

### PROTECTION PRODUCTS - RailClamp®

#### Description

The RClamp®3321P provides ESD protection for USB3.0, HDMI1.3/1.4, and other high-speed ports. It may be used to meet the ESD immunity requirements of IEC 61000-4-2. The RClamp3321P is designed to minimize both the ESD peak clamping and the TLP clamping. The dynamic resistance is minimized (0.47 Ohms typical) for optimum protection of sensitive circuits. Maximum capacitance is only 0.35pF. This allows the RClamp3321P to be used in applications operating in excess of 5GHz without signal attenuation. These devices are manufactured using Semtech's proprietary low voltage technology for superior characteristics at operating voltages up to 3.3 volts.

The RClamp3321P is in a 2-pin SLP1006P2 package. It measures 1.0 x 0.6 x 0.5mm. The leads are spaced at a pitch of 0.65mm and are finished with lead-free NiPdAu. Each device will protect one line operating at 3.3 volts. The combination of low peak ESD clamping, low dynamic resistance, and low capacitance makes this device suitable for applications such as USB 3.0, HDMI and V-By-One interfaces in portable devices.

#### Features

- ◆ Transient protection for data lines to **IEC 61000-4-2 (ESD) ±17kV (air), ±12kV (contact)**  
**IEC 61000-4-4 (EFT) 40A (tp = 5/50ns)**  
**Cable Discharge Event (CDE)**
- ◆ Ultra-small package (1.0 x 0.6 x 0.5mm)
- ◆ Protects one data or I/O line
- ◆ Low capacitance: 0.35pF
- ◆ Dynamic Resistance: 0.47 Ohms Typical
- ◆ Low ESD clamping voltage
- ◆ Operating voltage: 3.3V
- ◆ Solid-state silicon-avalanche technology

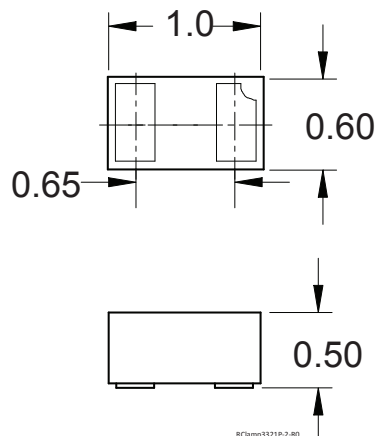
#### Mechanical Characteristics

- ◆ SLP1006P2 package
- ◆ Molding compound flammability rating: UL 94V-0
- ◆ Marking: Marking code
- ◆ Packaging: Tape and Reel
- ◆ Lead Finish: NiPdAu
- ◆ Pb-Free, Halogen Free, RoHS/WEEE Compliant

#### Applications

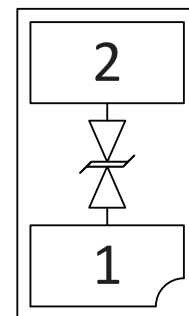
- ◆ USB 3.0
- ◆ HDMI 1.3/1.4
- ◆ V-By-One
- ◆ Display Port
- ◆ MHL / MDDI
- ◆ LVDS Interfaces
- ◆ eSATA Interfaces

#### Package Dimensions



Nominal Dimensions (mm)

#### Schematic & Pin Configuration



SLP1006P2 (Bottom View)

