

### PROTECTION PRODUCTS - RailClamp®

#### Description

RailClamp is an ultra low capacitance Transient Voltage Suppressor (TVS) designed to protect high speed data interfaces. This device has been specifically designed to protect sensitive components which are connected to high-speed data and transmission lines from over-voltage caused by **ESD** (electrostatic discharge), **CDE** (Cable Discharge Events), and **EFT** (electrical fast transients).

The RClamp™0531TQ has a maximum capacitance of only 0.80pF. This allows it to be used on circuits operating in excess of 2.5GHz without signal attenuation. They may be used to meet the ESD immunity requirements of IEC 61000-4-2.

The RClamp0531TQ is in a 2-pin SLP1006P2T package measuring 1.0 x 0.6 x 0.4mm. The leads are spaced at a pitch of 0.65mm and feature a lead-free finish. Each device will protect one high-speed line operating at 5 volts. It gives the designer the flexibility to protect single lines in applications where arrays are not practical. The combination of small size, low capacitance, and high ESD surge capability makes them ideal for use in applications such as cellular phones and digital video interfaces.

The RClamp0531TQ is AEC-Q100 Grade 1 qualified for Automotive use.

#### Features

- ◆ Transient protection for data lines to  
**IEC 61000-4-2 (ESD) ±20kV (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 0.4mm)
- ◆ Protects one I/O line
- ◆ Low capacitance: **0.8pF**
- ◆ Low clamping voltage
- ◆ Solid-state silicon-avalanche technology
- ◆ AEC-Q100 Grade 1 qualified.

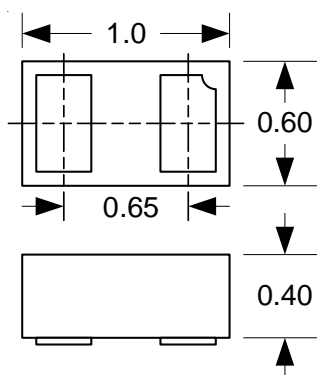
#### Mechanical Characteristics

- ◆ SLP1006P2T package
- ◆ Molding compound flammability rating: UL 94V-0
- ◆ Marking: Marking code + date code
- ◆ Packaging : Tape and Reel
- ◆ Lead Finish: NiPdAu
- ◆ Pb-Free, Halogen Free, RoHS/WEEE Compliant

#### Applications

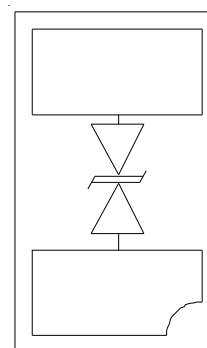
- ◆ Cellular Handsets & Accessories
- ◆ Digital Visual Interface (DVI)
- ◆ FM Antenna
- ◆ MDDI Ports
- ◆ USB Ports
- ◆ PCI Express
- ◆ Serial ATA
- ◆ Automotive Applications

