Surface Mount PIN Diode SP2T Switches

MSW2040-204 & MSW2041-204 Series Datasheet

AEROFLEX
A passion for performance.

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 > 500 Volts for Higher RF Peak Power (500 W)
- Lower Insertion Loss (0.25 dB) & Higher IIP3 (65 dBm)
- Operates From + Voltage Only (+5V & +28V to + 125V)
- RoHS Compliant

Description

The MSW2040-204 and MSW2041-204 Series of Surface Mount Silicon PIN Diode SP2T Switches 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 a symmetrical topology to optimize Insertion Loss and Isolation performance.

Using PIN Diodes with lower thermal resistance (< 10 ºC/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 ºC. The lower PIN Diode series resistance (< 1.0 Ω), coupled with the longer minority carrier lifetime, (> 2 µS), provides better IIP3 distortion values > +65 dBm.

Applications

These MSW2040-204 and MSW2041-204 Series SP2T Switches are designed to be used in higher power switch applications, operating from 20 MHz to 4000 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 MSW2040-204 and MSW2041-204 Series 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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MSW2040-204 Electrical Specifications @ Zo = 50 Ω, TA=+ 25°C (Unless Otherwise Defined)

Parameter	Symbol	Units	Test Conditions	Minimum Value	Typical Value	Maximum Value
Frequency	F	MHz		20	50 – 1000	1500
J0-J1 or J0-J2 Insertion Loss	IL	dB	0 V @ 150 mA (ON) 28 V @ 25 mA (OFF)		| -0.2 |	| -0.3 |
J0-J1 or J0-J2 Return Loss	RL	dB	0 V @ 150 mA (ON) 28 V @ 25 mA (OFF)	| -20 |	| -22 |	
J0-J1 or J0-J2 Isolation	Isol	dB	0 V @ 150 mA (ON) 28 V @ 25 mA (OFF	| -45 |	| -50 |	
C.W. Incident Power	Pinc (CW)	dBm	0 V @ 150 mA (ON) 28 V @ 25 mA (OFF) 1.5:1 Source & Load VSWR		+52	+52
Peak. Incident Power	Pinc (Pk)	dBm	0 V @ 150 mA (ON) 28 V @ 25 mA (OFF) 1.5:1 Source & Load VSWR		+58 @ 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 0 V @ 150 mA (ON) 28 V @ 25 mA (OFF)	60	65	

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. 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.
3. 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.

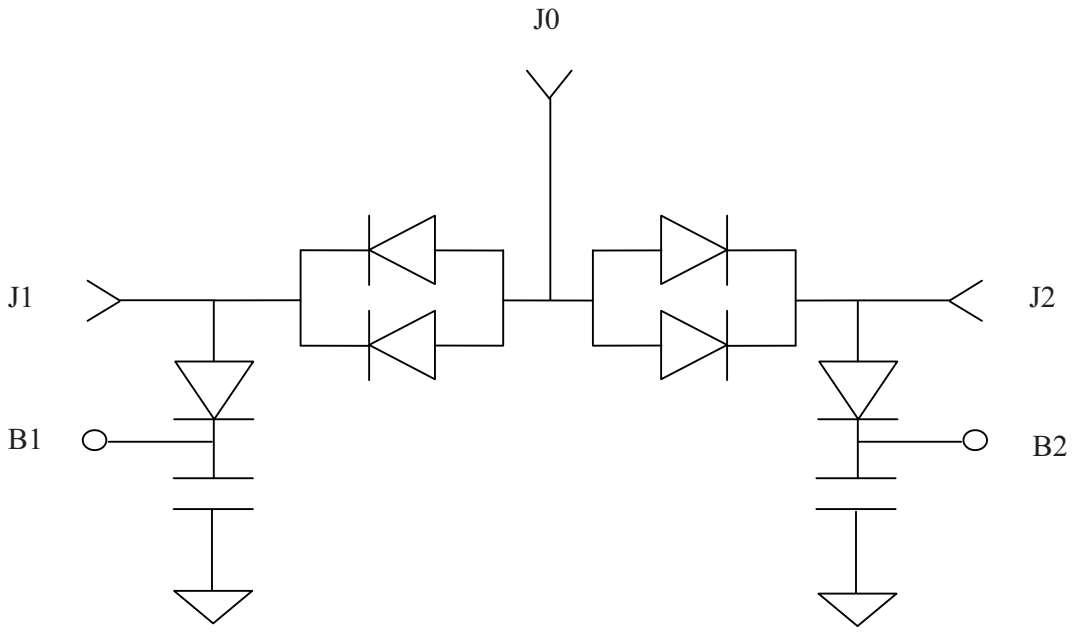
MSW2041-204 Electrical Specifications @ Zo = 50 Ω, TA=+ 25°C (Unless Otherwise Defined)

