

### PROTECTION PRODUCTS - RailClamp®

#### Description

RailClamp® TVS diodes are specifically designed to protect sensitive components which are connected to high-speed data and transmission lines from overvoltage caused by ESD (electrostatic discharge), CDE (cable discharge events), and EFT (electrical fast transients).

The unique design incorporates surge rated, low capacitance steering diodes and a TVS diode in a single package. This allows the device to absorb large amounts of energy while protecting downstream components from harmful transient events.

The RClamp®0534N is in a 10-pin SLP3020N10 package. It measures 3.0 x 2.0 x 0.60mm. The leads are finished with lead-free NiPdAu. The combination of small size, low capacitance, and high surge capability makes them ideal for use in applications such as 10/100 Ethernet, USB 2.0, and video interfaces.

#### Features

- ◆ ESD protection for high-speed data lines to **IEC 61000-4-2 (ESD)  $\pm 30\text{kV}$  (air),  $\pm 30\text{kV}$  (contact)**
- ◆ **IEC 61000-4-4 (EFT) 40A (5/50ns)**
- ◆ **IEC 61000-4-5 (Lightning) 25A (8/20 $\mu\text{s}$ )**
- ◆ Array of surge rated diodes with internal TVS Diode
- ◆ Small package saves board space
- ◆ Protects four I/O lines and Voltage Bus
- ◆ Low capacitance: 5pF (VR=0V)
- ◆ Low clamping voltage
- ◆ Low operating voltage: 5.0V
- ◆ Solid-state silicon-avalanche technology

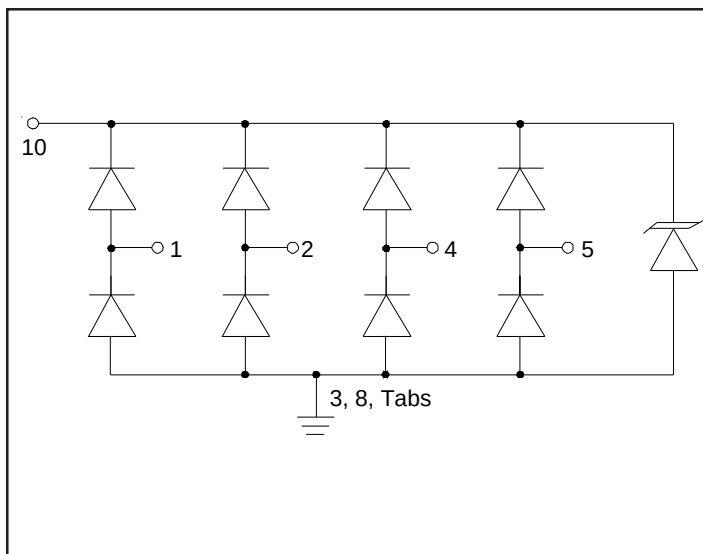
#### Mechanical Characteristics

- ◆ SLP3020N10 10L package
- ◆ Pb-Free, Halogen Free, RoHS/WEEE Compliant
- ◆ Nominal Dimensions: 3.0 x 2.0 x 0.60 mm
- ◆ Lead Finish: NiPdAu
- ◆ Molding compound flammability rating: UL 94V-0
- ◆ Marking : Marking code + Date code
- ◆ Packaging : Tape and Reel

