

Surface Mount PIN Diode SP3T Switches MSW3200-320 & MSW3201-320 Series Datasheet



Features

- Surface Mount SP3T Switch in Compact Outline:
8mm L x 8mm W x 2.5 mm H
- Higher Average Power Handling than Plastic (100 W C.W.)
- Higher Voltage > 1,000 Volts for Higher RF Peak Power (500 W)
- Lower Insertion Loss (0.5 dB) & Higher IIP3 (65 dBm)
- Faster Switching Speed (1 μ S)
- Operates From +5 V & -180 V for Higher Linearity
- RoHS Compliant



Description

The MSW3200-320 and MSW3201-320 Surface Mount Silicon PIN Diode SP3T Switches are 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, (8 mm L x 8 mm W x 2.5 mm H) offers superior low and high signal performance to comparable MMIC devices in QFN packages. The SP3T switches are designed in a symmetrical topology to optimize Insertion Loss and Isolation performance.

Using PIN Diodes with lower thermal resistance (< 10 °C/W), RF C.W. incident power levels of +50 dBm and RF peak incident power levels of + 57 dBm are very achievable in higher power cold and hot switching applications @ +85 °C. The lower PIN Diode series resistance (< 1.0 Ω), coupled with the longer minority carrier lifetime, (> 4 μ S), provides better IIP3 distortion values > + 65 dBm.

Applications

These MSW3200-320 & MSW3201-320 SP3T Switches are designed to be used in higher power switch applications, operating from 20 MHz to 1,000 MHz, and 400-4,000 MHz respectively for high volume, surface mount, solder re-flow manufacturing useful in IED and Radar market segments. These products are durable, reliable, and capable of meeting all military, commercial, and industrial environments. The devices are fully RoHS compliant.

Environmental Capabilities

The MSW3200-320 and MSW3201-320 SP3T 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.



MSW3200-320 Electrical Specifications

@ $Z_0 = 50 \Omega$, $T_A = +25^\circ\text{C}$ (Unless Otherwise Defined)

Parameter	Symbol	Units	Test Conditions	Minimum Value	Typical Value	Maximum Value
Frequency	F	MHz		10	20 – 1000	1500
J0-J1, J0-J2 or J0-J3 Insertion Loss (Note 3)	IL	dB	-180V @ -50 mA (ON) +1V @ +50 mA (OFF)		-0.4	-0.6
J0-J1, J0-J2 or J0-J3 Return Loss (Note 3)	RL	dB	-180V @ -50 mA (ON) +1V @ +50 mA (OFF)	-18	-20	
J0-J1, J0-J2 or J0-J3 Isolation (Note 3)	Isol	dB	-180V @ -50 mA (ON) +1V @ +50 mA (OFF)	-44	-47	
C.W. Incident Power (Note 3)	Pinc (CW)	dBm	-180V @ -50 mA (ON) +1V @ +50 mA (OFF) 3.0:1 Source & Load VSWR		+50	
Peak. Incident Power (Note 3)	Pinc (Pk)	dBm	-180V @ -50 mA (ON) +1V @ +50 mA (OFF) 1.5:1 Source & Load VSWR		+57 @ 10 μs Pulse, 1 % Duty	
Switching Speed	Ts	μs	(10% -90% RF Voltage) TTL Rep rate = 100 kHz		2	3
Input 3rd Order Intercept Point	IIP3	dBm	F1 = 500 MHz F2 = 510 MHz P1 = P2 = +40 dBm -180V @ -50 mA (ON) +1V @ +50 mA (OFF)	60	65	

