

## PROTECTION PRODUCTS

### Description

RailClamp® TVS diodes are designed to provide ESD and EOS protection on high-speed ports. RClamp3521ZA is a 1-line, bidirectional device with a typical capacitance of only 0.45pF and a working voltage of 3.5V. It is manufactured using Semtech's proprietary snap-back technology which minimizes both ESD peak clamping and TLP clamping voltages. The dynamic resistance is extremely low (0.12 Ohms typical) providing optimum protection of sensitive circuits.

RClamp3521ZA is in a 2-pin SLP0603P2X3F package measuring 0.6 x 0.3 x 0.25mm. Leads are finished with lead-free NiAu.

### Features

- ESD protection for high speed lines to:
  - ◆ IEC 61000-4-2 (ESD): +/-20kV (Contact)
  - ◆ IEC 61000-4-4 (EFT): 4kV, 80A
  - ◆ IEC 61000-4-5 (Lightning): 6A (tp = 8/20µs)
- Ultra-small package
- Protects one line
- Low ESD clamping voltage
- Working voltage: 3.5V
- Low capacitance: 0.45 pF Typical
- Low leakage current
- Low dynamic resistance
- Solid-state silicon-avalanche technology

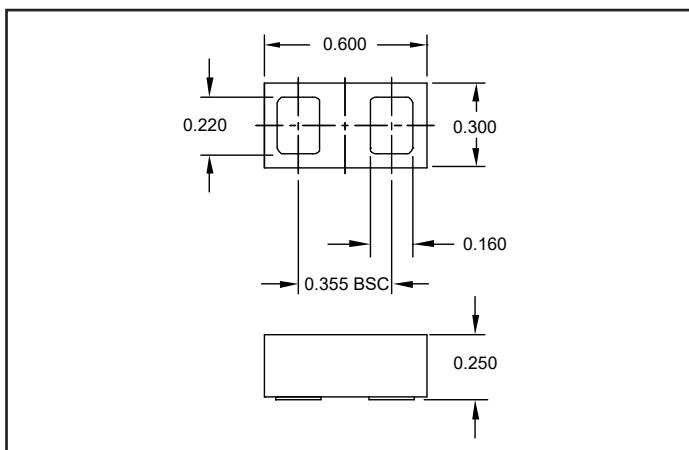
### Mechanical Characteristics

- SLP0603P2X3F package
- Pb-Free, Halogen Free, RoHS/WEEE compliant
- Nominal Dimensions: 0.6 x 0.3 x 0.25 mm
- Lead Finish: NiAu
- Marking: Marking code
- Packaging: Tape and Reel

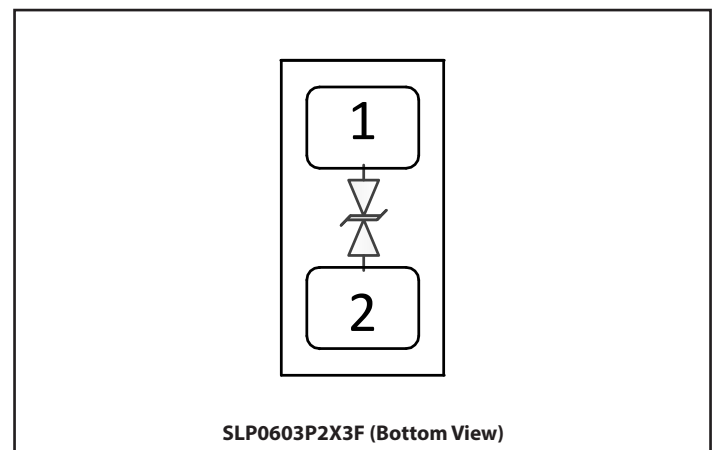
### Applications

- USB3.0 / USB 3.1
- USB Type-C
- V-By-One
- MHL / MDDI
- LVDS Interfaces

### Package Dimension



### Schematic & Pin Configuration



## Absolute Maximum Rating

Rating	Symbol	Value	Units
Peak Pulse Power ( $t_p = 1.2/50\mu s$ )	$P_{PK}$	30	W
Peak Pulse Current ( $t_p = 1.2/50\mu s$ )	$I_{PP}$	6	A
ESD per IEC 61000-4-2 (Air) <sup>(1)</sup> ESD per IEC 61000-4-2 (Contact) <sup>(1)</sup>	$V_{ESD}$	$\pm 25$ $\pm 20$	kV
Operating Temperature	$T_J$	-40 to +125	°C
Storage Temperature	$T_{STG}$	-55 to +150	°C

