

PROTECTION PRODUCTS - RailClamp®

Description

The RClamp®3324T provides ESD protection for USB3.0, HDMI1.3/1.4, and other high-speed ports. It features a high maximum ESD withstand voltage of $\pm 25\text{kV}$ contact and $\pm 30\text{kV}$ air discharge per IEC 61000-4-2. RClamp3324T is designed to minimize both the ESD peak clamping and the TLP clamping. Peak ESD clamping voltage is extremely low and approximately the same at each pin. The dynamic resistance is among the industry's lowest at 0.35 Ohms (typical). Typical capacitance on each line to ground is approximately 0.40pF. This allows the RClamp3324T to be used in applications operating in excess of 5GHz without signal attenuation. These devices are manufactured using Semtech's proprietary low voltage EPD technology for superior characteristics at operating voltages up to 3.3 volts. Each device will protect up to four lines (two high-speed pairs).

The RClamp3324T is in a 6-pin SLP1710P4T package. It measures 1.7 x 1.0mm with a nominal height of 0.40mm. The leads have a nominal pin-to-pin pitch of 0.40mm. The flow-through package design simplifies PCB layout and maintains signal integrity on high-speed lines.

The combination of low peak ESD clamping, low dynamic resistance, and innovative package design enables this device provides the highest level of ESD protection for applications such as USB 3.0, HDMI and V-By-One interfaces.

Features

- ◆ ESD protection for high-speed data lines to **IEC 61000-4-2 (ESD) $\pm 30\text{kV}$ (air), $\pm 25\text{kV}$ (contact)**
- ◆ **IEC 61000-4-5 (Lightning) 5A (8/20 μs)**
- ◆ **IEC 61000-4-4 (EFT) 40A (5/50ns)**
- ◆ Flow-Through design
- ◆ Protects four high-speed lines
- ◆ Low capacitance: **0.40pF** typical (I/O to ground)
- ◆ Low ESD clamping voltage
- ◆ Extremely low dynamic resistance: 0.35 Ohms (Typ)
- ◆ Solid-state silicon-avalanche technology

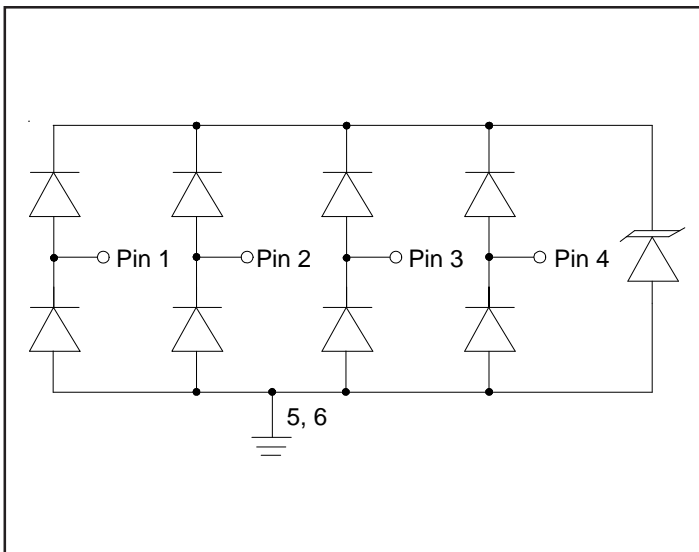
Mechanical Characteristics

- ◆ SLP1710P4T 6L package
- ◆ Pb-Free, Halogen Free, RoHS/WEEE Compliant
- ◆ Nominal Dimensions: 1.7 x 1.0 x 0.40 mm
- ◆ Lead Finish: NiPdAu
- ◆ Molding compound flammability rating: UL 94V-0
- ◆ Marking : Marking code + date code
- ◆ Packaging : Tape and Reel

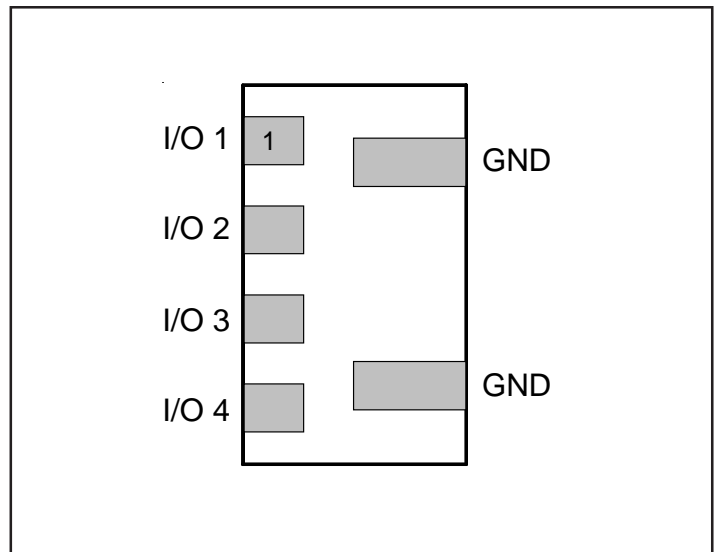
Applications

- ◆ USB 3.0
- ◆ HDMI 1.3/1.4
- ◆ 10GBase-T Ethernet
- ◆ V-By-One
- ◆ Display Port
- ◆ MHL
- ◆ LVDS Interfaces
- ◆ eSATA Interfaces

