

PROTECTION PRODUCTS - RailClamp®
Description

RailClamps are ultra low capacitance TVS arrays designed to protect high speed data interfaces. This series has been 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 RClamp™0522P and RClamp™0524P have a typical capacitance of only 0.30pF between I/O pins. This allows it to be used on circuits operating in excess of 3GHz without signal attenuation. They may be used to meet the ESD immunity requirements of IEC 61000-4-2, Level 4 ($\pm 15\text{kV}$ air, $\pm 8\text{kV}$ contact discharge). The RClamp0522P is designed to protect two lines, while the RClamp0524P will protect four lines.

The RClamp0522P is in a 6-pin, RoHS/WEEE compliant, SLP1610P4 package. It measures 1.6 x 1.0 x 0.58mm. The RClamp0524P is in a 10-pin, RoHS/WEEE compliant, SLP2510P8 package. It measures 2.5 x 1.0 x 0.58mm. The leads are spaced at a pitch of 0.5mm and are finished with lead-free NiPd. They are designed for easy PCB layout by allowing the traces to run straight through the device. The combination of small size, low capacitance, and high level of ESD protection makes them a flexible solution for applications such as HDMI, UDI, DisplayPort™, MDDI, Serial ATA, and Infiniband circuits.

Features

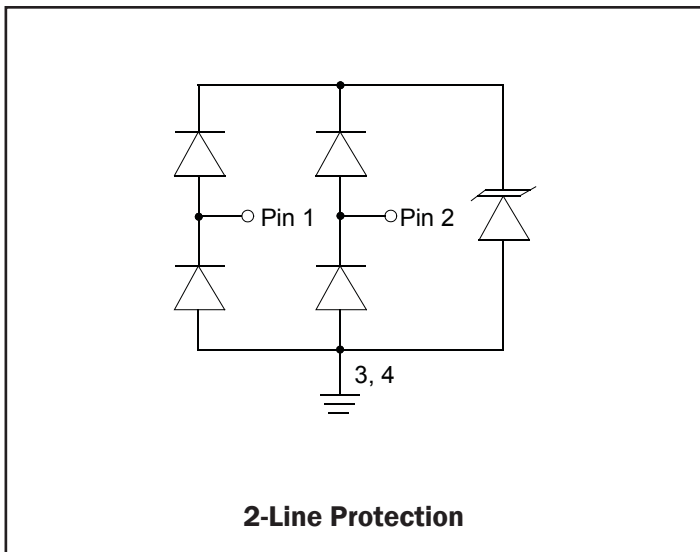
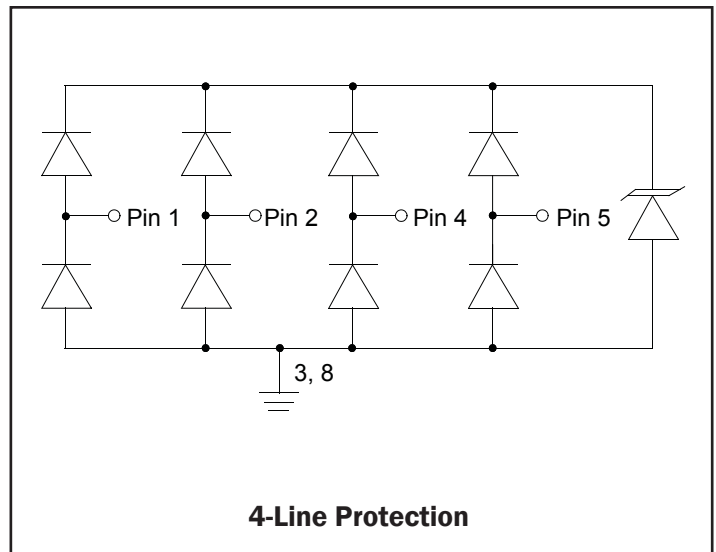
- ◆ ESD protection for high-speed data lines to **IEC 61000-4-2 (ESD) $\pm 15\text{kV}$ (air), $\pm 8\text{kV}$ (contact)**
- ◆ **IEC 61000-4-5 (Lightning) 5A (8/20 μs)**
- ◆ **IEC 61000-4-4 (EFT) 40A (5/50ns)**
- ◆ Package design optimized for high speed lines
- ◆ Flow-Through design
- ◆ Protects two or four I/O lines
- ◆ Low capacitance: **0.3pF** typical (I/O to I/O)
- ◆ Low clamping voltage
- ◆ Low operating voltage: 5V
- ◆ Solid-state silicon-avalanche technology