## Electrical Characteristics (T=25°C unless otherwise specified)

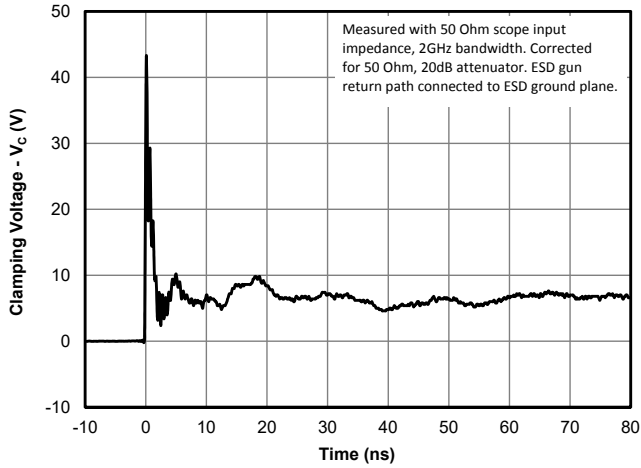
Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Reverse Stand-Off Voltage	$V_{RWM}$				3.5	V
Reverse Breakdown Voltage	$V_{BR}$	$I_t = 1mA$	5.5	7.5	8.5	V
Reverse Leakage Current	$I_R$	$V_{RWM} = 3.5V$		<1	50	nA
Holding Current	$I_H$		50	120		mA
Clamping Voltage <sup>2</sup>	$V_C$	$I_{PP} = 6A, t_p = 1.2/50\mu s, 8/20\mu s$ Combination Waveform		5		V
ESD Clamping Voltage <sup>3</sup>	$V_C$	$I = 4A, t_{lp} = 0.2/100ns$		4.5		V
		$I = 16A, t_{lp} = 0.2/100ns$		6		
Dynamic Resistance <sup>3,4</sup>	$R_{DYN}$	$t_{lp} = 0.2/100ns$		0.12		$\Omega$
Junction Capacitance	$C_J$	$V_R = 0V, f = 1MHz$		0.45	0.55	pF

Notes:

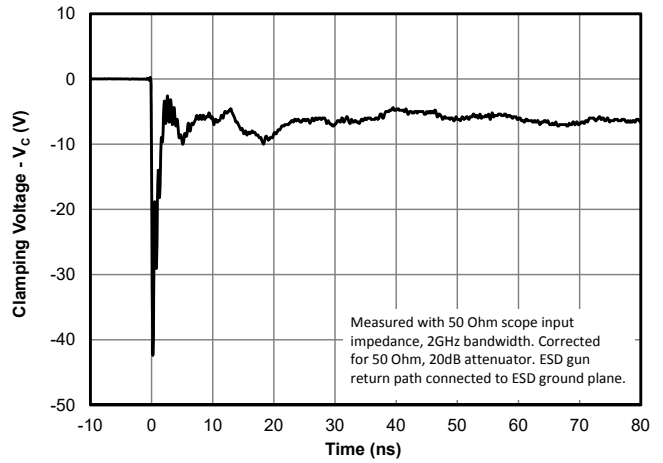
- 1) ESD gun return path connected to ESD ground plane.
- 2) Measured using a 1.2/50us voltage, 8/20us current combination waveform,  $R_s = 8 \text{ Ohms}$ . Clamping is defined as the peak voltage across the device after the device snaps back to a conducting state.
- 3) Transmission Line Pulse Test (TLP) Settings:  $t_p = 100ns, t_r = 0.2ns, I_{TLP}$  and  $V_{TLP}$  averaging window:  $t_1 = 70ns$  to  $t_2 = 90ns$ .
- 4) Dynamic resistance calculated from  $I_{TLP} = 4A$  to  $I_{TLP} = 16A$

# Typical Characteristics

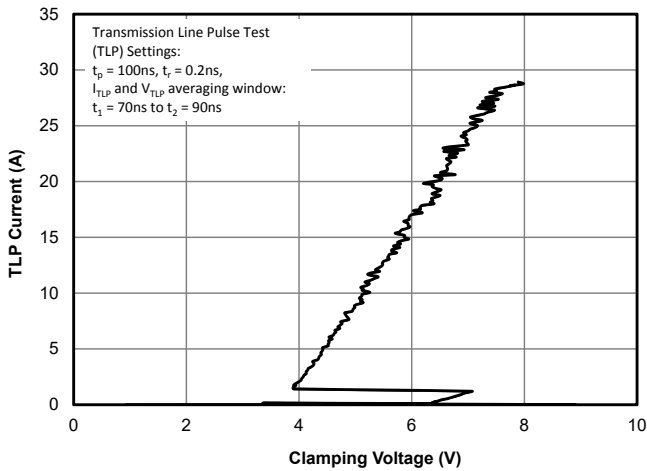
**ESD Clamping (8kV Contact per IEC 61000-4-2)**