Parameter	Symbol	Units	Test Conditions	Minimum Value	Typical Value	Maximum Value
Frequency	F	MHz		200	400 – 4000	4500
J0-J1 or J0-J2 Insertion Loss	IL	dB	0 V @ 150 mA (ON) 28 V @ 25 mA (OFF)		| -0.5 |	| -0.6 |
J0-J1 or J0-J2 Return Loss	RL	dB	0 V @ 150 mA (ON) 28 V @ 25 mA (OFF)	| -14 |	| -15 |	
J0-J1 or J0-J2 Isolation	Isol	dB	0 V @ 150 mA (ON) 28 V @ 25 mA (OFF	| -32 |	| -35 |	
C.W. Incident Power	Pinc (CW)	dBm	0 V @ 150 mA (ON) 28 V @ 25 mA (OFF) 1.5:1 Source & Load VSWR		+52	+52
Peak. Incident Power	Pinc (Pk)	dBm	0 V @ 150 mA (ON) 28 V @ 25 mA (OFF) 1.5:1 Source & Load VSWR		+58 @ 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 = 2000 MHz F2 = 2010 MHz P1 = P2 = +40 dBm 0 V @ 150 mA (ON) 28 V @ 25 mA (OFF)	60	65	

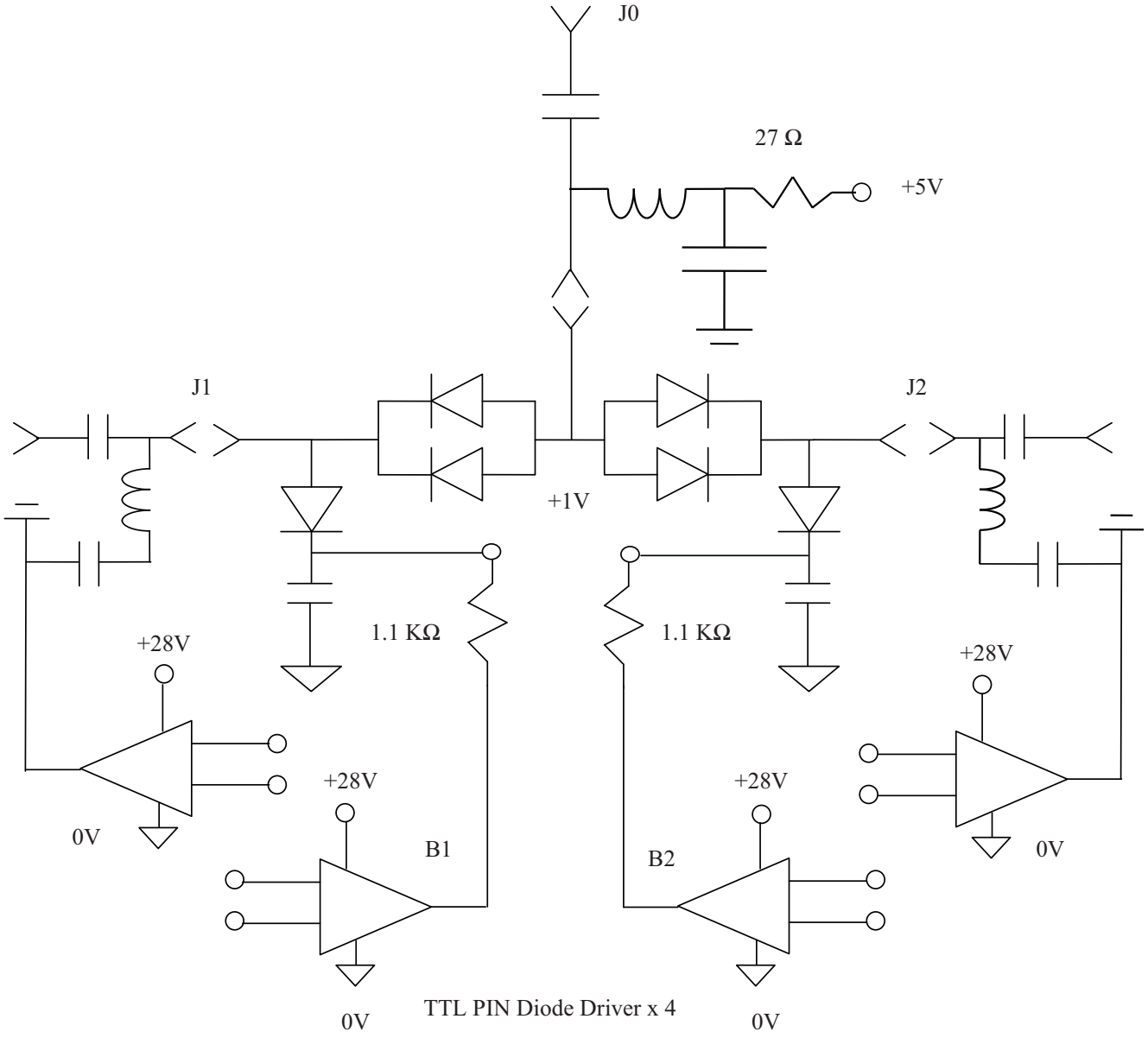
Notes:

1. PIN Diode Drivers compatible with the MSW2040 series SP2T PIN Diode Switches may be found on the Impellimax Product Website at www.impellimax.com.

MSW2040-204 & MSW2041-204 SP2T Schematic



SP2T Switch Schematic with RF Bias Network and Truth Table



RF Bias Network Values

Part Number	F (MHz)	DC Blocking Capacitors	Inductors	RF Bypass Capacitors
MSW2040-204	50 – 1,000	270 pF	560 nH	270 pF
MSW2041-204	400 – 4,000	27 pF	82 nH	270 pF

D.C. Bias to RF Truth Table

RF State	J1 Bias	J2 Bias	B1 Bias	B2 Bias
J1-J0 Low Loss & J2-J0 Isolation	0V @ 150 mA	+28 V @ 25 mA	+28V @ 0 mA	0 V @ 25 mA
J2-J0 Low Loss & J1-J0 Isolation	+28 V @ 0 mA	0V @ 150 mA	0 V @ 25 mA	+28 V @ 0 mA

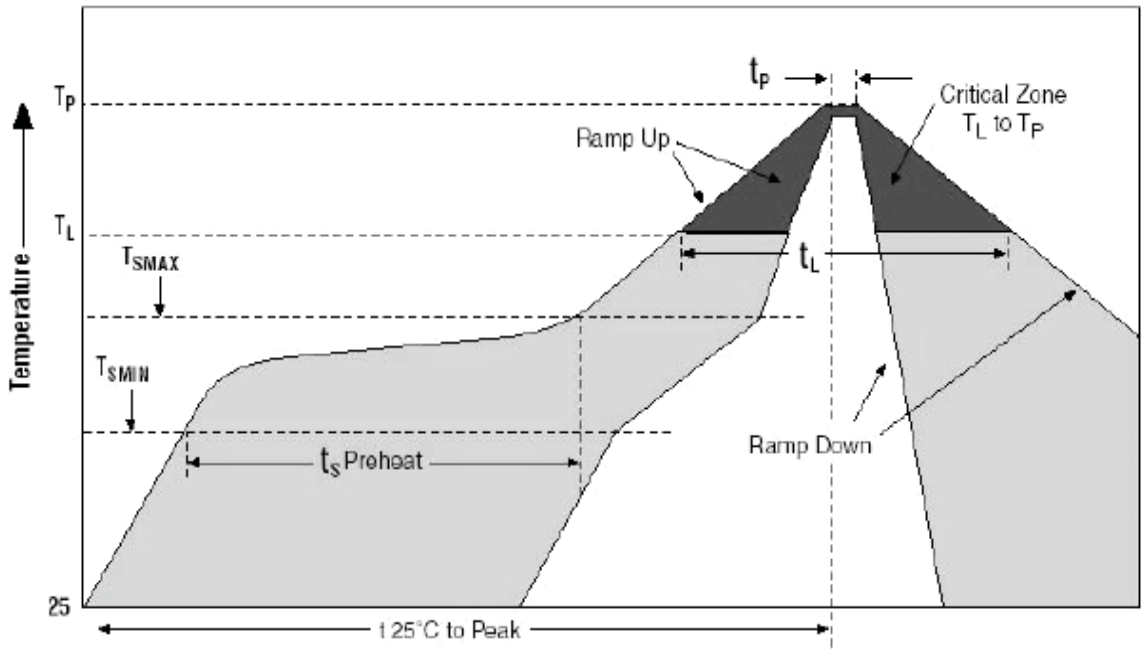
Minimum Reverse Bias Voltage @ J1, J2, B1, B2 vs. Frequency for 100 W C.W. Power with 1.5:1 VSWR