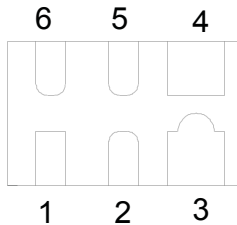
Mechanical Characteristics

- ◆ SLP1610P4 6-pin package (1.6 x 1.0 x 0.58mm)
- ◆ SLP2510P8 10-pin package (2.5 x 1.0 x 0.58mm)
- ◆ RoHS/WEEE Compliant
- ◆ Lead Pitch: 0.5mm
- ◆ Lead finish: NiPd
- ◆ Marking: Marking Code
- ◆ Packaging: Tape and Reel per EIA 481

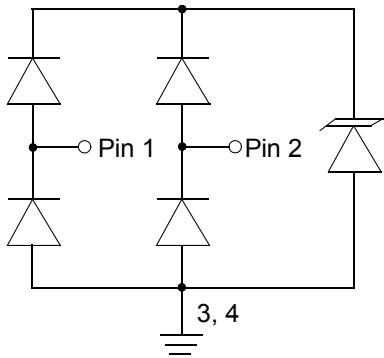
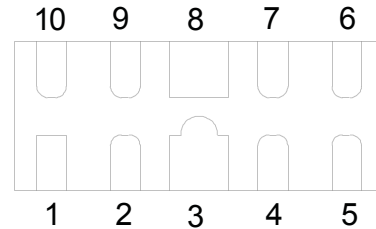
Applications

- ◆ High Definition Multi-Media Interface (HDMI)
- ◆ Digital Visual Interface (DVI)
- ◆ Unified Display Interface (UDI)
- ◆ DisplayPort™ Interface
- ◆ MDDI Ports
- ◆ PCI Express
- ◆ Serial ATA

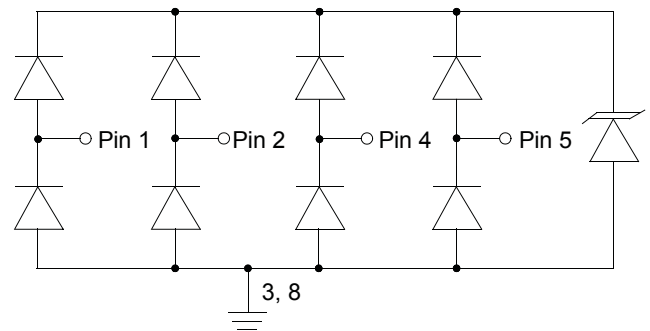
Circuit Diagram - RClamp0522P

Circuit Diagram - RClamp0524P


PROTECTION PRODUCTS - RailClamp®
Pin Identification and Configuration
RClamp0522P


Pin	Identification
1 - 2	Input Lines
5 - 6	Output Lines (No Internal Connection)
3 - 4	Ground

SLP1610P4 Pin Configuration (Top View)

Circuit Diagram
RClamp0524P


Pin	Identification
1, 2, 4, 5	Input Lines
6, 7, 9, 10	Output Lines (No Internal Connection)
3, 8	Ground

SLP2510P8 Pin Configuration (Top View)

Circuit Diagram
Ordering Information

Part Number	Number of Lines	Qty per Reel	Reel Size
RClamp0522P.TCT	2	3000	7 Inch
RClamp0524P.TCT	4	3000	7 Inch

Note: Lead finish is lead-free NiPd.

RailClamp and RClamp are marks of Semtech Corporation.

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Absolute Maximum Rating

Rating	Symbol	Value	Units
Peak Pulse Power (tp = 8/20μs)	P_{pk}	150	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}	+/- 17 +/- 12	kV
Operating Temperature	T_J	-55 to +125	°C
Storage Temperature	T_{STG}	-55 to +150	°C

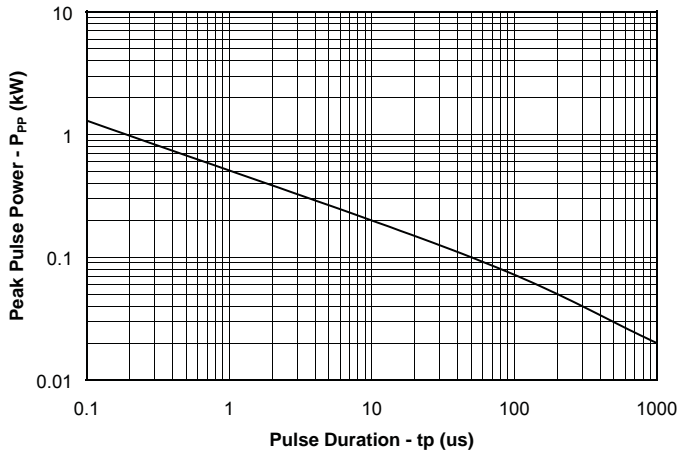
Electrical Characteristics (T=25°C)

