TDSW002040X-198

Product Specification

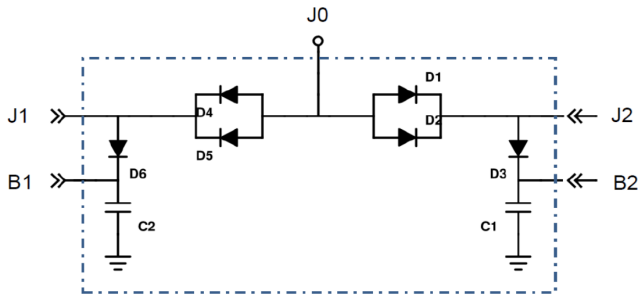
June 21, 2021

SPDT SMT Extended High Power PIN Diode

Switch Features

- Wide Operating Frequency Band .... 100 MHz to 2.0 GHz
- Surface Mount SPDT Switch..... 10.1 mm x 6.2 mm x 2.5 mm
- Average Power ..... +56 dBm
- Peak Power ..... +60 dBm
- Low Insertion Loss ..... 0.8 dB
- High IIP3 ..... +65 dBm
- High Linearity
- RoHS Compliant
- –65 °C to +125 °C Operating temperature range

Figure 1 TDSW002040X-198 Schematic



Applications

- Radar T/R Modules
- IFF Systems
- High Power Transmit/Receive Switching
- Switch Bank Filters
- Mil-Com Radios

Product Description

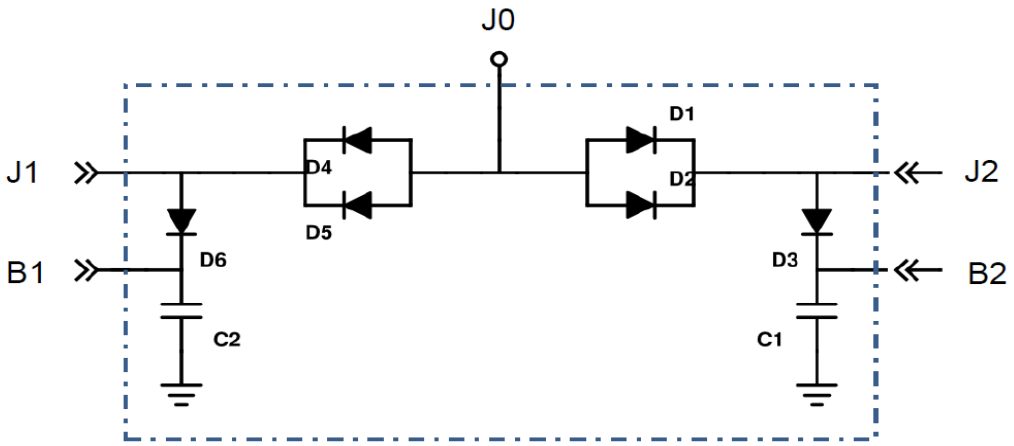
The TDSW002040X-198 SPDT surface mount, Extra High Power, PIN Diode switch operates across the frequency band from 100 MHz to 2.0 GHz. The TDSW002040X-198 Extra High Power switch leverages high reliability hybrid manufacturing processes which yield both superior RF and thermal characteristics performance 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 factor (10.1 mm x 6.2 mm x 2.5 mm) offers world class power handling, low insertion loss, and superior intermodulation performance exceeding all competitive technologies. The TDSW002040X-198 symmetrical switch is tailored to minimize Transmit-to-Antenna loss while maximizing Transmit-to-Receive isolation and to enable maximum flexibility as the designer can assign either port as Transmit Port and the other as the Receive Port. The extremely low thermal resistance of the hybrid assembly permits reliably handling up to +56 dBm CW power and up to +60 dBm peak RF incident power while operating at the $T_{amb\ (MAX)}$ = +125 °C.

The TDSW002040X-198 Extra High Power SPDT switch is intended for use in high power, high reliability, mission critical applications from 100 MHz to 2.0 GHz. The manufacturing process has been proven through decades of extensive use in high reliability applications and is capable of being screened to industry HIREL standards.