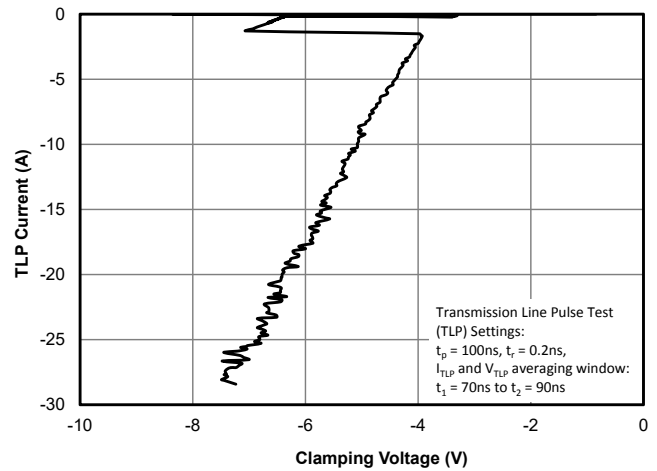
**ESD Clamping (-8kV Contact per IEC 61000-4-2)**



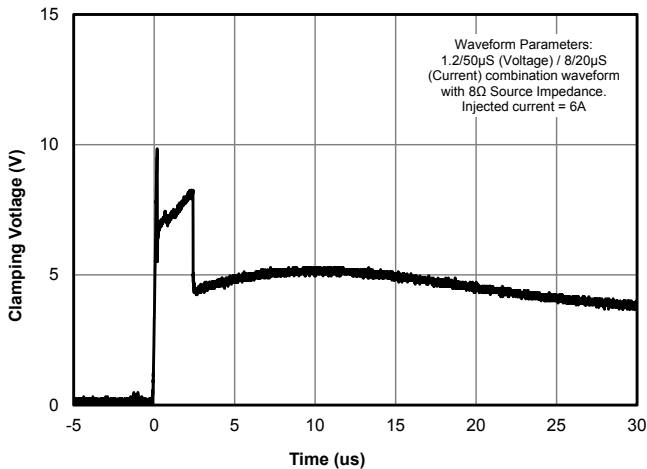
**TLP Characteristic (Positive Pulse)**



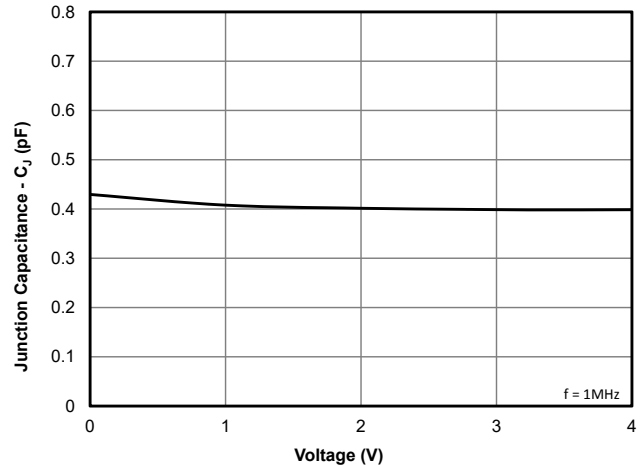
**TLP Characteristic (Negative Pulse)**



**Clamping Characteristic (6A, Combination Waveform)**

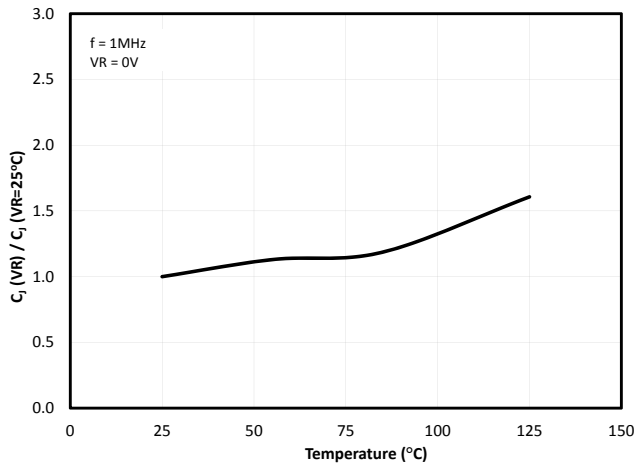


**Capacitance vs. Reverse Voltage**

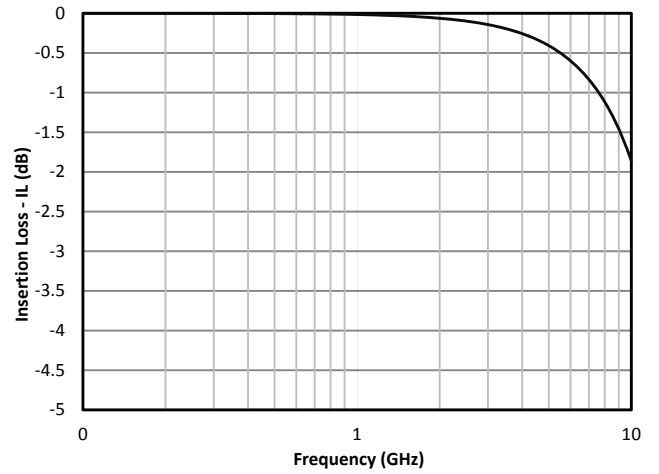


# Typical Characteristics (Continued)

### Capacitance vs. Temperature



### Insertion Loss - S21



# Application Information

## Assembly Guidelines

The small size of this device means that some care must be taken during the mounting process to insure reliable solder joints. The figure at the right details Semtech's recommended mounting pattern. Recommended assembly guidelines are shown in Table 1. Note that these are only recommendations and should serve only as a starting point for design since there are many factors that affect the assembly process. Exact manufacturing parameters will require some experimentation to get the desired solder application.