Parameter	Symbol	Conditions	Minimum	Typical	Maximum	Units
Reverse Stand-Off Voltage	V_{RWM}	Any I/O pin to ground			5	V
Reverse Breakdown Voltage	V_{BR}	$I_t = 1mA$ Any I/O pin to ground	6			V
Reverse Leakage Current	I_R	$V_{RWM} = 5V, T=25°C$ Any I/O pin to ground			1	μA
Clamping Voltage	V_C	$I_{pp} = 1A, tp = 8/20μs$ Any I/O pin to ground			15	V
Junction Capacitance	C_j	$V_R = 0V, f = 1MHz$ Between I/O pins		0.30	0.4	pF
Junction Capacitance	C_j	$V_R = 0V, f = 1MHz$ Any I/O pin to ground			0.8	pF

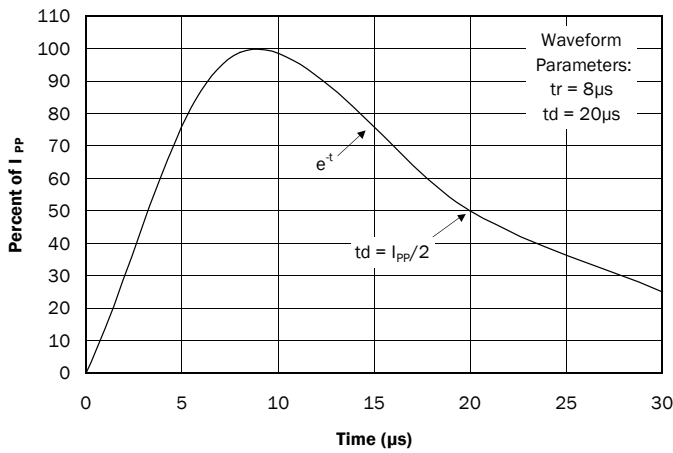
PROTECTION PRODUCTS

Typical Characteristics

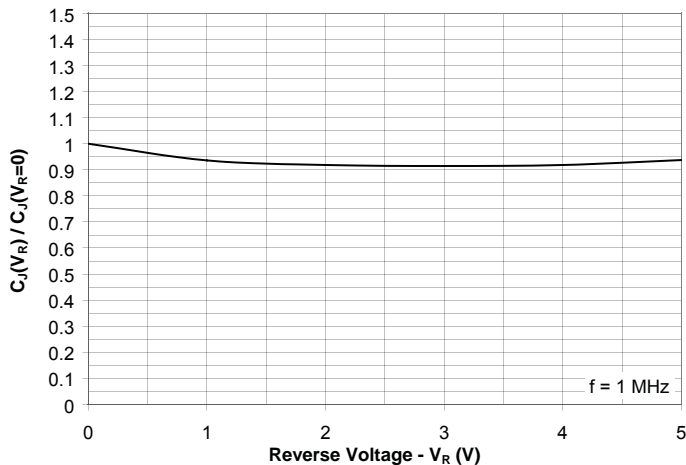
Non-Repetitive Peak Pulse Power vs. Pulse Time



