Surface Mount PIN Diode SP2T Switch

MSW2020-202

Series Datasheet

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Features

- Surface Mount SP2T Switch in Compact Outline: 8mm L x 5mm W x 2.5 mm H
- Higher Average Power Handling than Plastic (158 W C.W.)
- Higher Voltage > 800 Volts for Higher RF Peak Power (500 W)
- Lower Insertion Loss (0.3 dB) & Higher IIP3 (60 dBm)
- Operates with +5V & -200V for Lower Linear Frequency Operation
- RoHS Compliant

Description

The MSW2020-202 Silicon PIN Diode, Surface Mount SP2T T-R Switch is manufactured using Aeroflex / Metelics proven hybrid manufacturing process incorporating High Voltage PIN Diodes and passive devices integrated within a ceramic substrate. This low profile, compact, surface mount component, (8mm L x 5mm W x 2.5 mm H) offers superior low and high signal performance to comparable MMIC devices in QFN packages. The SP2T switches are designed in an asymmetrical Series & Series-Shunt topology to optimize Tx & Rx performance. The MSW2020-202 operates from 10–1,000 MHz to provide broadband performance for low and high signal superior operation.

Using PIN Diodes with lower thermal resistance (< 8 ºC/W), RF C.W. incident power levels of +52 dBm and RF peak incident power levels of +57 dBm are very achievable in higher power cold and hot switching applications @ + 85 º C. The lower PIN Diode series resistance (< 1.0 Ω), coupled with the longer minority carrier lifetime, (> 4 µS), provides better IIP3 distortion values > +60 dBm.

Applications

These MSW2020-202 SP2T Switches are designed to be used in higher power switch applications, operating from 10 MHz to 10000 MHz, requiring high volume, surface mount, solder re-flow manufacturing. These products are durable, reliable, and capable of meeting all military, commercial, and industrial environments. The devices are fully RoHS compliant.

Environmental Capabilities

The MSW2020-202 SP2T Switches are capable of meeting the environmental requirements of MIL-STD-202, and MIL-STD-750.

ESD and Moisture Sensitivity Level Rating

PIN Diode Switches are susceptible to ESD conditions as with all semiconductors. The ESD rating for this device is Class 1C, HBM. The moisture sensitivity level rating for this device is MSL 2.

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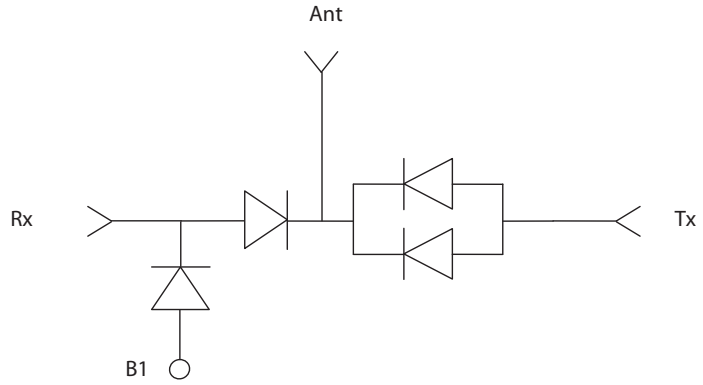
MSW2020-202 Electrical Specifications
@ Zo = 50 Ω, T_A = +25 °C (Unless Otherwise Defined)