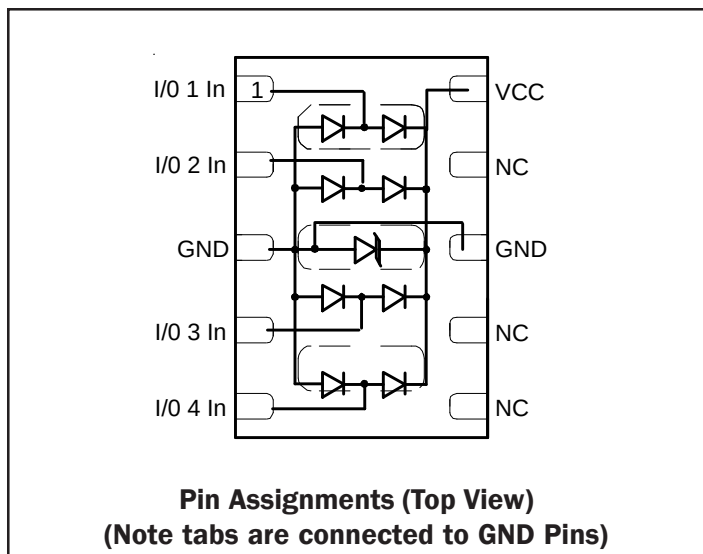
#### Applications

- ◆ USB 2.0 Power and Data Line Protection
- ◆ Video Graphics Cards
- ◆ Monitors and Flat Panel Displays
- ◆ Digital Video Interface (DVI)
- ◆ Notebook Computers
- ◆ Networking Equipment

#### Circuit Diagram



#### Circuit Diagram



## PROTECTION PRODUCTS

### Absolute Maximum Rating

| Rating                                                         | Symbol           | Value            | Units |
|----------------------------------------------------------------|------------------|------------------|-------|
| Peak Pulse Power (tp = 8/20μs)                                 | P <sub>pk</sub>  | 500              | Watts |
| Peak Pulse Current (tp = 8/20μs)                               | I <sub>pp</sub>  | 25               | A     |
| ESD per IEC 61000-4-2 (Air)<br>ESD per IEC 61000-4-2 (Contact) | VESD             | +/- 30<br>+/- 30 | kV    |
| Operating Temperature                                          | T <sub>J</sub>   | -55 to +125      | °C    |
| Storage Temperature                                            | T <sub>STG</sub> | -55 to +150      | °C    |

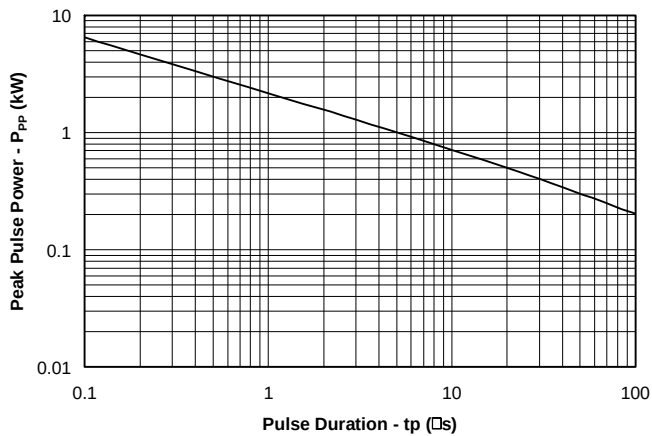
### Electrical Characteristics (T=25°C)

| 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       |         |         | V     |
| Reverse Leakage Current   | I <sub>R</sub>   | V <sub>RWM</sub> = 5V, T=25°C                        |         |         | 0.5     | μA    |
| Clamping Voltage          | V <sub>C</sub>   | I <sub>pp</sub> = 1A, tp = 8/20μs<br>Any I/O to GND  |         |         | 10      | V     |
| Clamping Voltage          | V <sub>C</sub>   | I <sub>pp</sub> = 10A, tp = 8/20μs<br>Any I/O to GND |         |         | 12      | V     |
| Clamping Voltage          | V <sub>C</sub>   | I <sub>pp</sub> = 25A, tp = 8/20μs<br>Any I/O to GND |         |         | 15      | V     |
| Junction Capacitance      | C <sub>J</sub>   | Any I/O to GND<br>V <sub>R</sub> = 0V, f = 1MHz      |         | 3.5     | 5       | pF    |
|                           |                  | I/O to I/O<br>V <sub>R</sub> = 0V, f = 1MHz          |         | 1.5     | 3       | pF    |