Circuit Diagram



Pin Configuration (Top View)



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) ESD per IEC 61000-4-2 (Contact) | V_{ESD} | +/- 30 +/- 25 | kV |
| Operating Temperature | T_J | -40 to +125 | °C |
| Storage Temperature | T_{STG} | -55 to +150 | °C |

Electrical Characteristics (T=25°C Unless Otherwise Specified)

| Parameter | Symbol | Conditions | Minimum | Typical | Maximum | Units |
|---------------------------|-----------|---|---------|---------|---------|-------|
| Reverse Stand-Off Voltage | V_{RWM} | Any I/O to GND | | | 3.3 | V |
| Punch-Through Voltage | V_{PT} | $I_{PT} = 2\mu A$ Any I/O to GND | 3.8 | 4.8 | 5.5 | V |
| Reverse Leakage Current | I_R | $V_{RWM} = 3.3V$ Any I/O to GND | | 0.005 | 0.100 | μA |
| Clamping Voltage | V_C | $I_{pp} = 1A$, tp = 8/20μs Any I/O to GND | | | 7 | V |
| Clamping Voltage | V_C | $I_{pp} = 5A$, tp = 8/20μs Any I/O to GND | | | 10.5 | V |
| Junction Capacitance | C_J | $V_R = 0V$, f = 1MHz, Any I/O to GND | | 0.40 | 0.65 | pF |
| | | $V_R = 0V$, f = 1MHz, Between I/O pins | | 0.30 | 0.4 | pF |

PROTECTION PRODUCTS
Electrical Characteristics (T=25°C Unless Otherwise Noted)

