

#### PROTECTION PRODUCTS - RailClamp®

#### Description

RailClamp® TVS arrays are ultra low capacitance ESD protection devices designed to protect high speed data interfaces. This series has been specifically engineered 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®7538P will protect eight lines or four differential pairs. Each line has a maximum capacitance of only 0.60pF between any I/O pin and ground. This allows it to be used on circuits operating in excess of 3GHz with minimal signal attenuation. They feature high maximum ESD withstand voltage of +/- 20kV contact, +/-25kV air discharge per IEC 61000-4-2.

The RClamp7538P is in a 9-pin SLP3810N9 package. It measures 3.8 x 1.0mm with a nominal height of 0.50mm. Intra-pair lead pitch is 0.40mm while the pair-to-pair pitch is 0.5mm. The innovative flow through package design simplifies pcb layout and allows matched trace lengths for constant impedance between high speed differential lines.

The combination of small size, low capacitance, and high level of ESD protection makes this device a flexible solution for applications such as HDMI, MHL, LVDS, and eSATA interfaces.

#### Features

- ◆ ESD protection for high-speed data lines to **IEC 61000-4-2 (ESD) ±25kV (air), ±20kV (contact)**
- ◆ **IEC 61000-4-5 (Lightning) 5A (8/20µs)**
- ◆ **IEC 61000-4-4 (EFT) 40A (5/50ns)**
- ◆ Package design optimized for high speed lines
- ◆ Flow-Through design
- ◆ Protects eight high-speed lines
- ◆ Low capacitance: **0.60pF** Maximum (I/O to Ground)
- ◆ Low ESD clamping voltage
- ◆ Low dynamic resistance: 0.42 Ohms (Typ)
- ◆ Solid-state silicon-avalanche technology

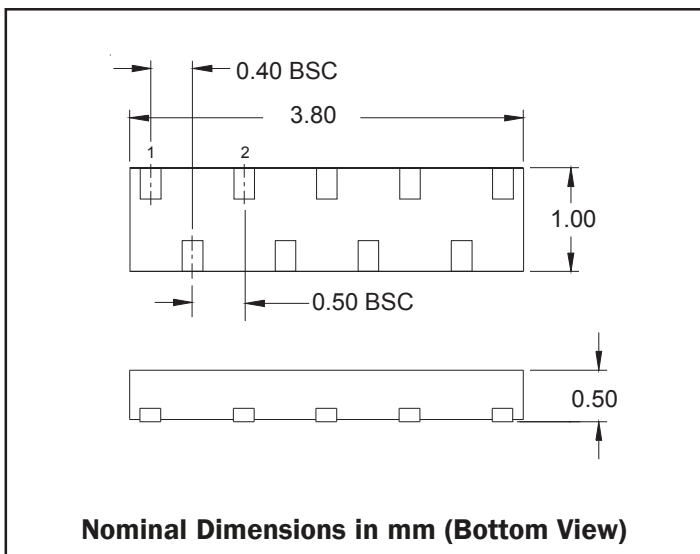
#### Mechanical Characteristics

- ◆ SLP3810N9 9-pin package (3.8 x 1.0 x 0.50mm)
- ◆ Pb-Free, Halogen Free, RoHS/WEEE Compliant
- ◆ Lead Pitch: 0.4mm (intra-pair), 0.50mm (pair-to-pair)
- ◆ Lead finish: NiPdAu
- ◆ Marking: Marking Code
- ◆ Packaging: Tape and Reel

