



MSW2T-200X-199

SP2T Surface Mount High Power PIN Diode Switch

Features:

- Frequency Band: 50 MHz to 6 GHz
- Surface Mount Package: 8mm x 5mm x 2.5mm
- Peak Power: +57 dBm
- Average Power: +50 dBm
- Insertion Loss (50 MHz to 1.0 GHz): 0.15 dB
- Insertion Loss (400 MHz to 4.0 GHz): 0.6 dB
- High IP3 (>65 dBm)
- High Linearity
- RoHS Compliant

Description:

The MSW2T-200X-199 series SP2T surface mount High Power PIN Diode switches are available in three operating frequency bands: MSW2T-2000-199 operates from 50 MHz to 1 GHz; MSW2T-2001-199 operates from 400 MHz to 4 GHz, and MSW2T-2002-199 operates from 2 GHz to 6 GHz. The MSW2T-200X-199 Series of high power switches leverage high reliability hybrid manufacturing processes which yield proven superior performance to both MMIC and 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 (8mm x 5mm x 2.5mm) offers world class power handling, low insertion loss, and superior intermodulation performance exceeding all competitive technologies. The MSW200X-199 family of asymmetrical switches are tailored to minimize Transmit to Antenna loss while maximizing Transmit to Receive isolation. Extremely low thermal resistance (<9.5°C/W) of the PIN Diodes enables reliably handling 51 dBm CW and RF Peak Power of 53 dBm in cold switching applications at ambient temperatures of 85°C.

Typical Applications:

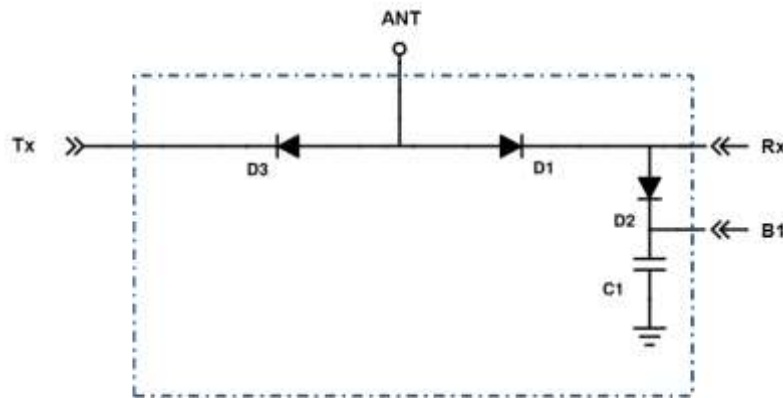
- Radar T/R Modules
- Switch Bank Filters
- Mil-Com Radios

The MSW2T-200X-199 series of High Power SP2T switches are intended for use in high power, high reliability, mission critical applications across the HF to C Band frequency ranges. The manufacturing process has been proven through decades of extensive use in high reliability applications.

ESD and Moisture Sensitivity Level Rating:

The MSW2T-200X-199 family of SP2T switches are fully RoHS compliant and carry an ESD ratings of Class 1C, Human Body Model (HBM) and a moisture sensitivity rating of MSL 1.

MSW2T-200X-199 Schematic



MSW2T-2000-199 Electrical Specifications @ $Z_0 = 50\Omega$; $T_a = +25^\circ\text{C}$

Parameter	Symbol	Test Condition	Min Value	Typ Value	Max Value	Units
Frequency	F		50		1,000	MHz
Tx-Ant Insertion Loss	IL (Tx)	Condition 1		0.15	0.25	dB
Tx-Ant Return Loss	RL (Tx)	Condition 1	20	22		dB
Ant-Rx Insertion Loss	IL (Rx)	Condition 2		0.25	0.35	dB
Ant-Rx Return Loss	RL (Rx)	Condition 2	20	23		dB
Tx-Rx Isolation	ISO (Rx)	Condition 1	48	52		dB
Rx-Tx Isolation	ISO (Tx)	Condition 2	22	26		dB
Tx CW Incident Power <small>(Note 2)</small>	P_{inc} (TxCW)	Condition 1, 1.5:1 source & load VSWR			51	dBm
Rx CW Incident Power <small>(Note 2)</small>	P_{inc} (RxCW)	Condition 2, 1.5:1 source & load VSWR			43	dBm
Tx Peak Incident Power <small>(Note 2)</small>	P_{inc} (Pk)	Condition 1, 10 us pulse width, 1% duty cycle, 1.5:1 source & load VSWR (IL)			57	dBm
Switching Time	t_{sw}	10% to 90% RF Voltage		1	2	usec