Parameter	Symbol	Units	Test Conditions	Minimum Value	Typical Value	Maximum Value
Frequency	F	MHz		10	30 – 1000	1200
Tx-Ant Insertion Loss (Note 3)	IL(Tx)	dB	+5V @ 100 mA (Tx) -200V @ 25 mA (Rx)		| -0.20 |	| -0.30 |
Ant-Rx Insertion Loss (Note 3)	IL(Rx)	dB	+5 V@ 100 mA (Rx) -200V @ 0 mA (Tx)		| -0.30 |	| -0.40 |
Tx-Ant Return Loss (Note 3)	RL(Tx)	dB	+5V @ 100 mA (Tx) -200V @ 25 mA (Rx)	| -18 |	| -20 |	
Ant-Rx Return Loss (Note 3)	RL(Rx)	dB	+5V @ 100 mA (Rx) -200V @ 0 mA (Tx)	| -18 |	| -20 |	
Tx-Rx Isolation (Note 3)	Isol(Rx)	dB	+5V @ 100 mA (Tx) -200V @ 25 mA (Rx)	| -40 |	| -45 |	
Rx-Tx Isolation (Note 3)	Isol(Tx)	dB	+5V @ 100 mA (Rx) -200V @ 25 mA (Tx)	| -20 |	| -23 |	
C.W. Incident Power (Tx)	Pinc(CW)	dBm	+5V @ 100 mA (Tx) -200V @ 25 mA (Rx) 1.5:1 Source & Load VSWR		+52	
C.W. Incident Power (Rx)	Pinc(CW)	dBm	+5V @ 100 mA (Rx) -200V @ 0mA(Tx) 1.5:1 Source & Load VSWR		+40	
Peak. Incident Power (Tx)	Pinc(Pk)	dBm	+5V @ 100 mA (Tx) -200V @ 25 mA (Rx) 1.5:1 Source & Load VSWR		+57 @ 10 µS Pulse, 1 % Duty	
Switching Speed	Ts	µS	(10% -90% RF Voltage)		2	3
Input 3rd Order Intercept Point	IIP3	dBm	F1 = 500 MHz F2 = 510 MHz P1 = P2 = +40 dBm	60	65	

MSW2020-202 SP2T Schematic

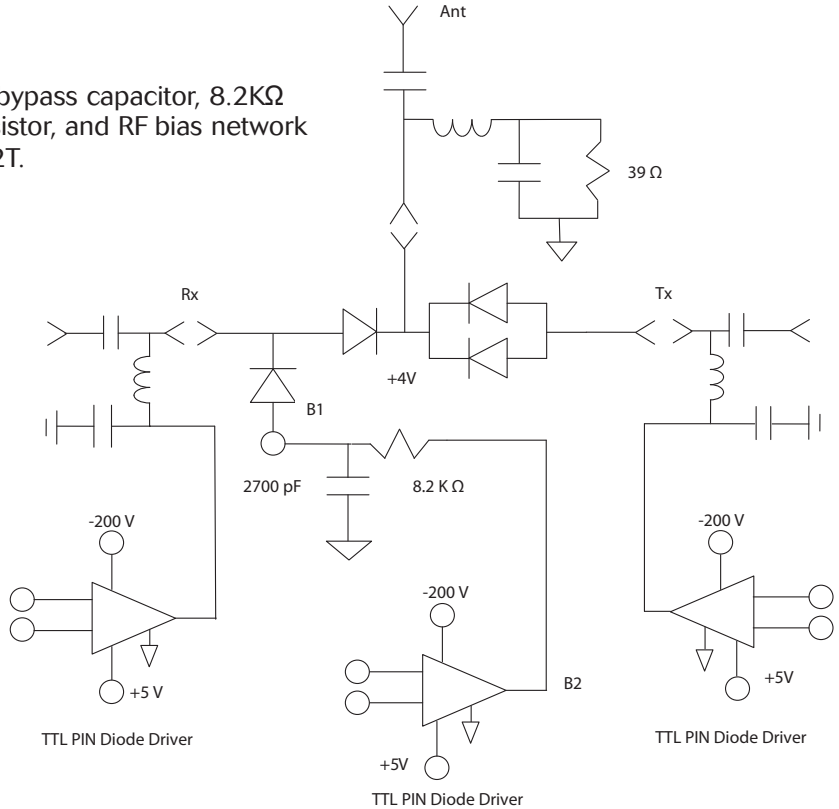


Electrical Specification Notes:

1. Switching Speed (50 % TTL – 10/90 % RF Voltage) is a Function of the PIN Diode Driver Performance. A RC " Current Spiking Network" is used on the Driver output to provide a Ic = C dV/dt transient current to move Stored charge through the PIN Diode, typical values are: R = 50 – 220 Ω and C = 470 – 1,000 pF.
2. Aeroflex / Metelics MPD2T5N200-702 is the recommended PIN Diode Driver to interface with the MSW2020-202 SP2T Switches and its data sheet may be found at http://www.aeroflex.com/metelics.
3. PIN Diode D.C. Reverse Voltage to maintain High Resistance in the OFF PIN diode is determined by RF Frequency, Incident Power, and VSWR. The Minimum D.C. Reverse Voltage value in the specification table provided applies to +52 dBm Incident Power. D.C. Power of +5V @ + 100 mA (Loss) & - 5V @ -25 mA (Isolation) values may be utilized for small signal testing (0 dBm) and the current limiting resistor from B1 to B2 will be adjusted accordingly.