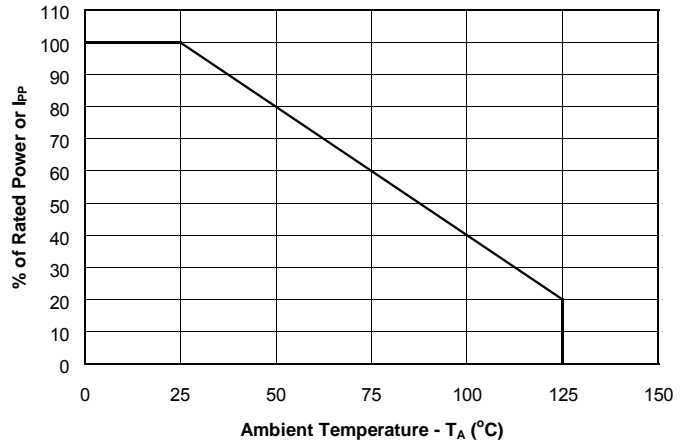
Pulse Waveform



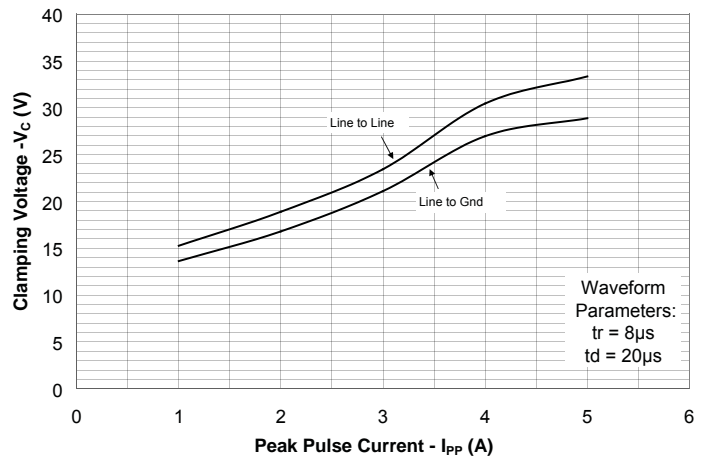
Normalized Capacitance vs. Reverse Voltage



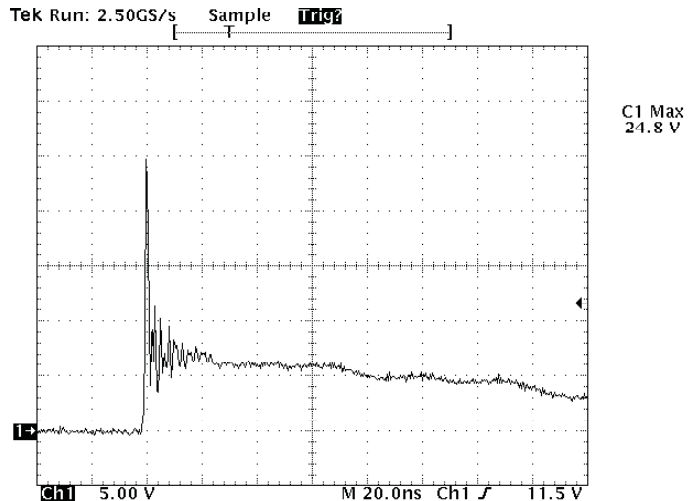
Power Derating Curve



Clamping Voltage vs. Peak Pulse Current



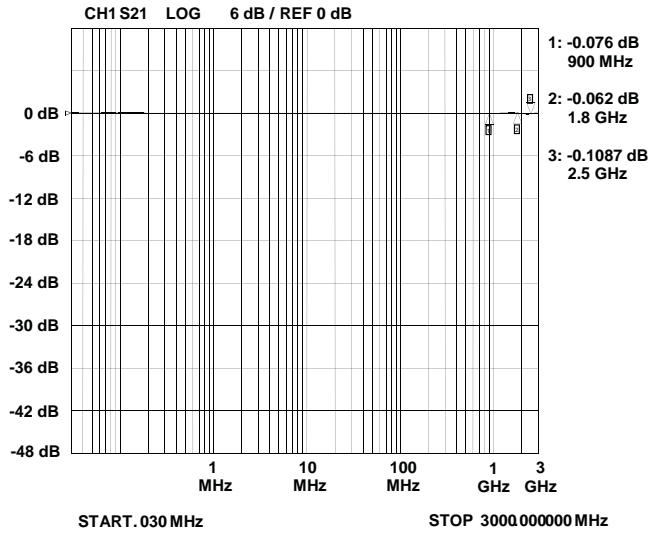
ESD Clamping for +8kV pulse per IEC 61000-4-2



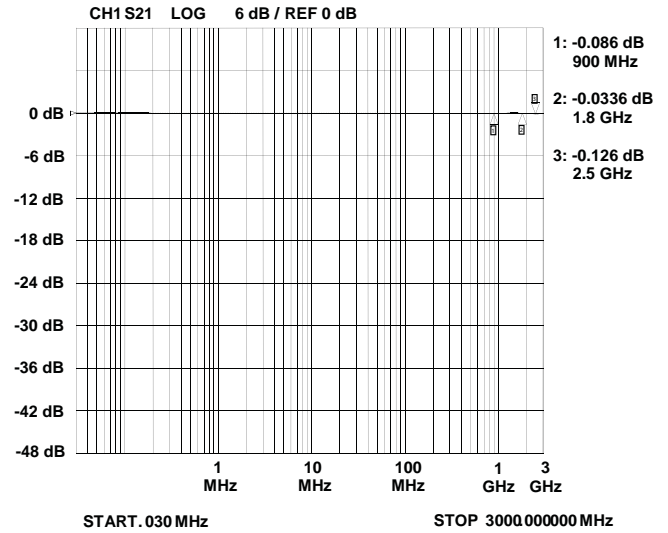
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Typical Characteristics (Con't)

Insertion Loss S21 - I/O to I/O



Insertion Loss S21 - I/O to GND



Design Considerations for HDMI Protection

Any protection to HDMI ports can be achieved by using protection devices have an impedance mismatch. However, adding even a small amount of protection because the impedance of the protection device and, large packages are not ideal and introduce discontinuities that can cause reflections.

