

PROTECTION PRODUCTS

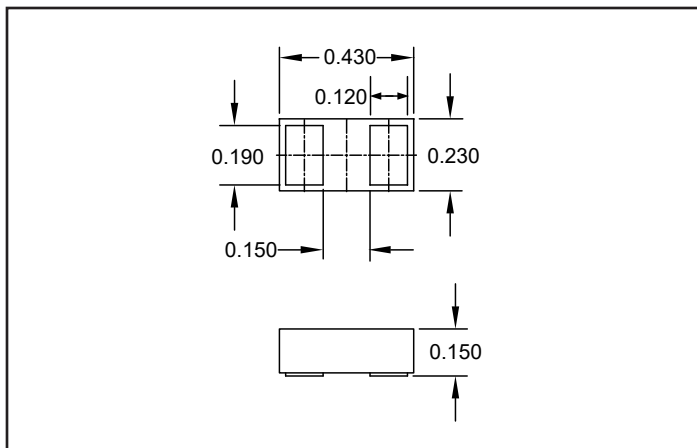
Description

RailClamp® TVS diodes are ultra low capacitance devices designed to protect sensitive electronics from damage or latch-up due to ESD, EFT, and EOS. They are designed for use on high speed ports in applications such as cell phones, notebook computers, and other portable electronics. These devices offer desirable characteristics for board level protection including fast response time, low operating and clamping voltage, and no device degradation.

RClamp®3331Z2C features extremely good ESD protection characteristics highlighted by low typical dynamic resistance, low peak ESD clamping voltage, and high ESD withstand voltage (+/-18kV contact per IEC 61000-4-2). Low typical capacitance (0.35pF at $V_R=0V$) minimizes loading on sensitive circuits. Each device will protect one high-speed data line operating at 3.3 Volts.

RClamp3331Z2C is in a 2-pin SLP0402P2X4C package measuring 0.43 x 0.23 mm with a nominal height of only 0.15mm. Leads are finished with NiAu. The small package gives the designer the flexibility to protect single lines in applications where arrays are not practical. The combination of small size and high ESD capability makes them ideal for use in portable applications such as cellular phones and wearables.

Package Dimension (mm)



Features

- High ESD withstand voltage: +/-18kV (contact) & +/-22kV (air) per IEC 61000-4-2
- Ultra-small 01005 package
- Protects one line
- Low ESD clamping voltage
- Working voltage: 3.3V
- Capacitance: 0.35 pF (Typical)
- Low leakage current
- Low dynamic resistance: 0.18 Ohms (Typical)
- Solid-state silicon-avalanche technology

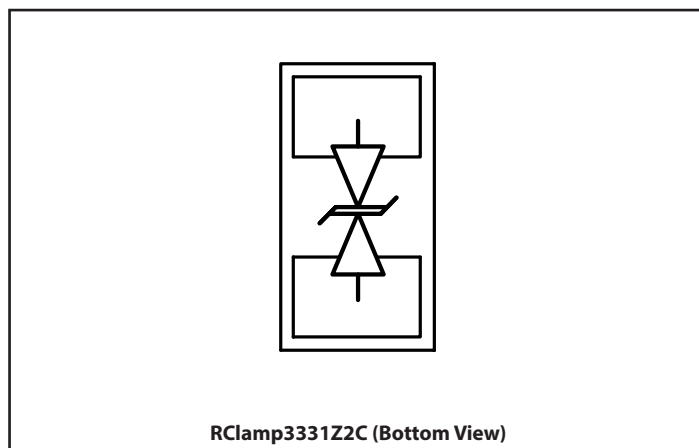
Mechanical Characteristics

- SLP0402P2X4C package
- Pb-Free, Halogen Free, RoHS/WEEE compliant
- Nominal Dimensions: 0.43 x 0.23 x 0.15 mm
- Lead Finish: NiAu
- Marking: Unmarked
- Packaging: Tape and Reel

Applications

- Smart Phones
- Wearables
- IoT Devices
- FM Antenna
- Tablet PC

Schematic & Pin Configuration



Absolute Maximum Rating

Rating	Symbol	Value	Units
Peak Pulse Power ($t_p = 8/20\mu s$)	P_{PK}	26	W
Peak Pulse Current ($t_p = 8/20\mu s$)	I_{PP}	4	A
ESD per IEC 61000-4-2 (Air) ⁽¹⁾ ESD per IEC 61000-4-2 (Contact) ⁽¹⁾	V_{ESD}	± 22 ± 18	kV
Operating Temperature	T_J	-40 to +85	°C
Storage Temperature	T_{STG}	-55 to +150	°C