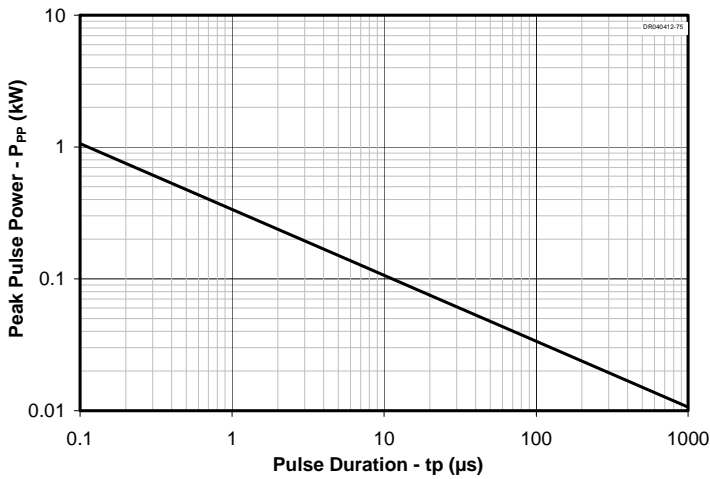
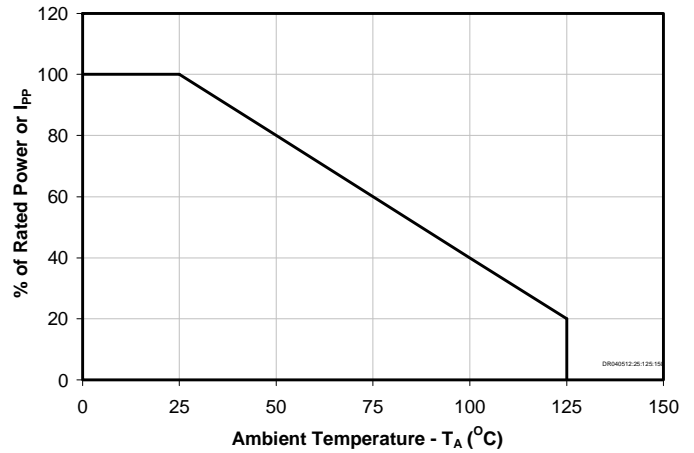
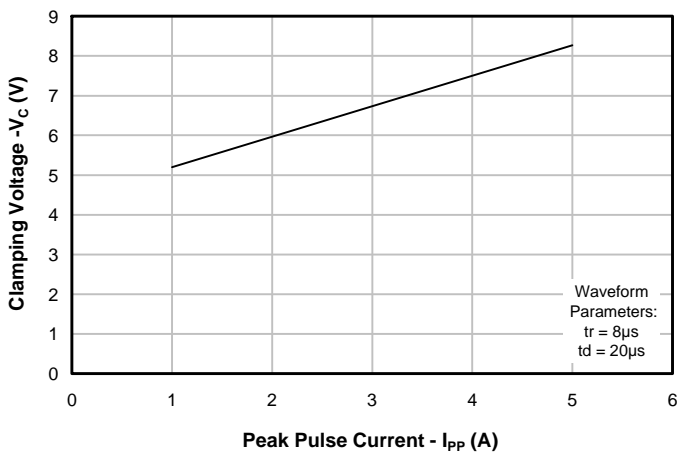
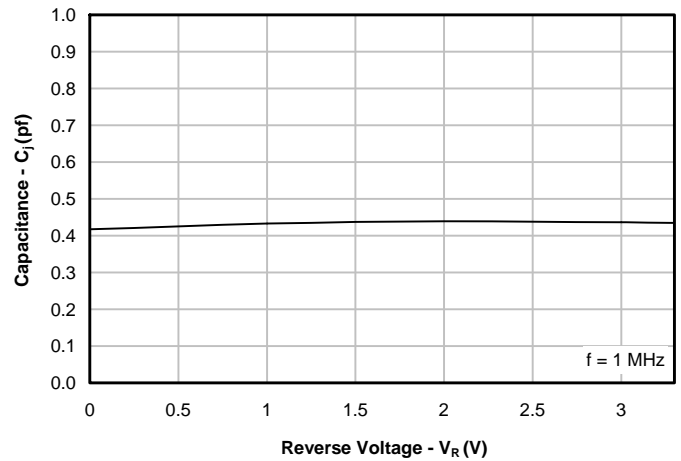
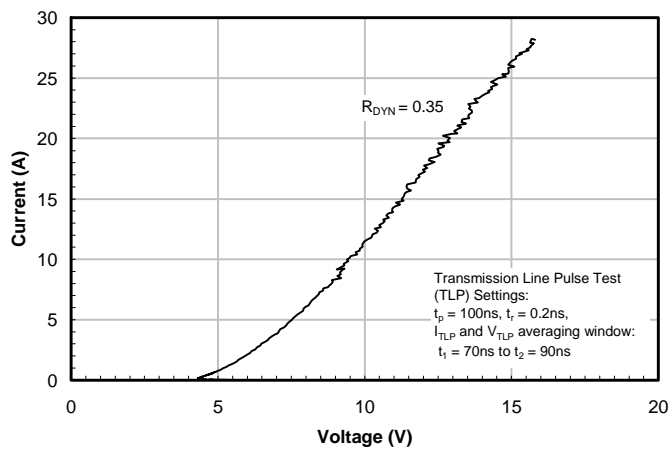
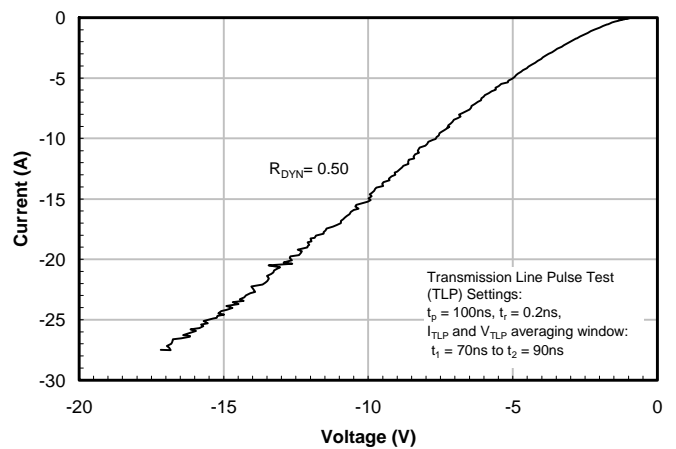
| ESD Ratings (Each Pin) | | | | | | |
|---|---------------|---|----------------|----------------|----------------|--------------|
| Parameter | Symbol | Conditions | Minimum | Typical | Maximum | Units |
| ESD Withstand Voltage ¹ | | Contact discharge per IEC 61000-4-2 | | | 25 | kV |
| ESD Withstand Voltage ¹ | | Air discharge per IEC 61000-4-2 | | | 30 | kV |
| ESD Peak Voltage ¹ | V_{pk} | +8kV per IEC 61000-4-2 | | 55 | | V |
| ESD Peak Voltage ¹ | V_{pk} | -8kV per IEC 61000-4-2 | | -60 | | V |
| ESD Clamping Voltage ² | V_{tjp} | $I_{pp} = 16A$, $t_{lp} = 0.2/100ns$ | | 11.5 | | V |
| ESD Clamping Voltage ² | V_{tjp} | $I_{pp} = -16A$, $t_{lp} = 0.2/100ns$ | | 11 | | V |
| Dynamic Resistance (Positive) ^{2, 3} | R_{dyn} | $t_p = 100ns$ | | 0.35 | | Ohms |
| Dynamic Resistance (Negative) ^{2, 3} | R_{dyn} | $t_p = 100ns$ | | 0.50 | | Ohms |

