RClamp3324T
Low Voltage RailClamp®
4-Line ESD Protection

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 ±25kV contact and ±30kV 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 characteritics 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) ±30kV (air), ±25kV (contact)
  IEC 61000-4-5 (Lightning) 5A (8/20µs)
  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

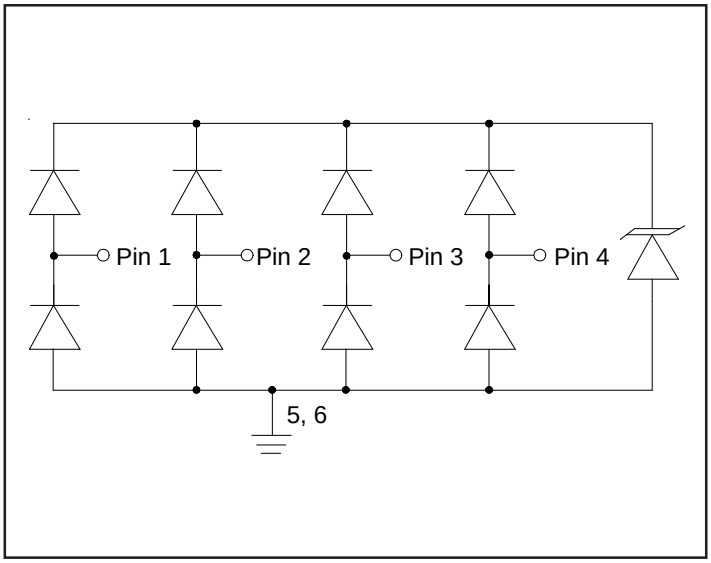
Mechanical Characteristics

- 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

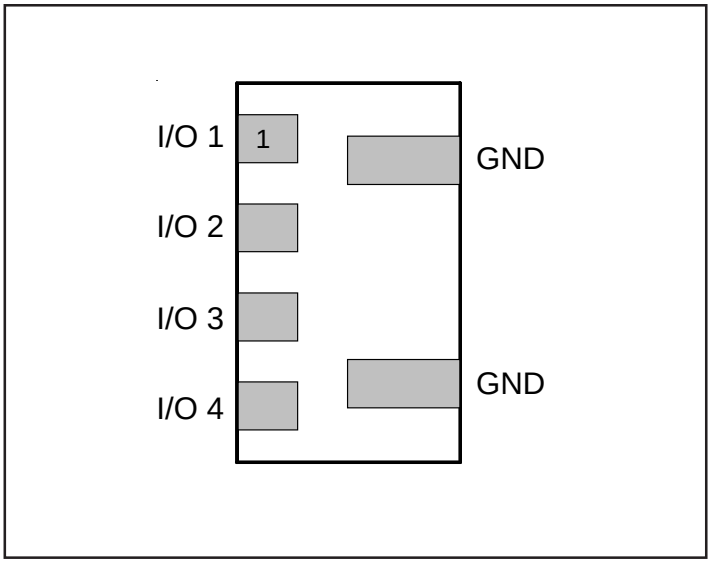
Applications

- 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)



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} = 2μA 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

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_{tlp}	I_{PP} = 16A, tlp = 0.2/100ns		11.5		V
ESD Clamping Voltage[2]	V_{tlp}	I_{PP} = -16A, tlp = 0.2/100ns		11		V
Dynamic Resistance (Positive)[2, 3]	R_{Dyn}	tp = 100ns		0.35		Ohms
Dynamic Resistance (Negative)[2, 3]	R_{Dyn}	tp = 100ns		0.50		Ohms