**PROTECTION PRODUCTS**
**Absolute Maximum Ratings**

Rating	Symbol	Value	Units
Peak Pulse Power (tp = 8/20µs)	$P_{PK}$	25	Watts
Maximum Peak Pulse Current (tp = 8/20µs)	$I_{PP}$	3	Amps
ESD per IEC 61000-4-2 (Air) <sup>1</sup> ESD per IEC 61000-4-2 (Contact) <sup>1</sup>	$V_{ESD}$	+/- 17 +/- 12	kV
Operating Temperature	$T_J$	-55 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	$V_{RWM}$				3.3	V
Breakdown Voltage	$V_{BR}$	$I_{BR} = 1mA$	5.5	7	8.5	V
Reverse Leakage Current	$I_R$	$V_{RWM} = 3.3V$		10	50	nA
Clamping Voltage	$V_C$	$I_{PP} = 1A, tp = 8/20µs$		9.5	10	V
Clamping Voltage	$V_C$	$I_{PP} = 4A, tp = 8/20µs$		10.5	13	V
ESD Clamping Voltage <sup>2</sup>	$V_C$	$I_{PP} = 4A,$ $t_{lp} = 0.2/100ns$		8.8		V
ESD Clamping Voltage <sup>2</sup>	$V_C$	$I_{PP} = 16A,$ $t_{lp} = 0.2/100ns$		14.5		V
Trigger Voltage <sup>2</sup>	$V_{TRIG}$	$t_{lp} = 0.2/100ns$		8		V
Dynamic Resistance <sup>2, 3</sup>	$R_{DYN}$	$t_{lp} = 0.2 / 100ns$		0.47		Ω
Junction Capacitance	$C_J$	$V_R = 0V, f = 1MHz$		0.22	0.35	pF

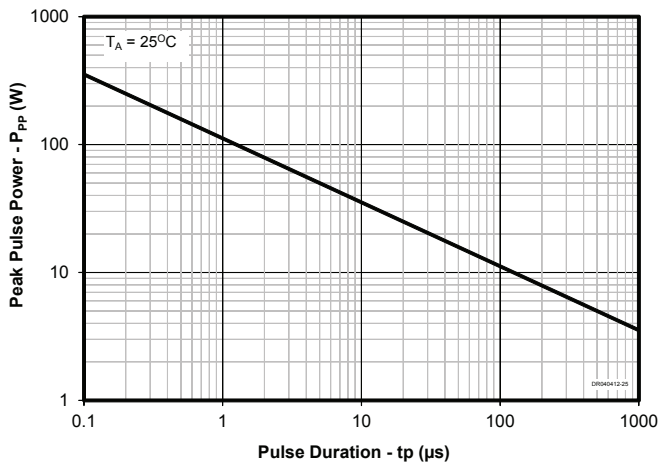
**Notes**

- 1)ESD gun return path connected to ESD ground reference plane.
- 2)TLP Settings:  $t_p = 100ns, t_r = 0.2ns, I_{TLP}$  and  $V_{TLP}$  sample window:  $t_1 = 70ns$  to  $t_2 = 90ns$ .
- 3) Dynamic resistance calculated from  $I_{pp} = 4A$  to  $I_{pp} = 16A$  using "Best Fit"
- 4) Device is electrically symmetrical

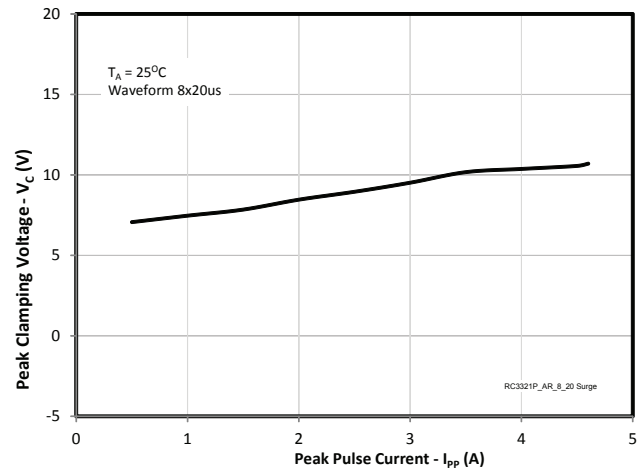
## PROTECTION PRODUCTS

### Typical Characteristics

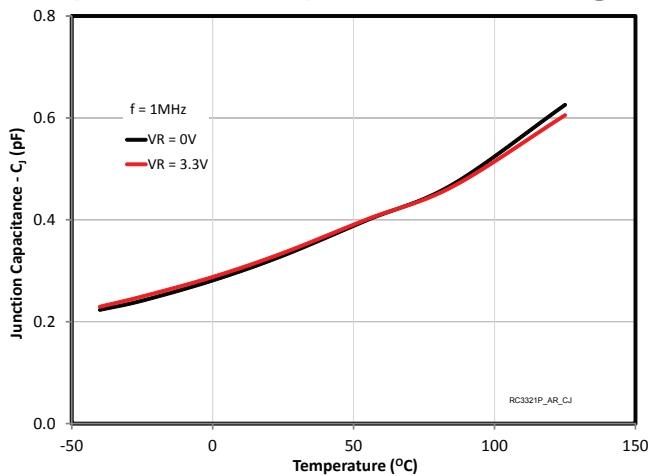
#### Non-Repetitive Peak Pulse Power vs. Pulse Time



