

PROTECTION PRODUCTS - RailClamp®
Description

RClamp® TVS diodes are designed to protect sensitive electronics from damage or latch-up due to ESD. They are designed to replace 0201 size multilayer varistors (MLVs) in portable applications such as cell phones, notebook computers, and other portable electronics. This device offers desirable characteristics for board level protection including fast response time, low operating and clamping voltage, and no device degradation.

RClamp®5011ZA features extremely good ESD protection characteristics highlighted by low typical dynamic resistance of 0.25 Ohms, low peak ESD clamping voltage, and high ESD withstand voltage (+/-15kV contact per IEC 61000-4-2). Low maximum capacitance (0.45pF at VR=0V) minimizes loading on sensitive circuits. Each device will protect one high-speed data line operating at 5 Volts.

RClamp5011ZA is in a 2-pin SLP0603P2X3F package measuring 0.6 x 0.3 mm with a nominal height of only 0.25mm. Leads are finished with NiAu. The small package gives the designer the flexibility to protect single lines in applications where arrays are not practical. The combination of small size and high ESD surge capability makes them ideal for use in portable applications such as cellular phones, digital cameras, and tablet PC's.

Features

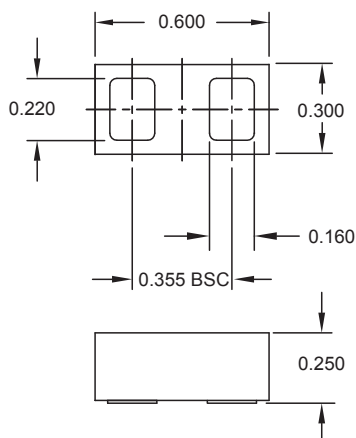
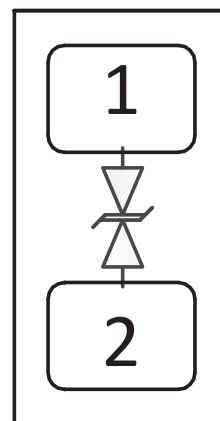
- ◆ High ESD withstand Voltage: +/-15kV (Contact) and +/- 18kV (Air) per IEC 61000-4-2
- ◆ Ultra-small package
- ◆ Protects one data line
- ◆ Low ESD clamping voltage
- ◆ Working voltage: 5V
- ◆ Low capacitance: 0.45pF maximum
- ◆ Low leakage current
- ◆ Extremely low dynamic resistance: 0.25 Ohms (Typ)
- ◆ Solid-state silicon-avalanche technology

Mechanical Characteristics

- ◆ SLP0603P2X3F package
- ◆ Pb-Free, Halogen Free, RoHS/WEEE Compliant
- ◆ Nominal Dimensions: 0.6 x 0.3 x 0.25 mm
- ◆ Lead Finish: NiAu
- ◆ Marking: Marking code
- ◆ Packaging: Tape and Reel

Applications

- ◆ HDMI
- ◆ USB 3.0
- ◆ MiPi / MDDI
- ◆ MHL
- ◆ FM Antenna

Package Dimensions

Nominal Dimensions in mm
Schematic & Pin Configuration

SLP0603P2X3F (Bottom View)

PROTECTION PRODUCTS

Absolute Maximum Ratings

Rating	Symbol	Value	Units
Peak Pulse Power ($t_p = 8/20\mu s$)	P_{PK}	50	W
Peak Pulse Current ($t_p = 8/20\mu s$)	I_{PP}	4	A
ESD per IEC 61000-4-2 (Air) ⁽¹⁾ ESD per IEC 61000-4-2 (Contact) ⁽¹⁾	V_{ESD}	± 18 ± 15	kV
Operating Temperature	T_J	-40 to +85	°C
Storage Temperature	T_{STG}	-55 to +150	°C