Electrical Characteristics ($T = 25^\circ C$ unless otherwise specified)

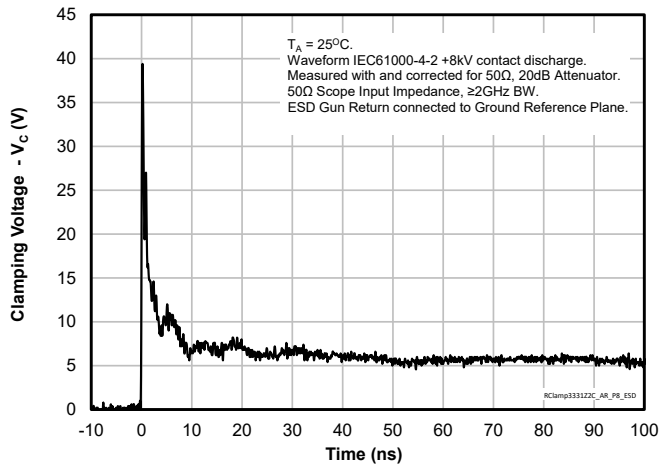
Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Reverse Stand-Off Voltage	V_{RWM}	Pin 1 to 2 or 2 to 1			3.3	V
Reverse Breakdown Voltage	V_{BR}	$I_{BR} = 10 \mu A$, Pin 1 to 2 or 2 to 1	5.5	8	10.5	V
Reverse Leakage Current	I_R	$V_{RWM} = 3.3V$, Pin 1 to 2 or 2 to 1		<1	50	nA
Clamping Voltage ²	V_C	$t_p = 1.2/50\mu s$ (Voltage), $8/20\mu s$ (Current) Combination Waveform	$I_{PP} = 1A$	3.5	5.5	V
			$I_{PP} = 4A$	4.7	6.5	
ESD Clamping Voltage ³	V_C	$I = 4A$, $t_{lp} = 0.2/100ns$		5		V
		$I = 16A$, $t_{lp} = 0.2/100ns$		7.3		
Dynamic Resistance ^{3,4}	R_{DYN}	$t_p = 0.2/100ns$		0.18		Ω
Junction Capacitance	C_J	$V_R = 0V$, $f = 1MHz$		0.35	0.45	pF

Notes:

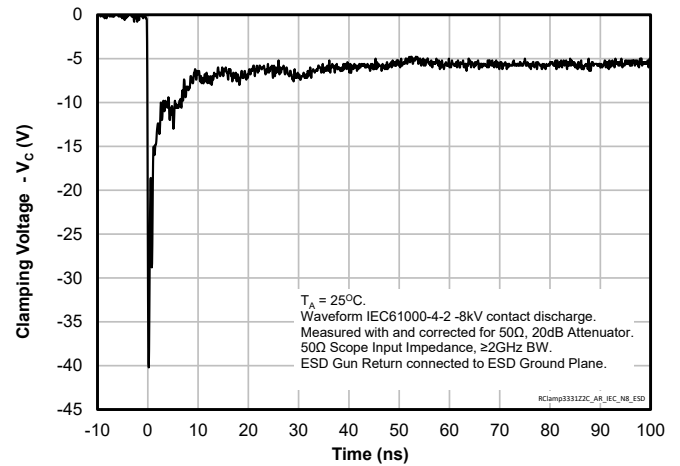
- 1) ESD gun return path connected to ESD ground plane.
- 2) Measured using a $1.2/50\mu s$ voltage, $8/20\mu s$ current combination waveform, $R_s = 2 \text{ Ohms}$. Clamping is defined as the peak voltage before the device snaps back to a conducting state.
- 3) Transmission Line Pulse Test (TLP) Settings: $t_p = 100ns$, $t_r = 0.2ns$, 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

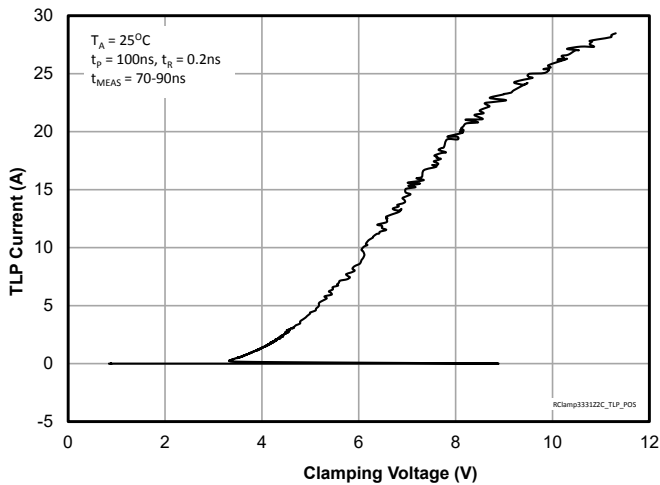
ESD Clamping (8kV Contact per IEC 61000-4-2)