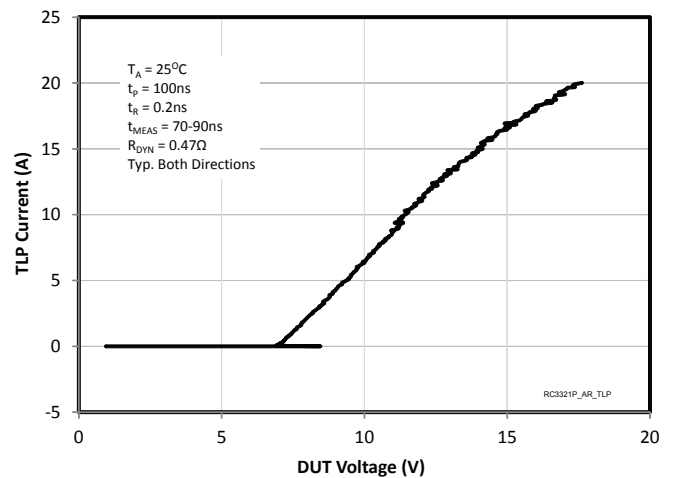
#### 8x20us Peak Clamping Voltage vs Peak Current



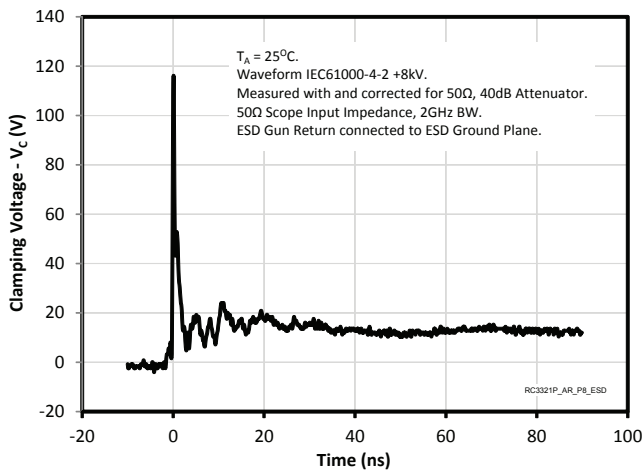
#### Capacitance vs. Temperature vs. Bias Voltage