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Applications Information

ment of 100 Ohm $\pm 15\%$ with plenty of margin. For signal integrity purposes, the best results will be obtained by using the RClamp0524P to protect the high-speed differential pairs. This is because the device is designed such that the data lines from the connector line up with the I/O pins of the device without altering the trace routing. Either the RClamp0522P or RClamp0524P may be used to protect the remaining lines (I2C, CEC, and hot plug) depending on layout constraints.

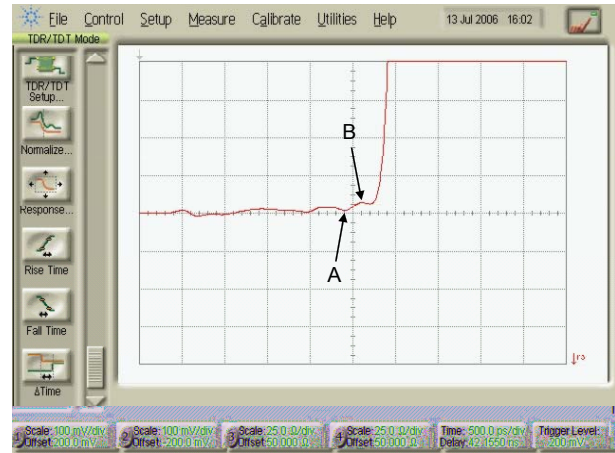
Layout Guidelines for Optimum ESD Protection

Good circuit board layout is critical not only for signal integrity, but also for effective suppression of ESD induced transients. For optimum ESD protection, the following guidelines are recommended:

- Place the device as close to the connector as possible. This practice restricts ESD coupling into adjacent traces and reduces parasitic inductance.
- The ESD transient return path to ground should be kept as short as possible. Whenever possible, use multiple micro vias connected directly from the device ground pad to the ground plane.
- Avoid running critical signals near board edges.

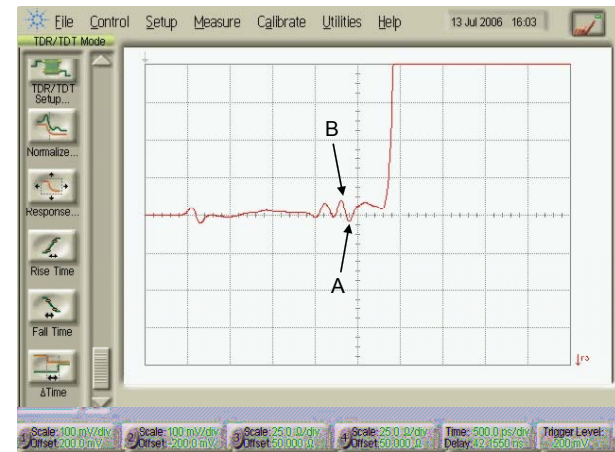
Protecting MDDI Ports with RClamp0524P and RClamp0522P

The small package size and low capacitance of the RClamp0522P and RClamp0524P make them ideal for high-speed lines in portable applications. One such application is the protection of MDDI ports in cellular phones. MDDI is a serial data interface operating at 480Mb/s per line pair. The lines are scalable for increased speed and display resolution. A MDDI port protection example is shown in Figure 4. The RClamp0524P is used to protect two differential line pairs while an RClamp0522P is used to protect the MDDI strobe lines. Note that devices are used on both the main board and LCD side of the MDDI port. Devices on the main board are needed to protect the MDDI controller in the Baseband processor. Devices on the LCD board are needed to protect MDDI controller in the LCD module. A TVS such as the uClamp0501P is used to protect the MDDI power line. The protection devices should be placed close to the connector of each board. Traces are routed directly through each device, minimizing parasitic inductance. Connections to the ground plane should be made with multiple micro vias when possible.



	A	B	
X-axis	1.905	2.081	(nsec)
Y-axis	101.0	107.0	(Ohm)

Figure 2 - TDR Measurement with 200ps risetime using Semtech Evaluation Board



	A	B	
X-axis	1.80	2.076	(nsec)
Y-axis	96	108.0	(Ohm)

Figure 3 - TDR Measurement with 100ps risetime using Semtech Evaluation Board

Note: Measurements were taken on SLP HDMI EVAL Rev C Board that has 100 Ω differential traces impedance throughout (No trace Compensation).