#### Package Dimensions



**Maximum Dimensions (mm)**

#### Schematic & Pin Configuration



**SLP1006P2T (Bottom View)**

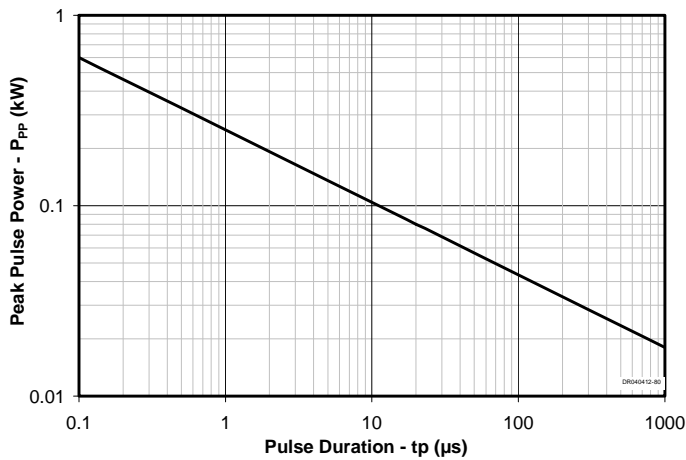
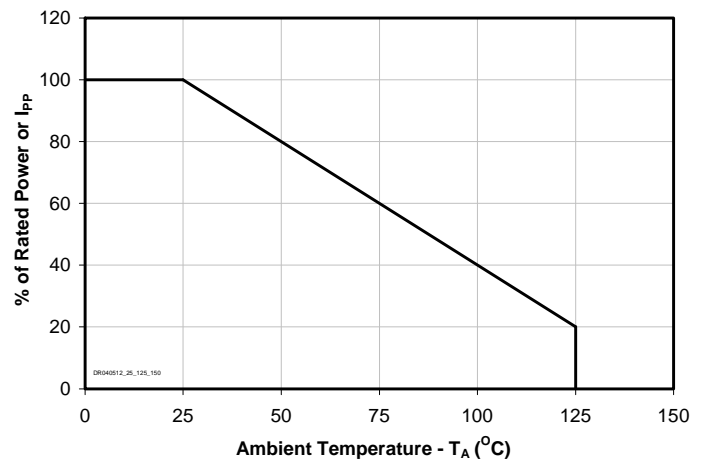
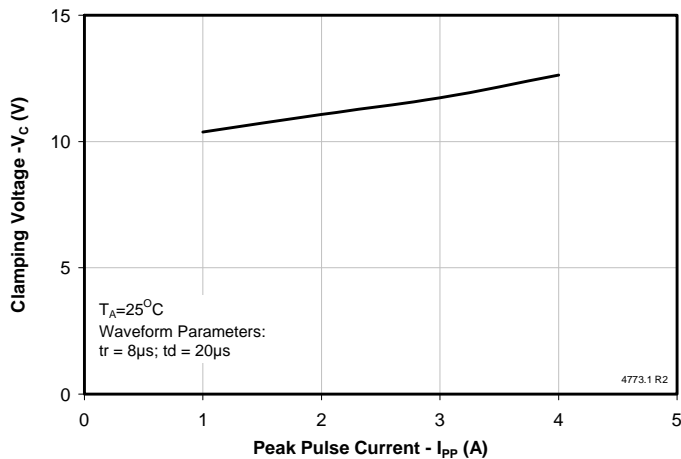
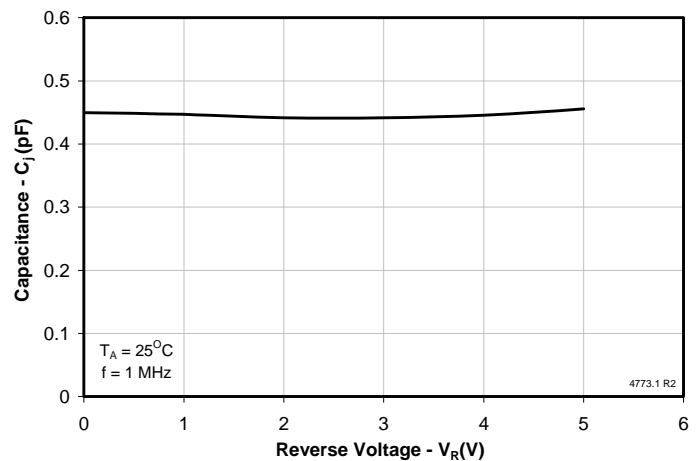
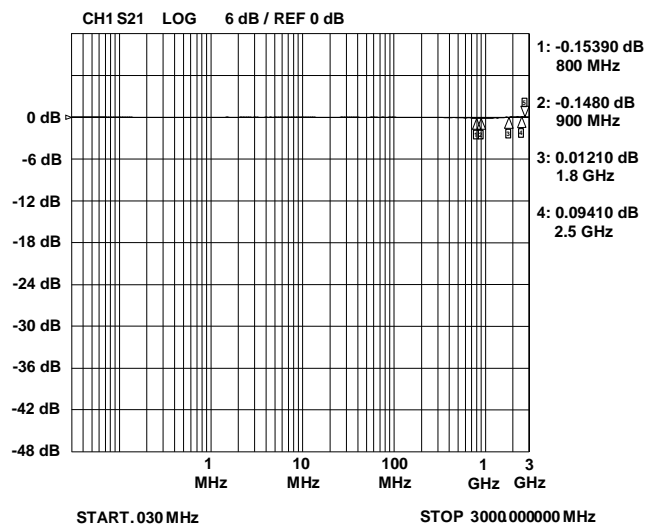
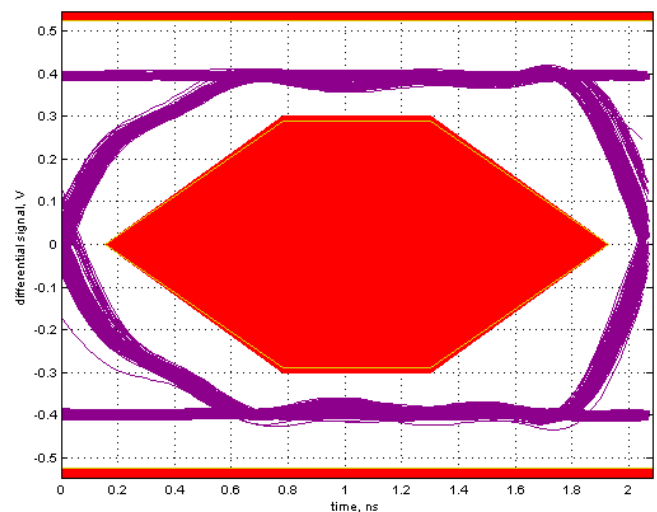
## PROTECTION PRODUCTS