Electrical Characteristics (T=25°C unless otherwise specified)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Reverse Stand-Off Voltage	V_{RWM}	$T = -40 \text{ to } +85^\circ\text{C}$			5	V
Punch-Through Voltage	V_{BR}	$I_{PT} = 1\text{mA}$	6.5	7.5	10	V
Reverse Leakage Current	I_R	$V_{RWM} = 5\text{V}$		<5	50	nA
Clamping Voltage	V_C	$I_{PP} = 2\text{A}, t_p = 8/20\mu s$			11.5	V
		$I_{PP} = 4\text{A}, t_p = 8/20\mu s$			12.5	V
ESD Clamping Voltage ²	V_C	$I_{PP} = 4\text{A}$ $t_p = 0.2/100\text{ns}$		8.5		V
ESD Clamping Voltage ²	V_C	$I_{PP} = 16\text{A}$ $t_p = 0.2/100\text{ns}$		11.5		V
Dynamic Resistance ^{2, 3}	R_{DYN}	$t_p = 0.2/100\text{ns}$		0.25		Ohms
Junction Capacitance	C_J	$VR = 0\text{V}; f = 1\text{MHz}$		0.40	0.45	pF

Notes

1) Measured with a 40dB attenuator, 50 Ohm scope input impedance, 2GHz bandwidth. ESD gun return path connected to ESD ground plane.

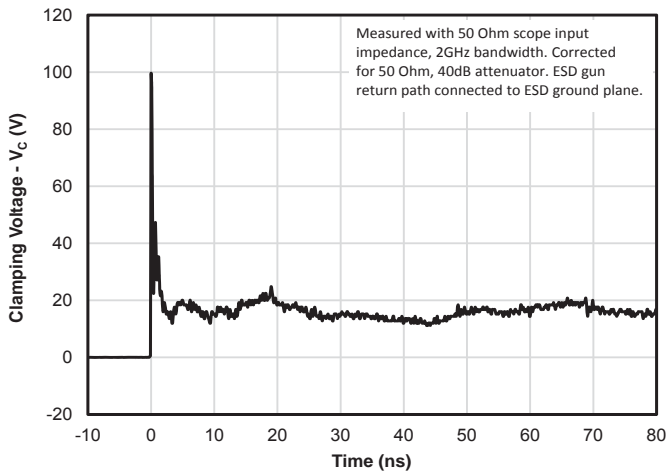
2) Transmission Line Pulse Test (TLP) Settings: $t_p = 100\text{ns}$, $t_r = 0.2\text{ns}$, I_{TLP} and V_{TLP} averaging window: $t_1 = 70\text{ns}$ to $t_2 = 90\text{ns}$.

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

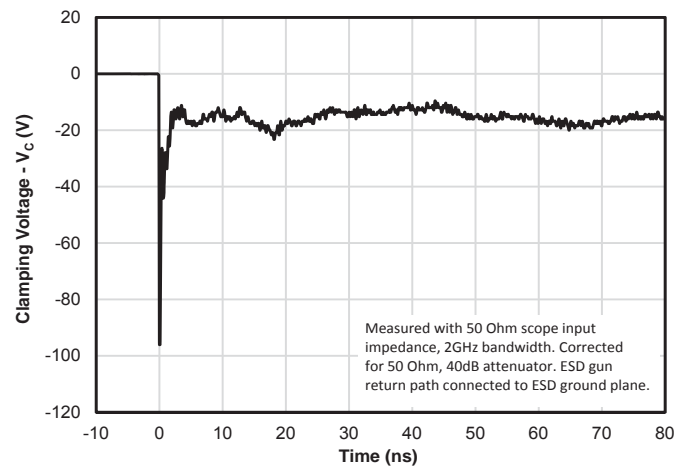
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Typical Characteristics

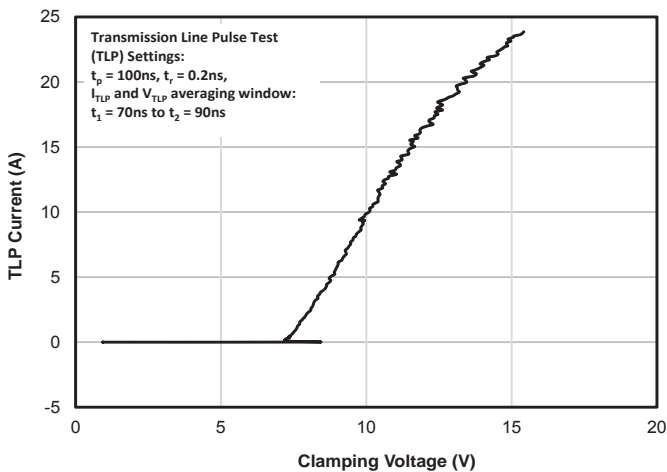
ESD Clamping (8kV Contact per IEC 61000-4-2)