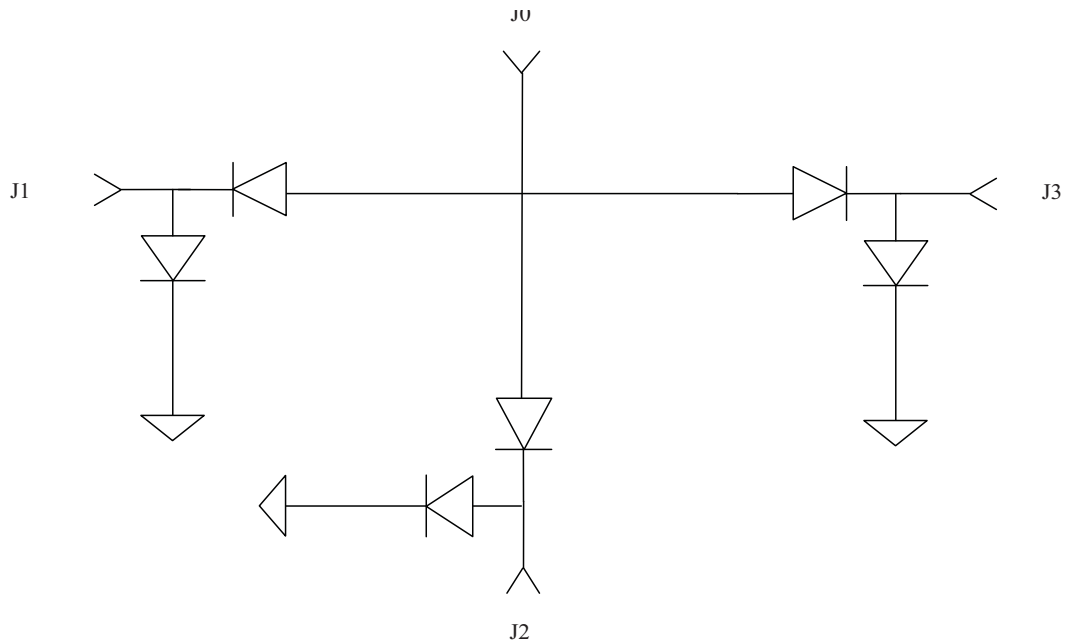
MSW3201-320 Electrical Specifications

@ $Z_0 = 50 \Omega$, $T_A = +25^\circ\text{C}$ (Unless Otherwise Defined)

Parameter	Symbol	Units	Test Conditions	Minimum Value	Typical Value	Maximum Value
Frequency	F	MHz		200	400 – 4000	4500
J0-J1, J0-J2 or J0-J3 Insertion Loss (Note 3)	IL	dB	-180V @ -50 mA (ON) +1V @ +50 mA (OFF)		-0.6	-0.8
J0-J1, J0-J2 or J0-J3 Return Loss (Note 3)	RL	dB	-180V @ -50 mA (ON) +1V @ +50 mA (OFF)	-13	-15	
J0-J1, J0-J2 or J0-J3 Isolation (Note 3)	Isol	dB	-180V @ -50 mA (ON) +1V @ +50 mA (OFF)	-32	-35	
C.W. Incident Power (Note 3)	Pinc (CW)	dBm	-180V @ -50 mA (ON) +1V @ +50 mA (OFF) 3.0:1 Source & Load VSWR		+50	
Peak. Incident Power (Note 3)	Pinc (Pk)	dBm	-180V @ -50 mA (ON) +1V @ +50 mA (OFF) 3.0:1 Source & Load VSWR		+57 @ 10 μs Pulse, 1 % Duty	
Switching Speed	Ts	μs	(10% -90% RF Voltage) TTL Rep rate = 100 kHz		1	2
Input 3rd Order Intercept Point	IIP3	dBm	F1 = 2000 MHz F2 = 2010 MHz P1 = P2 = +40 dBm -180V @ -50 mA (ON) +1V @ +50 mA (OFF)	60	65	

SP3T PIN Diode Switches

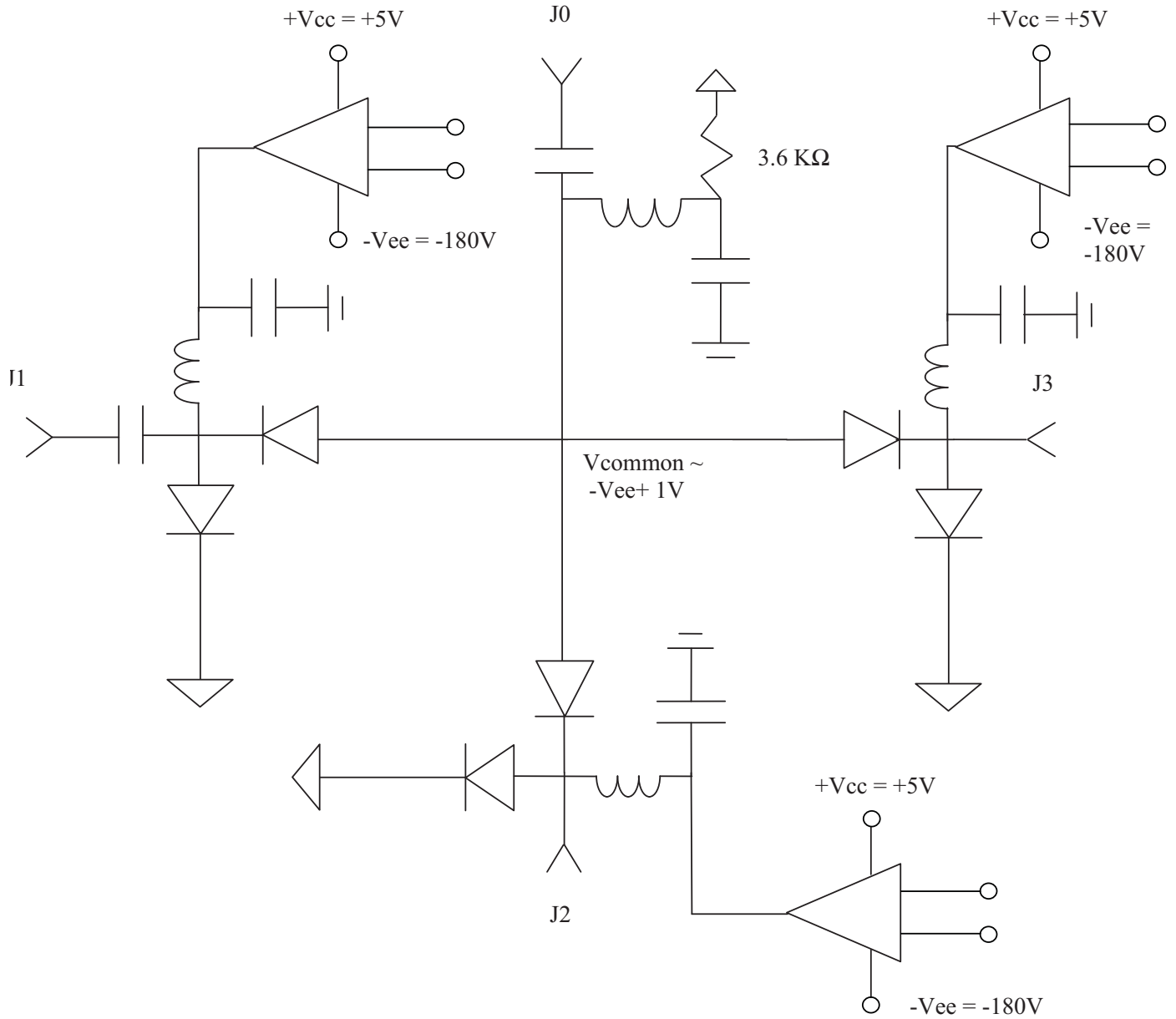
MSW3200-320 and MSW3201-320 SP3T Schematic