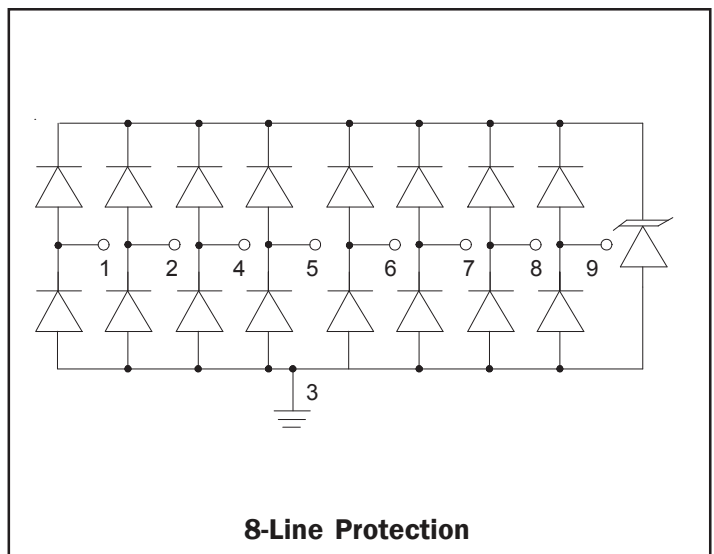
#### Applications

- ◆ HDMI 1.4
- ◆ V-By-One
- ◆ MHL
- ◆ LVDS Interfaces
- ◆ eSATA Interfaces

#### Dimensions



#### Circuit Diagram



**PROTECTION PRODUCTS**
**Absolute Maximum Rating**

| Rating                                                         | Symbol    | Value            | Units |
|----------------------------------------------------------------|-----------|------------------|-------|
| Peak Pulse Power (tp = 8/20μs)                                 | $P_{pk}$  | 75               | Watts |
| Peak Pulse Current (tp = 8/20μs)                               | $I_{pp}$  | 5                | A     |
| ESD per IEC 61000-4-2 (Air)<br>ESD per IEC 61000-4-2 (Contact) | $V_{ESD}$ | +/- 25<br>+/- 20 | kV    |
| Operating Temperature                                          | $T_J$     | -55 to +125      | °C    |
| Storage Temperature                                            | $T_{STG}$ | -55 to +150      | °C    |