ESD and Moisture Sensitivity Level Rating:

The TDSW002040X-198 SPDT switch is fully RoHS compliant and carries an ESD rating of Class 1C, Human Body Model (HBM) with a moisture sensitivity rating of MSL 1.

TDSW002040X-198 Schematic



TDSW002040X-198 Electrical Specifications @ Zo = 50 Ω; Ta = +25 °C

Parameter	Symbol	Test Condition	Min Value	Typ Value	Max Value	Units
Frequency	F		100		2,000	MHz
Insertion Loss	IL	Bias State 1: port J0 to J1 Bias State 2: port J0 to J2		0.8	1	dB
Return Loss	RL	Bias State 1: port J0 to J1 Bias State 2: port J0 to J2	7	10		dB
Isolation	ISO	Bias State 1: port J0 to J2 Bias State 2: port J0 to J1	43	47		dB
CW Incident Power /1	P_{inc}(CW)	Source & Load VSWR = 1.5:1			+56	dBm
Peak Incident Power /1	P_{inc}(Pk)	Source & Load VSWR = 1.5:1 Pulse width = 10 us, Duty Cycle = 1%			+60	dB
Switching Time /1	t_{SW}	10% to 90% RF Voltage,TTL rep rate = 100 kHz		2		µsec
Input 3rd Order Intercept Point /1	IIP3	F_1=500 MHz, F_2=510 MHz,P_1=P_2=10 dBm Measured on path biased to low loss state	60	65		dBm

Note:
/1 Guaranteed by characterization

TDSW002040X-198 Absolute Maximum Ratings @ T_A = +25 °C (unless otherwise noted)

Parameters	Conditions	Absolute Maximum Value
Forward Current –Ant, Tx or Rx Port		250 mA
Forward Current – DC Bias Port		100 mA
Reverse Voltage – Tx or Rx Port		125 V
Reverse Voltage – DC Bias Port		125 V
Forward Diode Voltage	I_F = 250 mA	1.2 V
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 – J0-J1 or J0-J2 /1	Source & Load VSWR = 1.5:1, T_{CASE} = +55 °C, cold switching	+56 dBm
Peak Incident Power Handling – J0-J1 or J0-J2 /1	Source & Load VSWR = 1.5:1, T_{CASE}= +55 °C, cold switching, Pulse Width = 10 µs, Duty Cycle = 1%	+60 dBm

Note:
/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 grounding.

Control Conditions Table

	State 1	State 2
Test Condition	J0-J1 in Low Insertion Loss J0-J2 in Isolation	J0-J1 in Isolation J0-J2 in Low Insertion Loss
B1	V_{HIGH}, 0 mA	0 V, -25 mA
B2	0 V, -25 mA	V_{HIGH}, 0 mA /1
J0	~0.9 V, +150 mA	~0.9 V, +150 mA
J1	0 V, -150 mA	V_{HIGH}, +25 mA /1
J2	V_{HIGH}, 25 mA /1	0 V, -150 mA

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.

/1 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 Minimum Reverse Bias Voltage Table shown below.

