

Description

RClamp®03391PW is an ultra low capacitance “FemtoClamp®” ESD protection device specifically designed to protect high-speed differential lines. It offers desirable characteristics for board level protection including fast response time, low operating and clamping voltage, and no device degradation.

RClamp03391PW features excellent ESD protection characteristics highlighted by low peak ESD clamping voltage, and high ESD withstand voltage ($\pm 8\text{kV}$ contact per IEC 61000-4-2). RClamp03391PW has a maximum capacitance of 0.25pF allowing it to be used on Thunderbolt and USB 3.2 high speed lines. These devices may also be used for EOS protection due to their high peak pulse current capability (7A, $t_p = 8/20\mu\text{s}$). Each device will protect one high-speed data line operating up to 3.3 volts.

RClamp03391PW is in a DFN 1.0 x 0.6 x 0.55mm 2-Lead package. The small package gives the designer the flexibility to protect single lines in applications where arrays are not practical.

Features

- ESD and EOS Protection
- ESD withstand voltage
 - IEC 61000-4-2 (ESD) $\pm 8\text{kV}$ (contact), $\pm 15\text{kV}$ (air)
- Ultra-Low capacitance: 0.25pF Maximum
- Very small PCB area
- Protects one line
- Working voltage: 3.3V
- Low reverse leakage current: 50nA max at $V_R = 3.3\text{V}$
- Solid-state silicon-avalanche technology

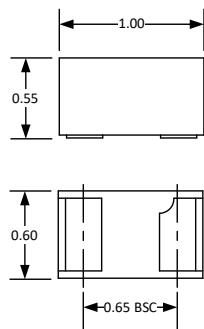
Mechanical Characteristics

- Package: DFN 1.0 x 0.6 x 0.55mm 2-Lead
- Pb-Free, Halogen Free, RoHS/WEEE Compliant
- Lead Finish: Pb-Free
- Marking : Marking Code
- Packaging : Tape and Reel

Applications

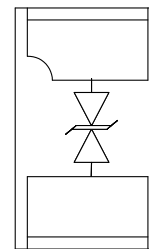
- Thunderbolt 3
- USB 3.2 and USB 3.0
- USB Type-C

Package Dimension



Nominal Dimensions (mm)

Schematic and Pin Configuration



DFN 1.0 x 0.6 x 0.55mm 2-Lead (Bottom View)

Absolute Maximum Ratings

Rating	Symbol	Value	Units
Peak Pulse Power (tp = 8/20μs)	P _{PK}	45	W
Peak Pulse Current (tp = 8/20μs)	I _{PP}	7	A
ESD per IEC 61000-4-2 (Contact) ⁽¹⁾ ESD per IEC 61000-4-2 (Air) ⁽¹⁾	V _{ESD}	±8 ±15	kV
Operating Temperature	T _{OP}	-40 to +125	°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}				3.3	V
Reverse Breakdown Voltage	V _{BR}	I _t = 1mA	5.5	7.7	10	V
Reverse Leakage Current	I _R	V _{RWM} = 3.3V		<5	50	nA
Clamping Voltage ²	V _C	tp = 1.2/50μs (Voltage), 8/20μs (Current) Combination Waveform, R _s = 2 Ω		4.2	6.5	V
ESD Clamping Voltage ³	V _C	tp = 0.2/100ns (TLP)	I _{TLP} = 4A	3.3		V
			I _{TLP} = 16A	5.3		
Trigger Voltage ³	V _{TRIG}	tp = 0.2/100ns (TLP)		8.9		V
Dynamic Resistance ^{3,4}	R _{DYN}	tp = 0.2/100ns (TLP)		0.18		Ohms
Junction Capacitance	C _J	V _R = 0V, f = 1MHz		0.2	0.25	pF

Notes:

(1): ESD gun return path connected to Ground Reference Plane (GRP)