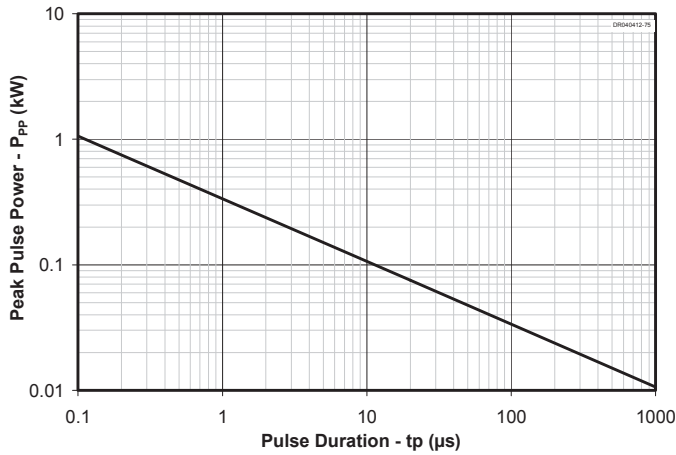
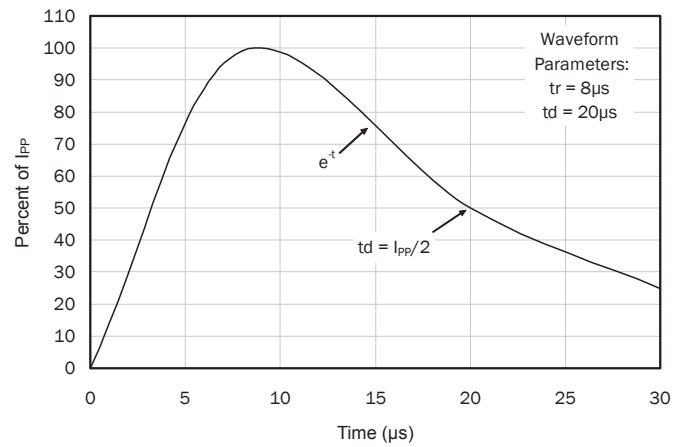
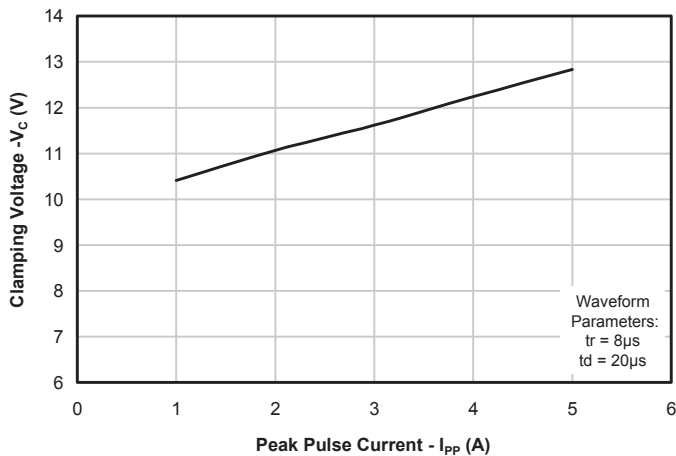