Control Truth Table for TDSW002040X-198

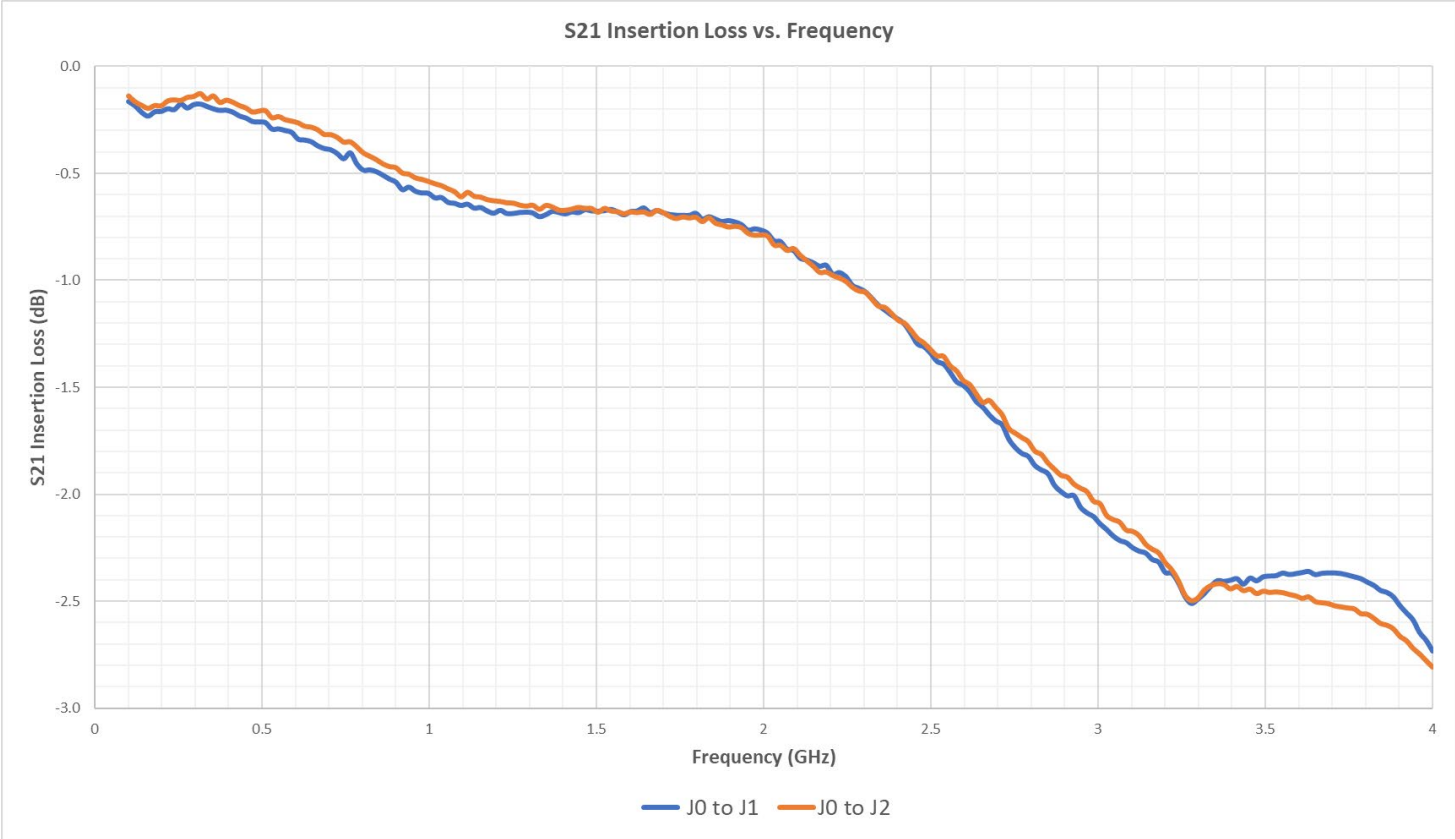
J0 – J1 Path	J0-J2 Path	J1 Bias (notes /1 & /2)	J2 Bias (notes /1 & /2)
Low Loss	Isolation	V_{LOW} @, I = -100 mA	V = +1 V I = +25 mA
Isolation	Low Loss	V =+1 V, I = +25 mA	V = V_{LOW}, I = -100 mA