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 $I_c = C \, dV/dt$ transient current to move Stored charge through the PIN Diode, typical values are: $R = 50 - 220 \, \Omega$ and $C = 470 - 1,000 \, \text{pF}$.
2. Aeroflex / Metelics MPD3T5N200-703 is the recommended Driver to interface with the MSW3200-320 and MSW3201-320 SP3T 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 values are provided on page 5 of this datasheet. -5 V @ -50 mA values may be utilized for small signal testing ~0 dBm.

SP3T Switch Schematic with RF Bias Network and Truth Table



SP3T PIN Diode Switches



RF Bias Network Values

Part Number	F (MHz)	DC Blocking Capacitors	Inductors	RF Bypass Capacitors
MSW3200-320	50 – 1,000	0.1 μ F	4.7 μ H	0.1 μ F
MSW3201-320	400 – 4,000	27 pF	82 nH	270 pF

D.C. Bias to RF Truth Table

RF State	J1 Bias	J2 Bias	J3Bias
J1-J0 Low Loss & J2-J0 Isolation & J3-J0 Isolation	-180V @ -50 mA	+1 V @ +25 mA	+1 V @ +25 mA
J2-J0 Low Loss & J1-J0 Isolation & J3-J0 Isolation	+1 V @ +25 mA	-180V @ -50 mA	+1 V @ +25 mA
J3-J0 Low Loss & J1-J0 Isolation & J2-J0 Isolation	+1 V @ +25 mA	+1 V @ +25 mA	-180V @ -50 mA

Minimum Reverse Bias Voltage @ J1, J2, J3 vs. Frequency for 100 W C.W. Power with 1.5:1 VSWR

Part Number	F (MHz) & - Vdc	F (MHz) & - Vdc	F (MHz) & - Vdc	F (MHz) & - Vdc	F (MHz) & - Vdc	F (MHz) & - Vdc
MSW3200-320	20 MHz -180 V	100 MHz -150 V	200 MHz -115 V	400 MHz -85 V	1,000 MHz -35 V	4,000 MHz NA
MSW3201-320	20 MHz NA	100 MHz NA	200 MHz -150 V	400 MHz -115 V	1,000 MHz -55 V	4,000 MHz -35 V

Notes:

1. " NA " denotes the Switch is not defined for that Frequency Band.