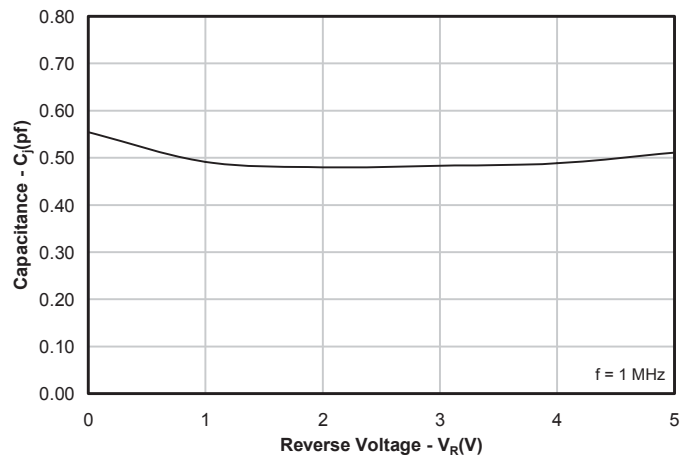
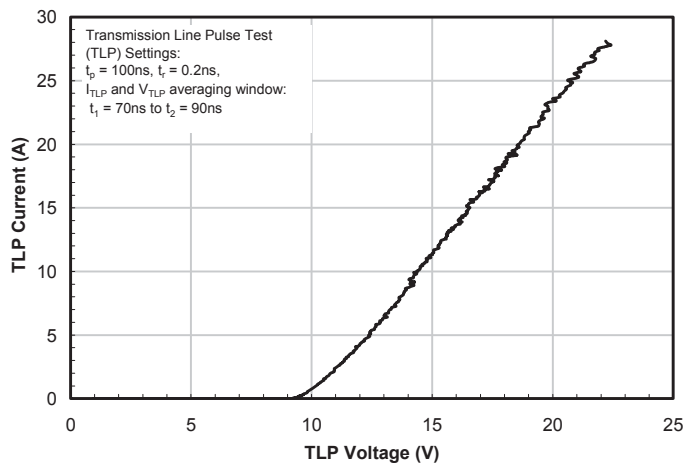
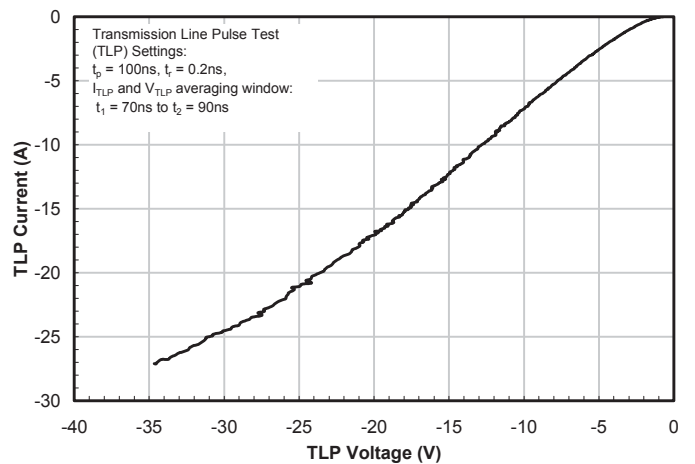
**Electrical Characteristics (T=25°C)**