Input 3 rd Order Intercept Point	IIP3	F ₁ =2.0GHz, F ₂ =2.01GHz, P ₁ =P ₂ =40dBm	60	65		dBm
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MSW2T-2001-199 Electrical Specifications @ Z_o = 50Ω; T_a = +25°C

Parameter	Symbol	Test Condition	Min Value	Typ Value	Max Value	Units
Frequency	F		400		4,000	MHz
Tx-Ant Insertion Loss	IL (Tx)	Condition 1		0.3	0.4	dB
Tx-Ant Return Loss	RL (Tx)	Condition 1	15	18		dB
Ant-Rx Insertion Loss	IL (Rx)	Condition 2		0.4	0.5	dB
Ant-Rx Return Loss	RL (Rx)	Condition 2	15	17		dB
Tx-Rx Isolation	ISO (Rx)	Condition 1	32	46		dB
Rx-Tx Isolation	ISO (Tx)	Condition 2	12	14		dB
Tx CW Incident Power (Note 2)	P _{inc} (TxCW)	Condition 1, 1.5:1 source & load VSWR			51	dBm
Rx CW Incident Power (Note 2)	P _{inc} (RxCW)	Condition 2, 1.5:1 source & load VSWR			43	dBm
Tx Peak Incident Power (Note 2)	P _{inc} (Pk)	Condition 1, 10 us pulse width, 1% duty cycle, 1.5:1 source & load VSWR (IL)			57	dBm
Switching Time	t _{sw}	10% to 90% RF Voltage		1	1.5	usec
Input 3 rd Order Intercept Point	IIP3	F ₁ =2.0GHz, F ₂ =2.01GHz, P ₁ =P ₂ =40dBm	60	65		dBm

MSW2T-2002-199 Electrical Specifications @ Z_o = 50Ω; T_a = +25°C

Parameter	Symbol	Test Condition	Min Value	Typ Value	Max Value	Units
Frequency	F		2.0		6.0	GHz
Tx-Ant Insertion Loss	IL (Tx)	Condition 1		0.6	0.7	dB
Tx-Ant Return Loss	RL (Tx)	Condition 1	13	15		dB
Ant-Rx Insertion Loss	IL (Rx)	Condition 2		0.9	1.0	dB
Ant-Rx Return Loss	RL (Rx)	Condition 2	11	13		dB
Tx-Rx Isolation	ISO (Rx)	Condition 1	32	34		dB
Rx-Tx Isolation	ISO (Tx)	Condition 2	11	13		dB
Tx CW Incident Power (Note 2)	P _{inc} (TxCW)	Condition 1, 1.5:1 source & load VSWR			51	dBm
Rx CW Incident Power (Note 2)	P _{inc} (RxCW)	Condition 2, 1.5:1 source & load VSWR			43	dBm

Tx Peak Incident Power (Note 2)	P_{inc} (PK)	Condition 1, 10 us pulse width, 1% duty cycle, 1.5:1 source & load VSWR (IL)			57	dBm
Switching Time	t_{sw}	10% to 90% RF Voltage		1	1.5	usec
Input 3 rd Order Intercept Point	IIP3	$F_1=2.0\text{GHz}$, $F_2=2.01\text{GHz}$, $P_1=P_2=40\text{dBm}$	60	65		dBm

Control Truth Table for MSW2T-200X-199

$+V_{cc1} = 5\text{V}$ and $+V_{cc2} = 28\text{V}$ (unless otherwise noted)

Condition	Ant – Tx Path	Ant – Rx Path	Tx Bias	ANT Bias	Rx Bias	B1 Bias
Condition 1	Low Loss	Isolation	-100 mA	+100 mA	25 mA @ 28 V	+25 mA
Condition 2	Isolation	Low Loss	+28 V	+100 mA	-100 mA, 0 V	+28 V