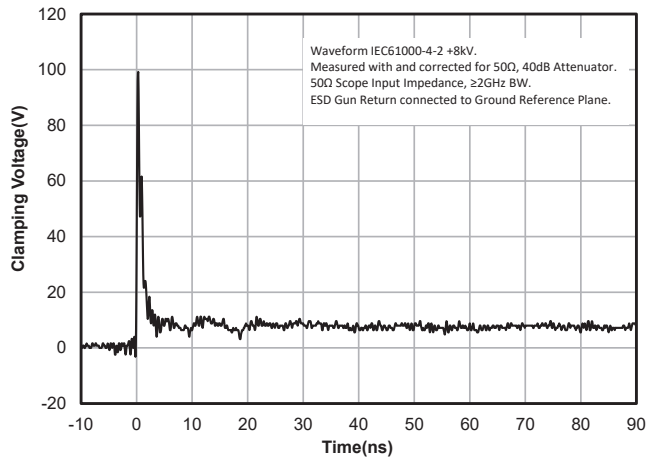
(2): Measured using a 1.2/50μs voltage, 8/20μs current combination waveform, R_s = 2 Ohms. Clamping voltage is defined as the peak voltage across the device after the device snaps back to a conducting state.

(3): Transmission Line Pulse Test (TLP) Settings: tp = 100ns, tr = 0.2ns, I_{TLP} and V_{TLP} averaging window: t₁ = 70ns to t₂ = 90ns

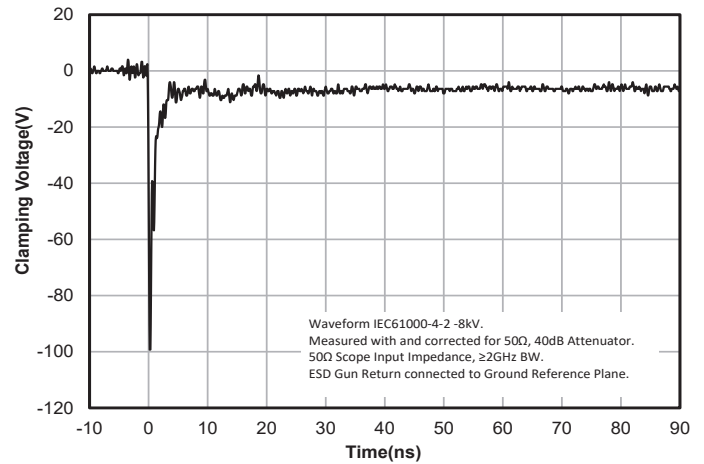
(4): Dynamic resistance calculated from I_{TLP} = 4A to I_{TLP} = 16A

Typical Characteristics

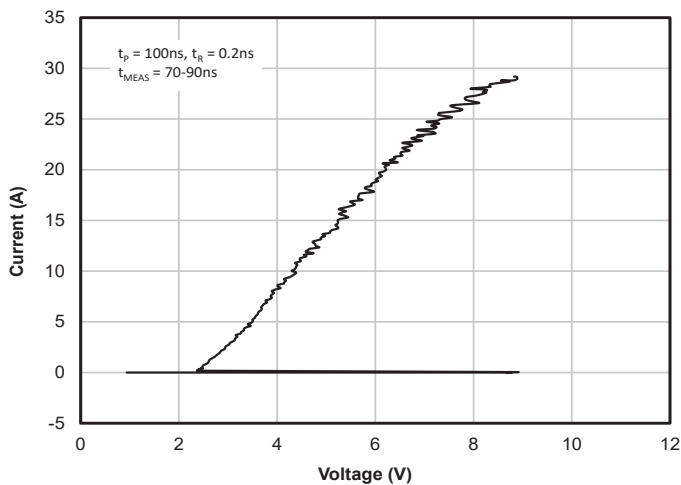
ESD Clamping (+8kV Contact per IEC 61000-4-2)



