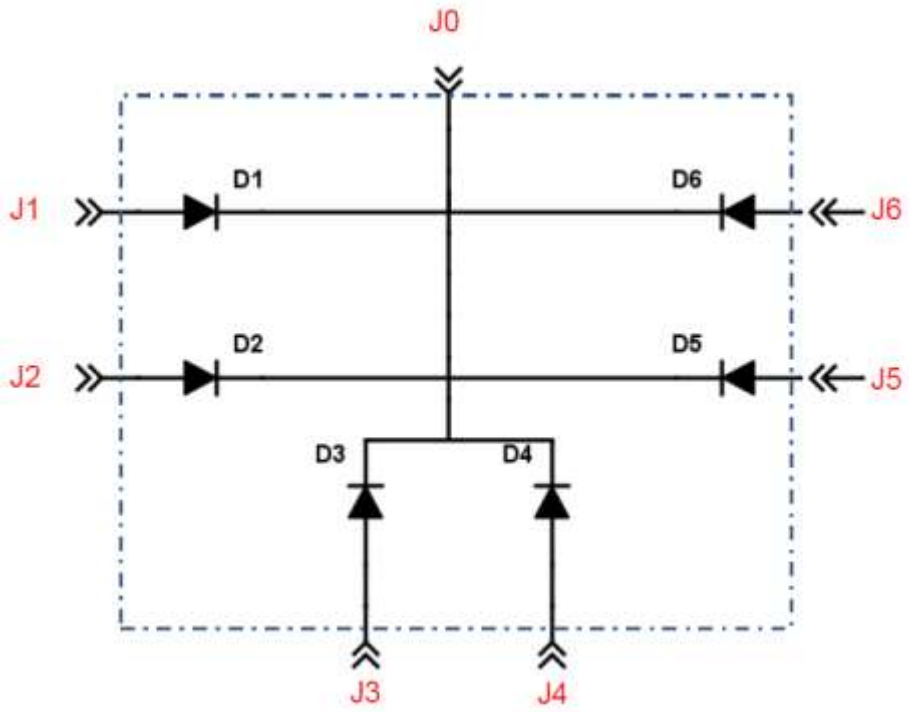
The MSW6T-6000-600 Switch Module carries a Class 1 ESD rating (HBM) and an MSL 1 moisture rating.

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, T_A= +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	I_F = 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

@ Zo=50Ω, TA= +25°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 mA OFF ARMs: V_R = -28V @ 0 mA P_{IN} = 0 dBm		0.25	0.4	dB
Return Loss	RL	P_{IN} = 0 dBm ON ARM: I_F = 100 mA OFF ARMS: V_R = -28V @ 0 mA	18	20		dB
Isolation	ISO	P_{IN} = 0 dBm ON ARM: I_F = 100 mA OFF ARMS: V_R = -28V @ 0 mA F = 30 MHZ to 88 MHz F = 89 MHz to 512 MHz	40 30	42 32		dB
CW Incident Power (note 1)	P_{inc} (CW)	ON ARM: IF = 100 mA OFF ARMS: VR = -200V @ 0 mA 3.5:1 Source VSWR & 1.1:1 Load VSWR		50		dBm
Peak Incident Power Note 1)	P_{inc} (Peak)	ON ARM: IF = 100 mA OFF ARMS: VR = -200V @ 0 mA 3.5:1 Source VSWR & 1.1:1 Load VSWR, PW = 10 usec, Duty Cycle = 1%		53		dBm
Switching Time (note 2)	t_{SW}	10% to 90% RF Voltage		1	2	usec
Input 3rd Order Intercept Point	IIP3	F1 = 200 MHz, F2 = 210 MHz, P1 = P2 = 0 dBm, ON ARM: I_F=100mA OFF ARM: V_R= -28V @ 0 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

MSW6T-000-600 Operating Truth Table: PIN= 0 dBm, Zo=50Ω

State	J0 Bias	J1 Bias	J2 Bias	J3 Bias	J4 Bias	J5 Bias	J6 Bias
State 1 J0-J1 Low Loss J2-J6 Isolation	0V	+5V @ +100mA	V_{MRB} @ 0 mA	V_{MRB} @ 0 mA	V_{MRB} @ 0 mA	V_{MRB} @ 0 mA	V_{MRB} @ 0 mA
State 2 J0-J2 Low Loss J1,J3–J6 Isolation	0V	V_{MRB} @ 0 mA	+5V @ +100mA	V_{MRB} @ 0 mA	V_{MRB} @ 0 mA	V_{MRB} @ 0 mA	V_{MRB} @ 0 mA
State 3 J0-J3 Low Loss J1,J2,J4-J6 Isolation	0V	V_{MRB} @ 0 mA	V_{MRB} @ 0 mA	+5V @ +100mA	V_{MRB} @ 0 mA	V_{MRB} @ 0 mA	V_{MRB} @ 0 mA
State 4 J0-J4 Low Loss J1-J3,J5,J6 Isolation	0V	V_{MRB} @ 0 mA	V_{MRB} @ 0 mA	V_{MRB} @ 0 mA	+5V @ +100mA	V_{MRB} @ 0 mA	V_{MRB} @ 0 mA
State 5 J0-J5 Low Loss J1-J4, J6 Isolation	0V	V_{MRB} @ 0 mA	V_{MRB} @ 0 mA	V_{MRB} @ 0 mA	V_{MRB} @ 0 mA	+5V @ +100mA	V_{MRB} @ 0 mA
State 6 J0-J6 Low Loss J1-J5 Isolation	0V	V_{MRB} @ 0 mA	V_{MRB} @ 0 mA	V_{MRB} @ 0 mA	V_{MRB} @ 0 mA	V_{MRB} @ 0 mA	+5V @ +100mA

Note: 1) V_{MRB} value please R\refer to the Minimum Reverse Bias Voltage vs Frequency table to determine the required biasing voltage as various frequencies and power levels.