Part Number	F (MHz) & | - Vdc |	F (MHz) & | - Vdc |	F (MHz) & | - Vdc |	F (MHz) & | - Vdc |	F (MHz) & | - Vdc	F (MHz) & | - Vdc |
MSW2040-204	50 MHz | -120 V |	100 MHz | -110 V |	200 MHz | -85 V |	400 MHz | -55 V |	1,000 MHz | -28 V |	4,000 MHz NA
MSW2041-204	50 MHz NA	100 MHz NA	200 MHz | -110 V |	400 MHz | -85 V |	1,000 MHz | -55 V |	4,000 MHz | -28 V |

Notes:

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

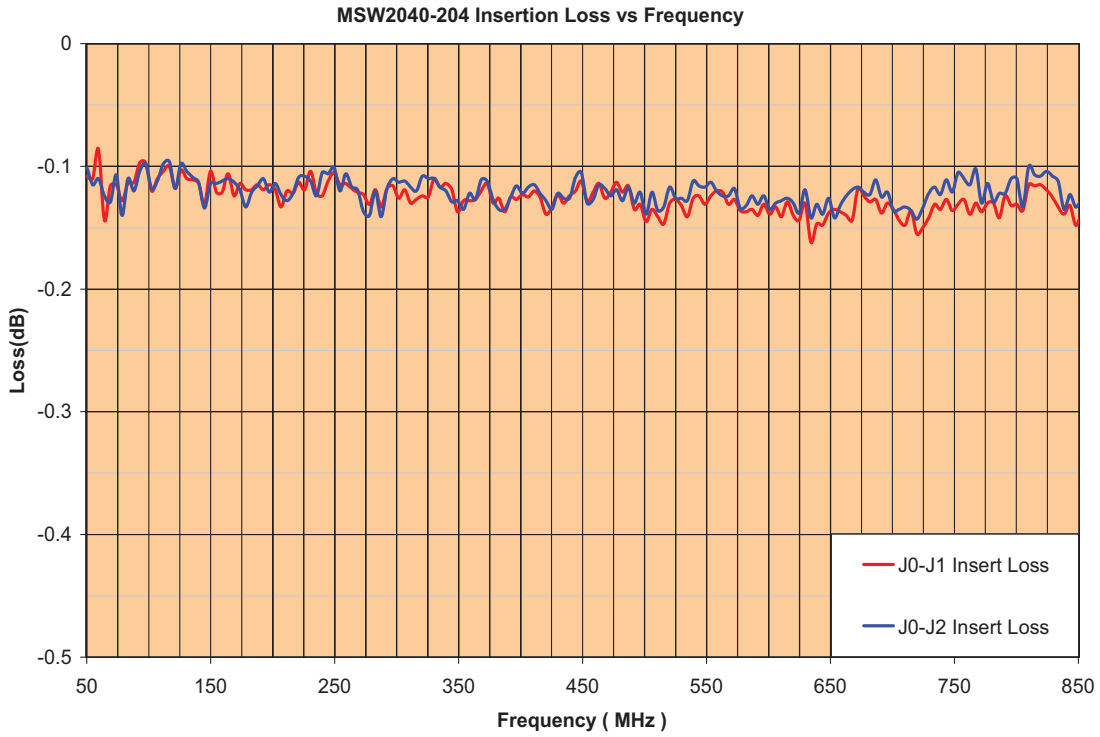
Graph1: Solder Re-Flow Time-Temperature Function