SP2T Switch Schematic with RF Bias Network

Note: 2700 pF RF bypass capacitor, 8.2KΩ current limiting resistor, and RF bias network are external to SP2T.



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RF Bias Network Values

Part Number	F (MHz)	DC Blocking Capacitors	Inductors	RF Bypass Capacitors
MSW2020-202	30 – 1,000	0.1 µF	4.7 µH	0.1 µF

D.C. Bias to RF Truth Table

RF State	Tx Bias	Rx Bias	B1 Bias	B2 Bias
Tx-Ant Low Loss & Tx-Rx Isolation	+5V @ +100 mA	-200V @ -25 mA	-199V @ -25 mA	0 V @ -25 mA
Ant-Rx Low Loss & Rx – Tx Isolation	-200 V @ 0 mA	+5V @ +100 mA	-200 V @ 0 mA	-200 V @ 0 mA

Absolute Maximum Ratings @ T_A = + 25 ºC (Unless Otherwise Defined)

Parameter	Absolute Maximum Value
Forward Current @ Tx or Rx	250 mA
Reverse Voltage @ Tx, Rx, or B1	| -300 | V
Forward Diode Voltage	1.2 V @ 250 mA
Operating Temperature	-65 ºC to +125 ºC
Storage Temperature	-65 ºC to +150 ºC
Junction Temperature	+175 ºC
Assembly Temperature	+260 ºC for 10 Seconds
C.W. Incident Power Handling Source & Load VSWR = 1.5 :1 (Cold Switching & Hot Switching) Notes 1, 2	+52 dBm @ +85 ºC Case Temperature
Peak Incident Power Handling Source & Load VSWR = 1.5 :1 (Cold Switching & Hot Switching) Notes 1, 2	+57 @ 10 µS Pulse, 1 % Duty @ + 85 ºC Case Temperature
Total Dissipated RF & D.C. Power (Cold Switching) Notes 1, 2	10 W @ + 85 ºC Case Temperature

Notes:

1. For Hot Switching, PIN Diode Driver must Transition from Forward Bias to Reverse Bias and Reverse Bias to Forward Bias within 100 ηS with a parallel RC spiking network at the Driver Output.
2. Backside RF and D.C. Grounding Area of Device must be Completely Solder Attached to RF Circuit Board Vias for Proper Electrical and Thermal RF Circuit Grounding.