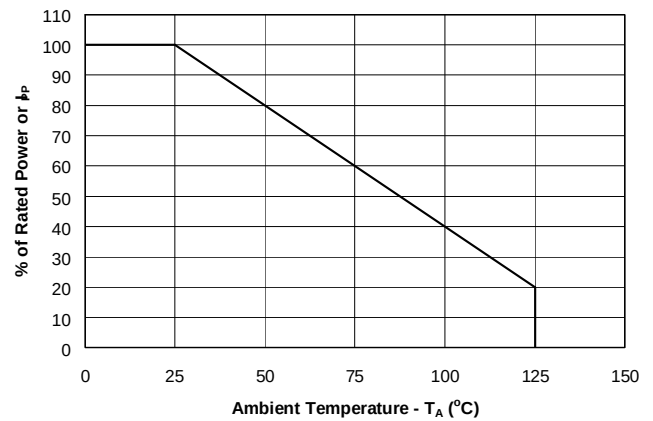
# PROTECTION PRODUCTS

## Typical Characteristics

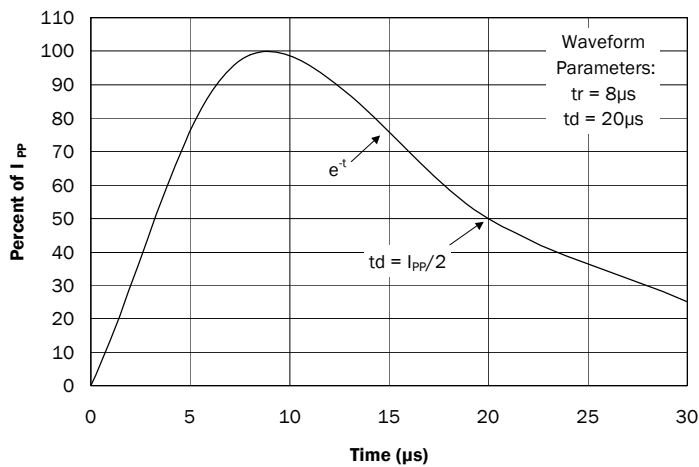
### Non-Repetitive Peak Pulse Power vs. Pulse Time



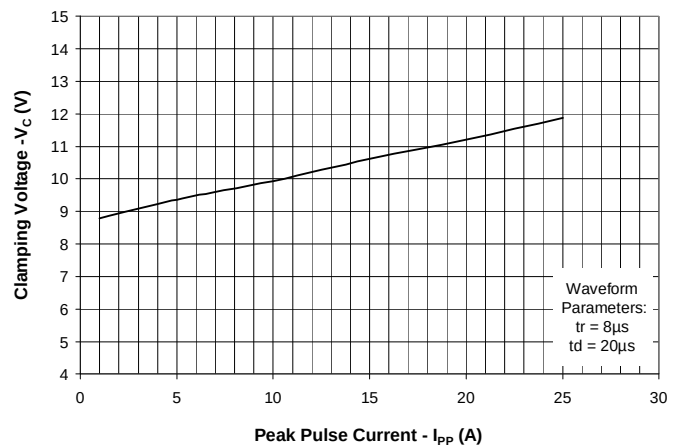
### Power Derating Curve



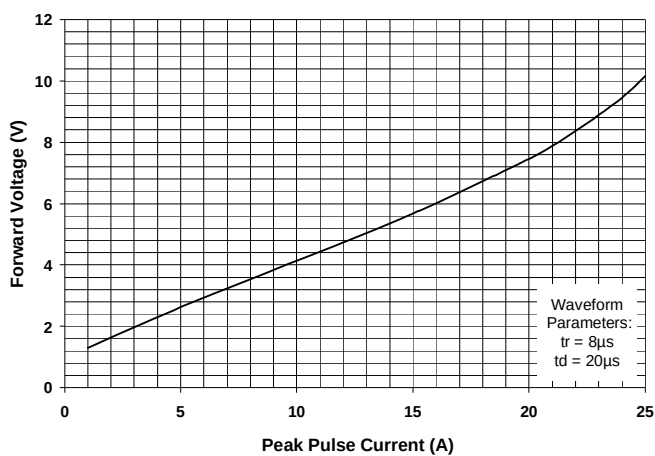
### Surge Current Output Waveform ( $t_p = 8/20\mu s$ )