### Absolute Maximum Ratings

Rating	Symbol	Value	Units
Peak Pulse Power (tp = 8/20μs)	P <sub>pk</sub>	80	Watts
Peak Pulse Current (tp = 8/20μs)	I <sub>pp</sub>	4	A
ESD per IEC 61000-4-2 (Air) ESD per IEC 61000-4-2 (Contact)	V <sub>ESD</sub>	+/- 20 +/- 12	kV
Operating Temperature	T <sub>J</sub>	-40 to +125	°C
Storage Temperature	T <sub>STG</sub>	-55 to +150	°C

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

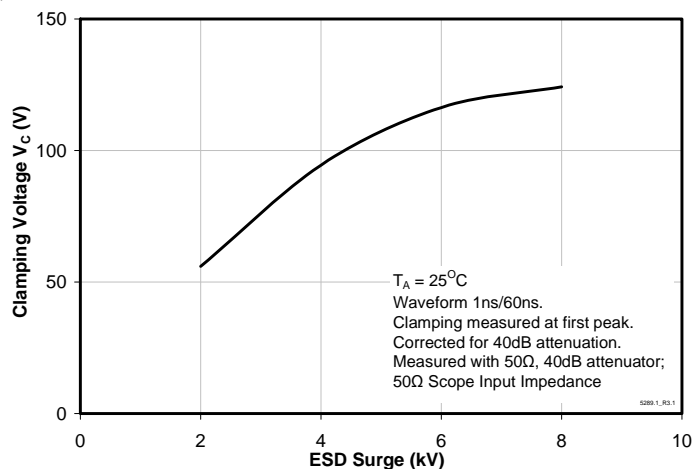
Parameter	Symbol	Conditions	Minimum	Typical	Maximum	Units
Reverse Stand-Off Voltage	V <sub>RWM</sub>				5	V
Reverse Breakdown Voltage	V <sub>BR</sub>	I <sub>t</sub> = 1mA	6	9.3	11	V
Reverse Leakage Current	I <sub>R</sub>	V <sub>RWM</sub> = 5V, T=25°C		0.010	0.100	μA
		V <sub>RWM</sub> = 5V, T=125°C		0.020	0.200	
Clamping Voltage	V <sub>C</sub>	I <sub>pp</sub> = 1A, tp = 8/20μs			12	V
Clamping Voltage	V <sub>C</sub>	I <sub>pp</sub> = 4A, tp = 8/20μs			20	V
Junction Capacitance	C <sub>J</sub>	V <sub>R</sub> = 0V, f = 1MHz, T=25°C		0.50	0.80	pF
		V <sub>R</sub> = 0V, f = 1MHz, T=125°C		0.85	1.5	