Notes:

- Switching time from 50% TTL to 10% or 90% RF Voltage is a function of the PIN diode driver circuit performance as well as the characteristic of the PIN diode. An RC (current spiking network) is used on the driver circuit output to provide a large transient current spike to rapidly remove stored charge from the PIN diode's intrinsic layer. Typical component values are : R = 50 to 220 Ω and C = 470 to 1,000 pF.
- PIN diode minimum reverse DC voltage (V_{HIGH}) is used to maintain high resistance in the OFF PIN diode state and is determined by RF frequency, incident power, duty cycle, characteristic impedance and VSWR as well by the characteristics of the PIN diode. The recommended minimum value of the reverse bias voltage (V_{HIGH}) value is provided in the Min Reverse Bias Voltage Table shown below.

RF Bias Network Recommended Component Values

Part Number	Operating Frequency (MHz)	DC Blocking Capacitors	Inductors	RF Bypass Capacitors
MSW2T-2000-199	50 – 1,000	0.1 uF	4.7 uH	0.1 uF
MSW2T-2001-199	400 – 4,000	27 uF	82 nH	270 pF
MSW2T-2002-199	4,000 – 6,000	22 uF	33 nH	33 pF

MSW2T-200X-199 Absolute Maximum Ratings @ $T_A = +25^\circ\text{C}$ (unless otherwise denoted)

Parameters	Conditions	Absolute Maximum Value
Forward Current – Ant, Tx or Rx Port		250mA
Forward Current – DC Port		150mA
Reverse Voltage – Tx or Rx Port		125V
Reverse Voltage – DC Port		125V
Forward Diode Voltage	$I_F = 250\text{mA}$	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 – Tx or Antenna Port (Note 1)	Source & Load VSWR = 1.5:1, $T_{CASE} = 85^\circ\text{C}$, cold switching	50 dBm
CW Incident Power Handling – Rx or Antenna Port (Note 1)	Source & Load VSWR = 1.5:1, $T_{CASE} = 85^\circ\text{C}$, cold switching	43 dBm
Peak Incident Power Handling –	Source & Load VSWR = 1.5:1,	

Tx or Antenna Port (Note 1)	TCASE= 85oC, cold switching, Pulse Width = 10 us, Duty Cycle = 1%	
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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.

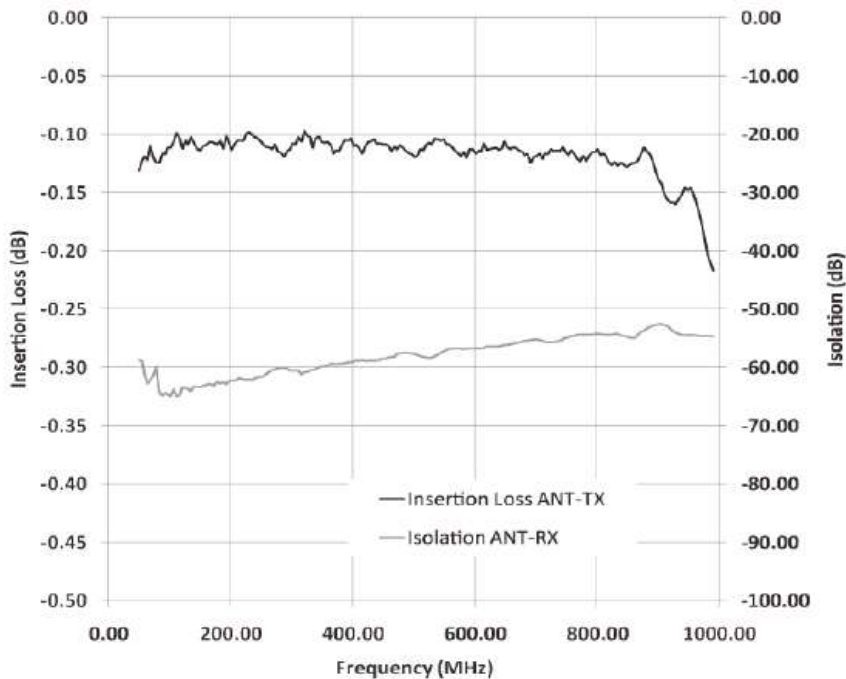
MSW2T-200X-199 Minimum Reverse Bias Voltage Table