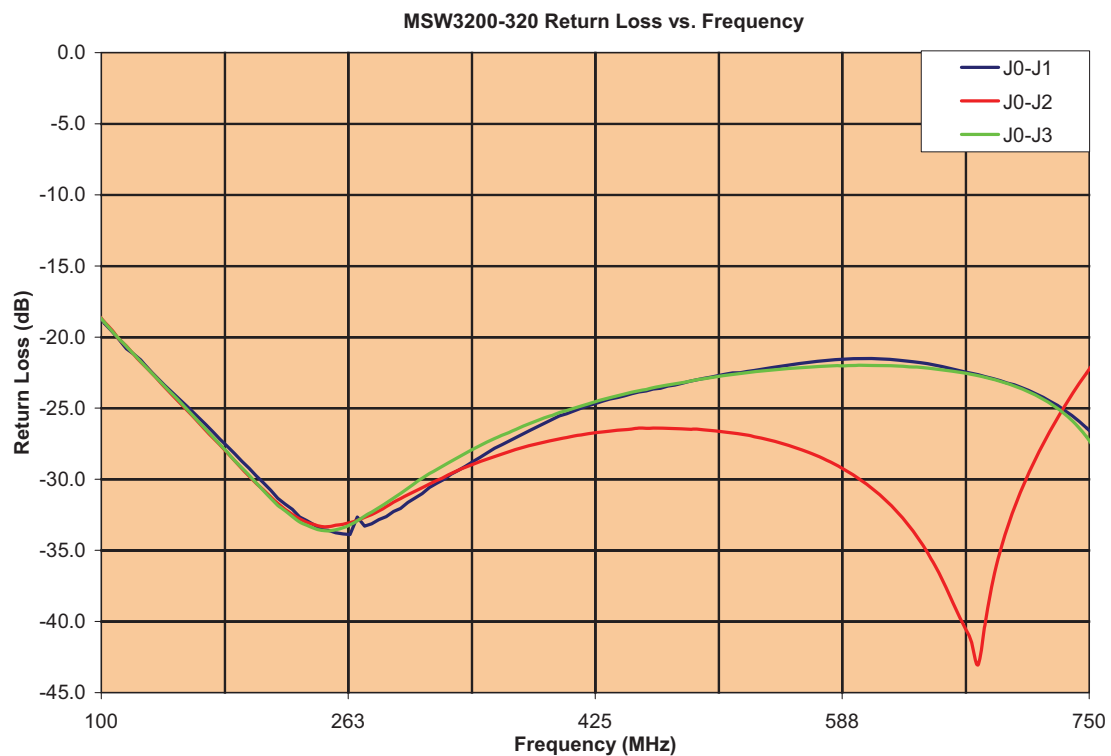
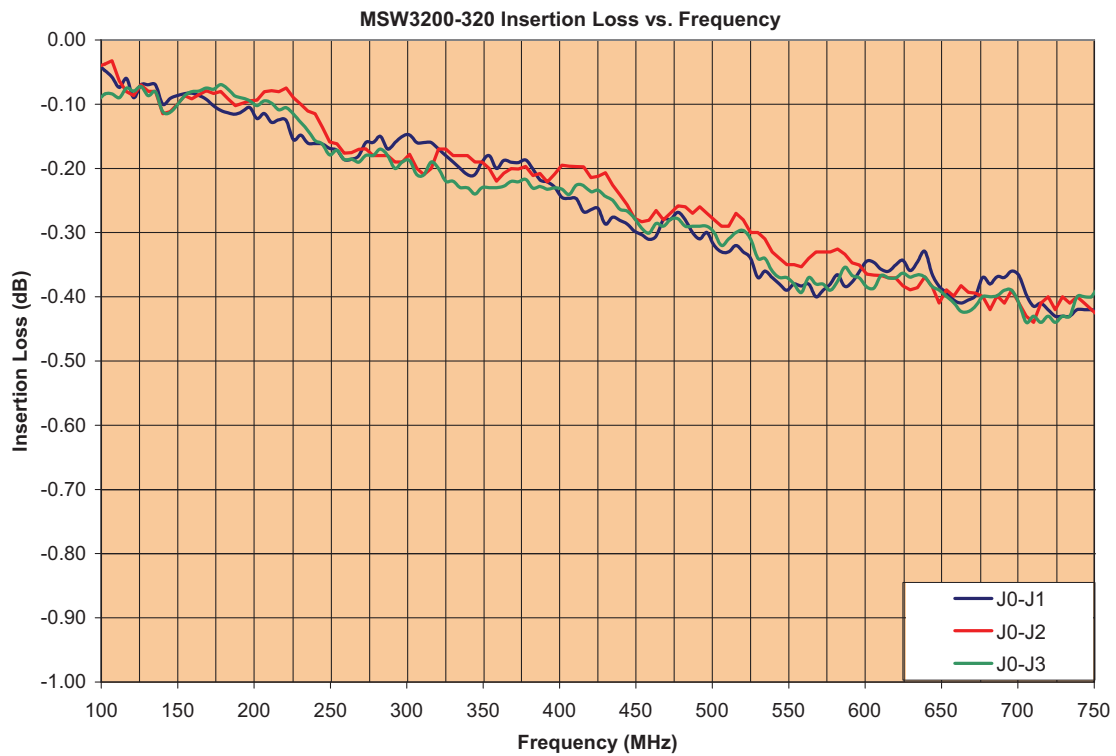
Absolute Maximum Ratings @ $T_A = + 25\text{ }^\circ\text{C}$ (Unless Otherwise Defined)