**PROTECTION PRODUCTS**
**Typical Characteristics**
**Non-Repetitive Peak Pulse Power vs. Pulse Time**

**Power Derating Curve**

**Clamping Voltage vs. Peak Pulse Current**

**Typical Capacitance vs. Reverse Voltage**

**Insertion Loss S21**

**USB 2.0 Eye Pattern with RClamp0531TQ**


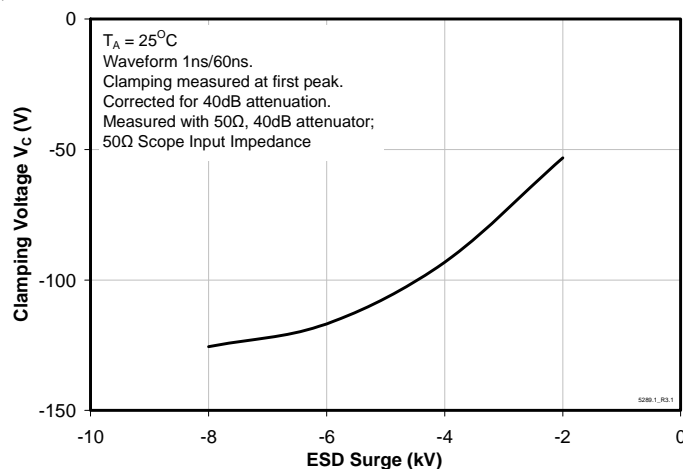
# PROTECTION PRODUCTS

## Typical Characteristics

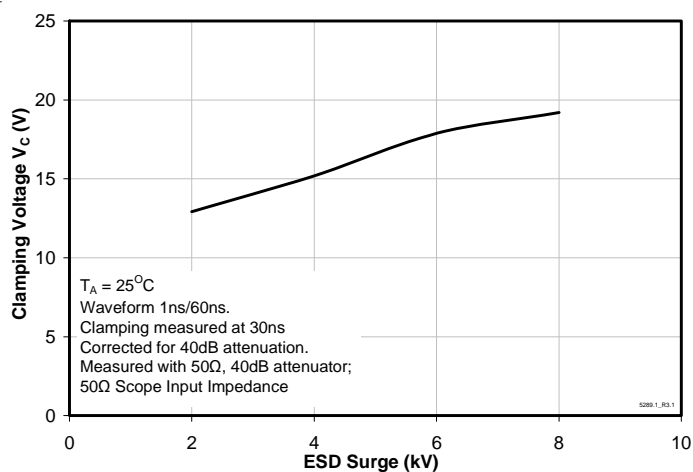
**ESD Clamping per IEC 61000-4-2**  
Positive clamping voltage at first peak



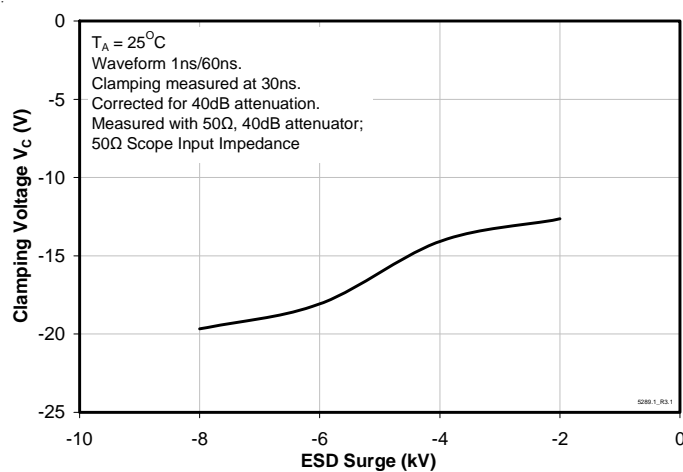
**ESD Clamping per IEC 61000-4-2**  
Negative clamping voltage at first peak



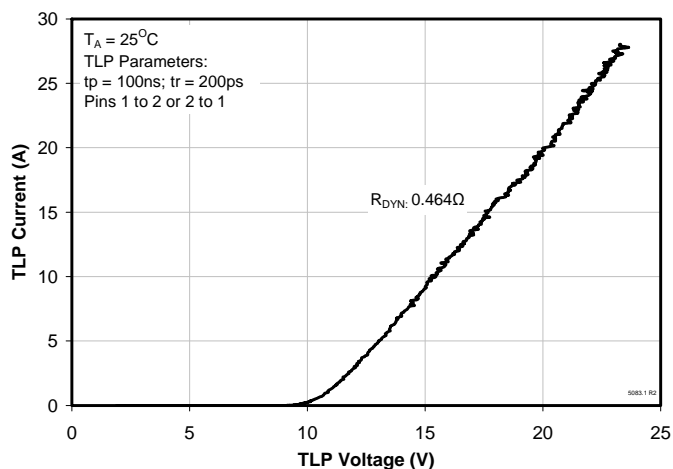
**ESD Clamping per IEC 61000-4-2**  
Positive clamping voltage at 30ns