Notes

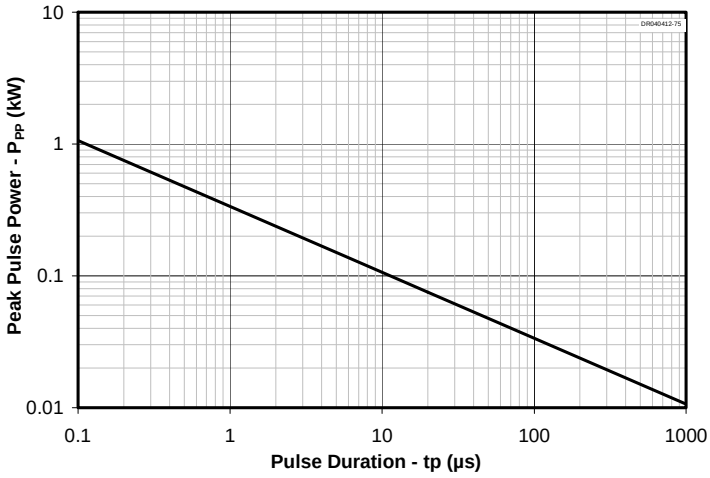
1)ESD peak voltage measured with a 20dB attenuator, 50 Ohm scope input impedance, 2GHz bandwidth. ESD gun return path connected to ESD ground plane.

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.

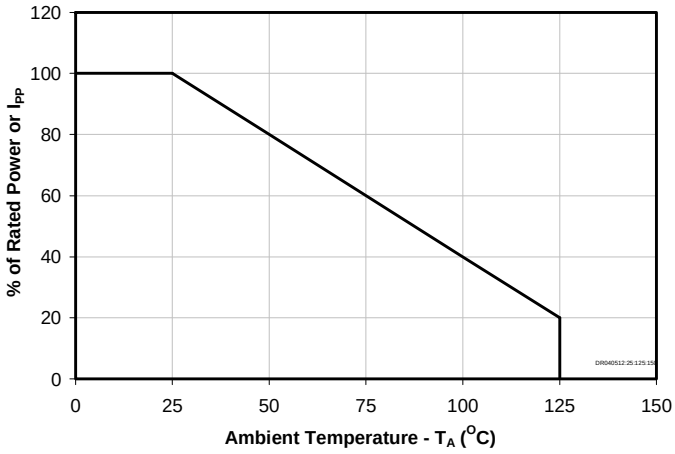
3) Dynamic resistance calculated from I_{TLP} = 4A to I_{TLP} = 16A

Typical Characteristics

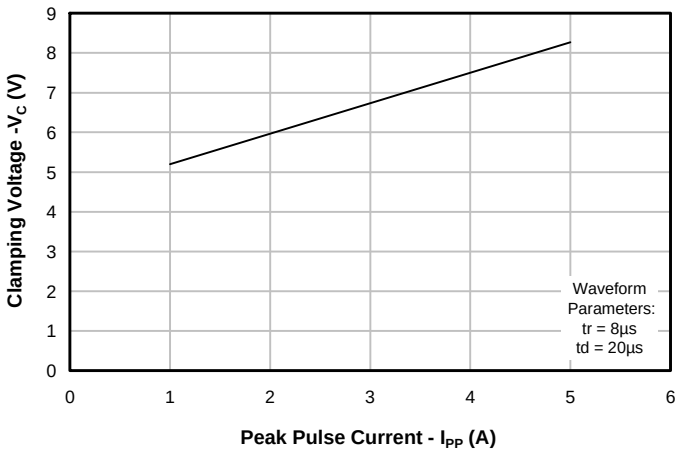
Non-Repetitive Peak Pulse Power vs. Pulse Time