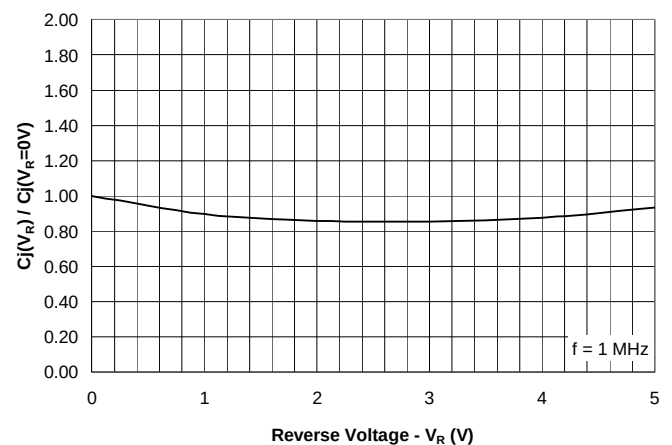
### Clamping Voltage vs. Peak Pulse Current Any I/O to GND ( $t_p = 8/20\mu s$ )



### Forward Voltage vs. Forward Current



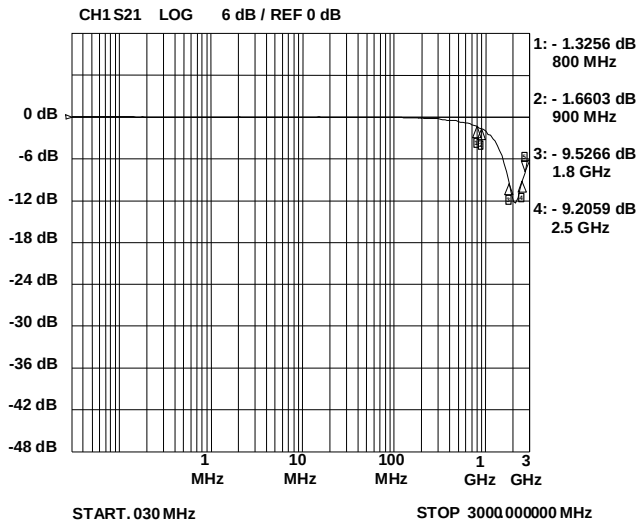
### Normalized Capacitance vs. Reverse Voltage