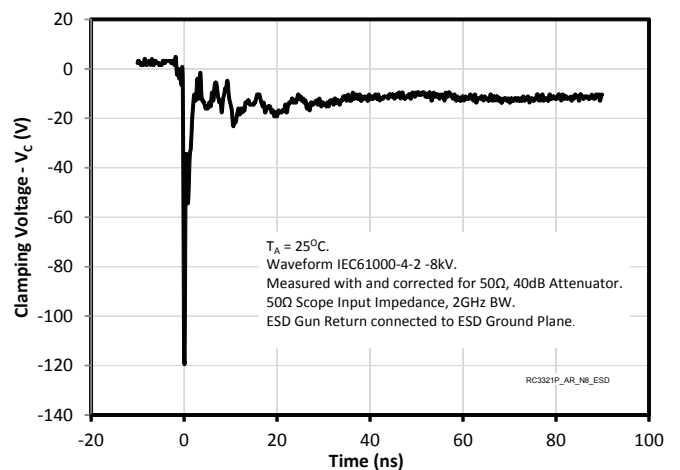
#### TLP Characteristic

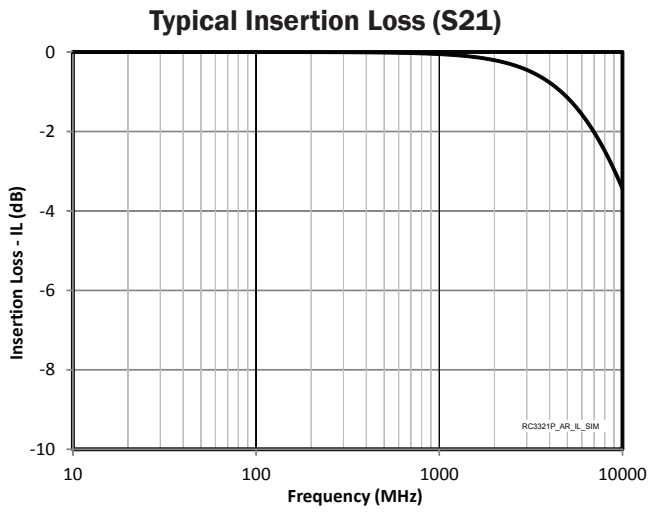