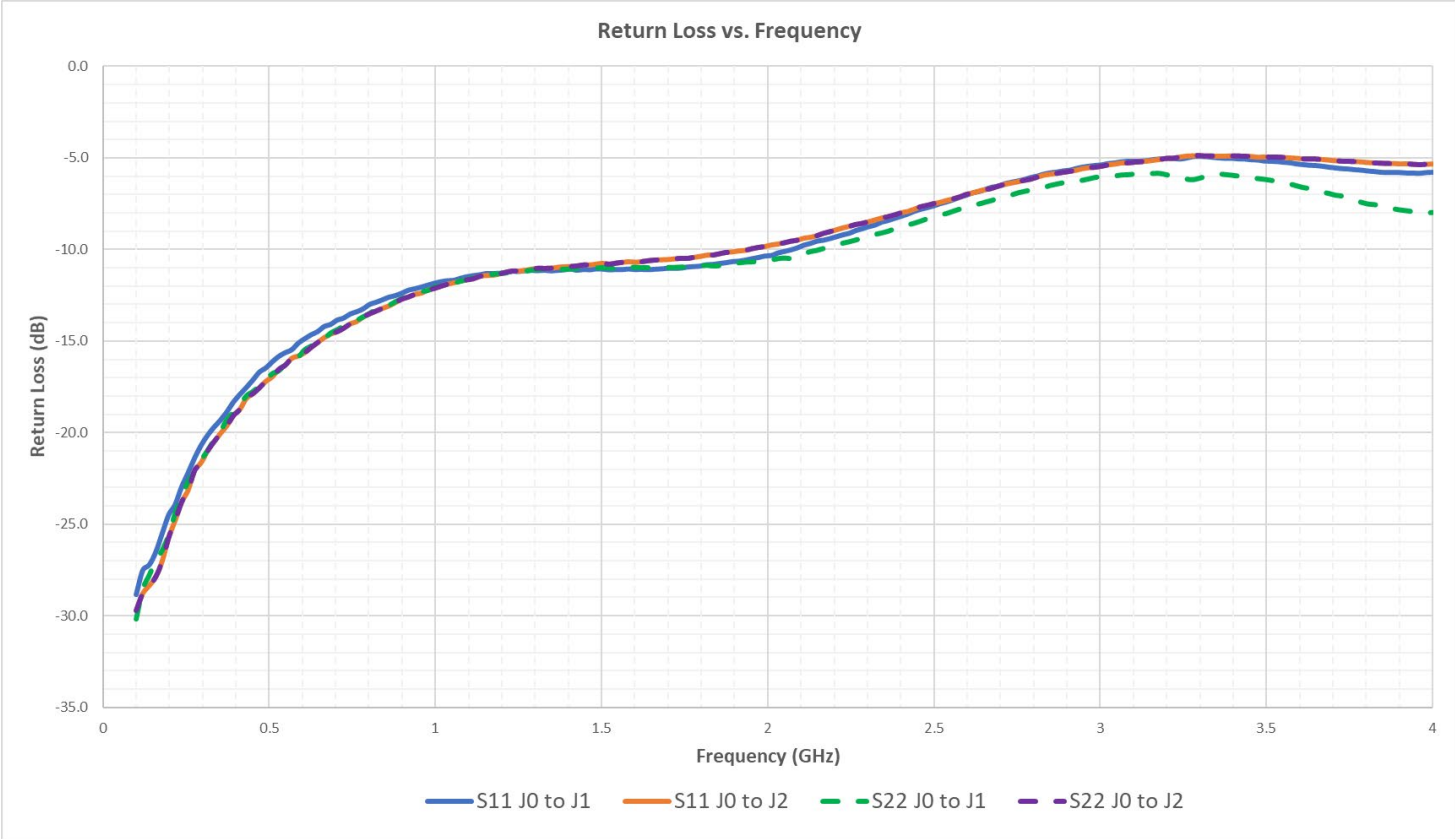
Notes:
/1 V_{LOW} determined by frequency of operation.
/2 PIN diode min reverse DC voltage (V_{HIGH}) to maintain high resistance state in the OFF PIN diode is determined by RF frequency. Incident power, duty cycle, characteristic impedance and VSWR as well as by characteristics of the diode. The recommended min reverse bias voltage (V_{HIGH}) values are provided in the Min Reverse Bias Voltage Table of this data sheet.