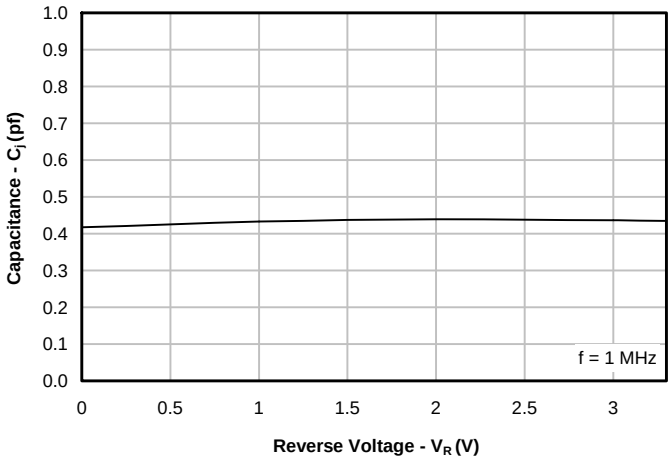
Power Derating Curve



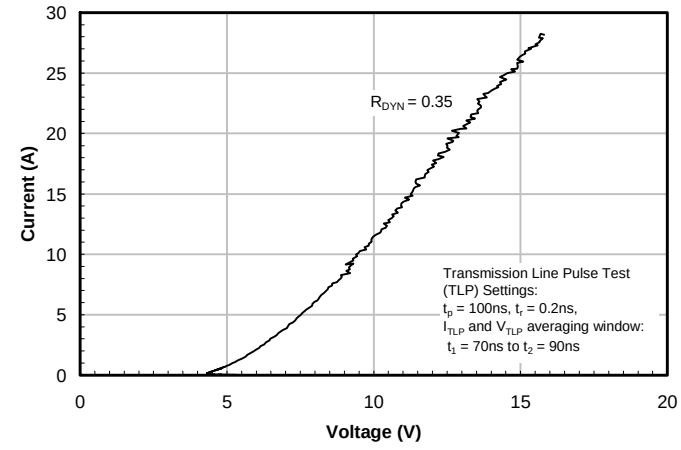
Clamping Voltage vs. Peak Pulse Current



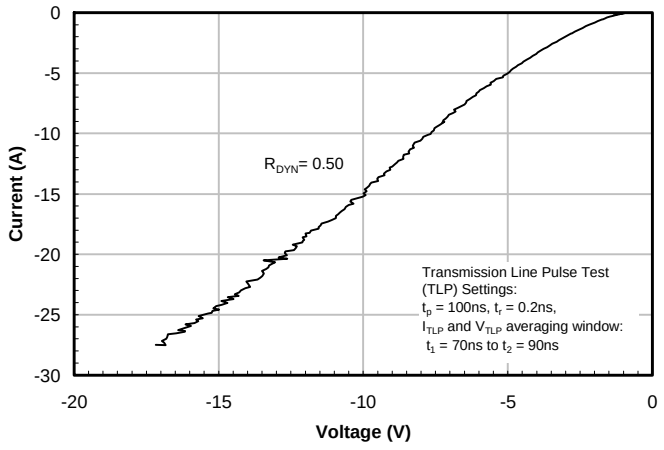
Capacitance vs. Reverse Voltage



TLP Characteristic (Positive Pulse)

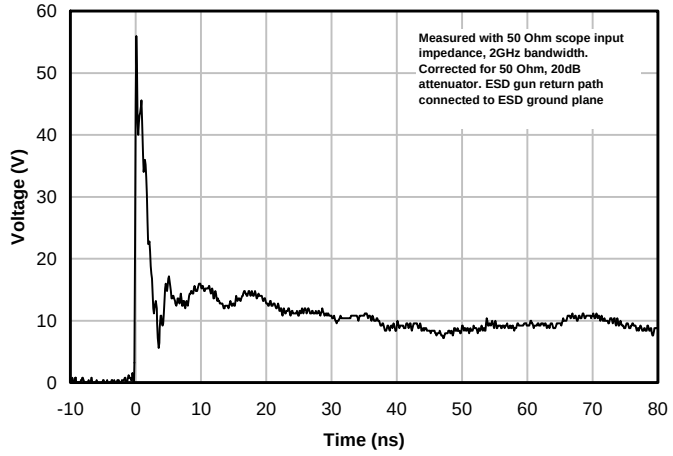


TLP Characteristic (Negative Pulse)