## Solder Stencil

Stencil design is one of the key factors which will determine the volume of solder paste which is deposited onto the land pad. The area ratio of the stencil aperture will determine how well the stencil will print. The area ratio takes into account the aperture shape, aperture size, and stencil thickness. A minimum area ratio of 0.66 is preferred for the subject package. The area ratio of a rectangular aperture is given as:

$$\text{Area Ratio} = (L * W) / (2 * (L + W) * T)$$

Where:

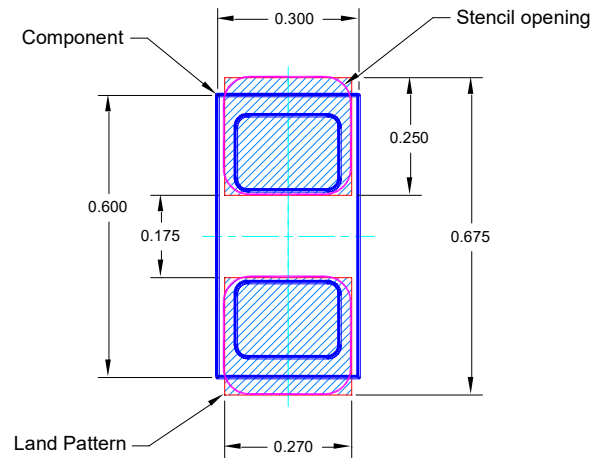
L = Aperture Length

W = Aperture Width

T = Stencil Thickness

Semtech recommends a stencil with square aperture and rounded corners for consistent solder release. The stencil should be laser cut with electro-polished finish. A stencil thickness of 0.075mm (0.003") is recommended. A 0.100mm (0.004") stencil may be used, however the stencil opening may need to be increased slightly to achieve the desired area ratio to ensure proper solder coverage on the pad.

## Recommended Mounting Pattern



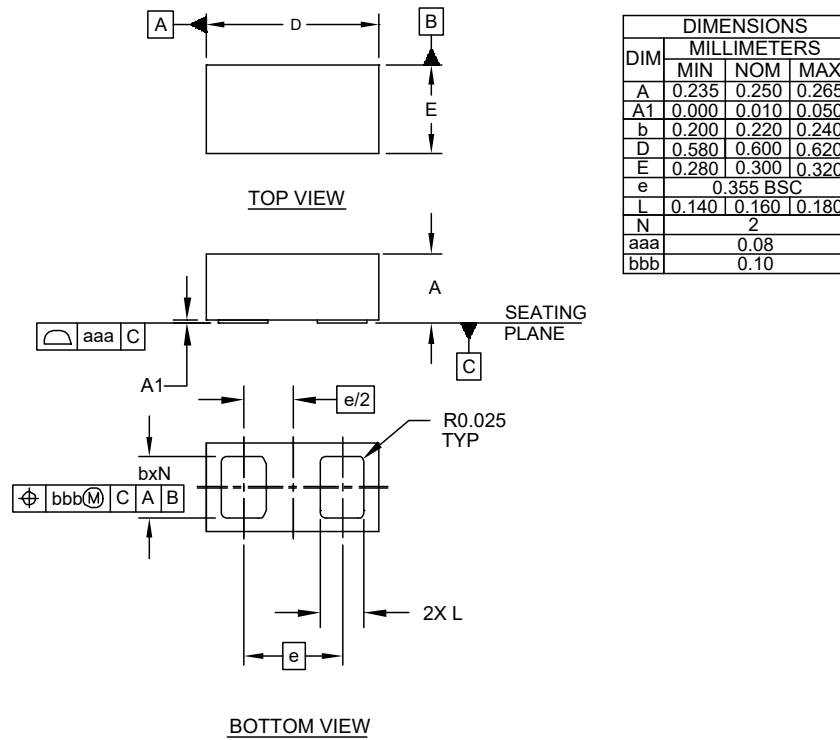
All Dimensions are in mm.