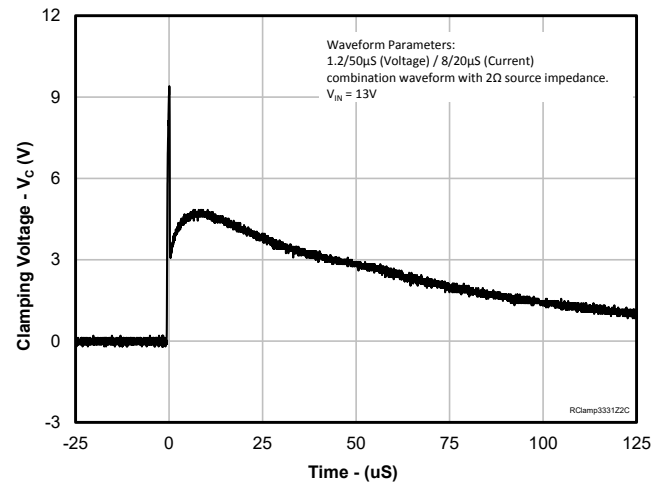
ESD Clamping (-8kV Contact per IEC 61000-4-2)



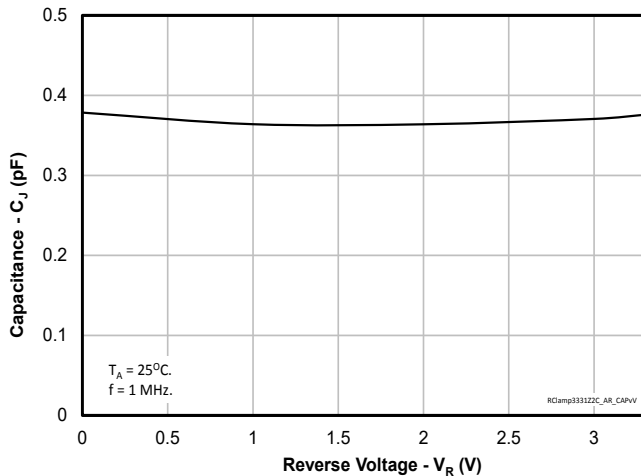
TLP Characteristic



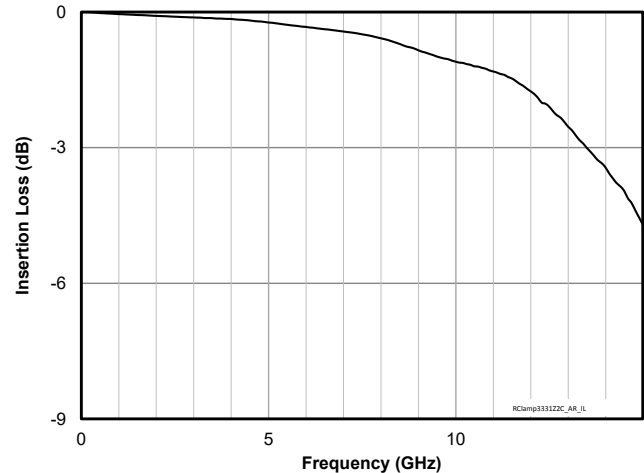
Clamping Voltage ($t_p = 1.2/50\mu\text{s}$)



Capacitance vs. Reverse Voltage



Insertion Loss-S21 (dB)



Application Information

Assembly Guidelines

The small size of this device means that some care must be taken during the mounting process to ensure reliable solder joints. 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.

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 0.050mm (0.002")
Solder Paste Type	Type 4 Size Sphere or Smaller
Solder Reflow Profile	Per JEDEC J-STD-020
PCB Solder Pad Design	Solder Mask Defined
PCB Pad Finish	OSP or NiAu

Solder Stencil

Stencil design is one of the key factors which determine the volume of solder paste which is deposited. For small pitch packages like the SLP0402P2X4C, Semtech recommends a stencil with square aperture and rounded corners for consistent solder release. The stencil should be laser cut with electro-polished finish. Stencil thickness of 0.075mm (0.003") or 0.050mm (0.002") may be used. A 0.100mm (0.004") stencil is not recommended as the resulting area ratio is too small to ensure proper solder coverage on the pad.