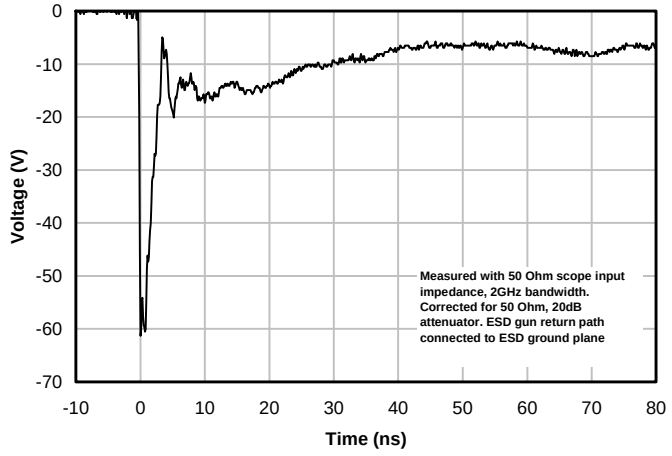


Typical Characteristics

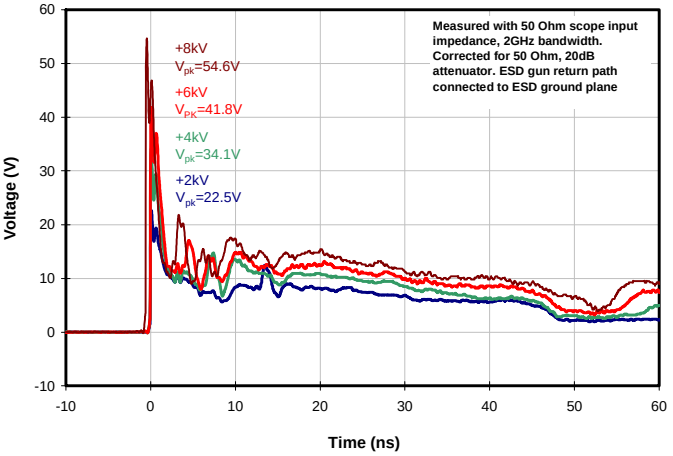
ESD Clamping at Each Pin (+8kV Contact per IEC 61000-4-2)



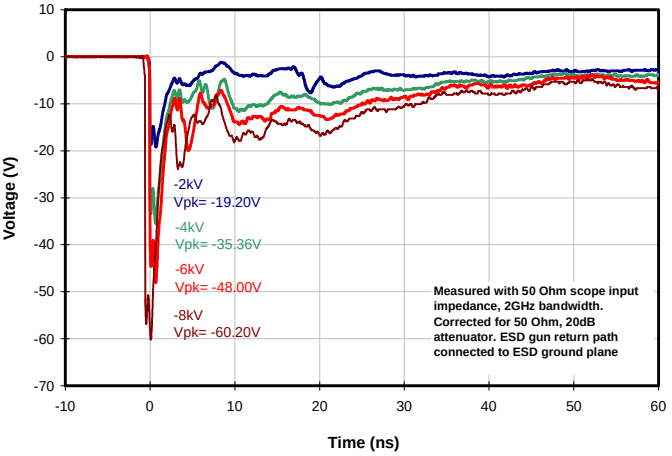
ESD Clamping at Each Pin (-8kV Contact per IEC 61000-4-2)



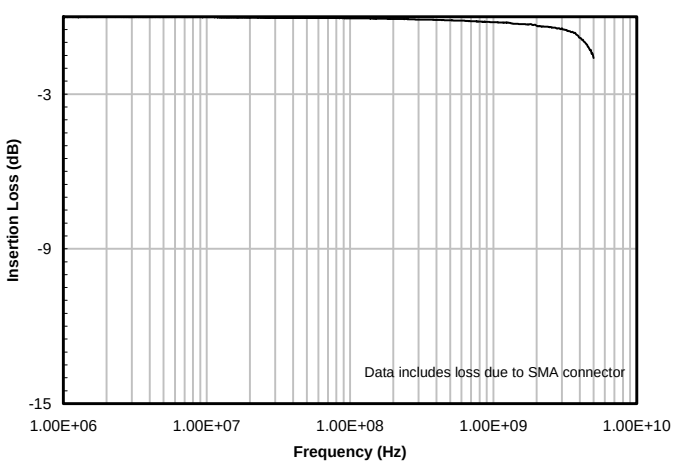
ESD Clamping vs. Positive Discharge Voltage (Contact Discharge per IEC 61000-4-2)