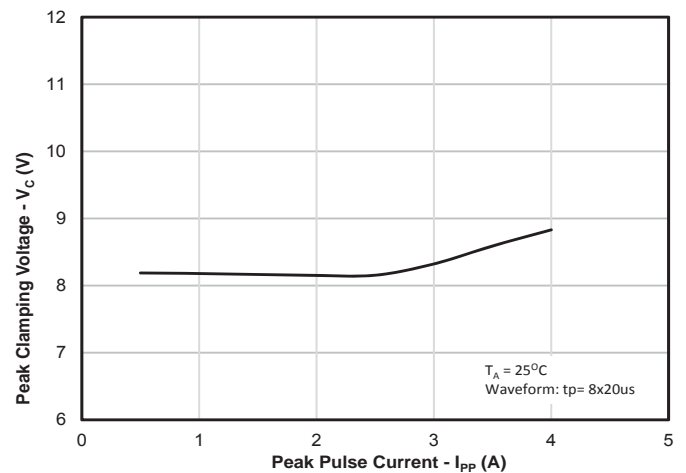
ESD Clamping (-8kV Contact per IEC 61000-4-2)



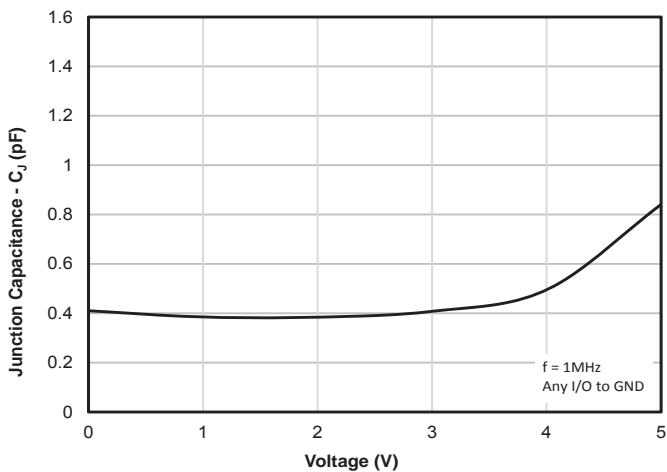
TLP Characteristic



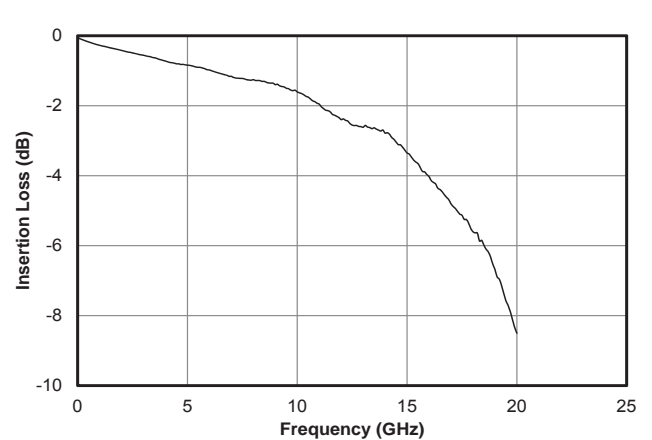
Clamping Voltage vs. Peak Pulse Current ($t_p=8/20\mu\text{s}$)