Based on board mount test results, Semtech's recommended mounting pattern for each size stencil are shown in Figure 1 and Figure 2. To achieve sufficient solder deposition volume using the 0.075mm thick stencil, the dimensions of the opening are the same as the recommended land pad dimensions. For the

0.050mm thick stencil, the openings are slightly smaller than the land pad resulting in an area ratio of approximately 0.79. A larger opening could result in device tilting after reflow due to too much solder being deposited on the pads. Due to the small apertures, a solder paste with Type 4 or smaller particles are recommended.

Figure 1 - Mounting Pattern - 0.075mm Stencil

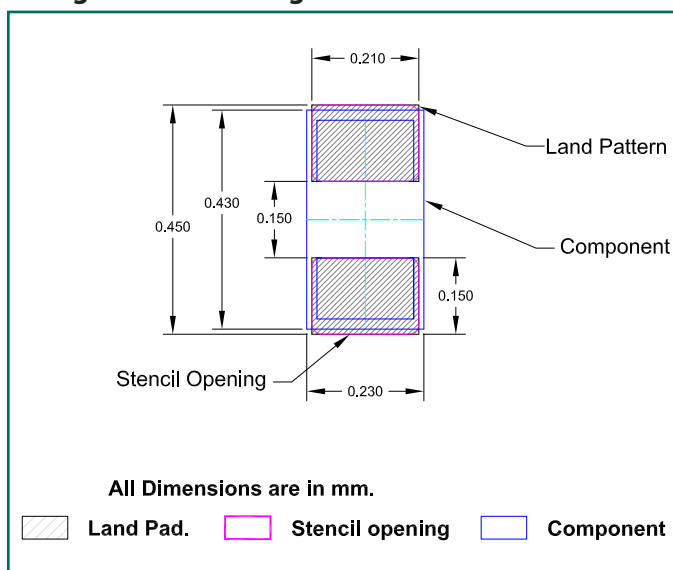
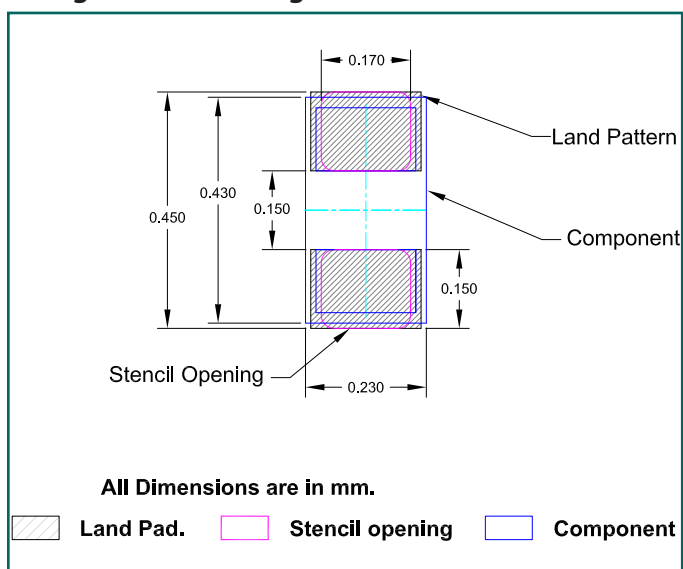
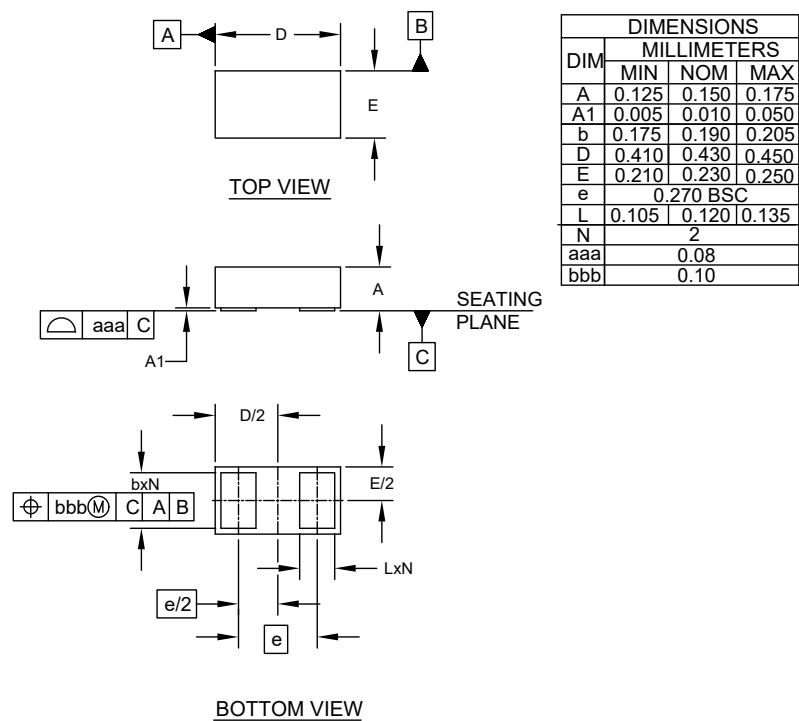