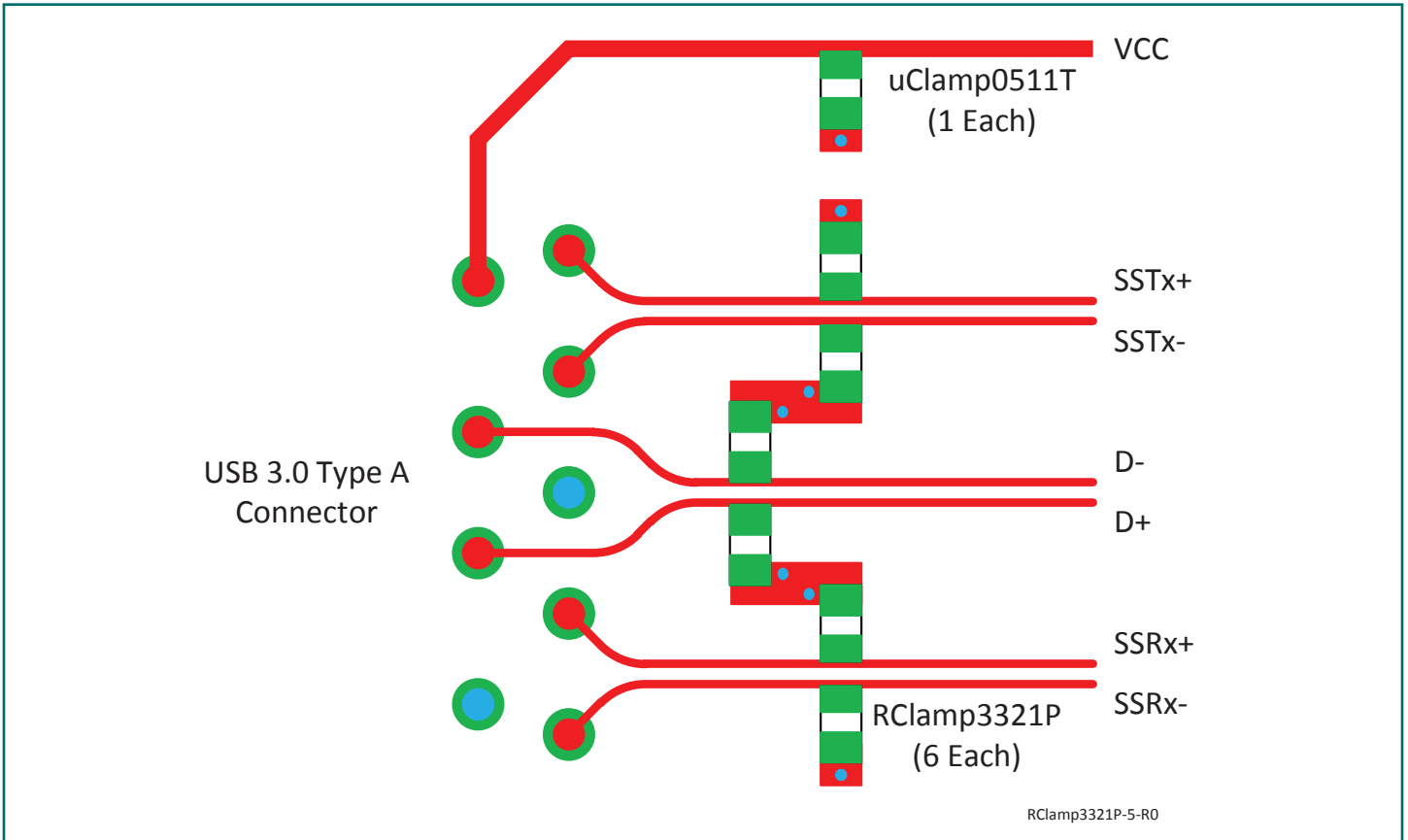
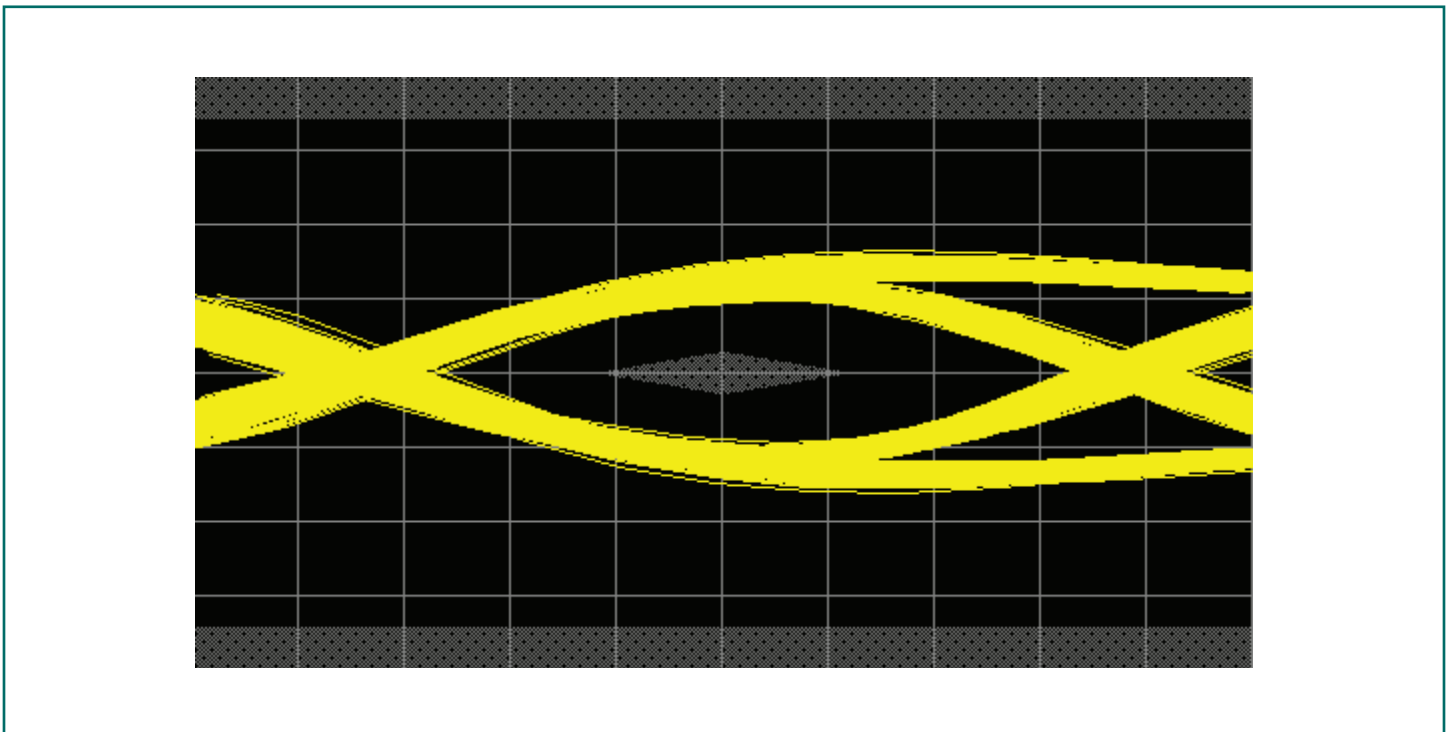
#### ESD Clamping (+8kV Contact per IEC 61000-4-2)