 Land Pad.  Stencil opening  Component

Table 1 - Assembly Guidelines

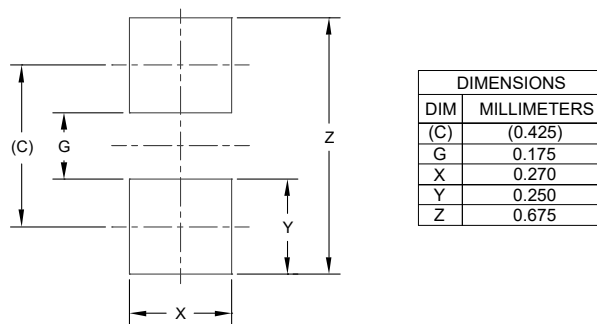
Assembly Parameter	Recommendation
Solder Stencil Design	Laser Cut, Electro-Polished
Aperture Shape	Rectangular with Rounded Corners
Solder Stencil Thickness	0.075mm (0.003") or 0.100mm (0.004")
Solder Paste Type	Type 4 Size Sphere or Smaller
Solder Reflow Profile	Per JEDEC J-STD-020
PCB Solder Pad Design	Solder Mask Defined or Non Solder Mask Defined
PCB Pad Finish	OSP or NiAu

# Outline Drawing - SLP0603P2X3F



NOTES:  
1. CONTROLLING DIMENSIONS ARE IN MILLIMETERS (ANGLES IN DEGREES).

# Land Pattern - SLP0603P2X3F

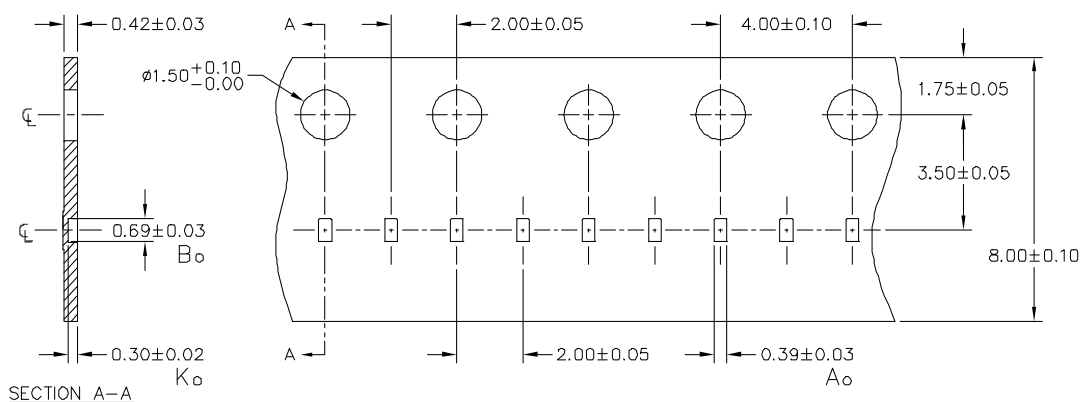


NOTES:  
1. CONTROLLING DIMENSIONS ARE IN MILLIMETERS (ANGLES IN DEGREES).  
2. THIS LAND PATTERN IS FOR REFERENCE PURPOSES ONLY.  
CONSULT YOUR MANUFACTURING GROUP TO ENSURE YOUR COMPANY'S MANUFACTURING GUIDELINES ARE MET.

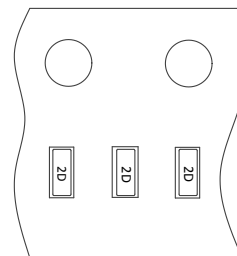
## Marking Code

2D

## Tape and Reel Specification



NOTES: ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.



## Ordering Information

Part Number	Qty per Reel	Reel Size
RClamp3521ZATFT	15,000	7"
RClamp3521ZATNT	10,000	7"



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