Minimum Reverse Bias Voltage vs Frequency

Frequency	30 MHz	88 MHz	225 MHz	512 MHz
Reverse Bias Voltage	-170V	-150V	-110V	-60V

Note: Signal conditions:

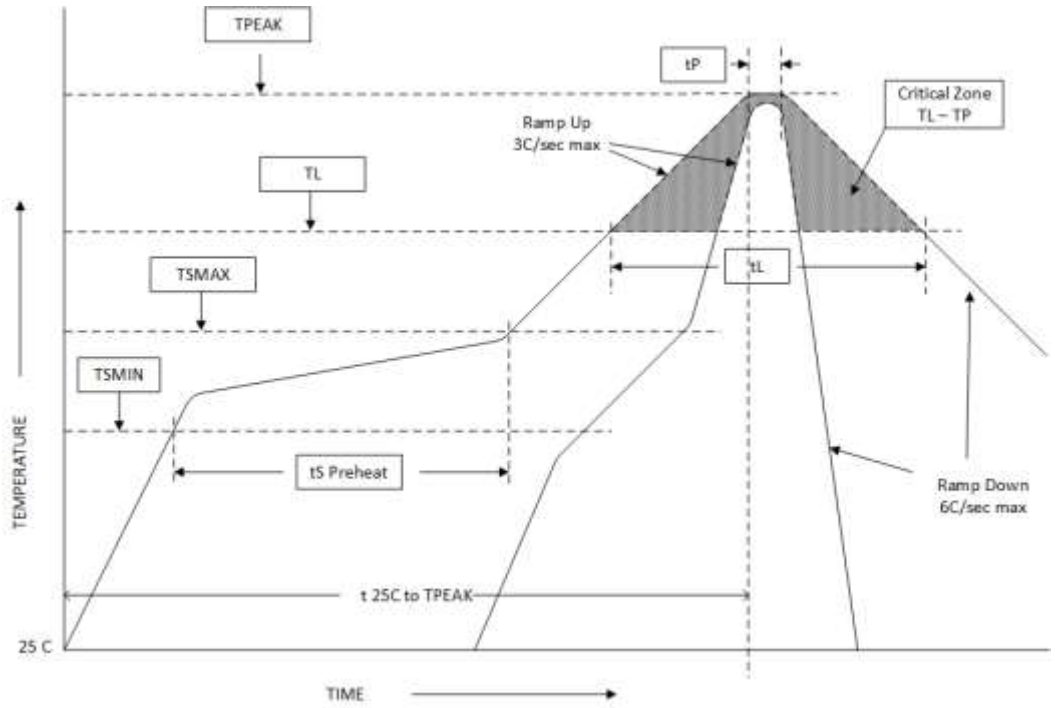
Input Power:	100W (CW)
Source VSWR:	3.5 : 1
Load VSWR:	1.1 : 1

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}) Temp Max (T_{smax}) Time (min to max) (t_s)	 100°C 150°C 60 – 120 sec	 100°C 150°C 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) Time (t_L)	 183°C 60 to 150 sec	 217°C 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

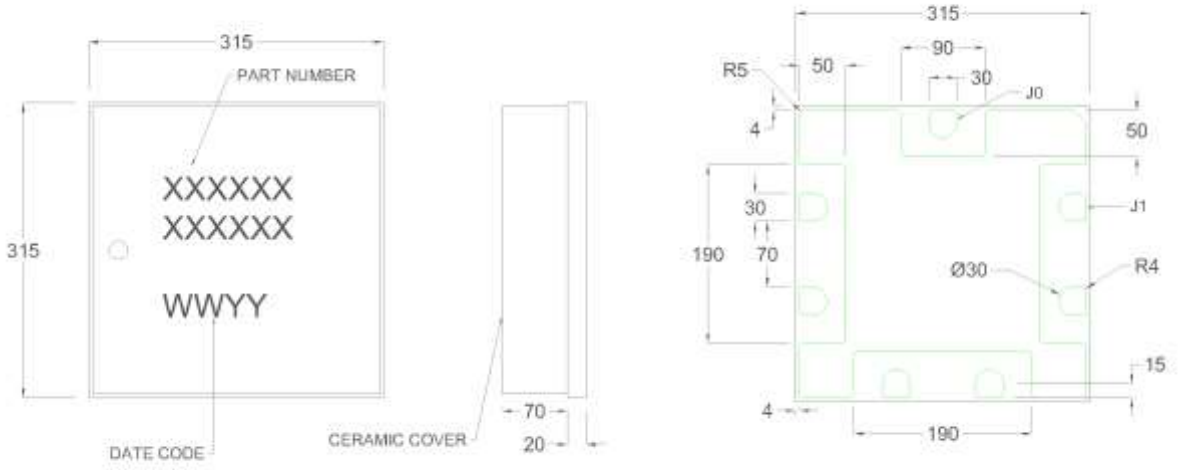


Figure 1 Module Outline and Markings; Units in mils

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