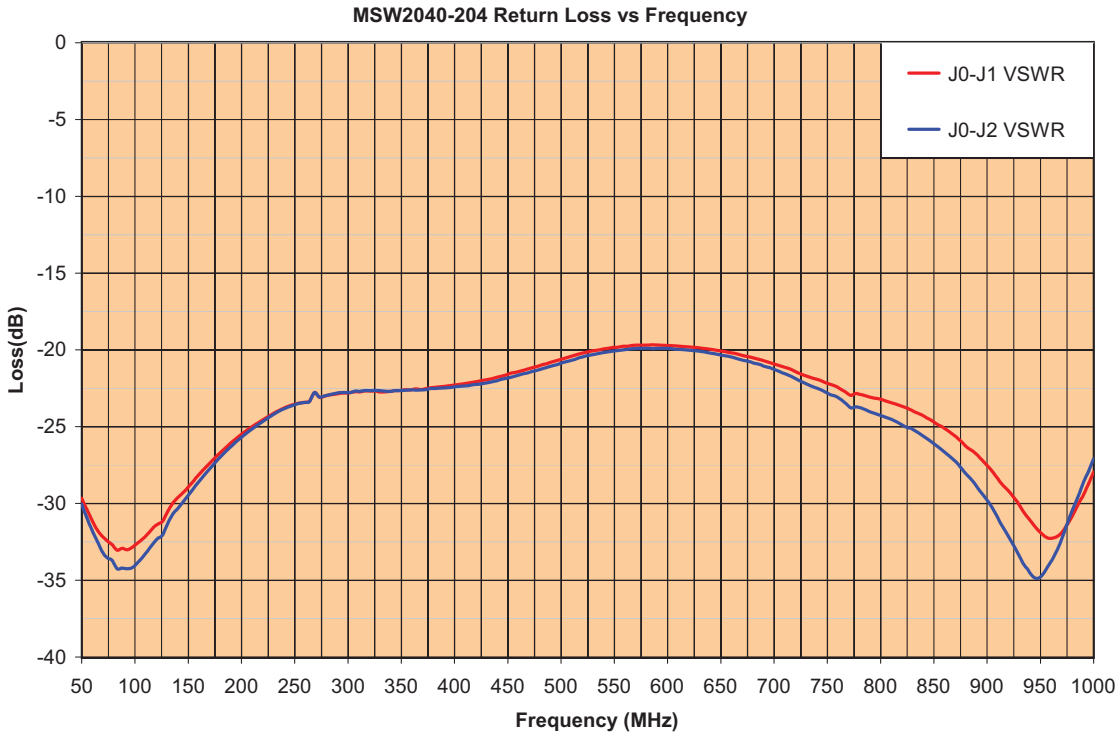


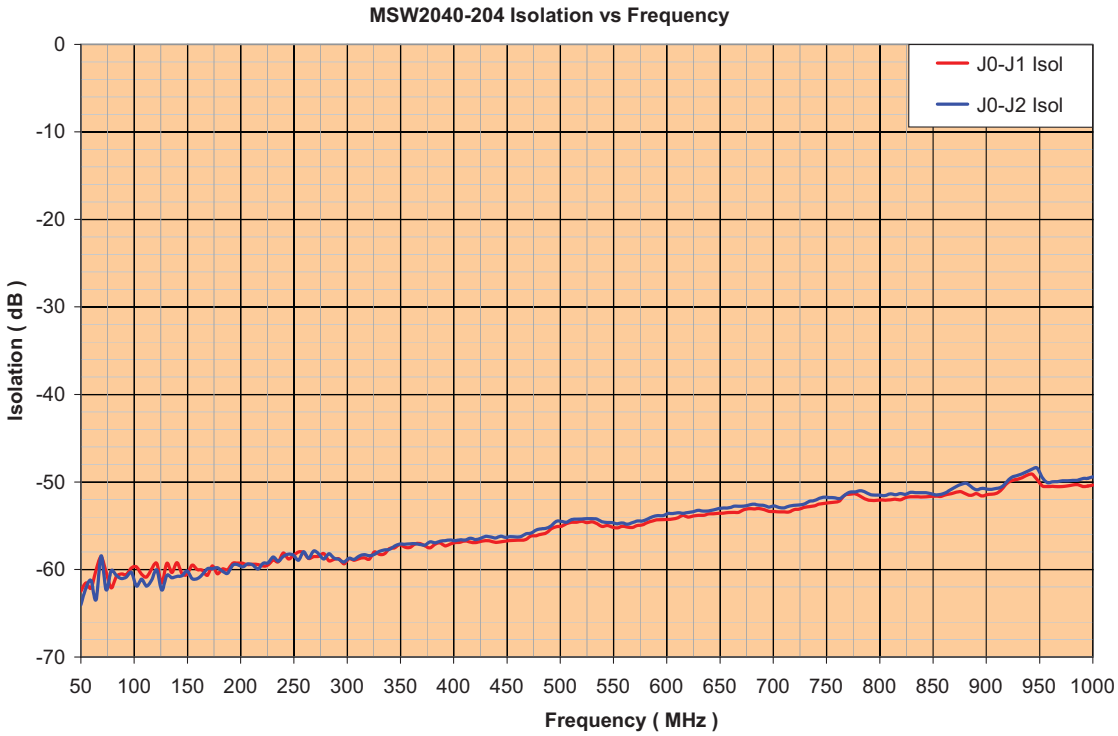
Absolute Maximum Ratings @ T_A = + 25 ºC (Unless Otherwise Defined)

Parameter	Absolute Maximum Value
Forward Current @ J0, J1 or J2	500 mA
Reverse Voltage @ J0, J1 or J2	| -200 | V
Reverse Voltage @ B1 or B2	| -125 | V
Forward Diode Voltage	1.2 V @ 500 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 2, 3 (page 2)	+50 dBm @ +85 ºC Case Temperature
Peak Incident Power Handling Source & Load VSWR = 1.5 :1 (Cold Switching & Hot Switching) Notes 2, 3 (page 2)	+57 @ 10 µS Pulse, 1 % Duty @ +85 ºC Case Temperature
Total Dissipated RF & D.C. Power (Cold Switching) Notes 2, 3 (page 2)	6.0 W @ +85 ºC Case Temperature