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





**USB3.0 Layout Diagram**

**USB3.0 Eye Diagram**


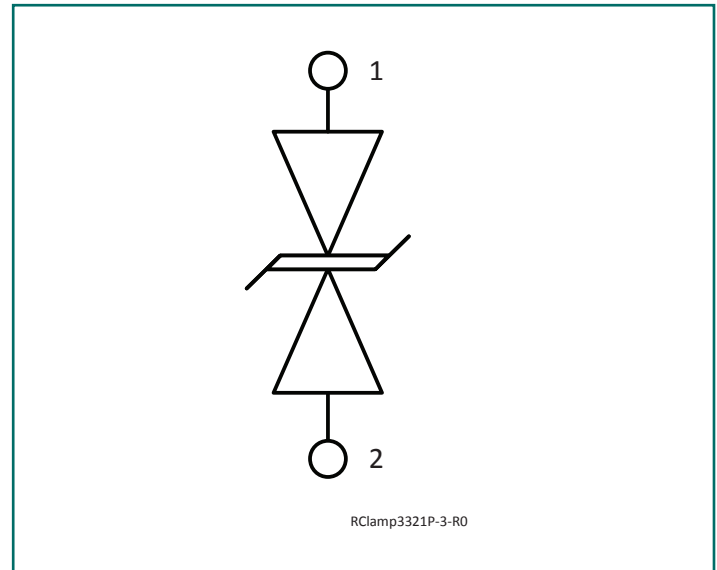
**PROTECTION PRODUCTS****Applications Information****Device Connection Options**

These low capacitance TVS diodes are designed to provide common mode protection for one high-speed line or differential protection for one line pair. The device is bidirectional and may be used on lines where the signal polarity is positive and negative.

**Circuit Board Layout Recommendations for Suppression of ESD.**

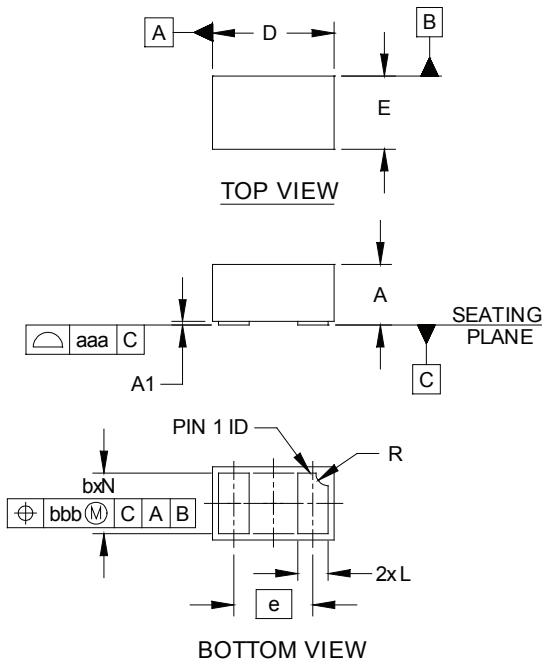
Good circuit board layout is critical for the suppression of ESD induced transients. The following guidelines are recommended:

- Place the TVS near the input terminals or connectors to restrict transient coupling.
- Minimize the path length between the TVS and the protected line.
- Minimize all conductive loops including power and ground loops.
- The ESD transient return path to ground should be kept as short as possible.
- Never run critical signals near board edges.
- Use ground planes whenever possible.