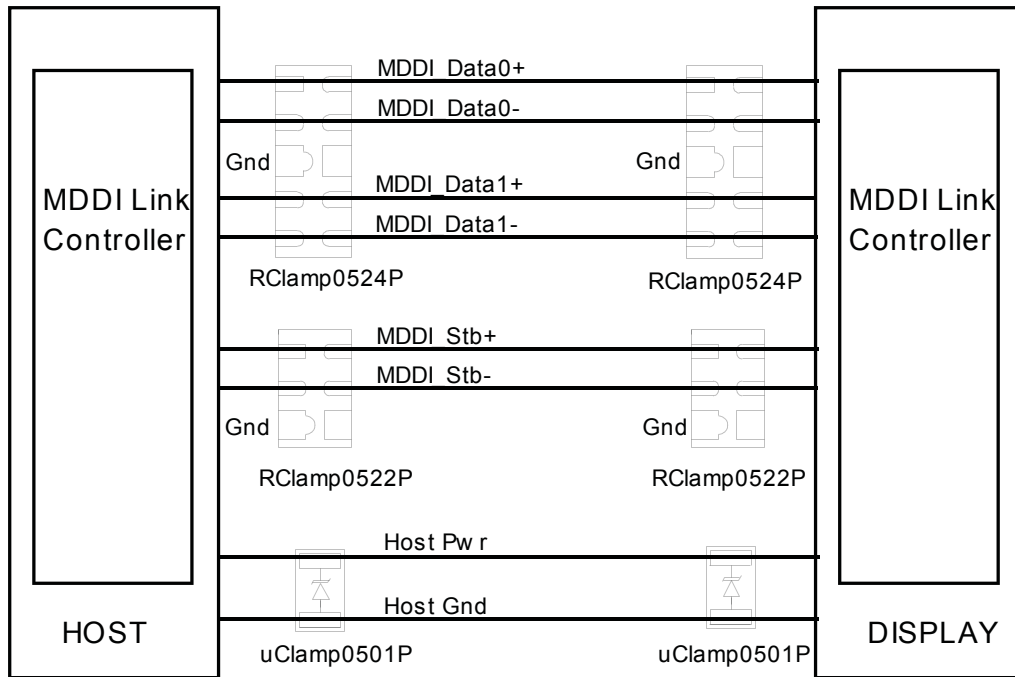
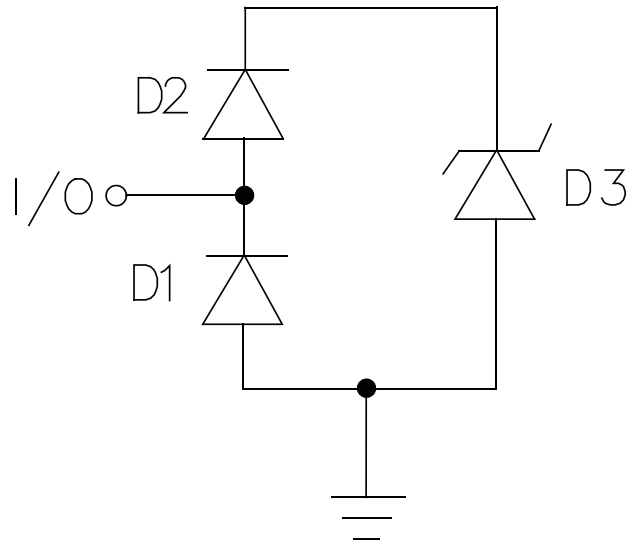


Figure 4. MDDI Port Protection

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Applications Information Spice Model

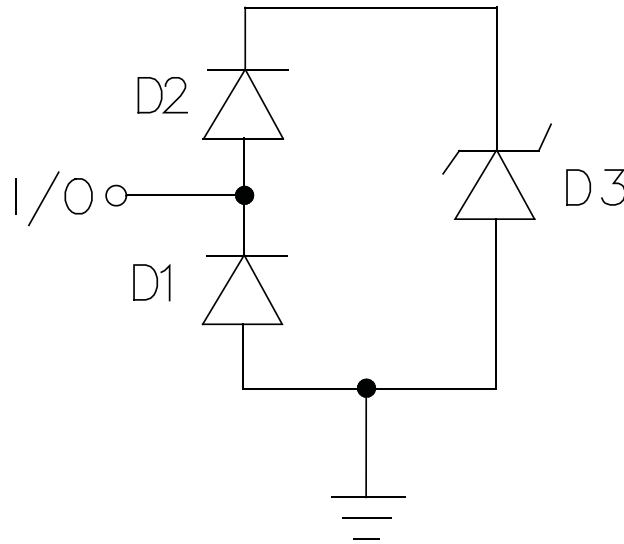


RClamp0522P Spice Model

RClamp0522P Spice Parameters				
Parameter	Unit	D1	D2 (LCRD)	D3 (TVS)
IS	Amp	1E-20	1E-20	2E-12
BV	Volt	100	100	9.36
VJ	Volt	0.7	0.7	0.6
RS	Ohm	0.458	1.0	2.6
IBV	Amp	1E-3	1E-3	1E-3
CJO	Farad	0.6E-12	0.6E-12	56E-12
TT	sec	2.541E-9	2.541E-9	2.541E-9
M	--	0.01	0.01	0.23
N	--	1.1	1.1	1.1
EG	eV	1.11	1.11	1.11