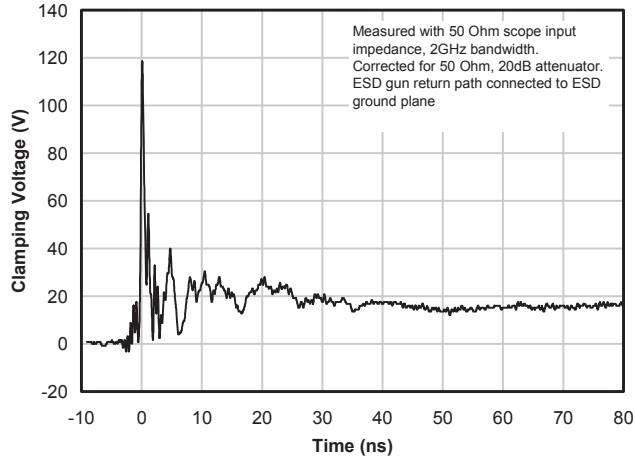
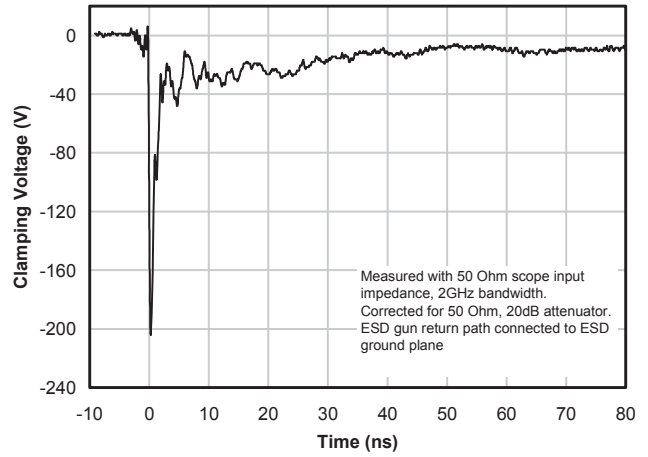
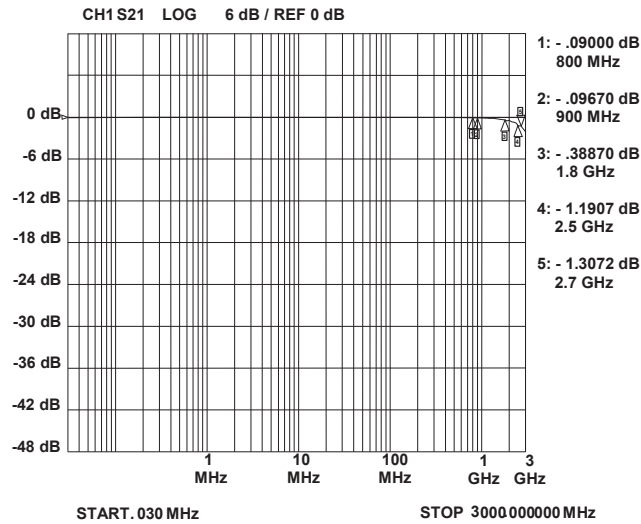
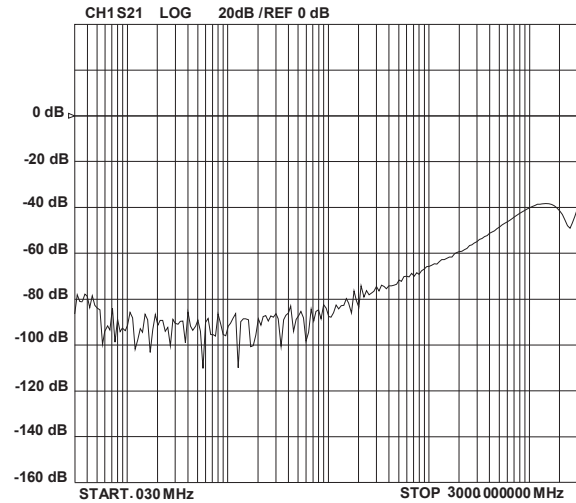
| Parameter                         | Symbol    | Conditions                                    | Minimum | Typical | Maximum | Units |
|-----------------------------------|-----------|-----------------------------------------------|---------|---------|---------|-------|
| Reverse Stand-Off Voltage         | $V_{RWM}$ | Any I/O to GND                                |         |         | 5       | V     |
| Reverse Breakdown Voltage         | $V_{BR}$  | $I_t = 1mA$ ,<br>Any I/O to GND               | 6.5     | 9       | 11      | V     |
| Reverse Leakage Current           | $I_R$     | $V_{RWM} = 5.0V$ ,<br>Any I/O to GND          |         | 0.005   | 0.100   | μA    |
| Clamping Voltage                  | $V_C$     | $I_{pp} = 1A$ , tp = 8/20μs<br>Any I/O to GND |         |         | 12      | V     |
| Clamping Voltage                  | $V_C$     | $I_{pp} = 5A$ , tp = 8/20μs<br>Any I/O to GND |         |         | 15      | V     |
| ESD Clamping Voltage <sup>1</sup> | $V_C$     | IPP = 4A,<br>t1p = 0.2/100ns                  |         | 12      |         | V     |
| ESD Clamping Voltage <sup>1</sup> | $V_C$     | IPP = 16A,<br>t1p = 0.2/100ns                 |         | 17      |         | V     |
| Dynamic Resistance <sup>2</sup>   | $R_D$     | tp = 100ns                                    |         | 0.42    |         | Ohms  |
| Junction Capacitance              | $C_j$     | $V_R = 0V$ , f = 1MHz,<br>Any I/O to GND      |         | 0.50    | 0.60    | pF    |
|                                   |           | $V_R = 0V$ , f = 1MHz,<br>Between I/O pins    |         | 0.25    | 0.4     | pF    |