**ESD Clamping per IEC 61000-4-2**  
Negative clamping voltage at 30ns



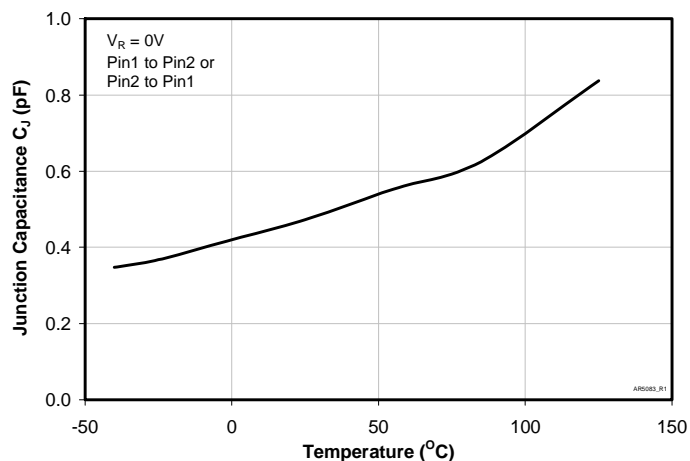
## Typical TLP Characteristics



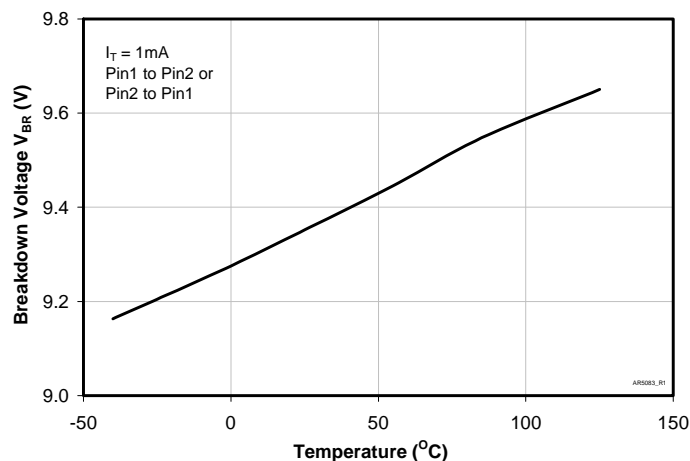
# PROTECTION PRODUCTS

## Typical Characteristics

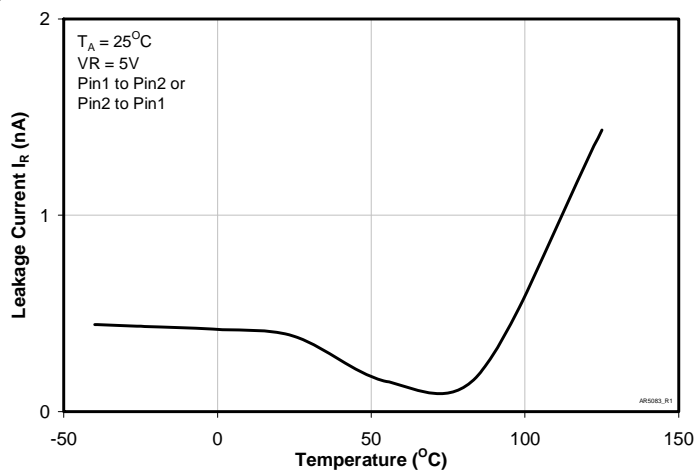
### Typical Capacitance v Temperature



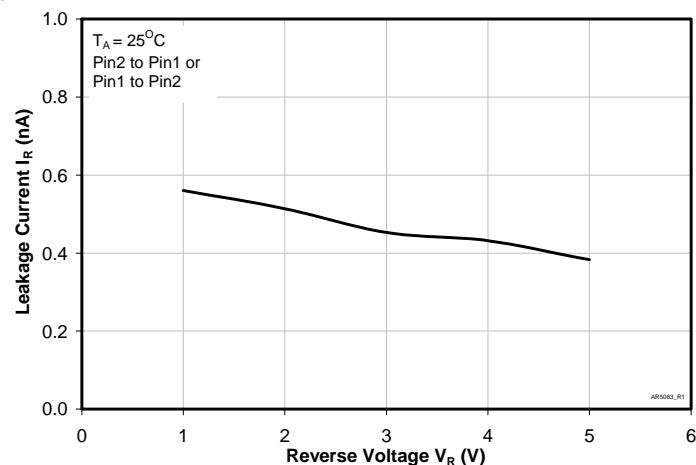
### Typical Breakdown Voltage v Temperature