Parameter	Absolute Maximum Value
Forward Current @ J0, J1, J2 or J3	$\pm 250\text{ mA}$
Reverse Voltage @ J0, J1, J2 or J3	-300 V
Forward Diode Voltage	1.2 V @ 250 mA
Operating Temperature	$-65\text{ }^\circ\text{C}$ to $+125\text{ }^\circ\text{C}$
Storage Temperature	$-65\text{ }^\circ\text{C}$ to $+150\text{ }^\circ\text{C}$
Junction Temperature	$+175\text{ }^\circ\text{C}$
Assembly Temperature	$+260\text{ }^\circ\text{C}$ for 10 Seconds
C.W. Incident Power Handling Source & Load VSWR = 1.5 :1 (Cold Switching & Hot Switching) Notes 1, 2	+50 dBm @ $+85\text{ }^\circ\text{C}$ 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 @ $+85\text{ }^\circ\text{C}$ Case Temperature
Total Dissipated RF & D.C. Power (Cold Switching) Notes 1, 2	12.0 W @ $+85\text{ }^\circ\text{C}$ Case Temperature

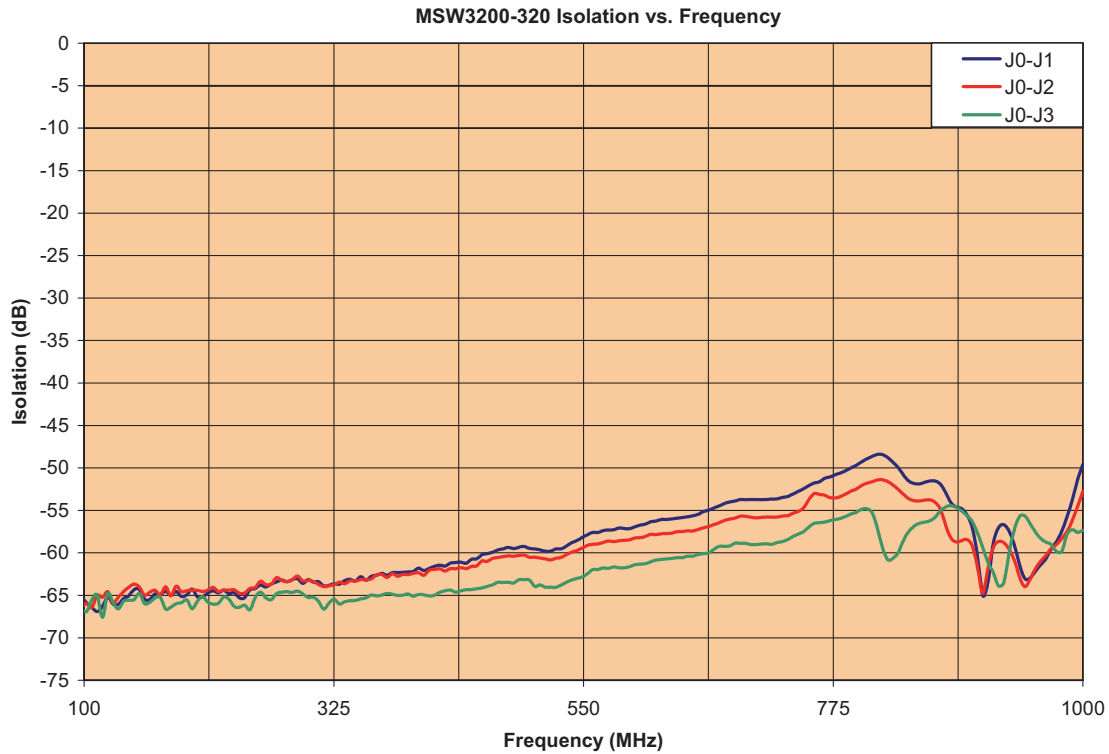
Notes:

1. For Hot Switching, PIN Diode Driver must Transition from Forward Bias to Reverse Bias and Reverse Bias to Forward Bias within 100 ns 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.