PROTECTION PRODUCTS

Applications Information Spice Model

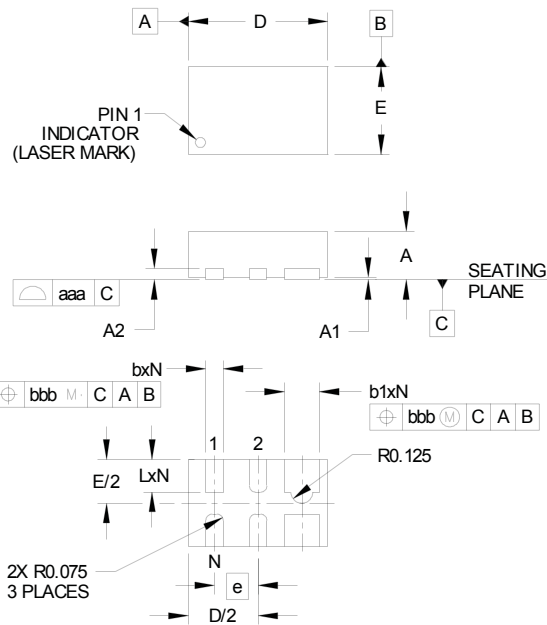


RClamp0524P Spice Model

RClamp0524P Spice Parameters				
Parameter	Unit	D1	D2 (LCRD)	D3 (TVS)
IS	Amp	1E-20	1E-20	2E-12
BV	Volt	100	100	9.36
VJ	Volt	0.7	0.7	0.6
RS	Ohm	0.458	1.0	2.6
IBV	Amp	1E-3	1E-3	1E-3
CJO	Farad	0.6E-12	0.6E-12	56E-12
TT	sec	2.541E-9	2.541E-9	2.541E-9
M	--	0.01	0.01	0.23
N	--	1.1	1.1	1.1
EG	eV	1.11	1.11	1.11

PROTECTION PRODUCTS

Outline Drawing - SLP1610P4

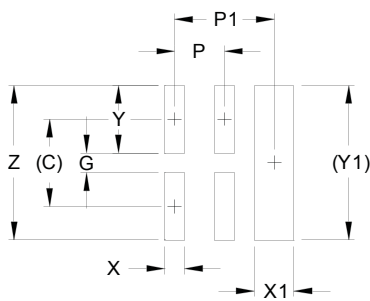


DIM	INCHES		MILLIMETERS	
	MIN	NOM MAX	MIN	NOM MAX
A	.020	.023	.026	0.50 0.58 0.65
A1	0.00	.001	.002	0.00 0.03 0.05
A2		(.005)		(0.13)
b	.006	.008	.010	0.15 0.20 0.25
b1	.014	.016	.018	0.35 0.40 0.45
D	.059	.063	.067	1.50 1.60 1.70
E	.035	.039	.043	0.90 1.00 1.10
e	.020 BSC		0.50 BSC	
L	.012	.015	.017	0.30 0.38 0.425
N	6		6	
aaa	.003		0.08	
bbb	.004		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 - SLP1610P4