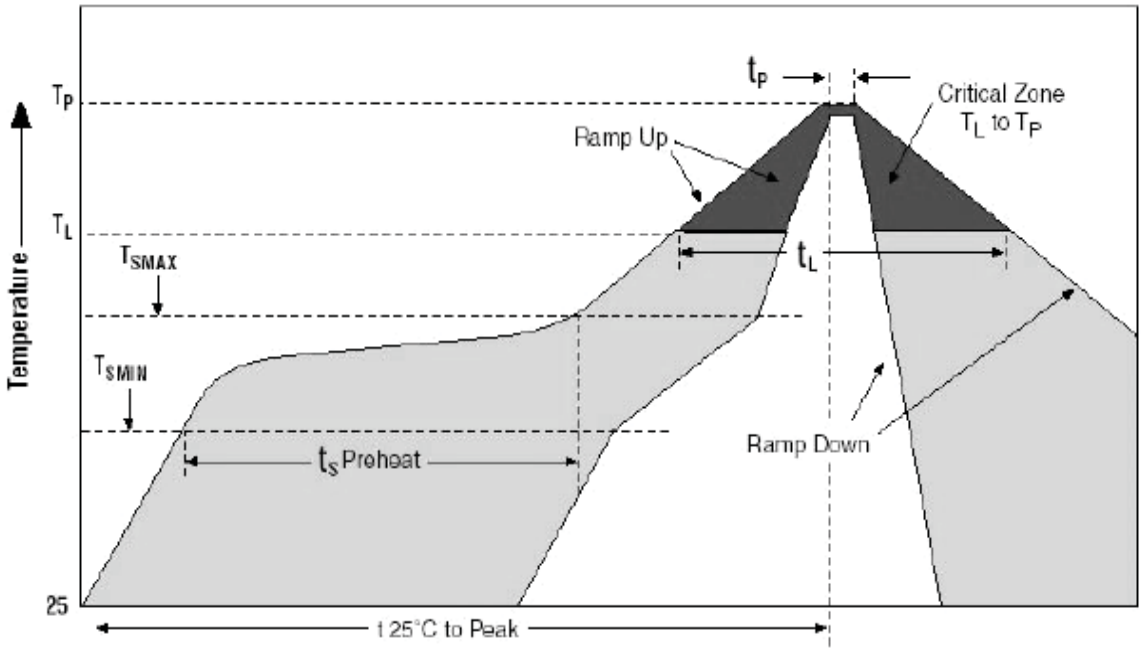
Assembly Instructions

The MSW2020-202 Switches are capable of being placed onto circuit boards with pick and place manufacturing equipment from tube or tape-reel dispensing. The devices are attached to the circuit board using conventional solder re-flow or wave soldering procedures with RoHS type or Sn 63 / Pb 37 type solders per Table I and Graph I Time-Temperature recommended profile.

Table 1: Time-Temperature Profile for Sn 60/Pb40 or RoHS Type Solders

Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
Average ramp-up rate (T_L to T_P)	3°C/second maximum	3°C/second maximum
Preheat - Temperature Minimum (T_{SMIN}) - Temperature Maximum (T_{SMAX}) - Time (Minimum to maximum) (t_S)	 100°C 150°C 60-120 seconds	 150°C 200°C 60-180 seconds
T_{SMAX} to T_L - Ramp-up Rate		 3°C/second maximum
Time Maintained above: - Temperature (T_L) - Time (t_L)	 183°C 60-150 seconds	 217°C 60-150 seconds
Peak Temperature (T_P)	225 +0 / -5°C	245 +0/-5°C
Time within 5°C of actual Peak Temperature (T_P)	10-30 seconds	20-40 seconds
Ramp-down Rate	6°C/second maximum	6°C/second maximum
Time 25°C to Peak Temperature	6 minutes maximum	8 minutes maximum