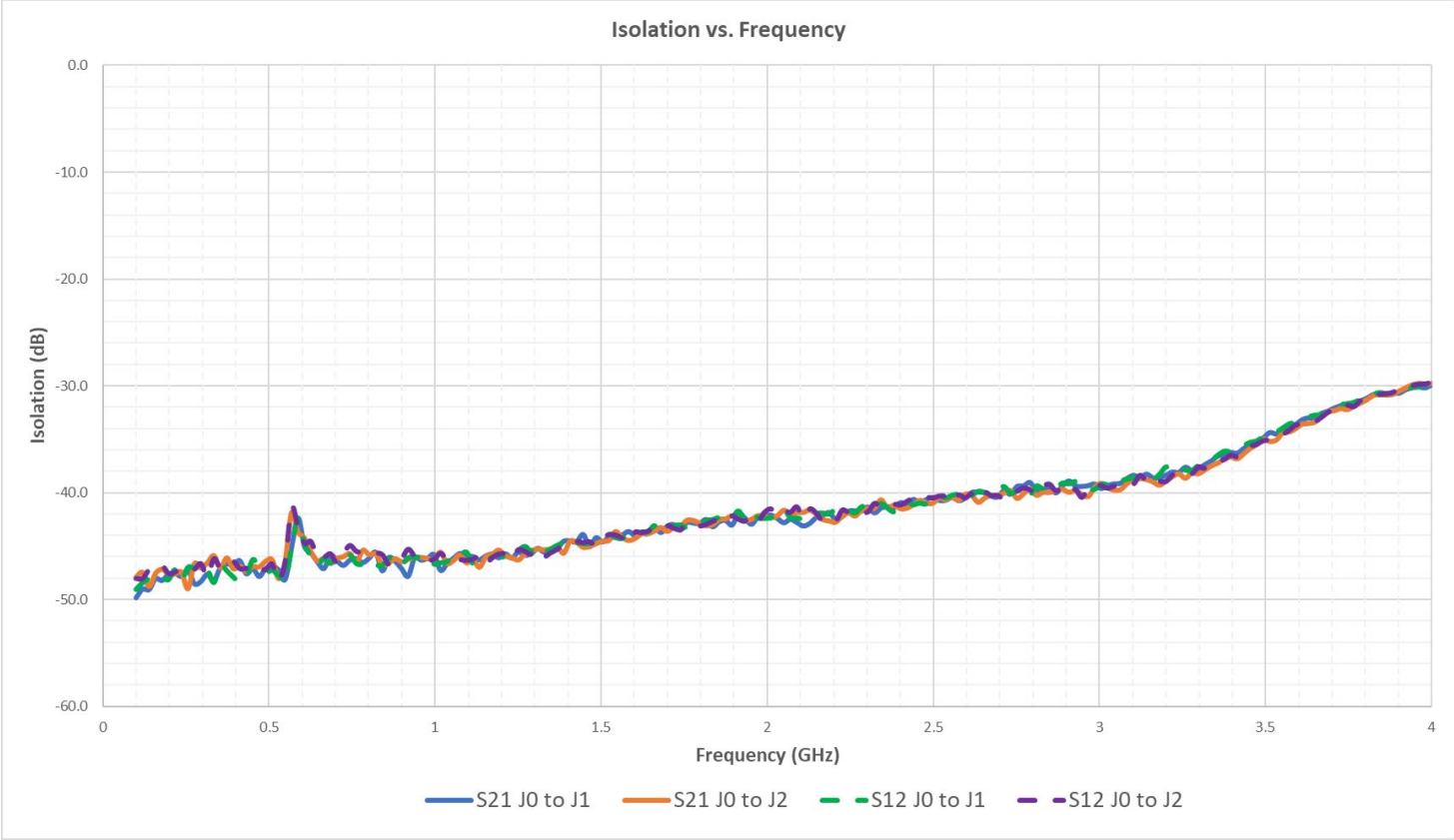
TDSW002040X-198 Minimum Reverse Bias Voltage Table

	Frequency of Operation (MHz)				
Part Number	100	200	400	1,000	2,000
TDSW002040X-198	150 V	115 V	85 V	35 V	28 V

TDSW002040X-198 Small Signal Parametric Performance:





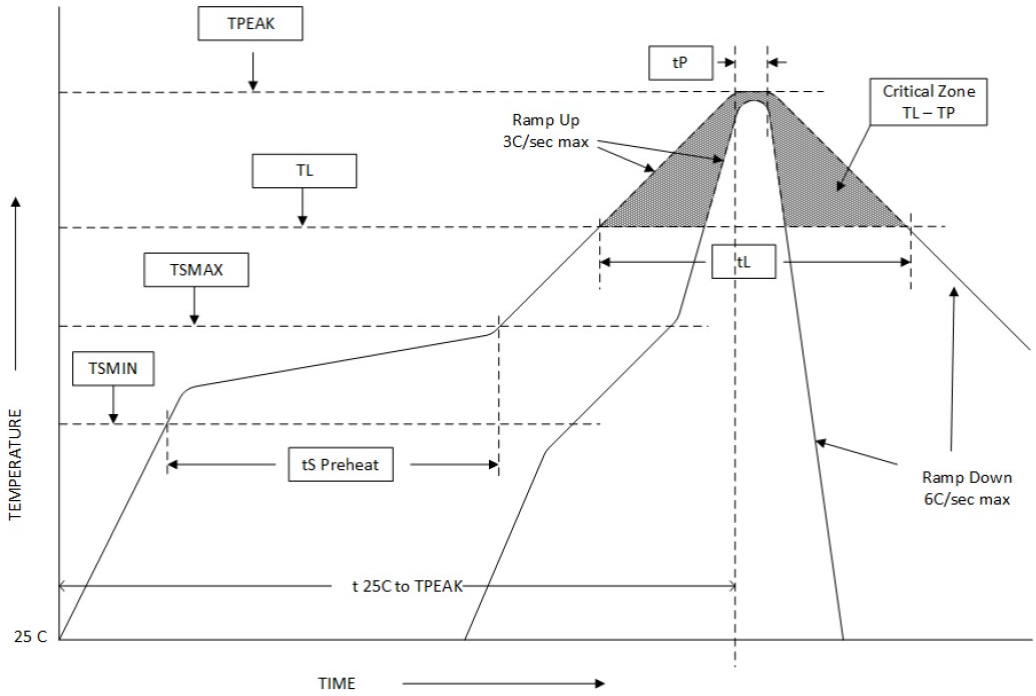


Assembly Instructions

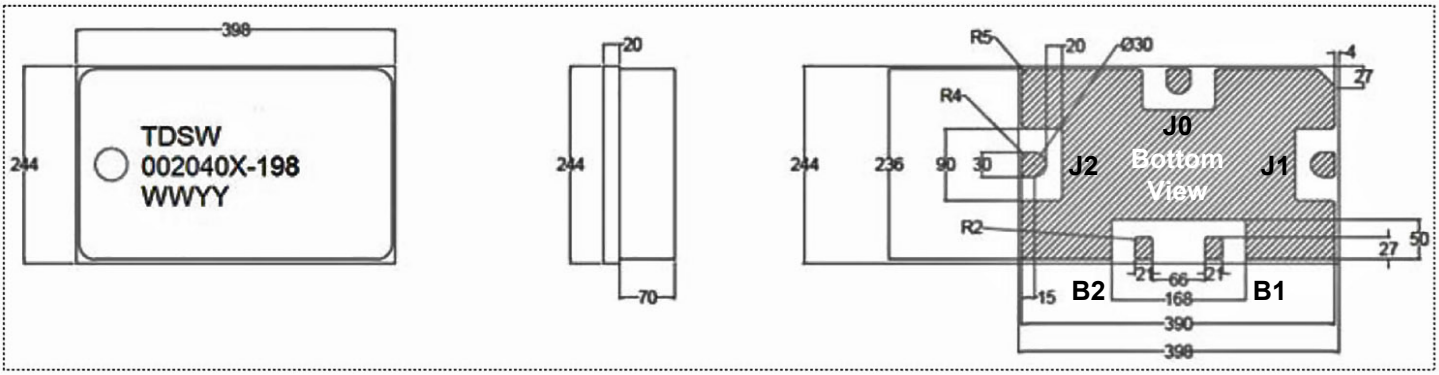
The TDSW002040X-198 may be attached to the printed circuit card using solder reflow procedures using either RoHS or Sn63/ Pb37 type solders per the Table and Temperature Profile Graph shown below:

Profile Parameter	Sn-Pb Assembly Technique	RoHS Assembly Technique
Average ramp-up rate (T_L to T_P)	3 °C/s (max)	3 °C/s (max)
Preheat Temp Min (T_{smin}) Temp Max (T_{smax}) Time (min to max) (t_s)	100 °C 150 °C 60 – 120 s	100 °C 150 °C 60 – 120 s
T_{smax} to T_L Ramp up Rate		3 °C/s (max)
Peak Temp (T_P)	225 °C +0 °C / -5 °C	245 °C +0 °C / -5 °C
Time within 5 °C of Actual Peak Temp (T_P)	10 to 30 s	20 to 40 s
Time Maintained Above: Temp (T_L) Time (t_L)	 183 °C 60 to 150 s	 217 °C 60 to 150 s
Ramp Down Rate	6 °C/s (max)	6 °C/s (max)
Time 25 °C to T_P	6 minutes (max)	8 minutes (max)