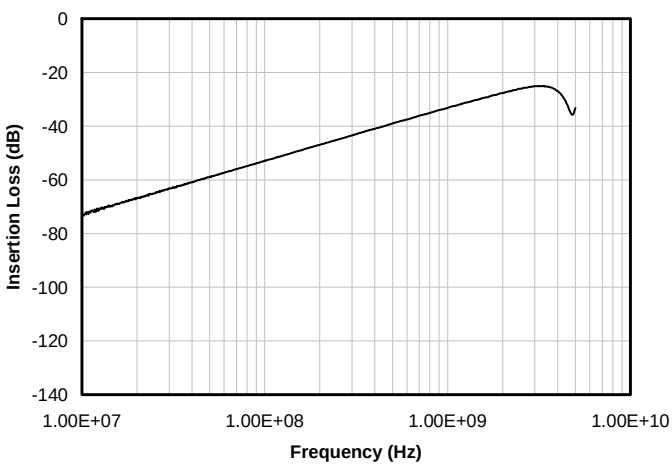
ESD Clamping vs. Negative Discharge Voltage (Contact Discharge per IEC 61000-4-2)



Typical Insertion Loss S21 (5GhZ)



Analog Crosstalk



Applications Information

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.

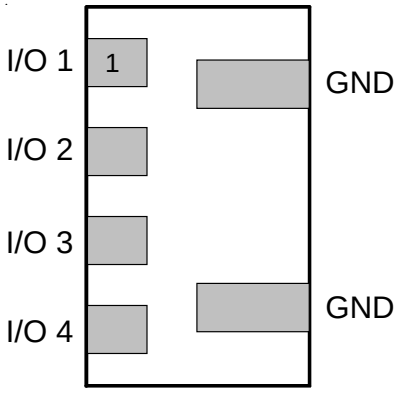