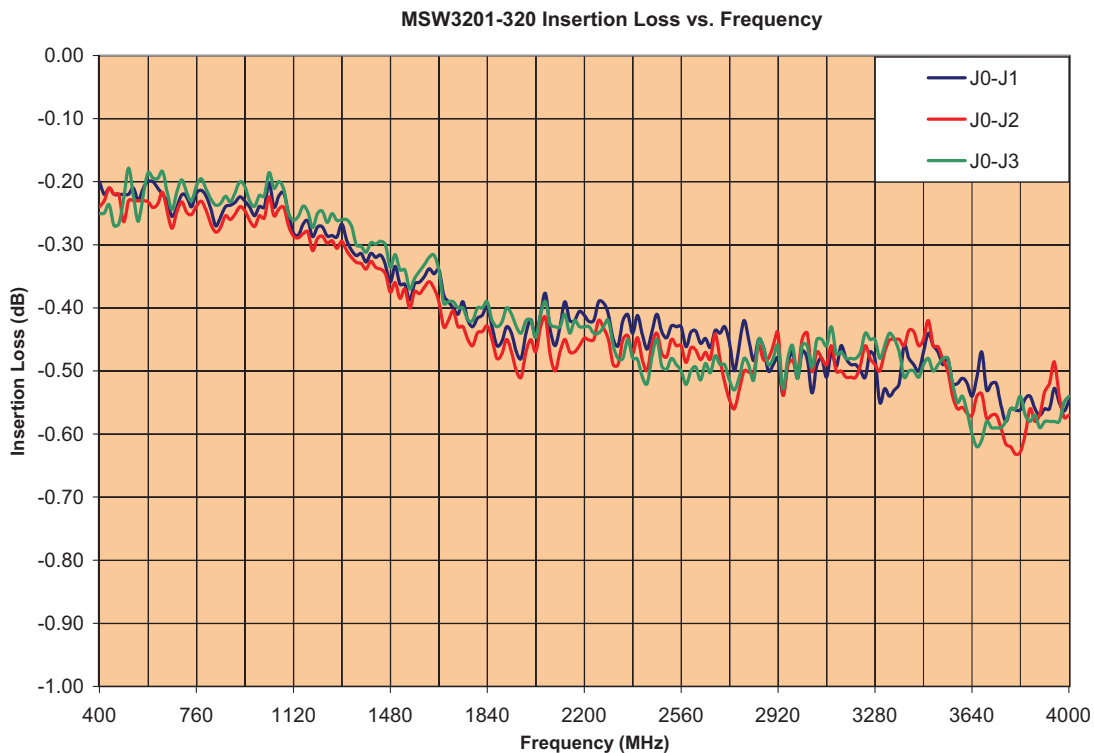
MSW3100-320 Parametric Performance



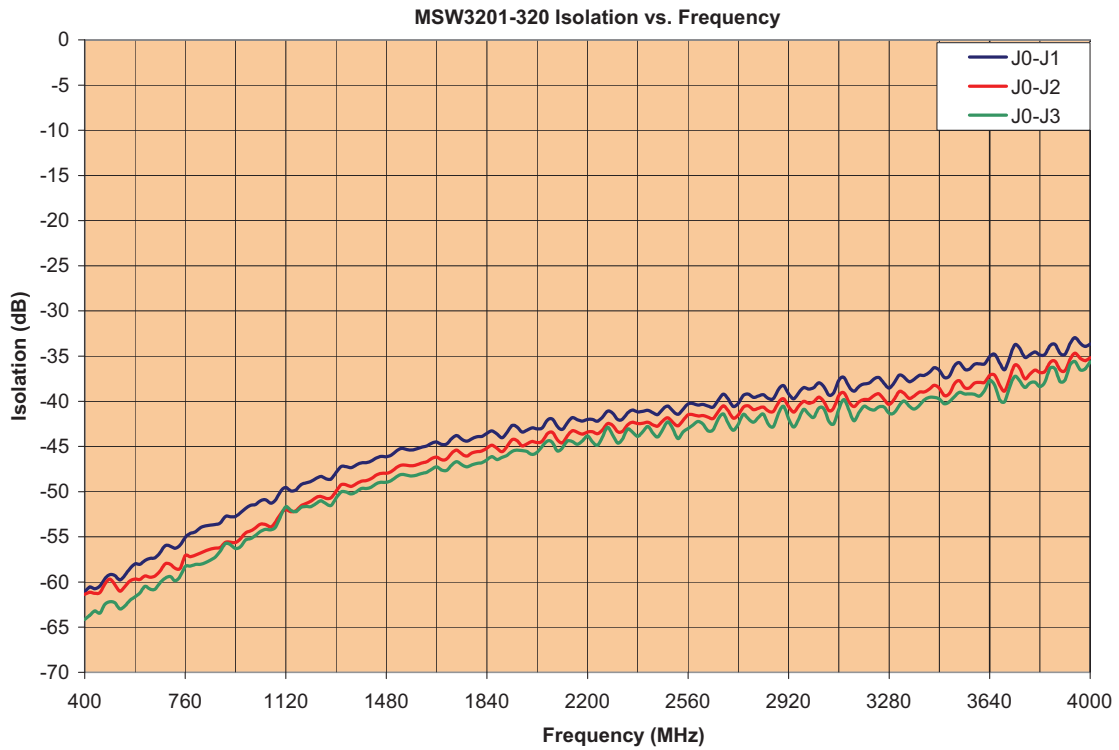
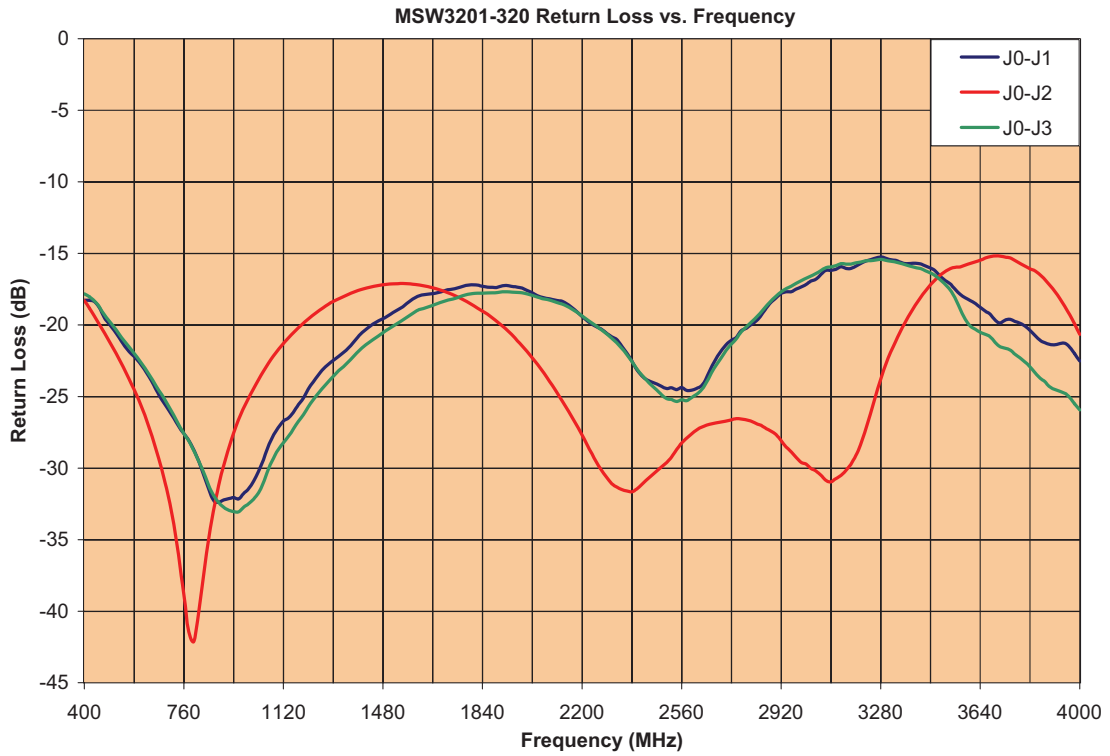
Notes: Data is only shown from 100 - 750 MHz due to bandwidth of RF Bias network.