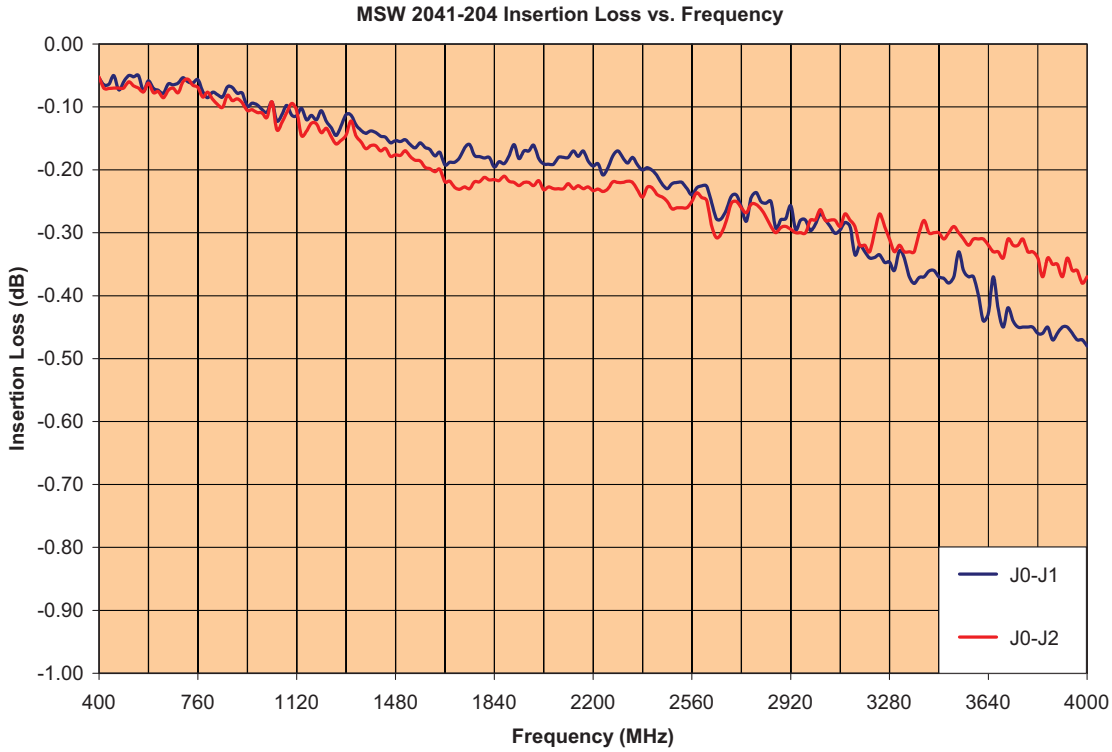
MSW2040-204 Small Signal Parametric Performance