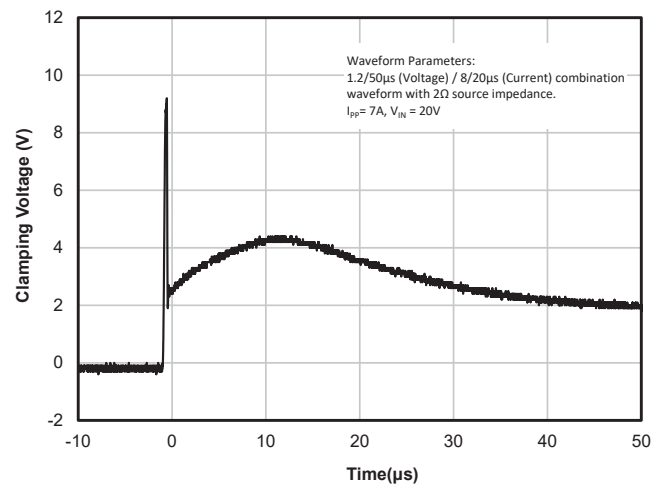
ESD Clamping (-8kV Contact per IEC 61000-4-2)



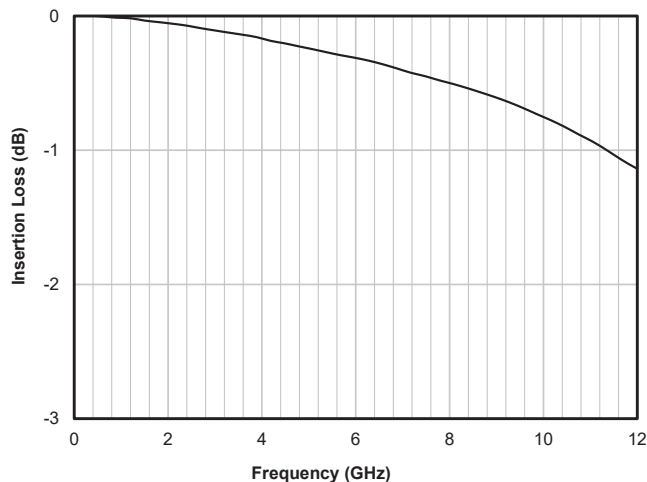
TLP Characteristic (Positive Pulse)



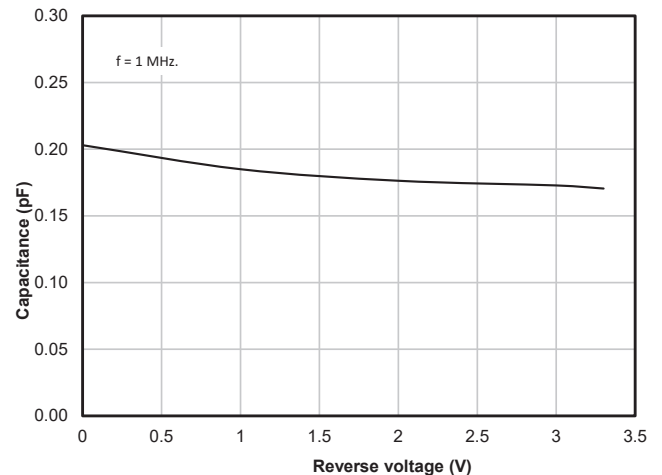
Clamping Characteristic (1.2/50μs Waveform)