Graph1: Solder Re-Flow Time-Temperature Function



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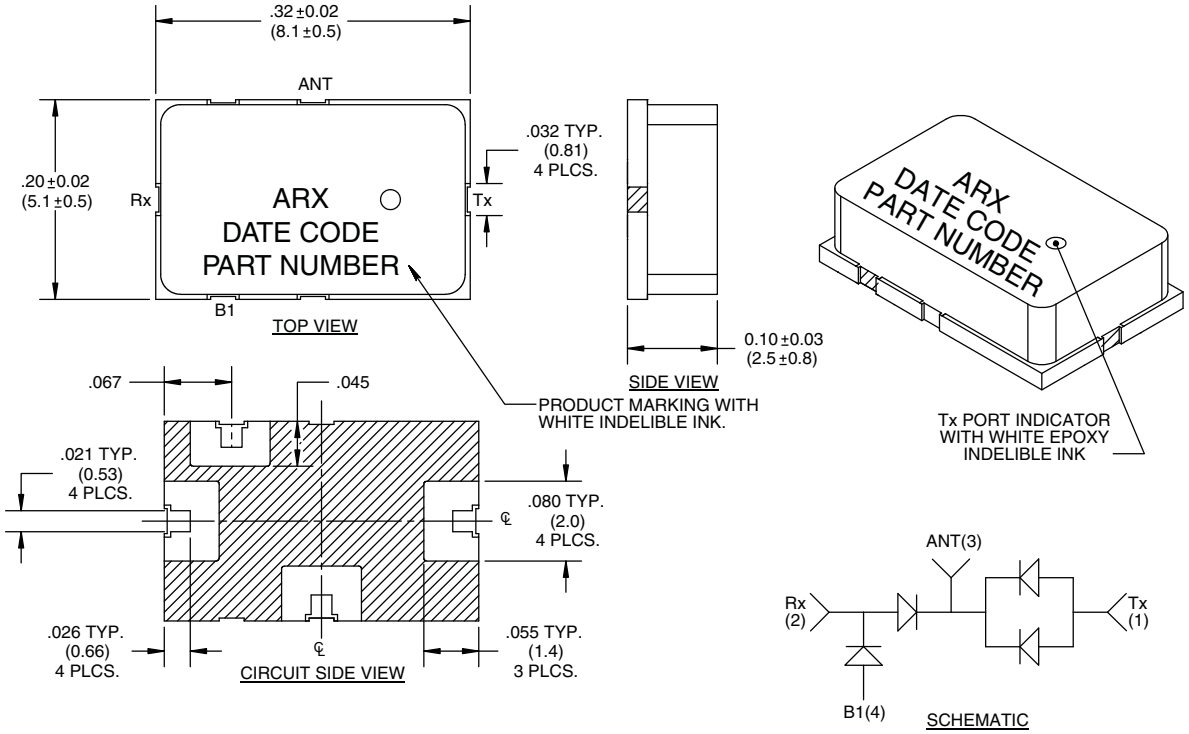
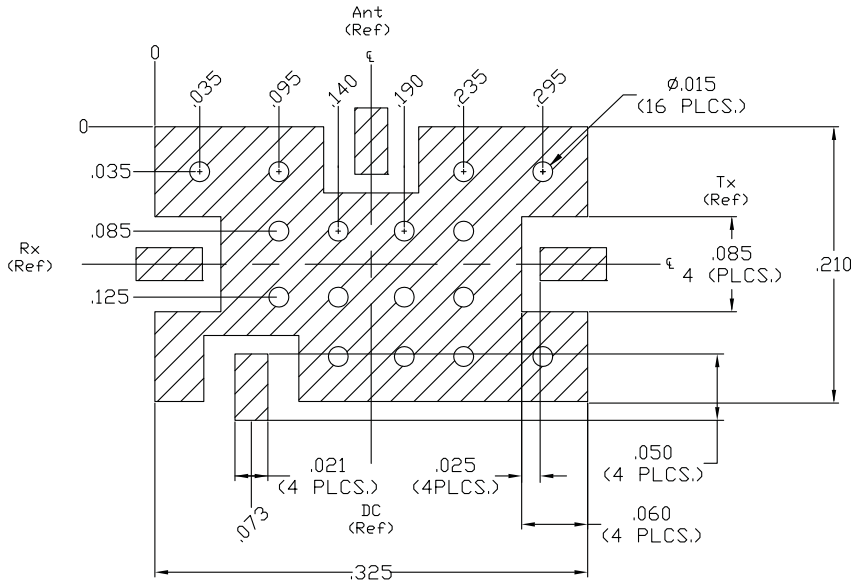
MSW2020-202 SP2T Switch Outline (Case Style 202)



NOTES:
1. SUBSTRATE MATERIAL: 20 MIL THICK ALUMINA NITRIDE (ALN) RF COVER: BLACK CERAMIC.
2. TOP SIDE AND BACKSIDE METALLIZATION: 40µ IN PLATED Au, 60µ IN PLATED Ni OVER Ti-Pd-Au.
3. DIMENSION IN PARENTHESIS ARE IN MM.

Note: Thatched Metal Area on Circuit Side of Device is RF and D.C. Ground.

RF Circuit Solder Footprint for Case Style 202 (CS202)



Thatched Area is RF, D.C., and Thermal Ground.Vias should be solid copper fill and gold plated for optimum heat transfer from backside of switch module through Circuit Vias to metal thermal ground.

Part Number Ordering Information:

Part Number	Packaging
MSW2020-202-T	Tube
MSW2020-202-R	Tape-Reel (Quantities of 250 or 500)
MSW2020-202-W	Waffle Pack
* RF Evaluation boards are rated at +45 dBm C.W. or Peak Incident Power due to the RF power rating values of the Passive L, C Bias Elements.	

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