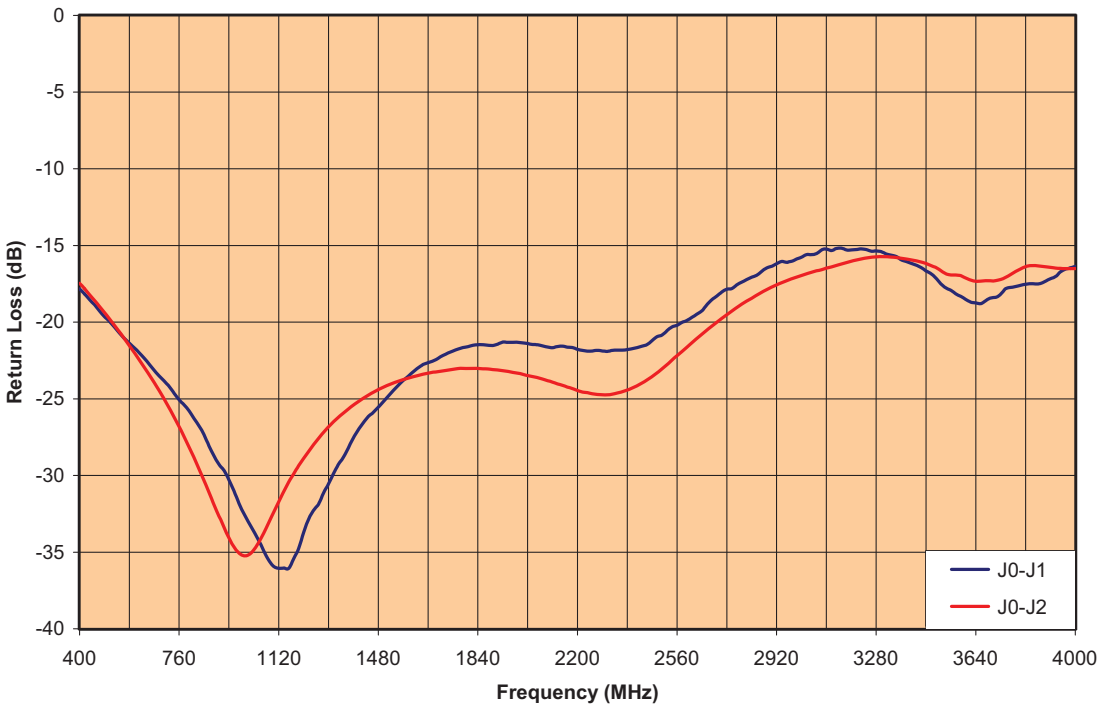




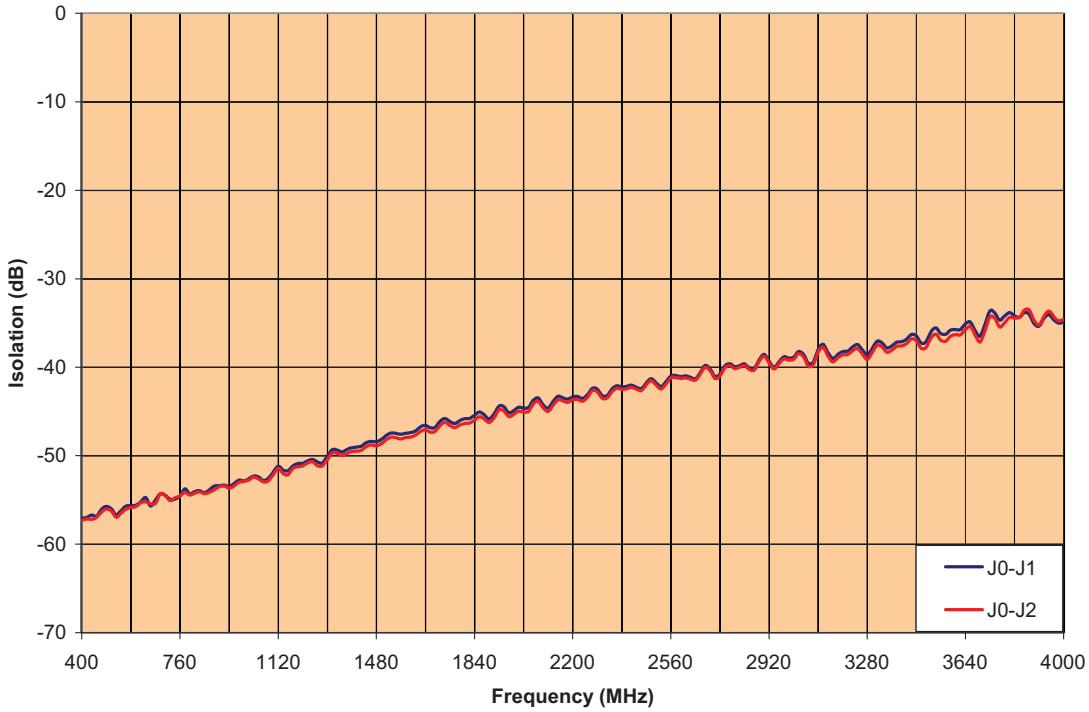
MSW2041-204 Small Signal Parametric Performance