Solder Re-Flow Time-Temperature Profile



TDSW002040X-198 SPDT Package Outline Drawing

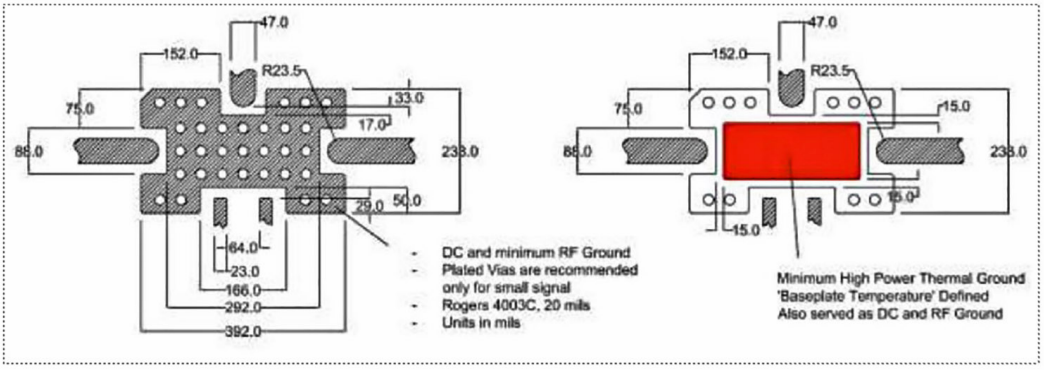


Note:
Metalized area on backside is the RF, dc and Thermal ground. In user's end application this surface temperature must be managed to meet the power handling requirements. External connections shown are: B1. B2, J0, J1, and J2.

Thermal Design Considerations

The design of the TDSW002040X-198 High Power Switch 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 TDSW002040X-198



Part Number Ordering Details

The TDSW002040X-198 High Power Switch is available in the following format:

Part Number	Packaging
TDSW002040X-198	Gel-Pack

Contact Information:

Teledyne e2v HiRel Electronics at: www.tdehirel.com

Email: hirel@teledyne.com

Preliminary Specification: The product is in a formative or design stage. The data sheet contains design target specifications for product development. Specifications and features may change in any manner without notice.
Advanced Information: The data sheet contains preliminary data. Additional data may be added at a later date. Teledyne e2v HiRel Electronics reserves the right to change specifications at any time without notice in order to supply the best possible product.
Product Specification - The data sheet contains final data. In the event Teledyne e2v HiRel Electronics decides to change the specifications, Teledyne e2v HiRel will notify customers of the intended changes by issuing a CNF (Customer Notification Form).

The information in this data sheet is believed to be reliable. However, Teledyne e2v HiRel Electronics assumes no liability for the use of this information. Use shall be entirely at the user's own risk. No patent rights or licenses to any circuits described in this data sheet are implied or granted to any third party. Teledyne e2v HiRel products are not designed or intended for use in devices or systems intended for surgical implant, or in other applications intended to support or sustain life, or in any application in which the failure of the Teledyne e2v HiRel product could create a situation in which personal injury or death might occur. Teledyne e2v HiRel assumes no liability for damages, including consequential or incidental damages, arising out of the use of its products in such applications.

Disclaimers: The information in this document is believed to be reliable. However, Teledyne e2v HiRel Electronics assumes no liability for the use of this information. Use shall be entirely at the user's own risk. No patent rights or licenses to any circuits described in this document are implied or granted to any third party. Teledyne e2v HiRel's products are not designed or intended for use in devices or systems intended for surgical implant, or in other applications intended to support or sustain life, or in any application in which the failure of the Teledyne e2v HiRel's product could create a situation in which personal injury or death might occur. Teledyne e2v HiRel Electronics assumes no liability for damages, including consequential or incidental damages, arising out of the use of its products in such applications.