Figure 1 - Pin Configuration

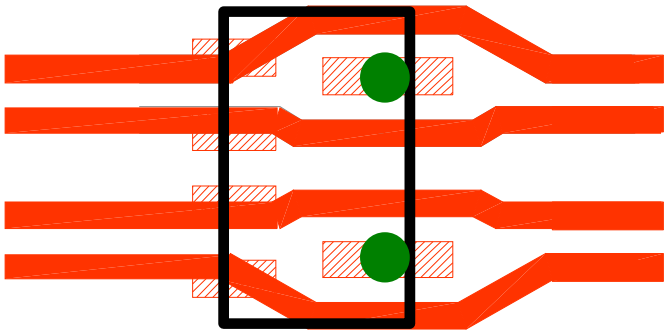


Figure 2 - Example Flow-Through Layout

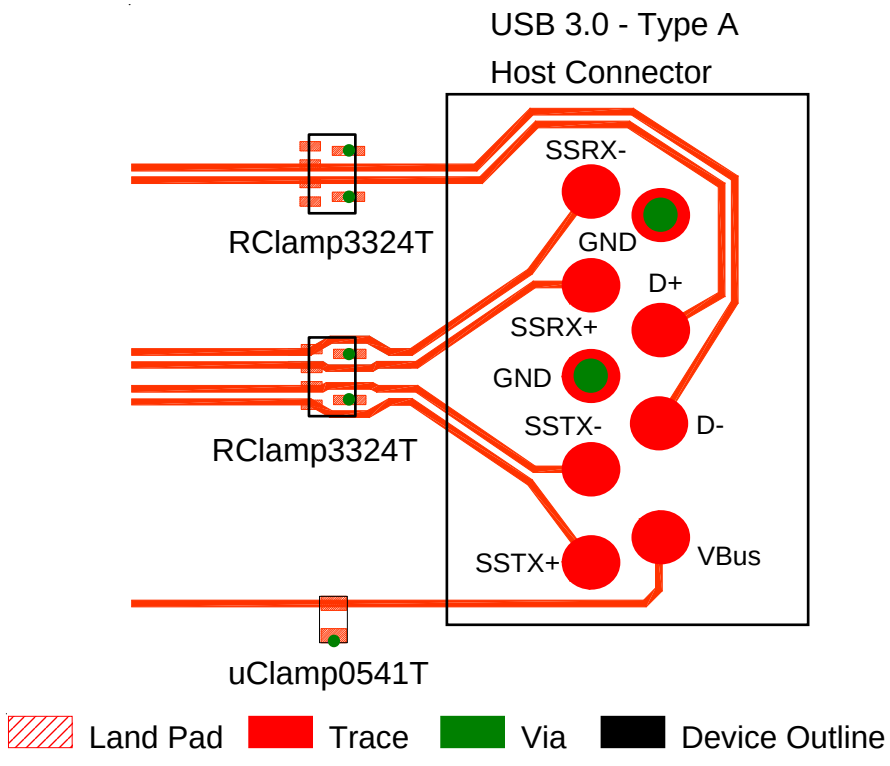


Figure 3 - USB 3.0 Layout (Type A Host Connector)

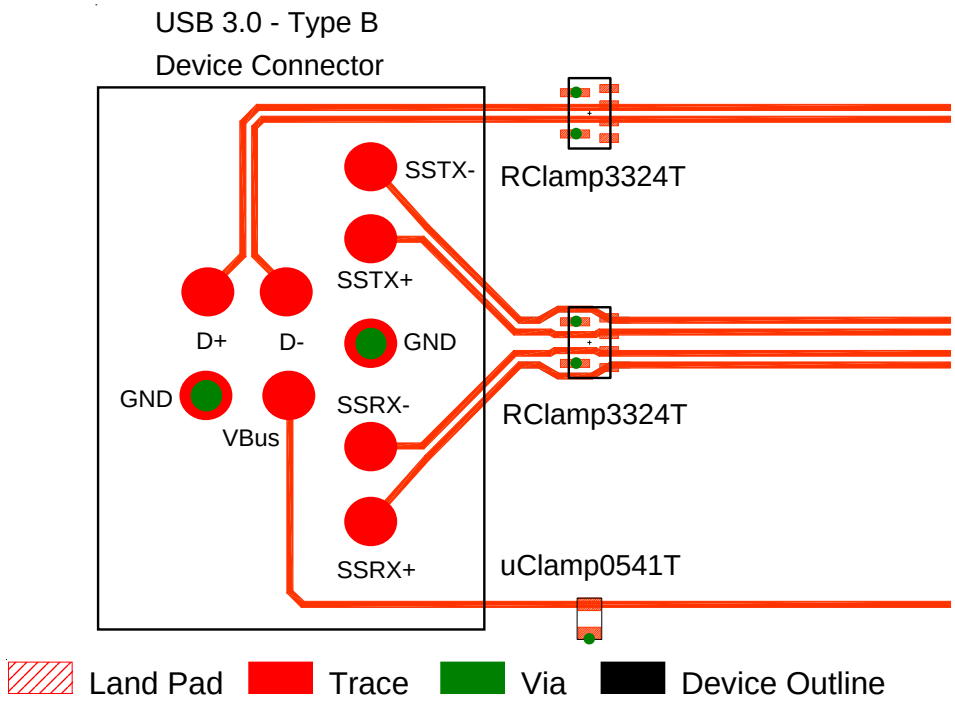


Figure 4 - USB 3.0 Layout (Type B Device Connector)