MSW3101-320 Parametric Performance



SP3T PIN Diode Switches



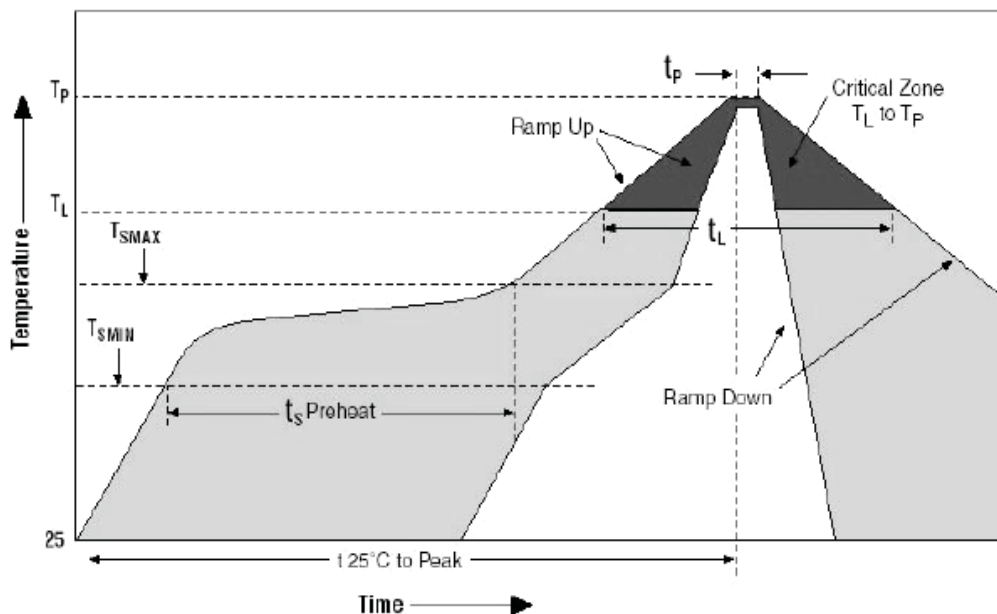
Assembly Instructions

The MSW3200-320 and MSW3201-320 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