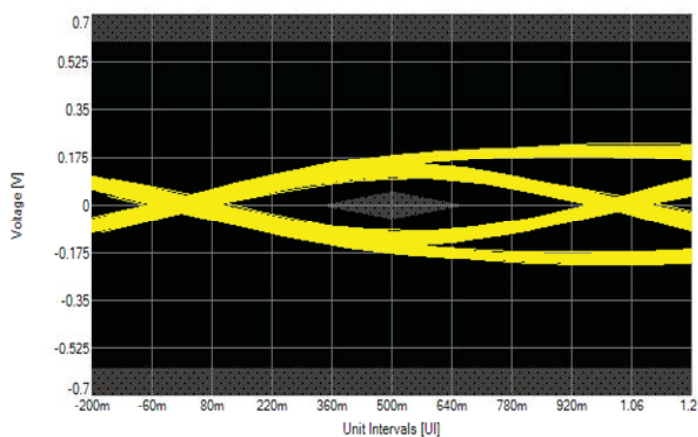
Capacitance vs. Reverse Voltage



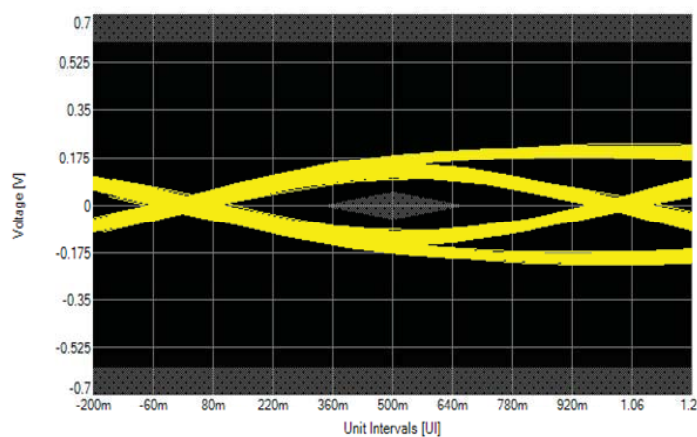
Insertion Loss - S21 (dB)



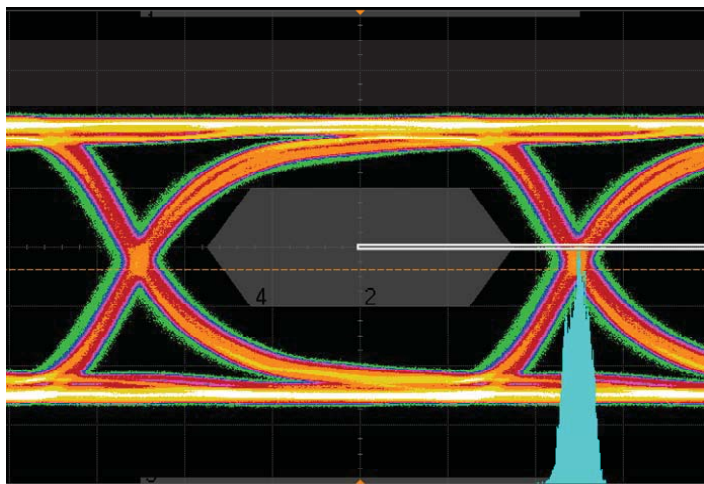
USB 3.0 Eye Pattern Without RClamp5011ZA