**Notes**

1)Transmission Line Pulse Test (TLP) Settings:  $t_p = 100ns$ ,  $t_r = 0.2ns$ ,  $I_{TLP}$  and  $V_{TLP}$  averaging window:  $t_1 = 70ns$  to  $t_2 = 90ns$ .

2) Dynamic resistance calculated between  $I_{pp} = 4A$  and  $I_{pp} = 16A$

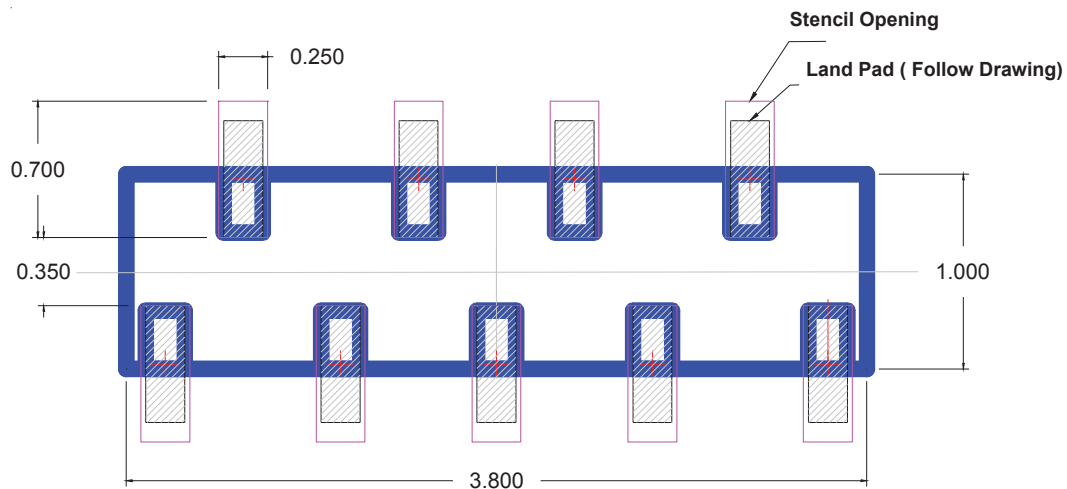
**PROTECTION PRODUCTS**
**Typical Characteristics**
**Non-Repetitive Peak Pulse Power vs. Pulse Time**

**8/20 $\mu$ s Pulse Waveform**

**Clamping Voltage vs. Peak Pulse Current  
(Between any I/O and Ground)**

**Junction Capacitance vs. Reverse Voltage  
(Between any I/O and Ground)**

**TLP Characteristic (Positive)**

**TLP Characteristic (Negative)**


**PROTECTION PRODUCTS**
**Typical Characteristics (Con't)**
**ESD Clamping (+8kV Contact per IEC 61000-4-2)  
(Between any I/O and Ground)**

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

**Typical Insertion Loss S21**

**Analog Crosstalk**


**PROTECTION PRODUCTS**
**Applications Information**
**Assembly Guidelines**

The small size of this device means that some care must be taken during the mounting process to insure reliable solder joint. Semtech's recommended assembly guidelines for mounting this device are shown in the Table. The figure below details Semtech's recommended aperture based on the below recommendations. 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. The exact manufacturing parameters will require some experimentation to get the desired solder application.

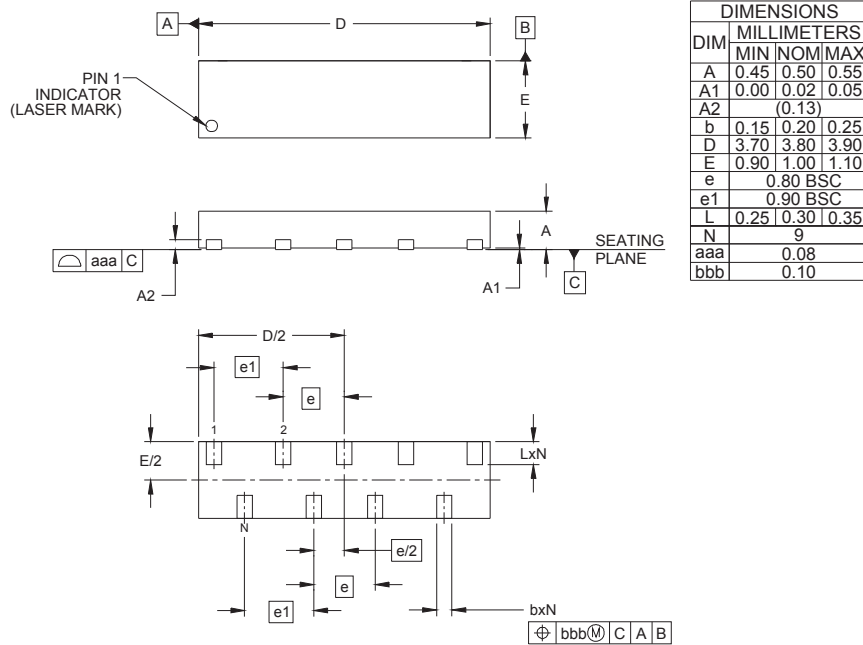
| Assembly Parameter       | Recommendation                   |
|--------------------------|----------------------------------|
| Solder Stencil Design    | Laser cut, Electro-polished      |
| Aperture shape           | Rectangular with rounded corners |
| Solder Stencil Thickness | 0.100 mm (0.004")                |
| Solder Paste Type        | Type 4 size sphere or smaller    |
| Solder Reflow Profile    | Per JEDEC J-STD-020              |
| PCB Solder Pad Design    | Non-Solder mask defined          |
| PCB Pad Finish           | OSP OR NiAu                      |