Part Number	Frequency of Operation (MHz)					
	20 -100	100 - 200	200 - 400	400 – 1,000	1,000 – 4,000	>4,000
MSW2T-2000-199	120V	110V	85V	55V	28V	N/A
MSW2T-2001-199	N/A	N/A	110V	85V	55V	28V
MSW2T-2002-199	N/A	N/A	N/A	N/A	28V	28V

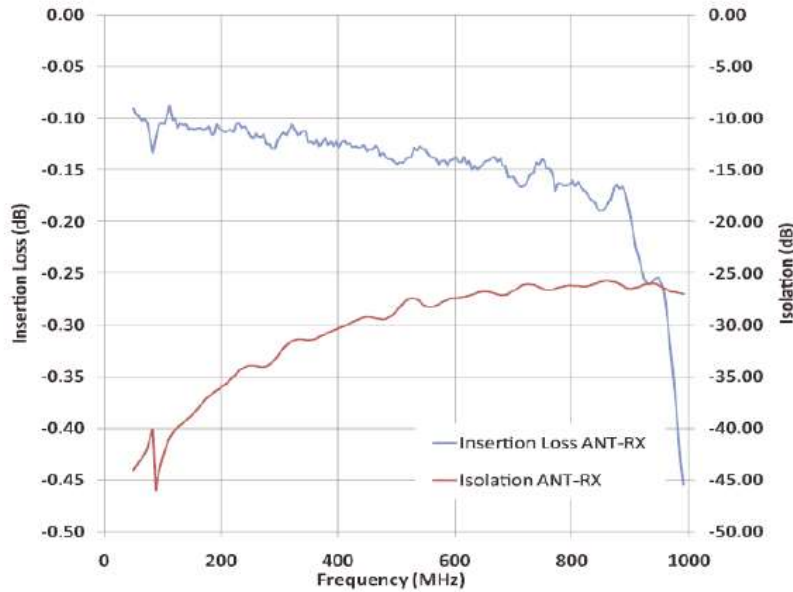
Note: N/A denotes an operating frequency outside the normal switch operating frequency range.

MSW2T-2000-199 Small Signal Parametric Performance:

MSW2T-2000-199: TX – ANT Insertion Loss and ANT-RX Isolation

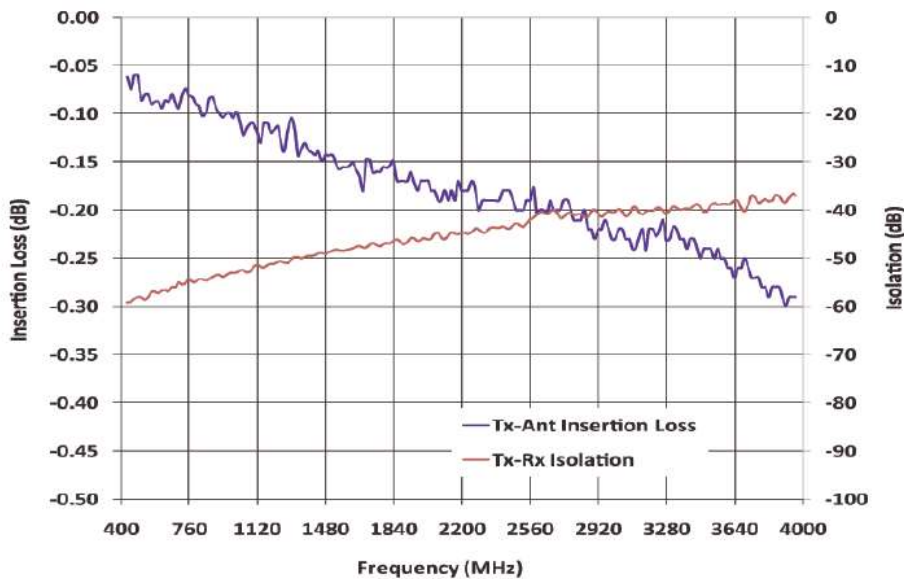


MSW2T-2000-199: ANT-RX Insertion Loss and TX-ANT Isolation

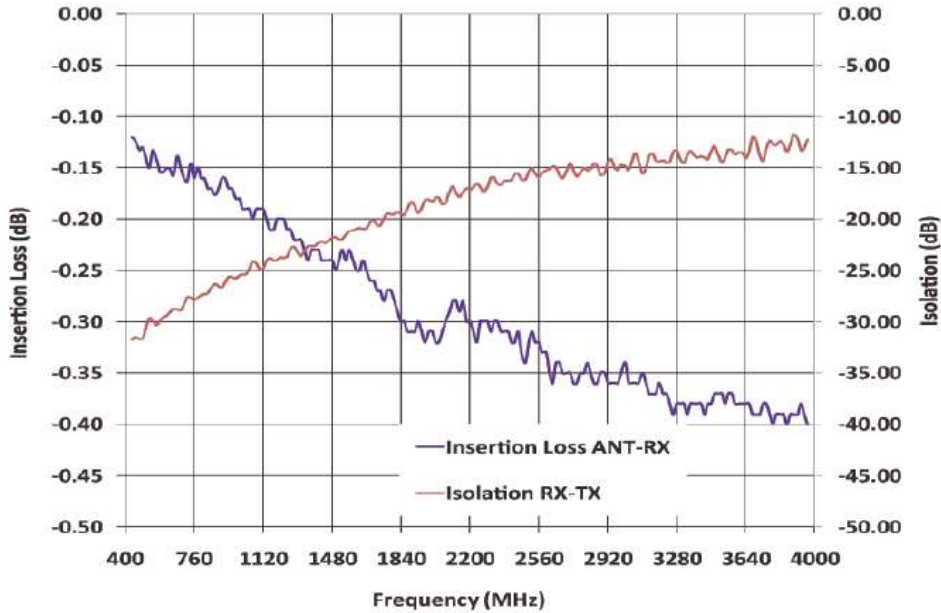


MSW2T-2001-199: Small Signal Parametric Performance:

MSW2T-2001-199: TX-ANT Insertion Loss and RX-TX Isolation

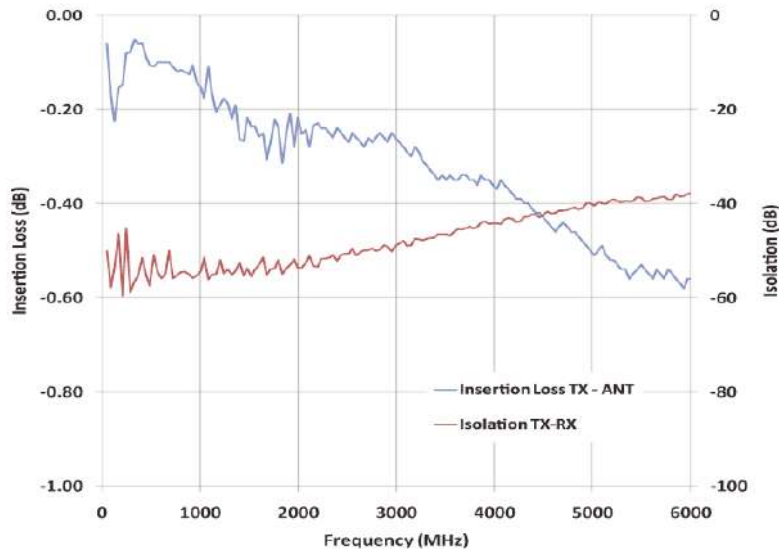


MSW2T-2001-199: ANT-RX Insertion Loss and TX-RX Isolation

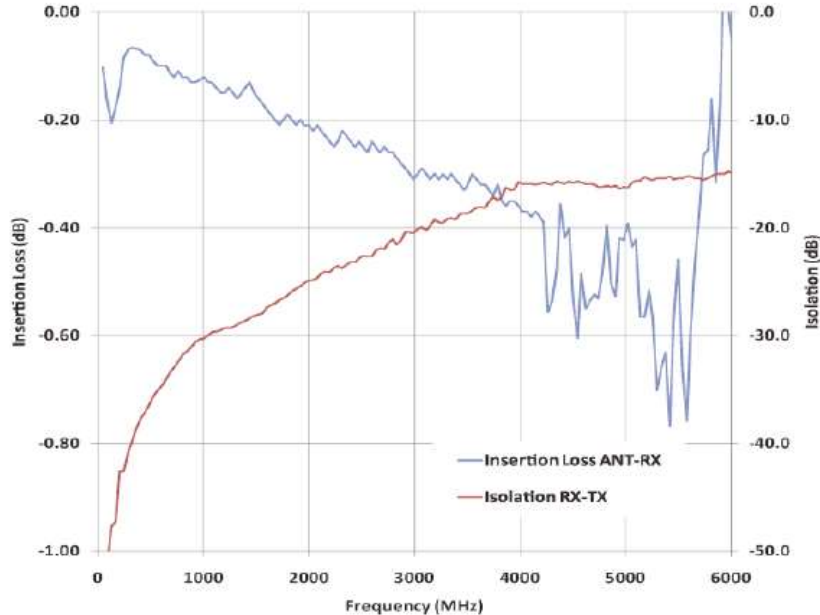


MSW2T-2002-199 Small Signal Parametric Performance:

MSW2T-2002-199: TX-ANT Insertion Loss and ANT-RX Isolation



MSW2T-2002-199: ANT-RX Insertion Loss and TX-ANT Isolation

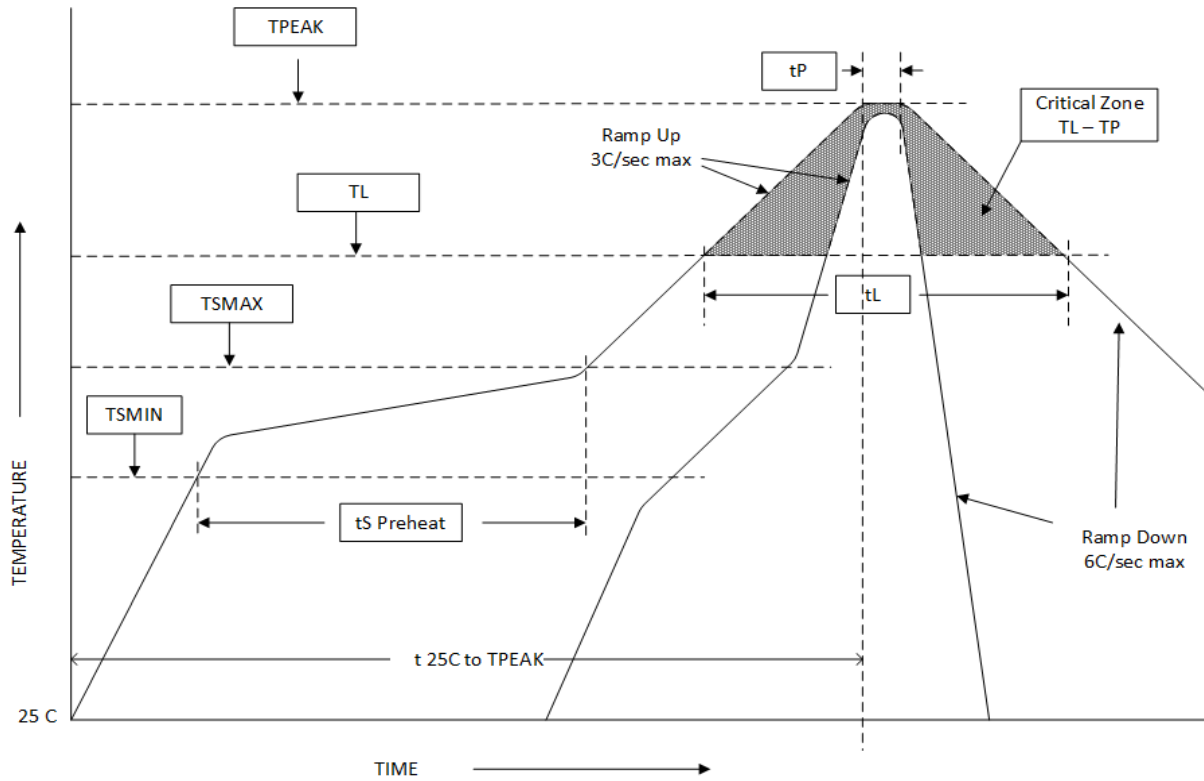


Assembly Instructions

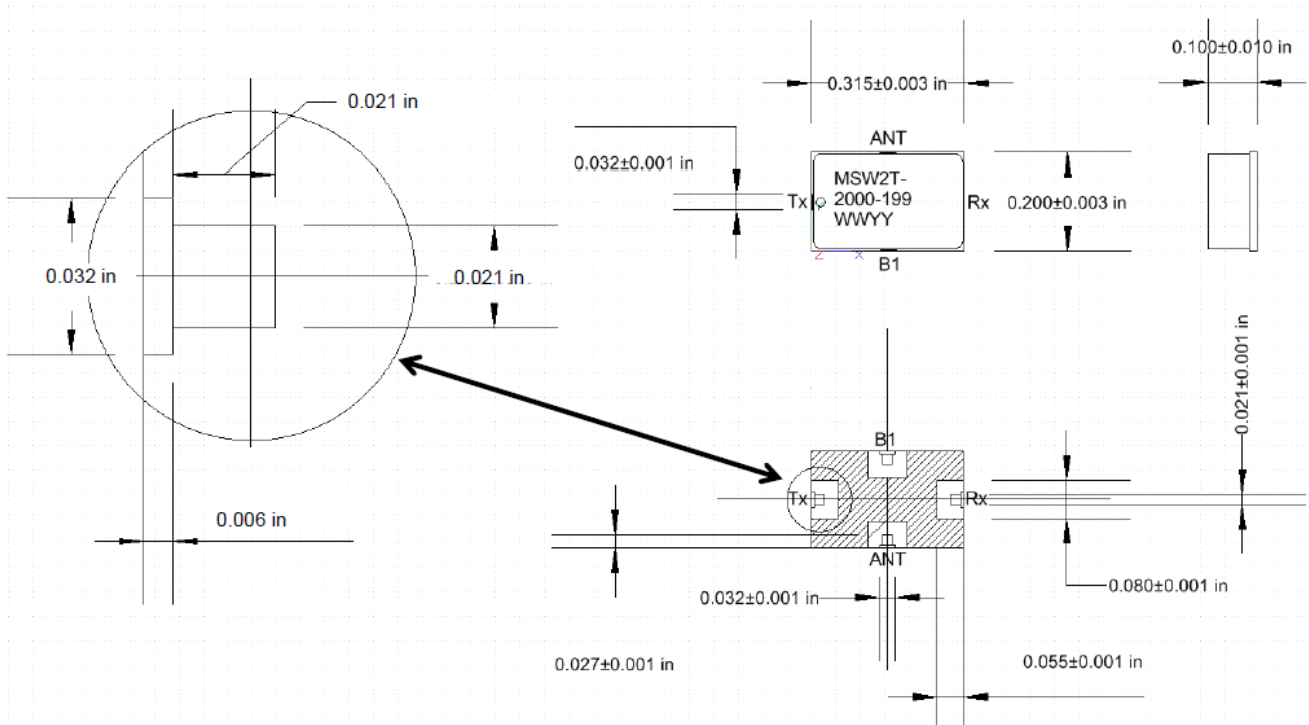
The MSW2T-200X-199 family of High Power Switches are available in either tube or Tape & Reel format. The MSW2T-200X-199 may be attached to the printed circuit card using solder reflow procedures using either RoHS or Sn63/ Pb37 type solders per the Table and Temperature Profile Graph shown below:

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	200°C
Time (min to max) (t_s)	60 – 120 sec	60 – 120 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