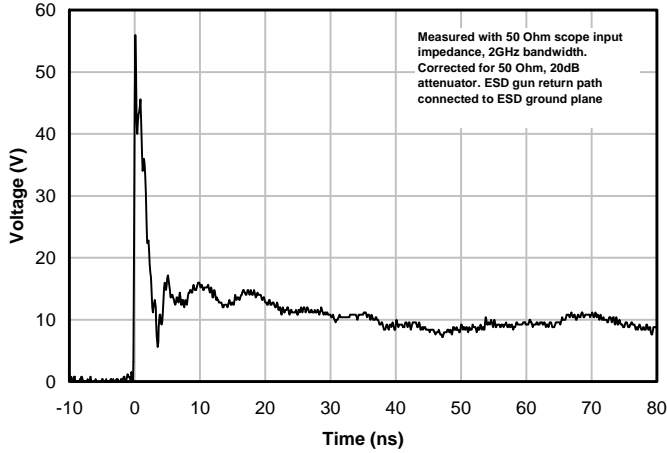
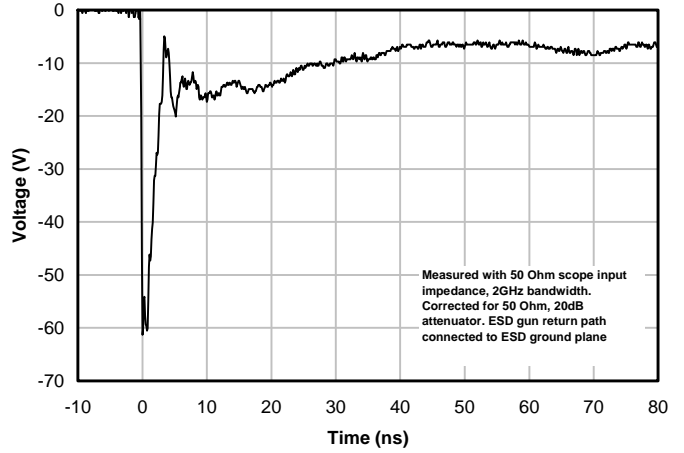
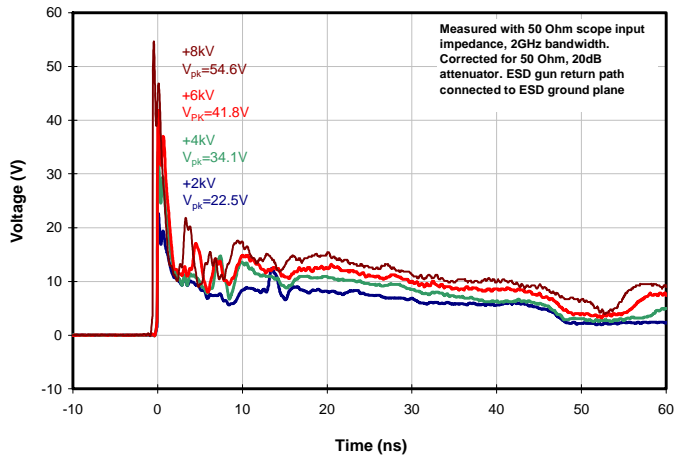
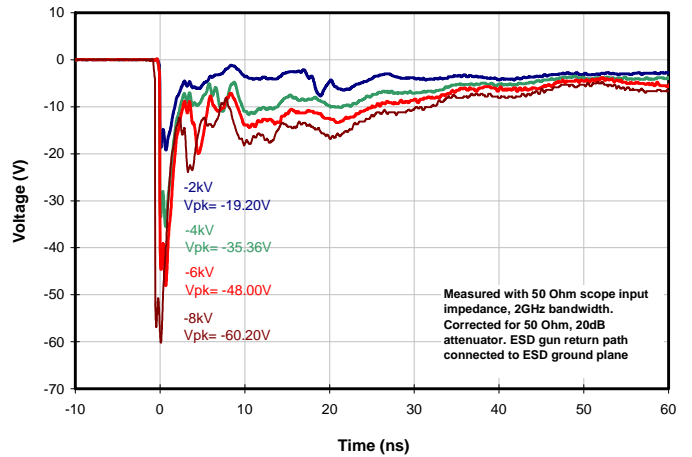
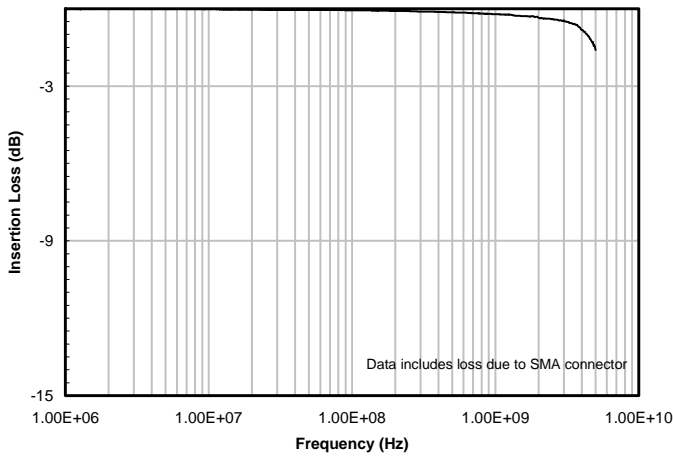
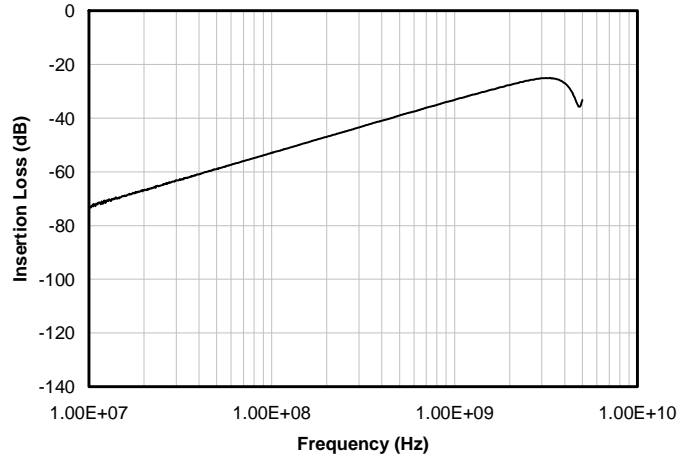
Notes