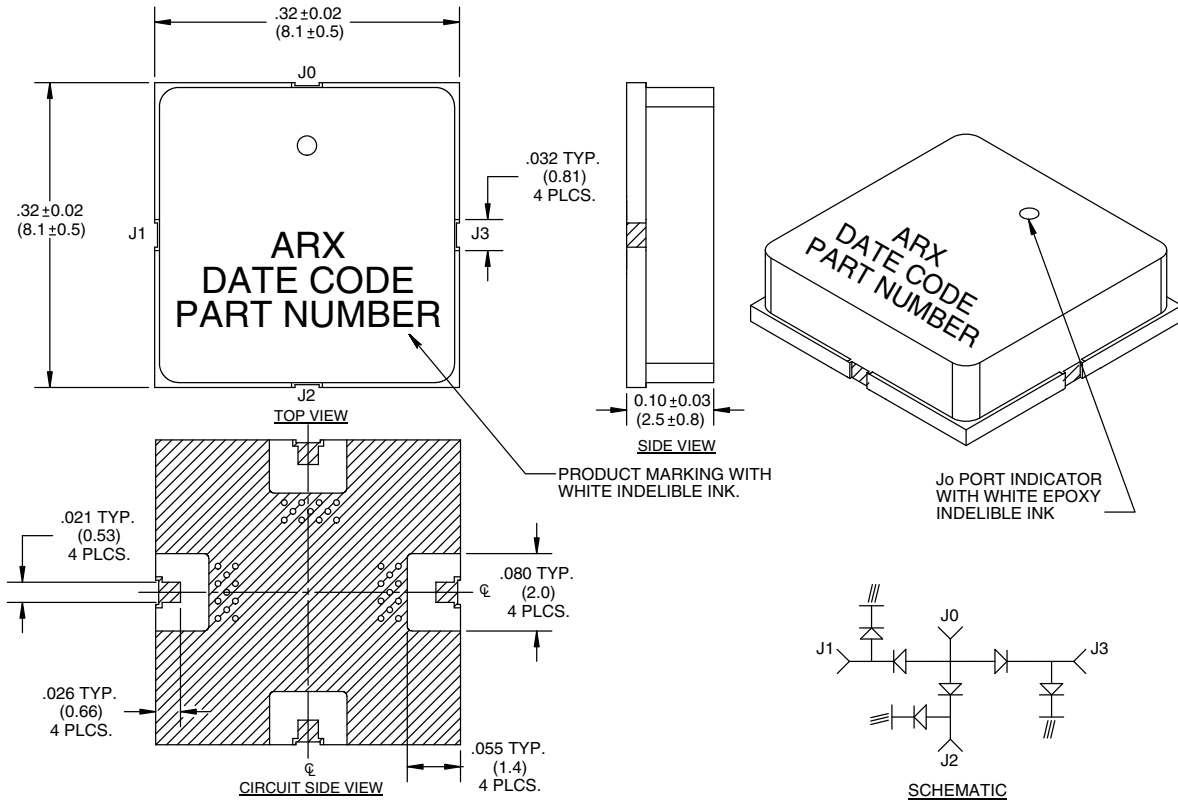
Graph1: Solder Re-Flow Time-Temperature Function



SP3T PIN Diode Switches



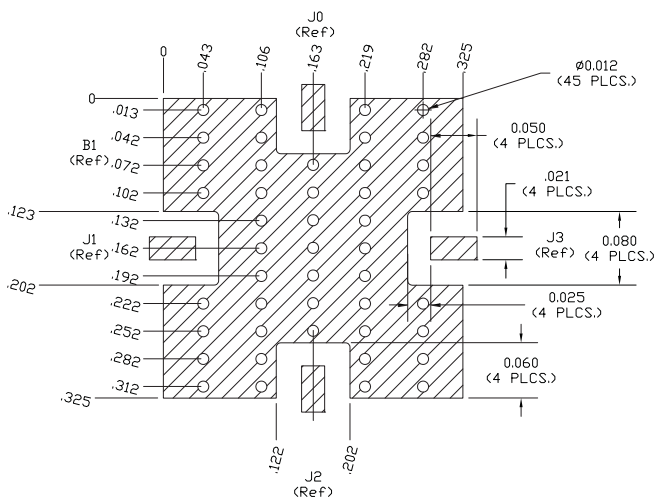
MSW3200-320 and MSW3201-320 SP3T Switch Outline (Case Style 320)



- NOTES:
 1. SUBSTRATE MATERIAL: 20 MIL THICK ALUMINA NITRIDE (ALN) RF COVER: BLACK CERAMIC.
 2. TOP SIDE AND BACKSIDE METALLIZATION: 40 μ IN PLATED Au, 60 μ 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 Solderable Footprint for Case Style 320 (CS320)



- NOTES:
 1. RECOMMENDED RF CIRCUIT IS ROGERS, R04350B, 10 MILS THICK.

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
MSW3200-320-T	Tube
MSW3200-320-R	Tape-Reel (Quantities of 250 or 500)
MSW3200-320-W	Waffle Pack
MSW3201-320-T	Tube
MSW3201-320-R	Tape-Reel (Quantities of 250 or 500)
MSW3201-320-W	Waffle Pack
MSW3200-320-E	RF Evaluation Board
MSW3201-320-E	RF Evaluation Board
* 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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