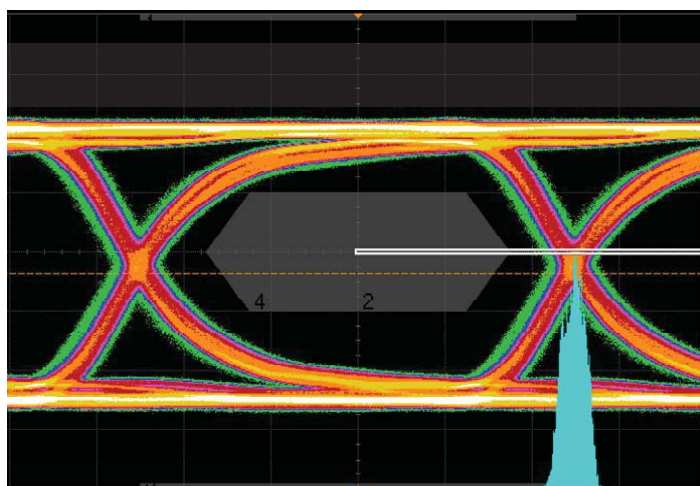
USB 3.0 Eye Pattern with RClamp5011ZA



HDMI 1.4 Eye Pattern Without RClamp5011ZA



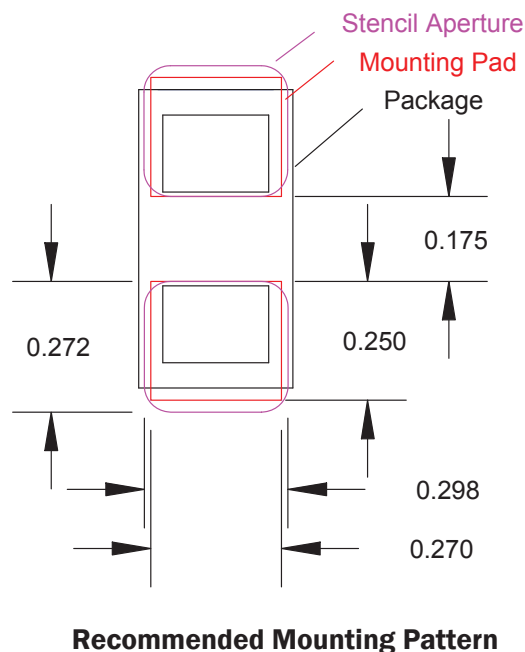
HDMI 1.4 Eye Pattern With RClamp5011ZA



PROTECTION PRODUCTS
Applications Information
Assembly Guidelines

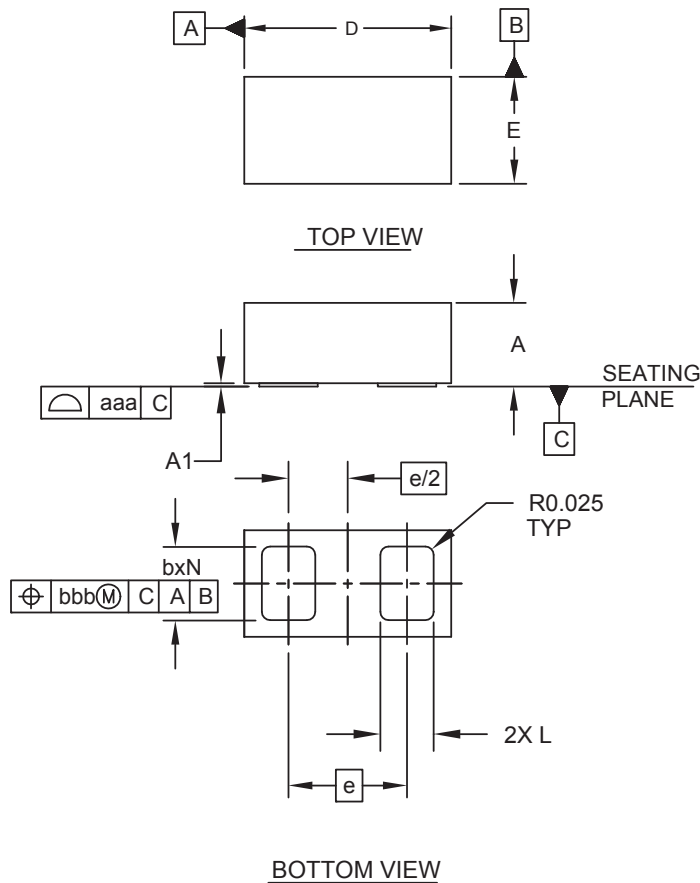
The small size of this device means that some care must be taken during the mounting process to insure reliable solder joint. The table below provides Semtech's recommended assembly guidelines for mounting this device. The figure at the right details Semtech's recommended aperture based on the below 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



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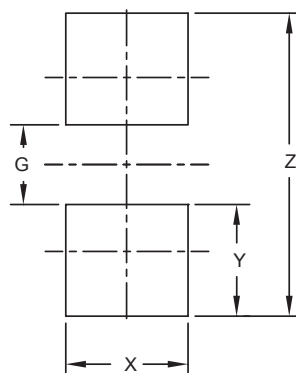
Outline Drawing - SLP0603P2X3F



DIM	DIMENSIONS MILLIMETERS		
	MIN	NOM	MAX
A	0.235	0.250	0.265
A1	0.000	0.010	0.050
b	0.200	0.220	0.240
D	0.580	0.600	0.620
E	0.280	0.300	0.320
e	0.355 BSC		
L	0.140	0.160	0.180
N	2		
aaa	0.08		
bbb	0.10		

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

Land Pattern - SLP0603P2X3F



DIM	DIMENSIONS MILLIMETERS	
	G	Y
G	0.177	
X	0.272	
Y	0.247	
Z	0.671	

NOTES:
CONTROLLING DIMENSIONS ARE IN MILLIMETERS (ANGLES IN DEGREES).
THIS LAND PATTERN IS FOR REFERENCE PURPOSES ONLY.
CONSULT YOUR MANUFACTURING GROUP TO ENSURE YOUR
COMPANY'S MANUFACTURING GUIDELINES ARE MET.