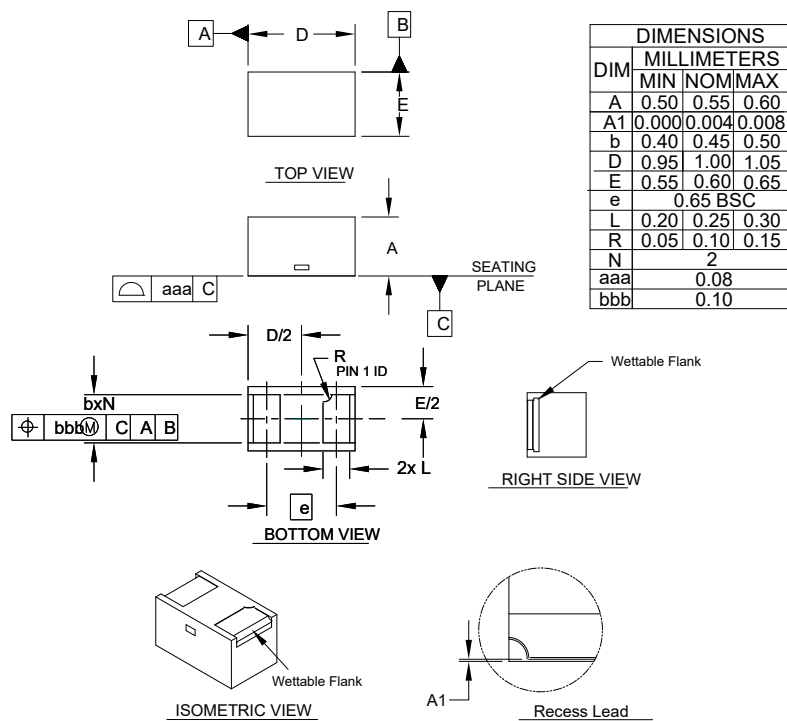
Insertion Loss (S21)



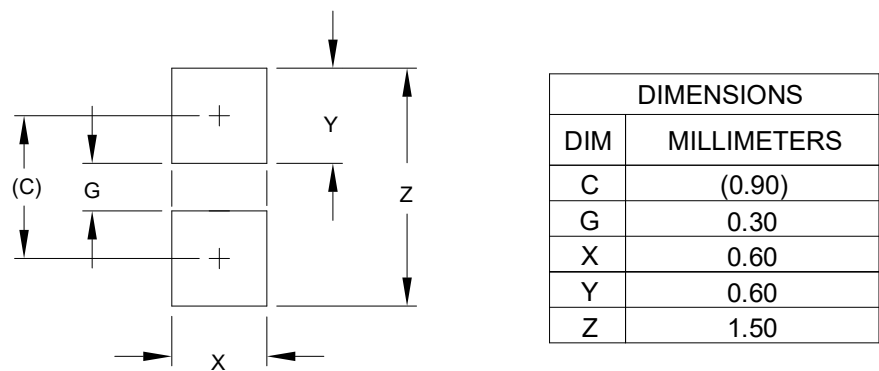
Capacitance vs. Reverse Voltage



Outline Drawing - DFN 1.0 x 0.6 x 0.55mm 2-Lead

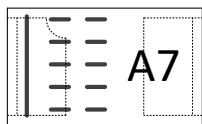


Land Pattern - DFN 1.0 x 0.6 x 0.55mm 2-Lead



- 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.