Applications Information

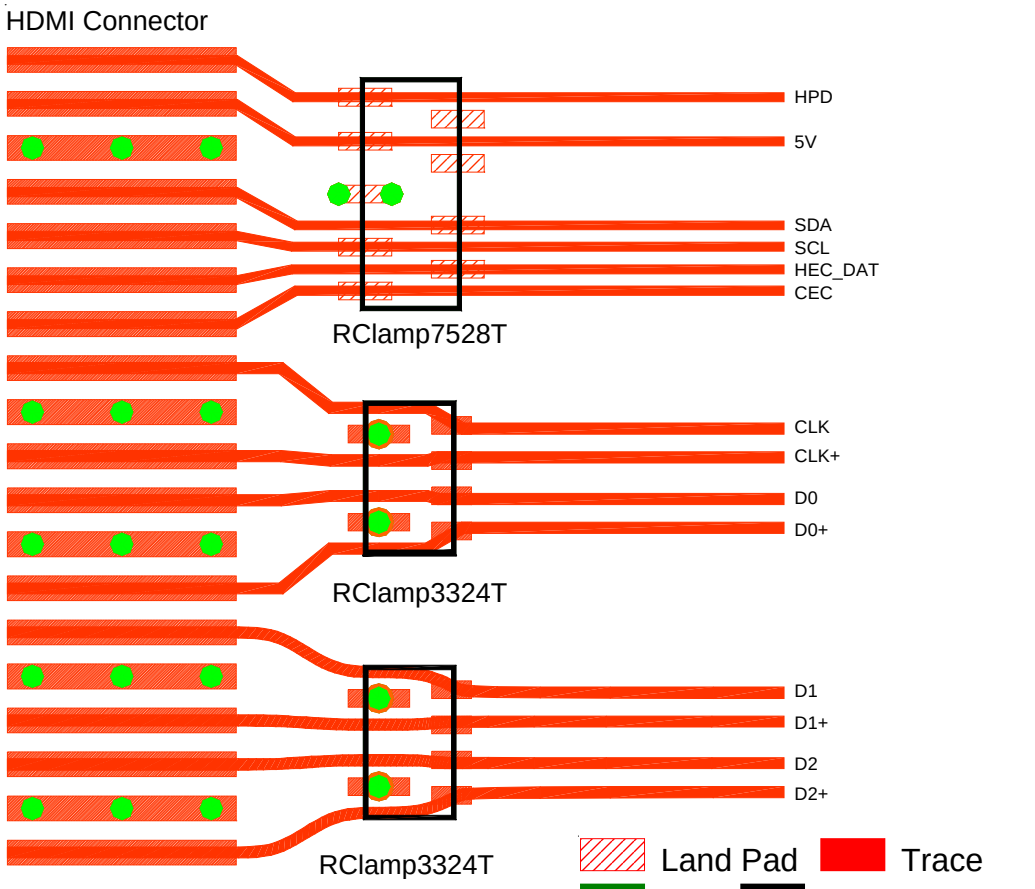
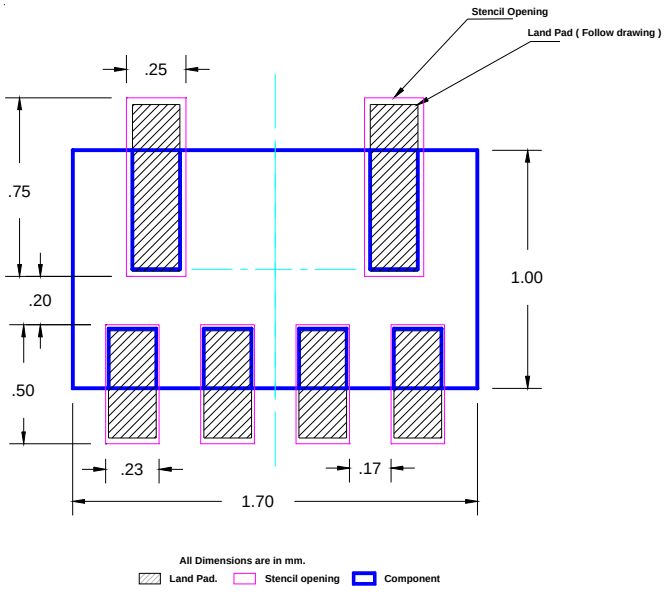


Figure 5 - HDMI 1.4 Layout

Recommended Assembly Parameters

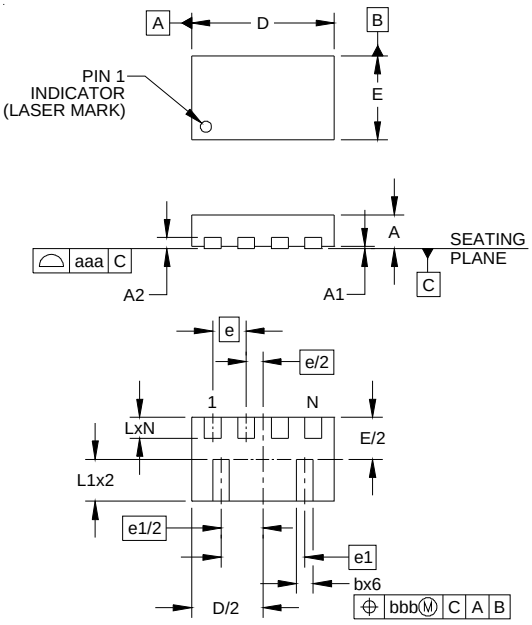
Assembly Parameter	Recommendation
Solder Stencil Design	Laser cut, Electro-polished
Aperture shape	Rectangular with rounded corners
Solder Stencil Thickness	0.100 mm (0.004")
Solder Paste Type	Type 3 size sphere or smaller
Solder Reflow Profile	Per JEDEC J-STD-020
PCB Solder Pad Design	Non-Solder mask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