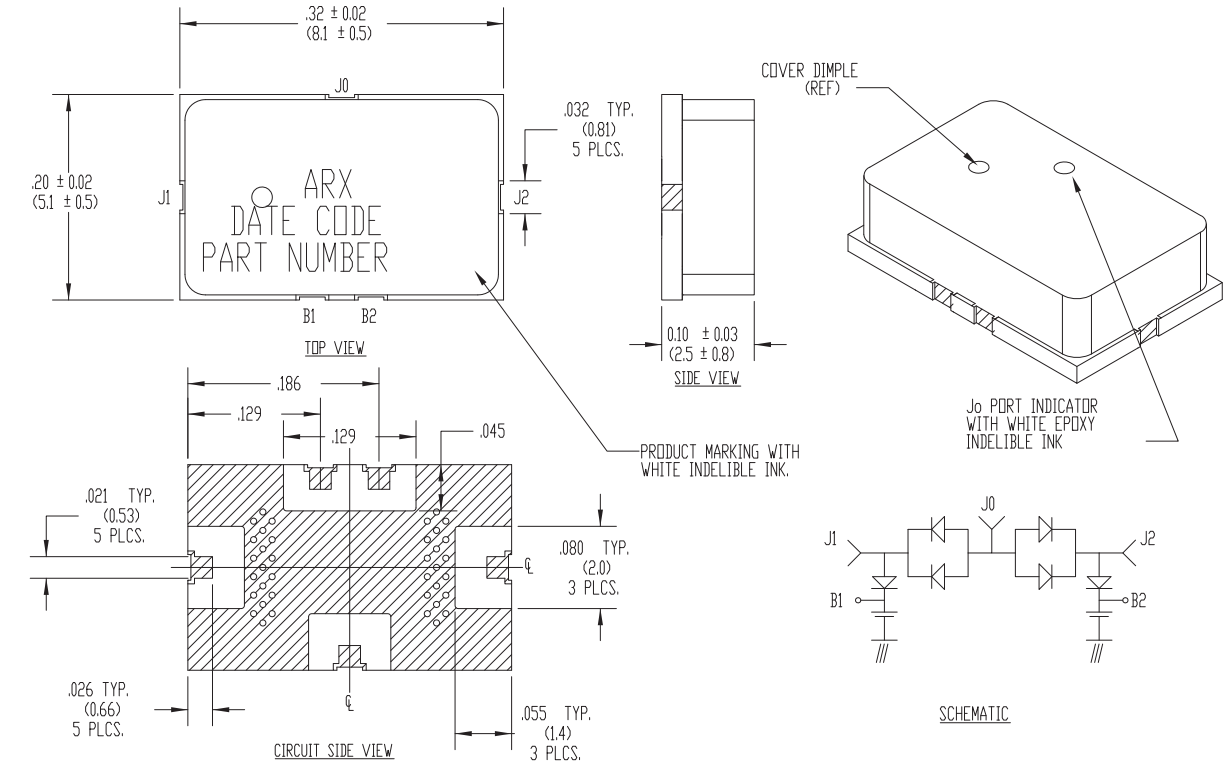
MSW 2041-204 Return Loss vs. Frequency



MSW2041-204 Isolation vs Frequency



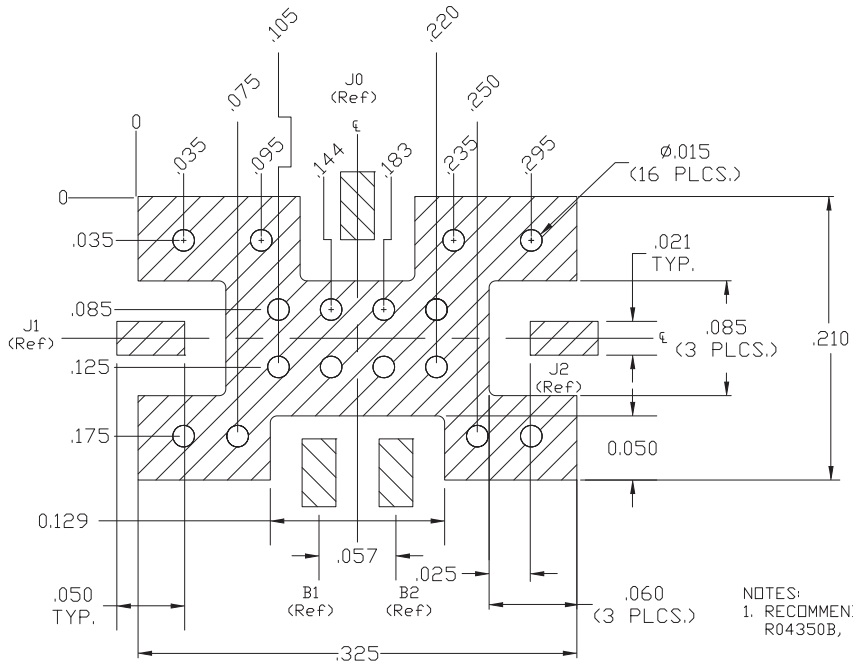
MSW2040-204 & MSW2041-204 SP2T Switch Outline (Case Style 204)



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 204 (CS204)



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

Part Number Ordering Information:

Part Number	Packaging
MSW2040-204-T	Tube
MSW2040-204-R	Tape-Reel
MSW2041-204-T	Tube
MSW2041-204-R	Tape-Reel
MSW2040-204-EVAL	RF Evaluation Board
MSW2041-204-EVAL	RF Evaluation Board

Assembly Instructions

The MSW2040-204 and MSW2041-204 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 Maintauined 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

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