1)ESD peak voltage measured with a 20dB attenuator, 50 Ohm scope input impedance, 2GHz bandwidth. ESD gun return path connected to ESD ground plane.

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

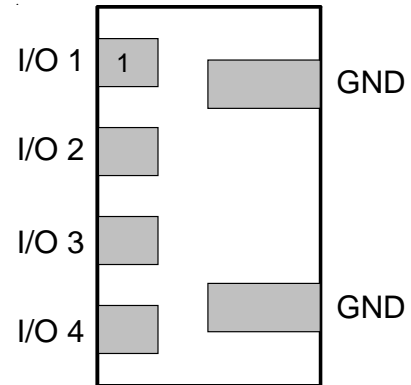
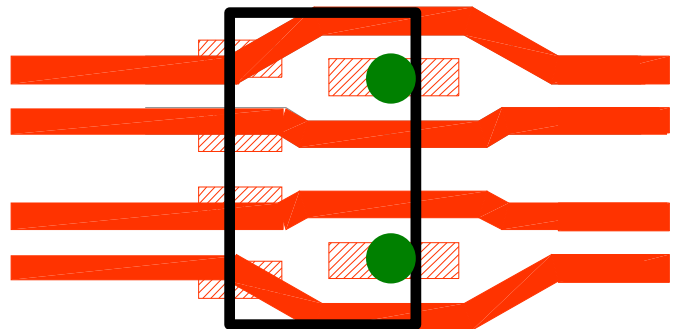
3) Dynamic resistance calculated from $I_{TLP} = 4A$ to $I_{TLP} = 16A$

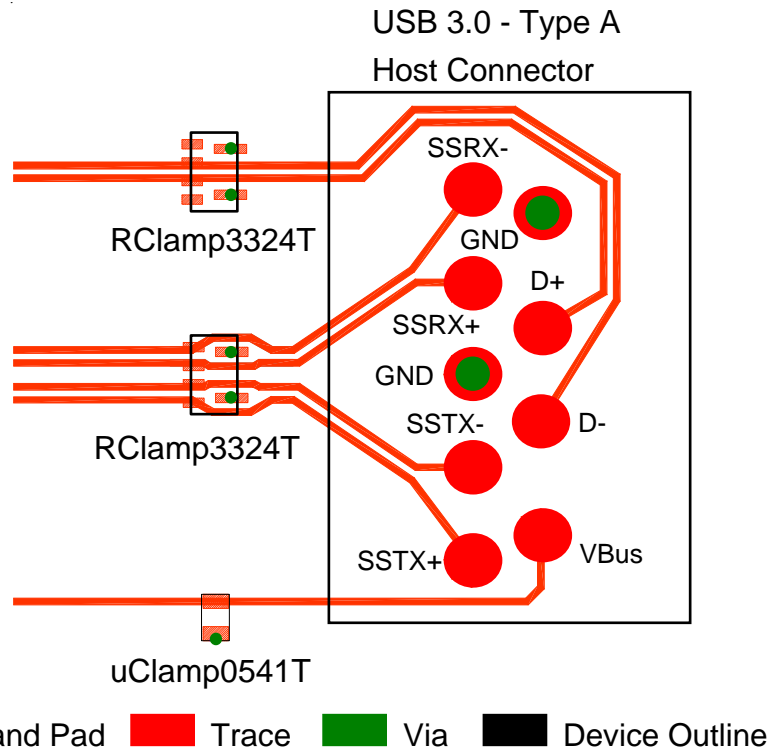
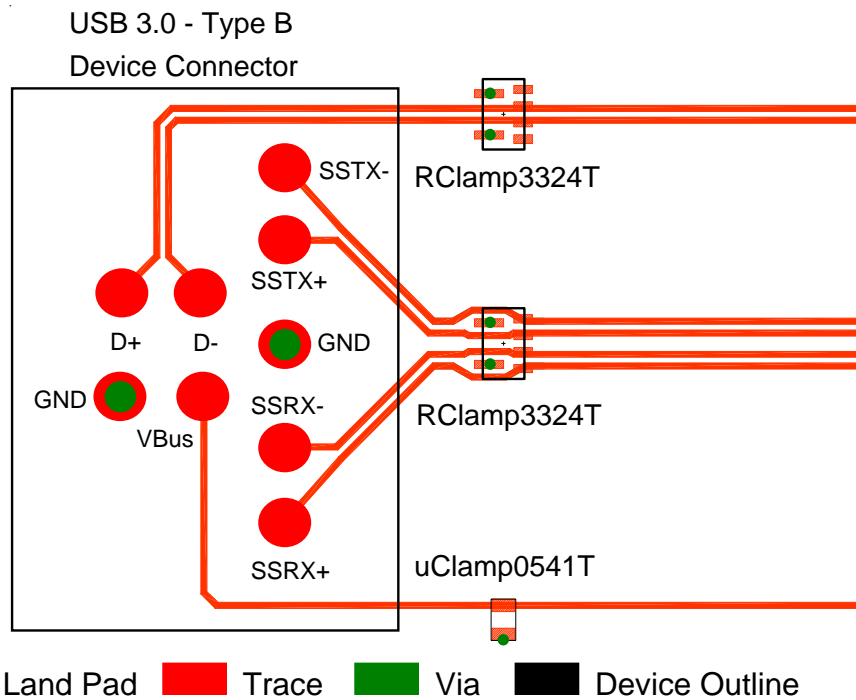
PROTECTION PRODUCTS
Typical Characteristics
Non-Repetitive Peak Pulse Power vs. Pulse Time