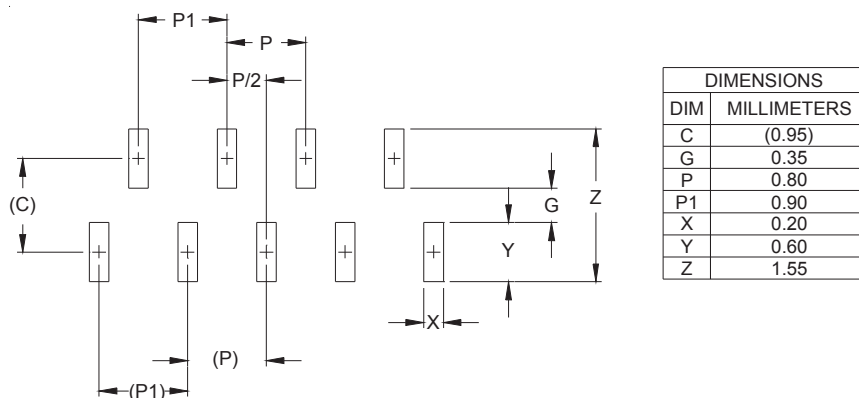
All Dimensions are in mm.

 Land Pad.  
  Stencil opening  
  Component

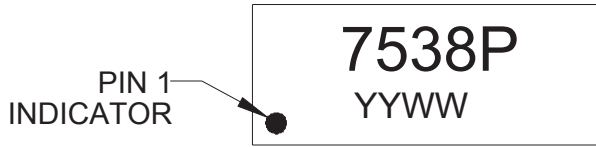
**Recommended Mounting Pattern**

**PROTECTION PRODUCTS**
**Outline Drawing - SLP3810N9**


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

**Land Pattern - SLP3810N9**


- 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.

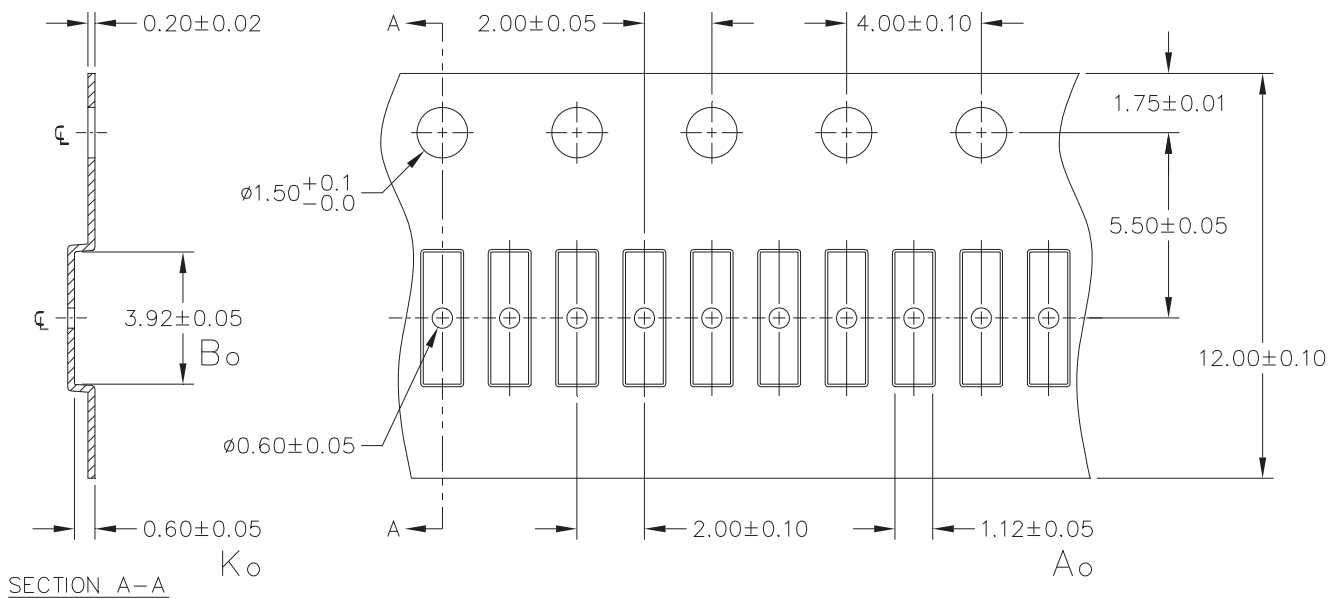
**PROTECTION PRODUCTS**
**Marking Code**