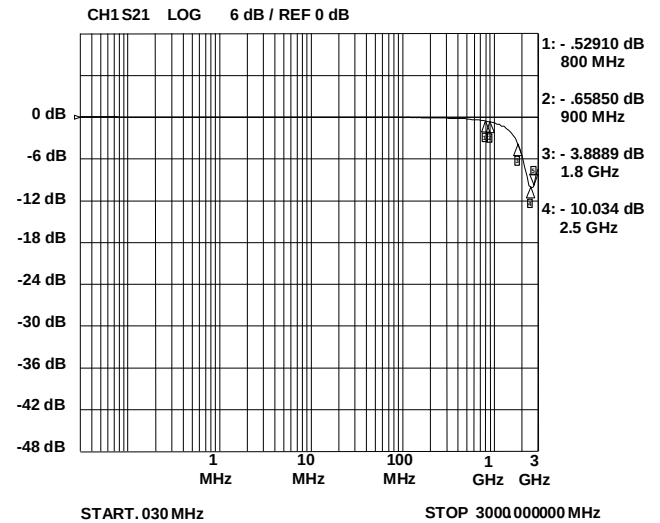
## PROTECTION PRODUCTS

### Typical Characteristics

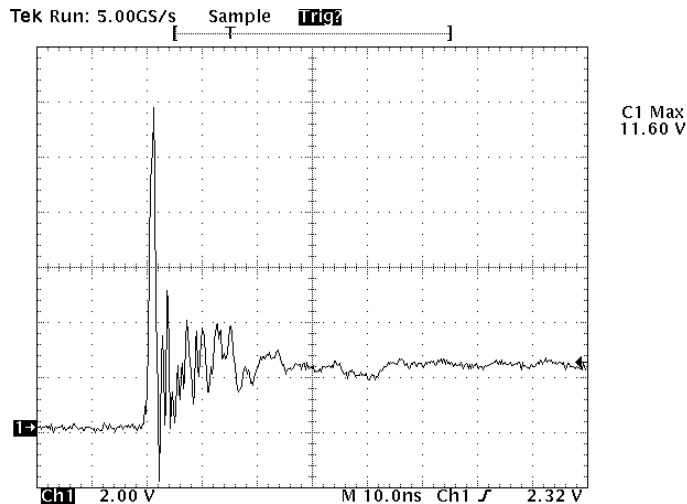
**Insertion Loss S21 - Any I/O to GND**



**Insertion Loss S21 - I/O to I/O**

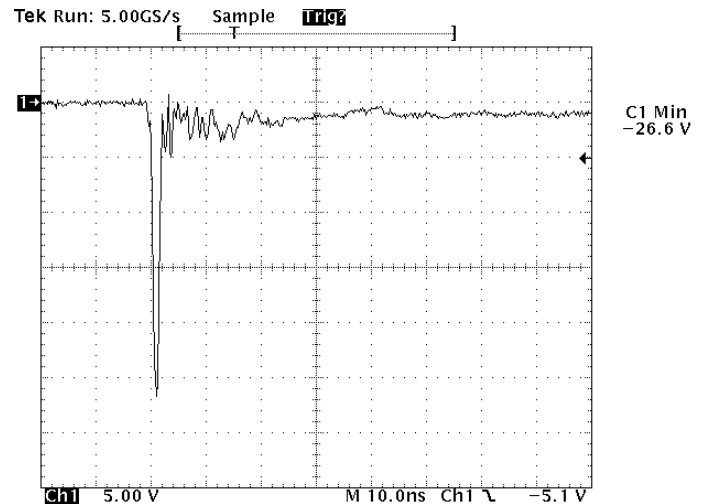


**ESD Clamping - Between any I/O and GND  
 (+8kV Contact per IEC 61000-4-2)**



Note: Data is taken with a 10x attenuator

**ESD Clamping - Between any I/O and GND  
 (-8kV Contact per IEC 61000-4-2)**



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## PROTECTION PRODUCTS

### Applications Information

#### Device Connection Options for Protection of Four High-Speed Data Lines

The RClamp0534N is designed to protect four data lines from transient over-voltages by clamping them to a fixed reference. When the voltage on the protected line exceeds the reference voltage (plus diode  $V_F$ ) the steering diodes are forward biased, conducting the transient current away from the sensitive circuitry. Data lines are connected at pins 1, 2, 4 and 5. The package is designed for easy trace routing. Pins 3 and 8 are internally connected to the center tabs and should be connected directly to a ground plane on the board for best results. The path length is kept as short as possible to minimize parasitic inductance. The positive reference (REF2) is connected at pin 9. The options for connecting the positive reference are as follows:

1. To protect data lines and the power line, connect pin 10 directly to the positive supply rail ( $V_{CC}$ ). In this configuration the data lines are referenced to the supply voltage. The internal TVS diode prevents over-voltage on the supply rail.
2. The RClamp0534N can be isolated from the power supply by adding a series resistor between pin 10 and  $V_{CC}$ . A value of  $100k\Omega$  is recommended. The internal TVS and steering diodes remain biased, providing the advantage of lower capacitance.
3. In applications where no positive supply reference is available, or complete supply isolation is desired, the internal TVS may be used as the reference. In this case, pin 10 is not connected. The steering diodes will begin to conduct when the voltage on the protected line exceeds the working voltage of the TVS (plus one diode drop).

**Figure 1- Pin Configuration (Top View)**

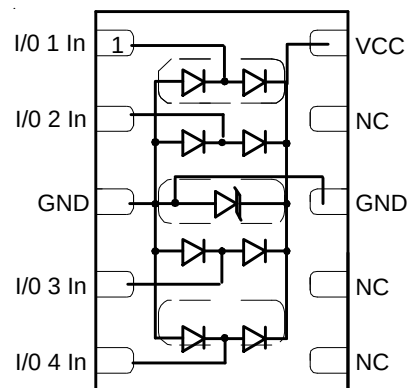
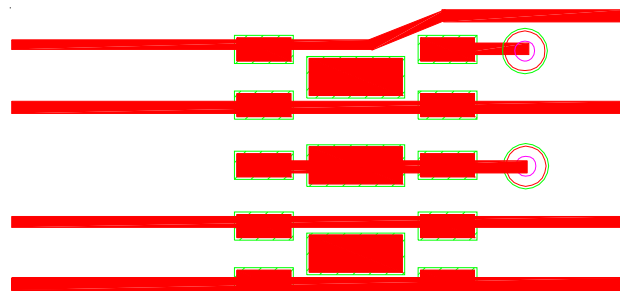