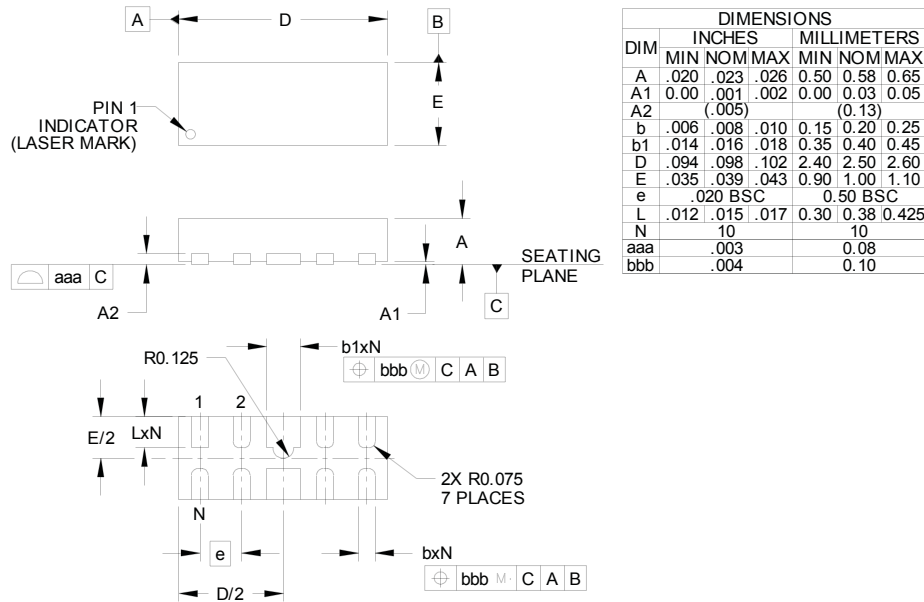
DIM	DIMENSIONS	
	INCHES	MILLIMETERS
C	(.034)	(0.875)
G	.008	0.20
P	.020	0.50
P1	.039	1.00
X	.008	0.20
X1	.016	0.40
Y	.027	0.675
Y1	(.061)	(1.55)
Z	.061	1.55

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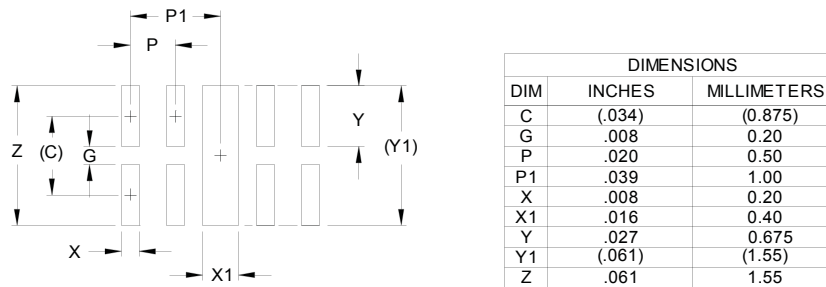
PROTECTION PRODUCTS

Outline Drawing - SLP2510P8



- NOTES:
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 2. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.

Land Pattern - SLP2510P8

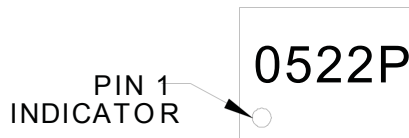


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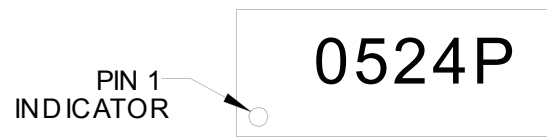
PROTECTION PRODUCTS

Marking Codes

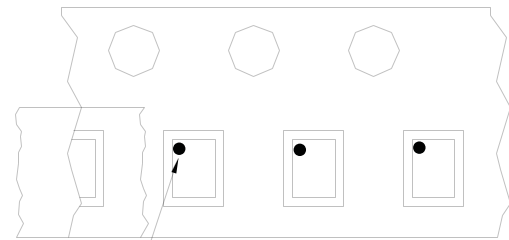
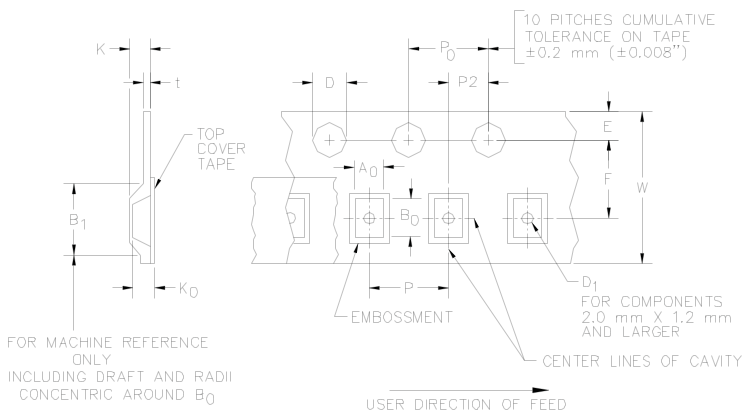
RClamp0522P



RClamp0524P



Tape and Reel Specification



Pin 1 Location

User Direction of feed

Device Orientation in Tape

Part Number	A0	B0	K0
RClamp0522P	1.12 +/-0.05 mm	1.30 +/-0.05 mm	0.76 +/-0.05 mm
RClamp0524P	1.23 +/-0.05 mm	2.70 +/-0.05 mm	0.70 +/-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 - 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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