MSW2T-200X-199 SP2T Package Outline Drawing

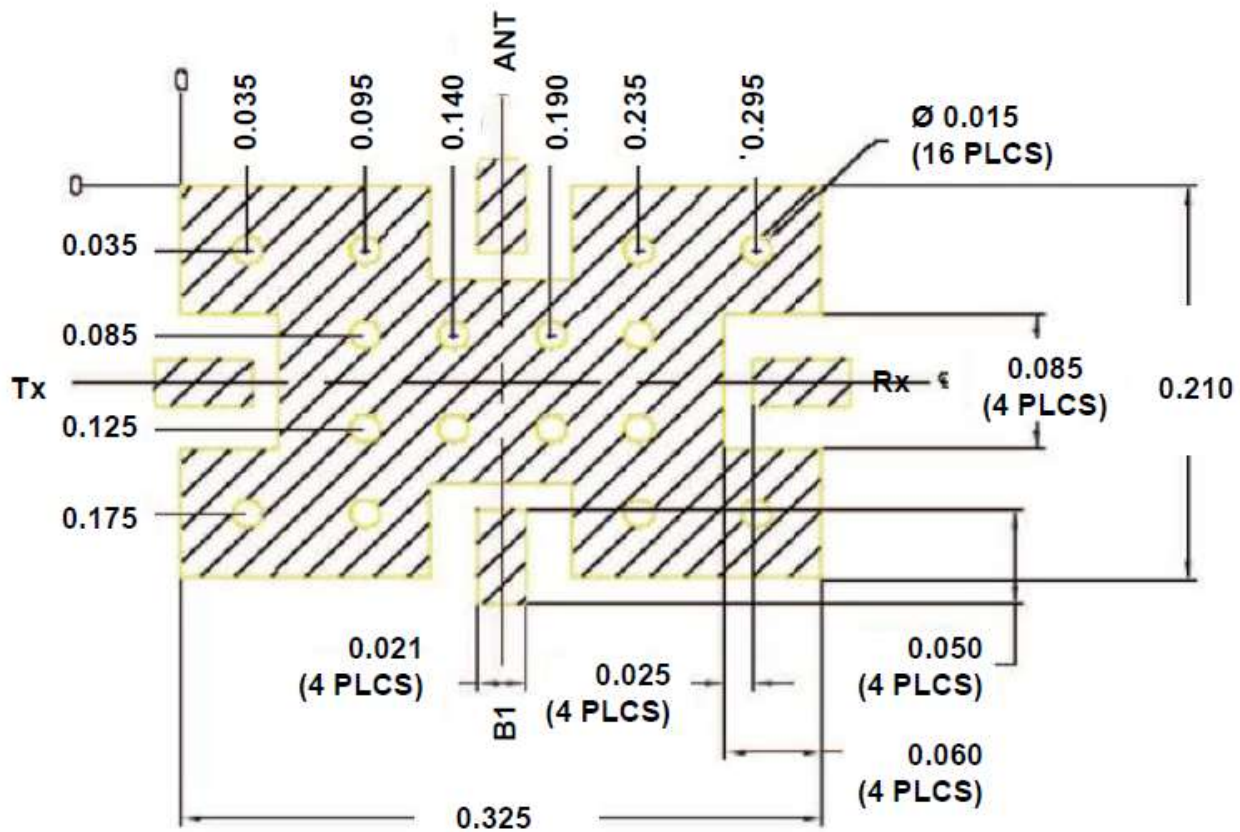


Note: Metalized area on backside is the RF, DC and Thermal ground. In user's end application this surface temperature must be managed to meet the power handling requirements.

Thermal Design Considerations:

The design of the MWT-200X-199 family of 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 85°C.

Recommended RF Circuit Solder Footprint for the MSW2T-200X-199



Notes:

- 1) All dimensions in inches.
- 2) Recommended RF Circuit Rogers: R04350B, 10 mils Thick.

Part Number Ordering Details:

Part Number	Packaging
MSW2T-2000-199	Gel Pack
MSW2T-2000-199 Small Signal EVB	Box
MSW2T-2001-199	Gel Pack
MSW2T-2001-199 Small Signal EVB	Box
MSW2T-2002-199	Gel Pack
MSW2T-2002-199 Small Signal EVB	Box