Power Derating Curve

Clamping Voltage vs. Peak Pulse Current

Capacitance vs. Reverse Voltage

TLP Characteristic (Positive Pulse)

TLP Characteristic (Negative Pulse)


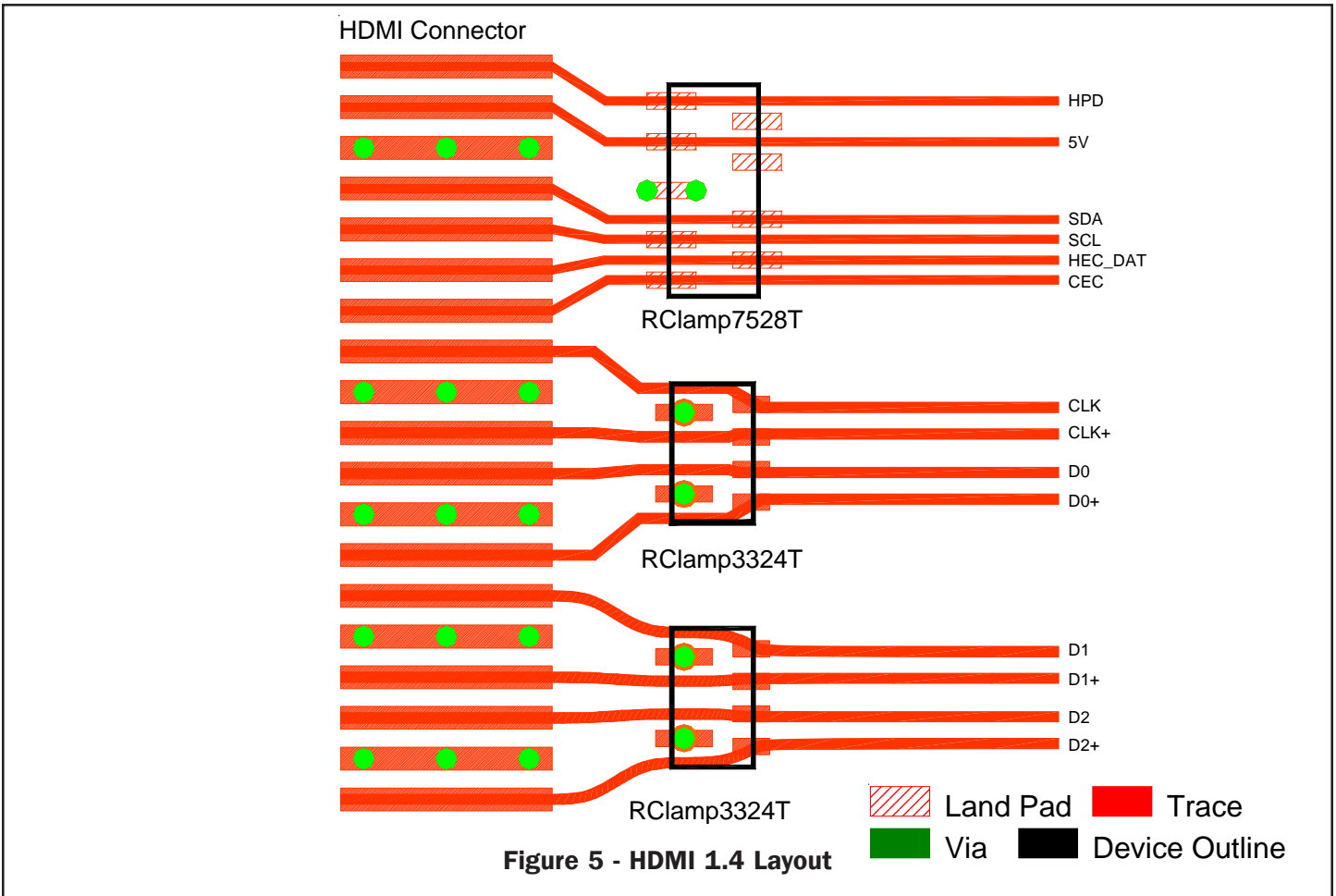
PROTECTION PRODUCTS
Typical Characteristics
**ESD Clamping at Each Pin
(+8kV Contact per IEC 61000-4-2)**