**Equivalent Circuit Diagram**

## PROTECTION PRODUCTS

### Outline Drawing - SLP1006P2

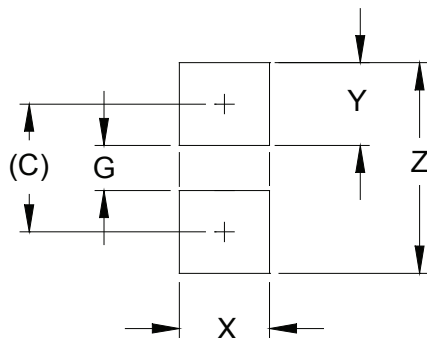


DIM	INCHES		MILLIMETERS	
	MIN	NOMMAX	MIN	NOMMAX
A	.016	.020 .022	0.40	0.50 0.55
A1	.000	.001 .002	0.00	0.03 0.05
b	.018	.020 .022	0.45	0.50 0.55
D	.035	.039 .043	0.90	1.00 1.10
E	.020	.024 .028	0.50	0.60 0.70
e	.026 BSC		0.65 BSC	
L	.008	.010 .012	0.20	0.25 0.30
R	.002	.004 .006	0.05	0.10 0.15
N	2		2	
aaa	.003		0.08	
bbb	.004		0.10	

**NOTES:**

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

### Land Pattern - SLP1006P2



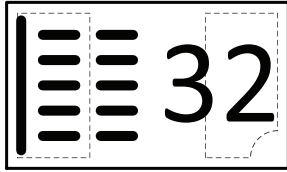
DIM	DIMENSIONS	
	INCHES	MILLIMETERS
C	(.033)	(0.85)
G	.012	0.30
X	.024	0.60
Y	.022	0.55
Z	.055	1.40

**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.

## PROTECTION PRODUCTS

### Marking



RClamp3321-9-R0

**Notes:**

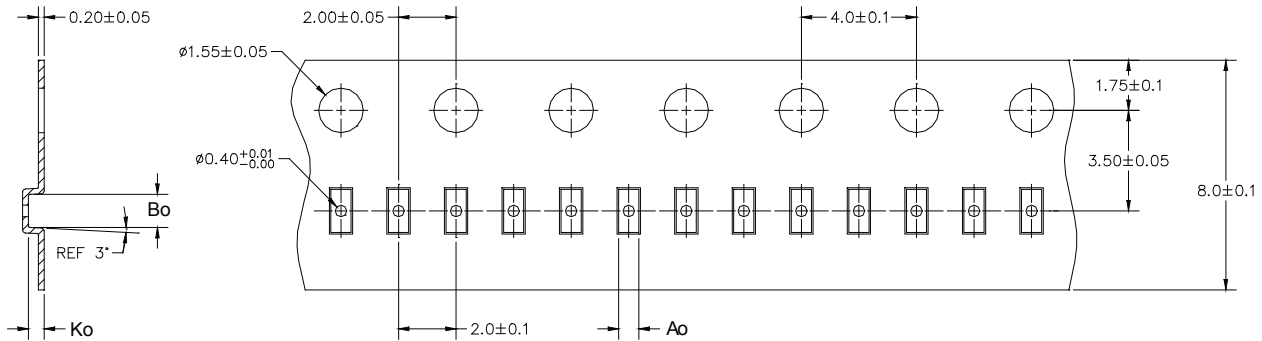
- 1) Device is electrically symmetrical
- 2) Marking will also include line matrix date code

### Ordering Information

Part Number	Qty per Reel	Reel Size
RClamp3321P.TNT	10,000	7 inch

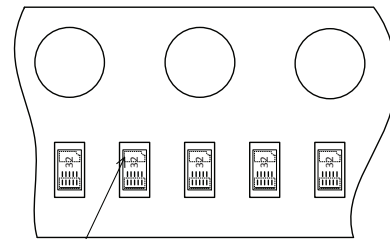
Note:  
RailClamp and RClamp are trademarks of Semtech Corporation

### Tape and Reel Specification



A0	B0	K0
0.69 ± 0.10 mm	1.19 ± 0.10 mm	0.66 ± 0.10 mm

Note: All dimensions in mm unless otherwise specified



Pin1 Location  
(Toward Sprocket Holes)

RClamp3321-9-R0

### Device Orientation in Tape

### Contact Information

Semtech Corporation  
Protection Products Division  
200 Flynn Rd., Camarillo, CA 93012  
Phone: (805)498-2111 FAX (805)498-3804