YYWW = Date Code

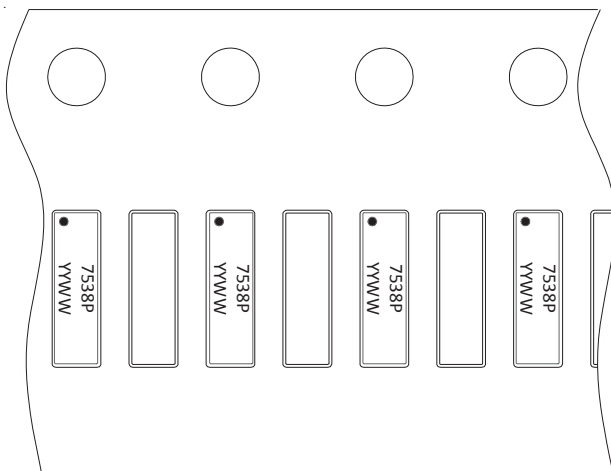
**Ordering Information**

| Part Number     | Qty per Reel | Device to Device Pitch | Reel Size |
|-----------------|--------------|------------------------|-----------|
| RClamp7538P.TZT | 5,000        | 4mm                    | 7 Inch    |
| RClamp7538P.TNT | 10,000       | 2mm                    | 7 Inch    |

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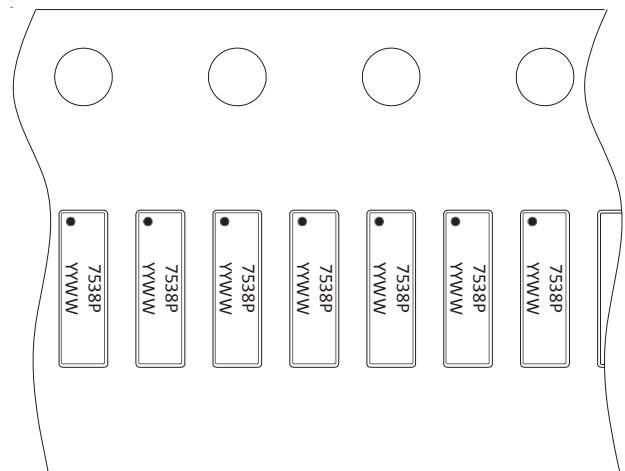
**Carrier Tape Specification**


NOTE: ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.



Notes:

- 1) Pin 1 towards sprocket holes
- 2) Every other pocket populated

**Device Orientation in Tape (5K Piece Option)**


Notes:

- 1) Pin 1 towards sprocket holes
- 2) Every pocket populated

**Device Orientation in Tape (10K Piece Option)**

**Contact Information**

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