**ESD Clamping at Each Pin
(-8kV Contact per IEC 61000-4-2)**

**ESD Clamping vs. Positive Discharge Voltage
(Contact Discharge per IEC 61000-4-2)**

**ESD Clamping vs. Negative Discharge Voltage
(Contact Discharge per IEC 61000-4-2)**

Typical Insertion Loss S21 (5GHz)

Analog Crosstalk


Layout Guidelines

RClamp3324T is designed to protect 2 high speed differential pairs. The PCB traces enter and exit each I/O pin. Ground is connected at pins 5 and 6. Figure 2 is an example of how to route the high speed differential traces through the RClamp3324T. The differential impedance of each pair can be controlled for high-speed interfaces such as HDMI (100 Ohms +/- 15%) and USB 3.0 (85 Ohms +/- 15%) while maintaining a minimum trace-to-trace and trace-to-pad spacing of 0.125mm when using 0.100mm wide traces. These are only guidelines. Individual PCB design constraints may necessitate different spacing or trace width. Both ground pads should be connected for optimal performance. Ground connection is made using 0.254mm diameter filled via-in-pad. The via should be filled with a conductive paste. This technique saves board space and eliminates the capillary effect of a non filled via.

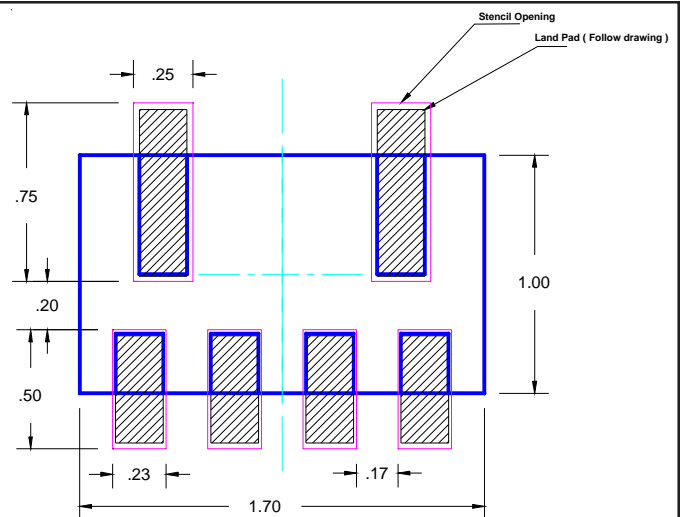

Figure 1 - Pin Configuration

Figure 2 - Example Flow-Through Layout


Figure 3 - USB 3.0 Layout (Type A Host Connector)

Figure 4 - USB 3.0 Layout (Type B Device Connector)

PROTECTION PRODUCTS
Applications Information

Recommended Assembly Parameters

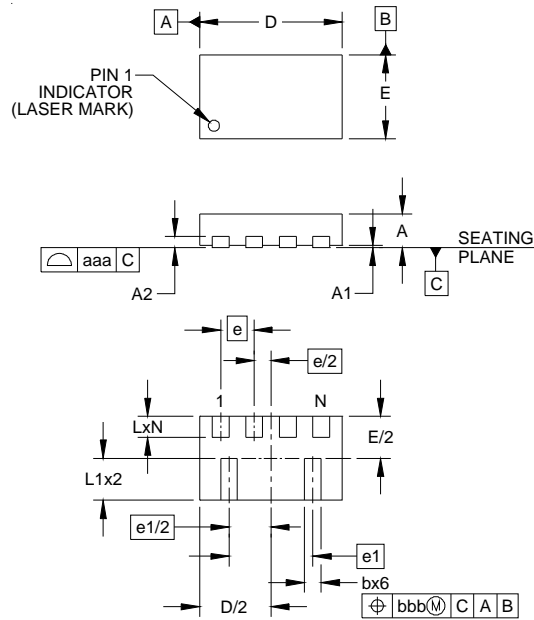
| Assembly Parameter | Recommendation |
|--------------------------|----------------------------------|
| Solder Stencil Design | Laser cut, Electro-polished |
| Aperture shape | Rectangular with rounded corners |
| Solder Stencil Thickness | 0.100 mm (0.004") |
| Solder Paste Type | Type 3 size sphere or smaller |
| Solder Reflow Profile | Per JEDEC J-STD-020 |
| PCB Solder Pad Design | Non-Solder mask defined |
| PCB Pad Finish | OSP OR NiAu |

Note that these are only recommendations and should serve only as a starting point for design. The exact manufacturing parameters will require some experimentation to get the desired solder application.