Recommended Mounting Pattern

Outline Drawing - SLP1710P4T

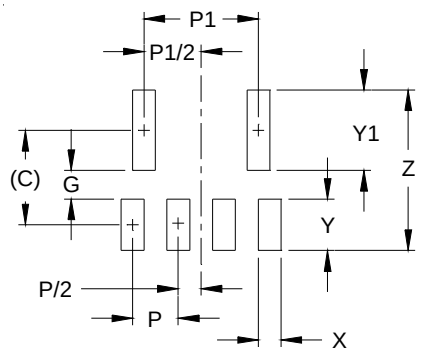


DIMENSIONS			
DIM	MILLIMETERS		
	MIN	NOM	MAX
A	0.37	0.40	0.43
A1	0.00	0.02	0.05
A2		(0.13)	
b	0.15	0.20	0.25
D	1.65	1.70	1.78
E	0.95	1.00	1.08
e		0.40 BSC	
e1		1.00 BSC	
L	0.20	0.25	0.30
L1	0.45	0.50	0.55
N		4	
aaa		0.08	
bbb		0.10	

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

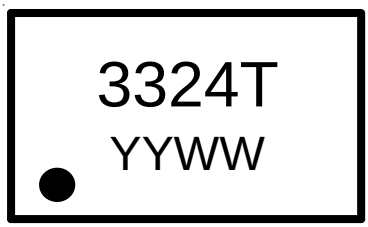


DIMENSIONS	
DIM	MILLIMETERS
C	(0.825)
G	0.25
P	0.40
P1	1.00
X	0.20
Y	0.45
Y1	0.70
Z	1.40

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.

Marking Codes



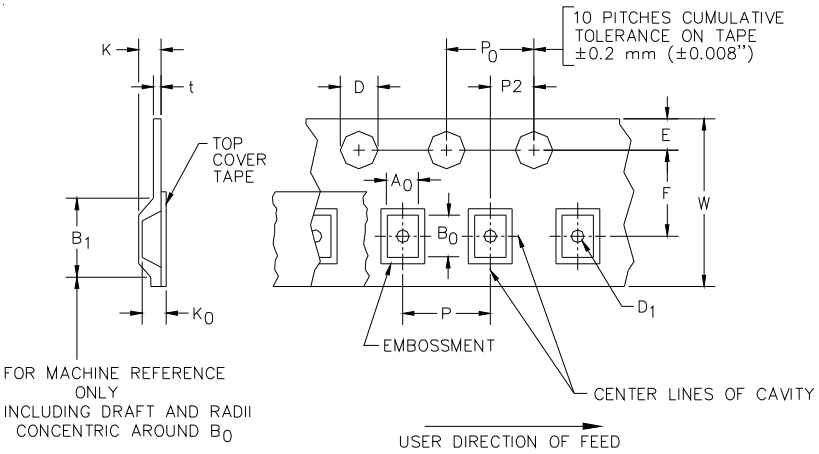
YYWW = Alphanumeric character Date Code

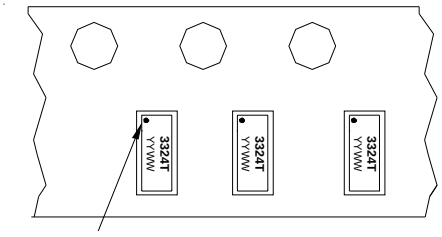
Ordering Information

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

RailClamp and RClamp are trademarks of Semtech Corporation.

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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