### Typical Leakage Current v Temperature



### Typical Leakage Current v Reverse Voltage



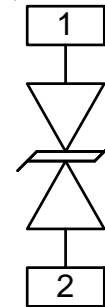
**PROTECTION PRODUCTS****Applications Information****Device Connection Options**

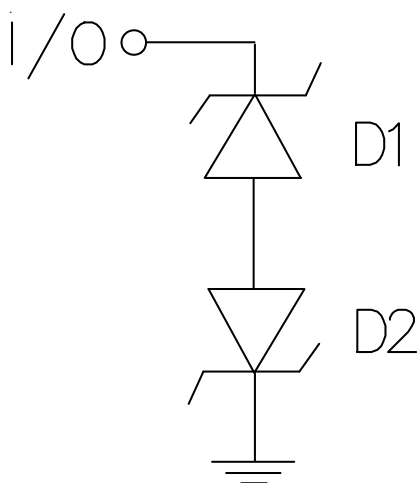
These low capacitance TVS diodes are designed to provide common mode protection for one high-speed line or differential protection for one line pair. The device is bidirectional and may be used on lines where the signal polarity is positive and negative.

**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:

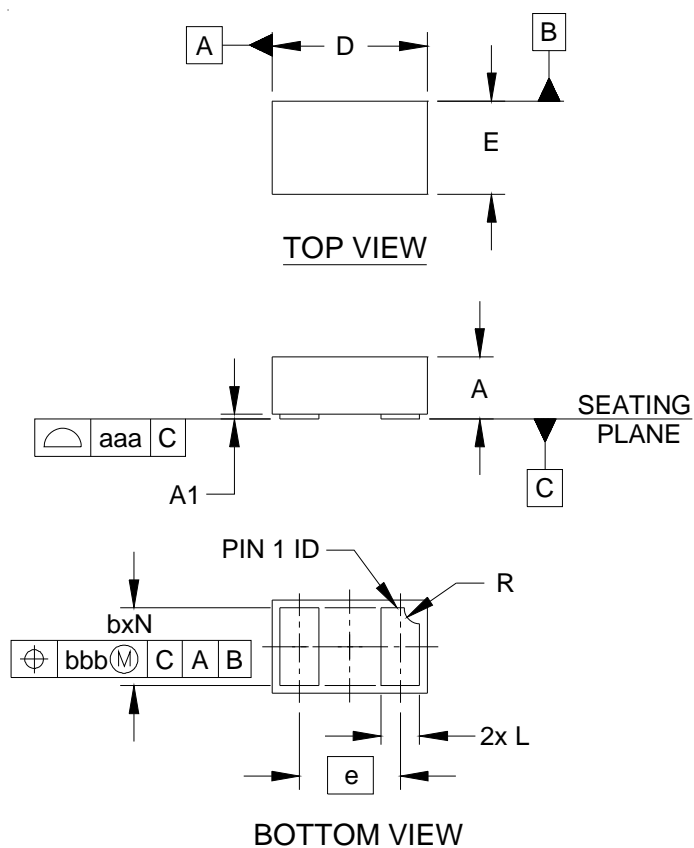
- Place the TVS near the input terminals or connectors to restrict transient coupling.
- Minimize the path length between the TVS and the protected line.
- Minimize all conductive loops including power and ground loops.
- The ESD transient return path to ground should be kept as short as possible.
-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