All Dimensions are in mm.
 Land Pad, Stencil opening, Component

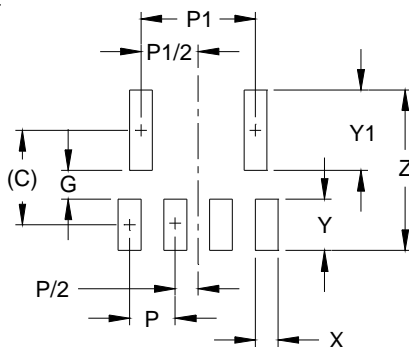
Recommended Mounting Pattern

PROTECTION PRODUCTS
Outline Drawing - SLP1710P4T


| DIMENSIONS | |
|------------|----------------|
| DIM | MILLIMETERS |
| | MIN NOM MAX |
| A | 0.37 0.40 0.43 |
| A1 | 0.00 0.02 0.05 |
| A2 | (0.13) |
| b | 0.15 0.20 0.25 |
| D | 1.65 1.70 1.78 |
| E | 0.95 1.00 1.08 |
| e | 0.40 BSC |
| e1 | 1.00 BSC |
| L | 0.20 0.25 0.30 |
| L1 | 0.45 0.50 0.55 |
| N | 4 |
| aaa | 0.08 |
| bbb | 0.10 |

NOTES:

1. CONTROLLING DIMENSIONS ARE IN MILLIMETERS (ANGLES IN DEGREES).
2. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.

Land Pattern - SLP1710P4T


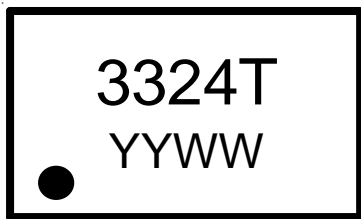
| DIMENSIONS | |
|------------|-------------|
| DIM | MILLIMETERS |
| C | (0.825) |
| G | 0.25 |
| P | 0.40 |
| P1 | 1.00 |
| X | 0.20 |
| Y | 0.45 |
| Y1 | 0.70 |
| Z | 1.40 |

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 Codes



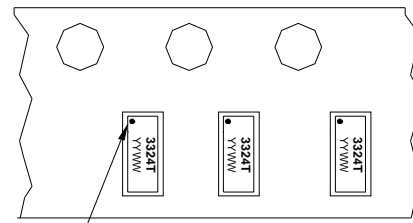
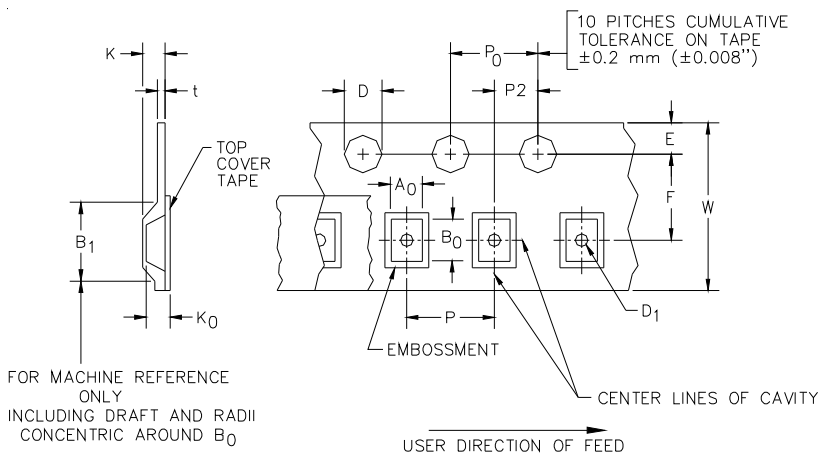
Ordering Information

| Part Number | Qty per Reel | Reel Size |
|-----------------|--------------|-----------|
| RClamp3324T.TCT | 3,000 | 7 Inch |

RailClamp and RClamp are trademarks of Semtech Corporation.

YYWW = Alphanumeric character Date Code

Carrier Tape Specification



Pin 1 Location (Towards Sprocket Holes)

User Direction of feed

| A0 | B0 | K0 |
|-----------------|-----------------|-----------------|
| 1.18 +/-0.05 mm | 1.88 +/-0.05 mm | 0.53 +/-0.05 mm |

Device Orientation in Tape

| 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 - 0.0 mm) | 0.5 mm ±0.05 | 1.750±.10 mm | 3.5±0.05 mm | 2.4 mm | 4.0±0.1 mm | 4.0±0.1 mm | 2.0±0.05 mm | 0.4 mm | 8.0 mm + 0.3 mm - 0.1 mm |

Contact Information

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