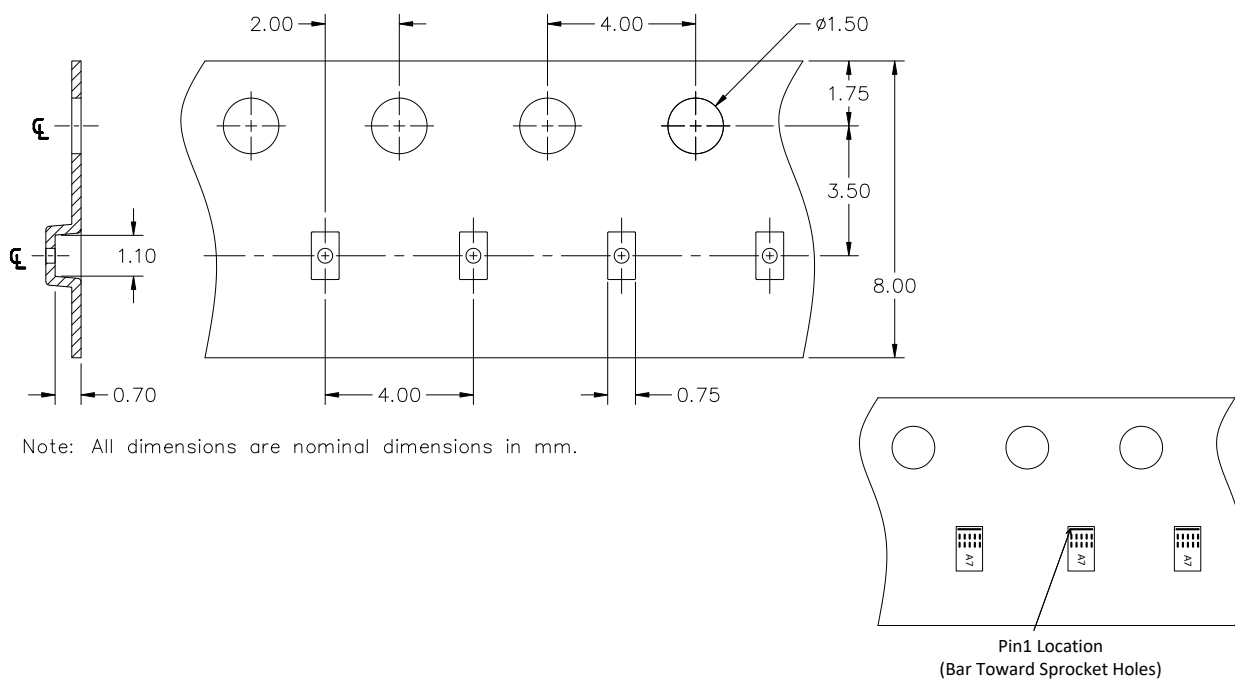
Marking Code



Notes:

1. Device is electrically symmetrical
2. Marking will also include line matrix date code
3. Bar indicates Pin 1 location

Tape and Reel Specification



Ordering Information

Part Number	Qty per Reel	Reel Size
RClamp03391PW.C	3,000	7 Inch
RailClamp and RClamp are registered trademarks of Semtech Corporation.		



Important Notice

Information relating to this product and the application or design described herein is believed to be reliable, however such information is provided as a guide only and Semtech assumes no liability for any errors in this document, or for the application or design described herein. Semtech reserves the right to make changes to the product or this document at any time without notice. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. Semtech warrants performance of its products to the specifications applicable at the time of sale, and all sales are made in accordance with Semtech's standard terms and conditions of sale.

SEMTECH PRODUCTS ARE NOT DESIGNED, INTENDED, AUTHORIZED OR WARRANTED TO BE SUITABLE FOR USE IN LIFE-SUPPORT APPLICATIONS, DEVICES OR SYSTEMS, OR IN NUCLEAR APPLICATIONS IN WHICH THE FAILURE COULD BE REASONABLY EXPECTED TO RESULT IN PERSONAL INJURY, LOSS OF LIFE OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE. INCLUSION OF SEMTECH PRODUCTS IN SUCH APPLICATIONS IS UNDERSTOOD TO BE UNDERTAKEN SOLELY AT THE CUSTOMER'S OWN RISK. Should a customer purchase or use Semtech products for any such unauthorized application, the customer shall indemnify and hold Semtech and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs damages and attorney fees which could arise.

The Semtech name and logo are registered trademarks of the Semtech Corporation. All other trademarks and trade names mentioned may be marks and names of Semtech or their respective companies. Semtech reserves the right to make changes to, or discontinue any products described in this document without further notice. Semtech makes no warranty, representation or guarantee, express or implied, regarding the suitability of its products for any particular purpose. All rights reserved.

© Semtech 2023

Contact Information

Semtech Corporation
200 Flynn Road, Camarillo, CA 93012
Phone: (805) 498-2111, Fax: (805) 498-3804
www.semtech.com