Figure 2 - Mounting Pattern - 0.050mm Stencil

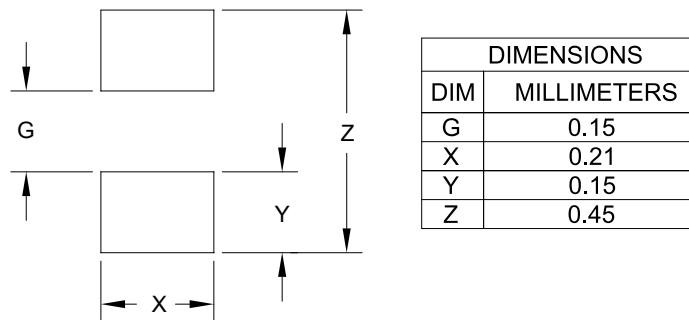


Outline Drawing - SLP0402P2X4C



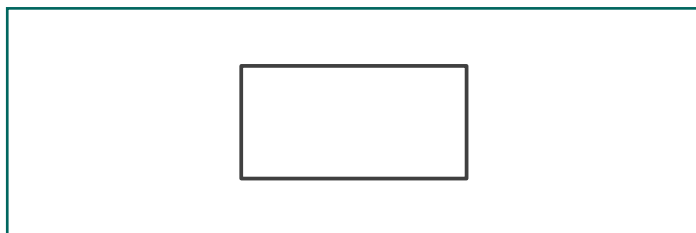
NOTES:
1. CONTROLLING DIMENSIONS ARE IN MILLIMETERS (ANGLES IN DEGREES).

Land Pattern - SLP0402P2X4C



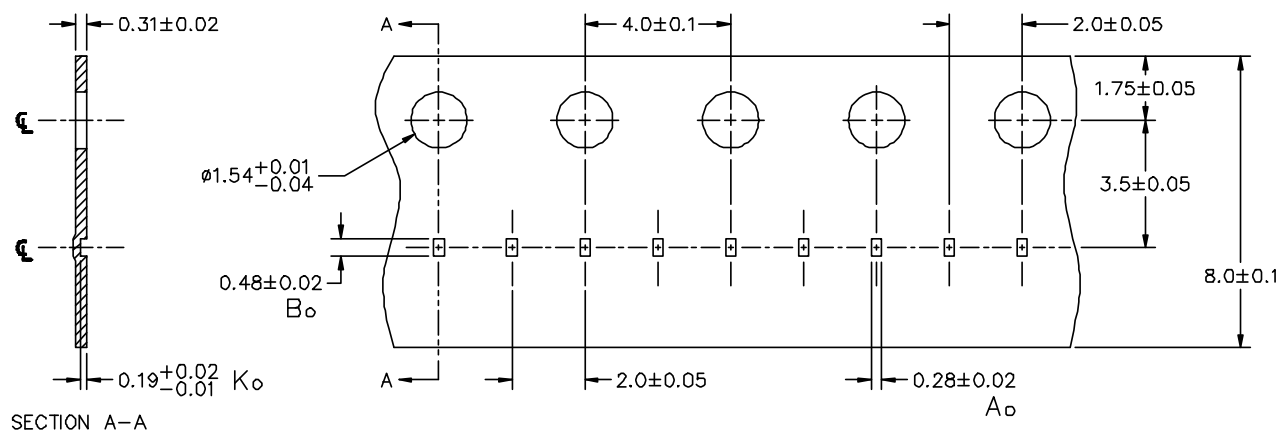
NOTES:
1. CONTROLLING DIMENSIONS ARE IN MILLIMETERS (ANGLES IN DEGREES).
2. THIS LAND PATTERN IS FOR REFERENCE PURPOSES ONLY.
CONSULT YOUR MANUFACTURING GROUP TO ENSURE YOUR COMPANY'S MANUFACTURING GUIDELINES ARE MET.

Marking Code



Note: Device is unmarked

Tape and Reel Specification



NOTE: ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.

Ordering Information

Part Number	Qty per Reel	Pocket Pitch	Reel Size
RClamp3331Z2CTKT	20,000	2mm	7"
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Contact Information

Semtech Corporation
200 Flynn Road, Camarillo, CA 93012
Phone: (805) 498-2111, Fax: (805) 498-3804
www.semtech.com