**Figure 2 - Layout Example**



# Outline Drawing - SLP3020N10

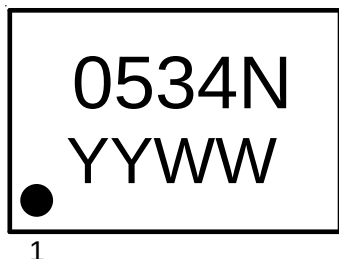


NOTES:

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



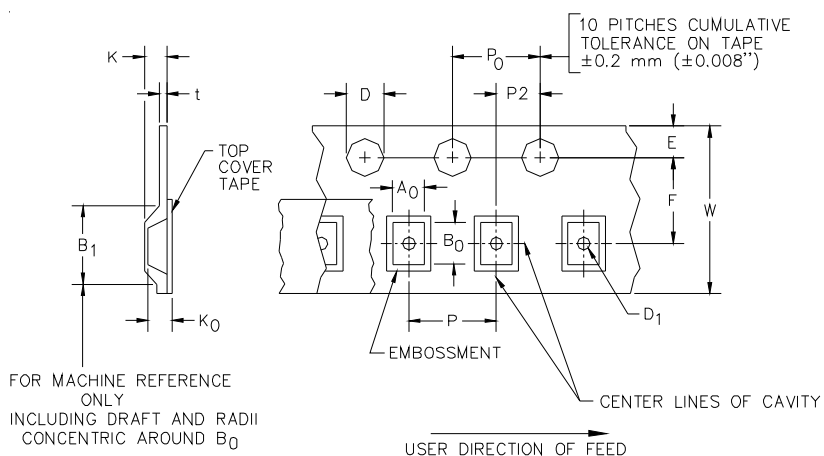
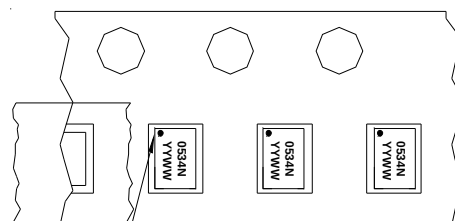
### Ordering Information

| Part Number     | Working Voltage | Qty per Reel | Reel Size |
|-----------------|-----------------|--------------|-----------|
| RClamp0534N.TCT | 5 Volts         | 3,000        | 7 Inch    |

RailClamp and RClamp are trademarks of Semtech Corporation

YYWW = Date Code

### Tape and Reel Specification



Pin 1 Location (Towards Sprocket Holes)

→  
User Direction of feed

### Device Orientation in Tape

| A0              | B0              | K0              |
|-----------------|-----------------|-----------------|
| 2.24 +/-0.05 mm | 3.23 +/-0.05 mm | 0.93 +/-0.05 mm |

| Tape Width | B, (Max) | D                          | D1              | E               | F              | K (MAX) | P             | P0            | P2             | T(MAX) | W                              |
|------------|----------|----------------------------|-----------------|-----------------|----------------|---------|---------------|---------------|----------------|--------|--------------------------------|
| 8 mm       | 4.2 mm   | 1.5 + 0.1 mm<br>- 0.0 mm ) | 0.5 mm<br>±0.05 | 1.750±.10<br>mm | 3.5±0.05<br>mm | 2.4 mm  | 4.0±0.1<br>mm | 4.0±0.1<br>mm | 2.0±0.05<br>mm | 0.4 mm | 8.0 mm<br>+ 0.3 mm<br>- 0.1 mm |

### Contact Information

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