**Equivalent Circuit Diagram**


**RClamp0531TQ Spice Model**

<b>RClamp0531TQ Spice Parameters</b>			
<b>Parameter</b>	<b>Unit</b>	<b>D1 (TVS)</b>	<b>D2 (TVS)</b>
IS	Amp	2.11E-14	2.11E-14
BV	Volt	8.6	8.6
VJ	Volt	0.7	0.7
RS	Ohm	0.4	0.4
IBV	Amp	1E-3	1E-3
CJO	Farad	0.8E-12	0.8E-12
TT	sec	2.541E-9	2.541E-9
M	--	0.02	0.02
N	--	1.1	1.1
EG	eV	1.11	1.11

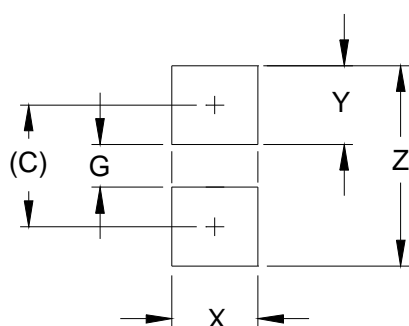
Note: Spice model is for simulating transient response only.

**PROTECTION PRODUCTS**
**Outline Drawing - SLP1006P2T**


DIM	INCHES			MILLIMETERS		
	MIN	NOM	MAX	MIN	NOM	MAX
A	.015	.016	.017	0.37	0.40	0.43
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 - SLP1006P2T**


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

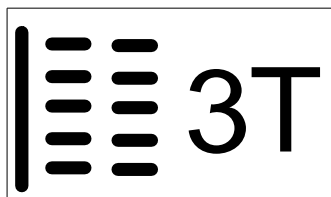
**NOTES:**

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



Notes:

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

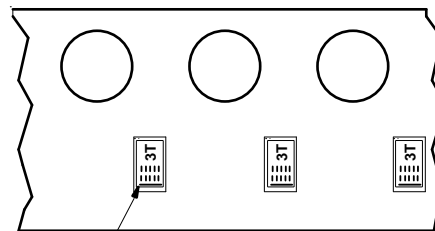
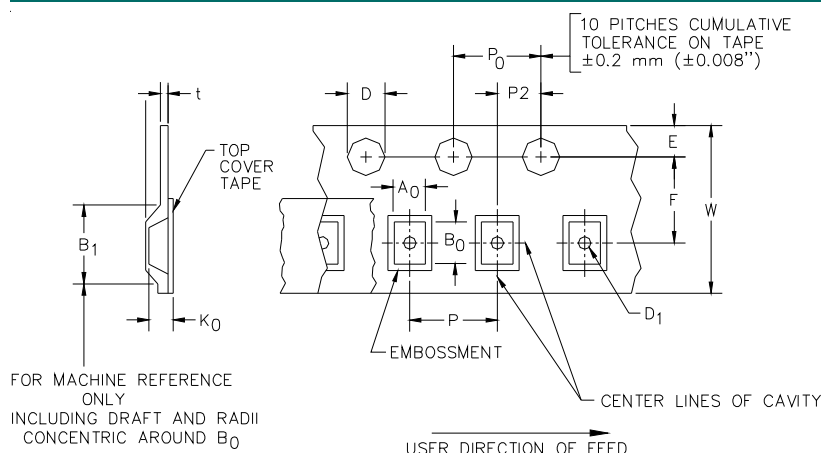
### Ordering Information

Part Number	Working Voltage	Qty per Reel	Reel Size
RClamp0531TQTCT	5V	3,000	7 Inch

Note: Lead finish is lead-free NiPdAu.

RailClamp and RClamp are marks of Semtech Corporation.

### Tape and Reel Specification



Band Location  
(Opposite Sprocket Holes)

### Device Orientation in Tape

A0	B0	K0
0.69 +/-0.10 mm	1.19 +/-0.10 mm	0.66 +/-0.10 mm

Tape Width	B, (Max)	D	D1	E	F	K (Max)	P	P0	P2	T (Max)	W
8 mm	4.2 mm (.165)	1.5 + 0.1 mm - 0.0 mm (0.59 +.005 - .000)	0.8 mm ±0.25 (.031)	1.750±0.1 mm (.069±.004)	3.5±0.05 mm (.138±.002)	2.4 mm (.094)	4.0±0.10 mm (.157±.004)	4.0±0.1 mm (.157±.004)	2.0±0.05 mm (.079±.002)	0.4mm (.016)	8.0 mm + 0.3 mm - 0.1 mm (.312±.012)

### Contact Information

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