

PROTECTION PRODUCTS

Description

RClamp®2581ZC 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.

RClamp2581ZC features extremely good ESD protection characteristics highlighted by low peak ESD clamping voltage, and high ESD withstand voltage (+/-12kV contact per IEC 61000-4-2). RClamp2581ZC has a typical capacitance of 0.26pF allowing it to be used on Thunderbolt and USB 3.1 high speed lines. These devices may also be used for EOS protection due to their high peak pulse current capability (8A, $t_p = 8/20\mu s$). Each device will protect one high-speed data line operating up to 2.5 volts.

RClamp2581ZC is in a 2-pin SLP0603P2X3J package measuring 0.60 x 0.30 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.

Features

- ESD and EOS Protection
- ESD withstand voltage
 - ♦ IEC 61000-4-2 (ESD) $\pm 17kV$ (air), $\pm 12kV$ (contact)
- Ultra-Low capacitance: 0.26pF Typical
- Very small PCB area
- Protects one high-speed data line
- Working voltage: 2.5V
- Low reverse leakage current: 50nA max at $V_R = 2.5V$
- Solid-state silicon-avalanche technology

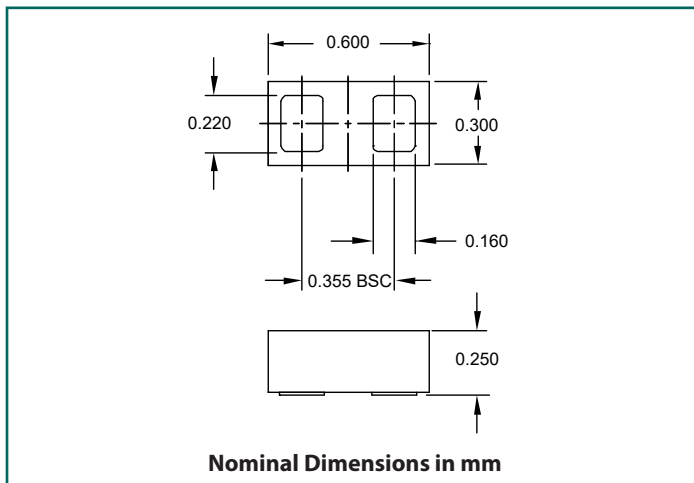
Mechanical Characteristics

- SLP0603P2X3J Package
- Pb-Free, Halogen Free, RoHS/WEEE Compliant
- Nominal Dimensions: 0.60 x 0.30 x 0.25 mm
- Lead Finish: NiAu
- Marking : Marking Code
- Packaging : Tape and Reel

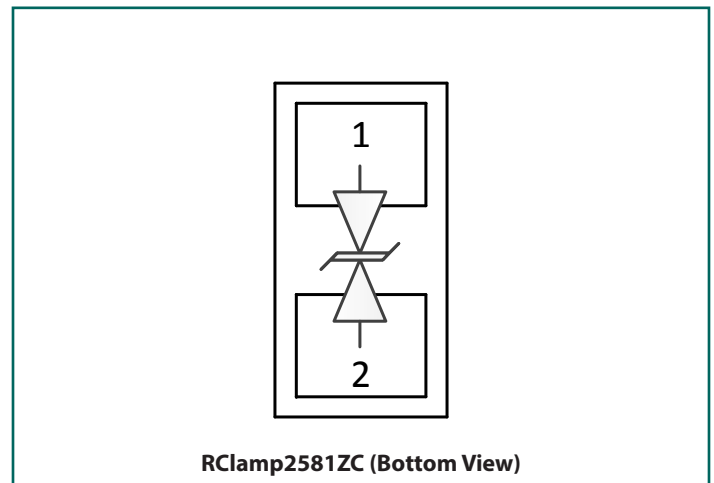
Applications

- USB 3.1/3.0
- HDMI 1.4 and HDMI 2.0
- USB Type-C
- Thunderbolt
- HD-SDI
- 10GbE

Nominal Dimensions



Schematic and Pin Configuration



Absolute Maximum Ratings

Rating	Symbol	Value	Units
Peak Pulse Power (tp = 8/20μs)	P _{PK}	56	W
Peak Pulse Current (tp = 8/20μs)	I _{PP}	8	A
ESD per IEC 61000-4-2 (Air) ⁽¹⁾ ESD per IEC 61000-4-2 (Contact) ⁽¹⁾	V _{ESD}	±17 ±12	kV
Operating Temperature	T _{OP}	-40 to +85	°C
Storage Temperature	T _{STG}	-55 to +150	°C

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

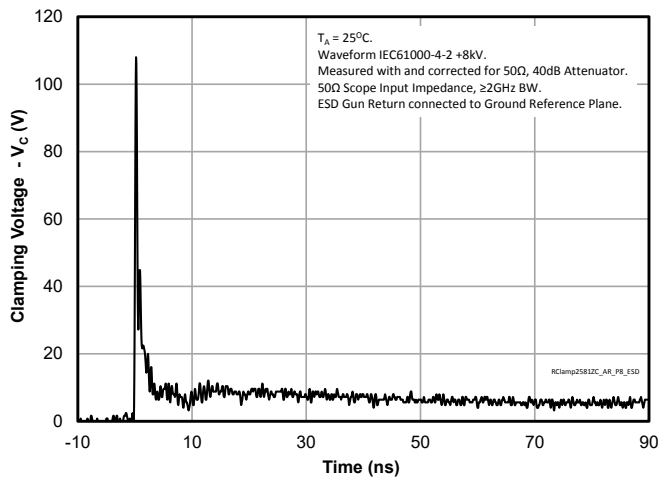
Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Reverse Stand-Off Voltage	V _{RWM}	-40°C to 85°C			2.5	V
Reverse Breakdown Voltage	V _{BR}	I _t = 1mA, -40°C to 85°C	5	7.5	9	V
Holding Voltage ³	V _H	I _H = 300mA, tp = 0.2/100ns (TLP)		2.8		V
Reverse Leakage Current	I _R	V _{RWM} = 2.5V		<5	50	nA
Clamping Voltage ²	V _C	tp = 1.2/50μs (Voltage), 8/20μs (Current) Combination Waveform, R _s = 2 Ω, I _{pp} = 8A		4.8	7	V
ESD Clamping Voltage ³	V _C	tp = 0.2/100ns (TLP)	I _{pp} = 4A	3.5		V
			I _{pp} = 16A	5.5		
Dynamic Resistance ^{3,4}	R _{DYN}	tp = 0.2/100ns (TLP)		0.18		Ohms
Junction Capacitance	C _J	V _R = 0V, f = 1MHz		0.26	0.30	pF

Notes:

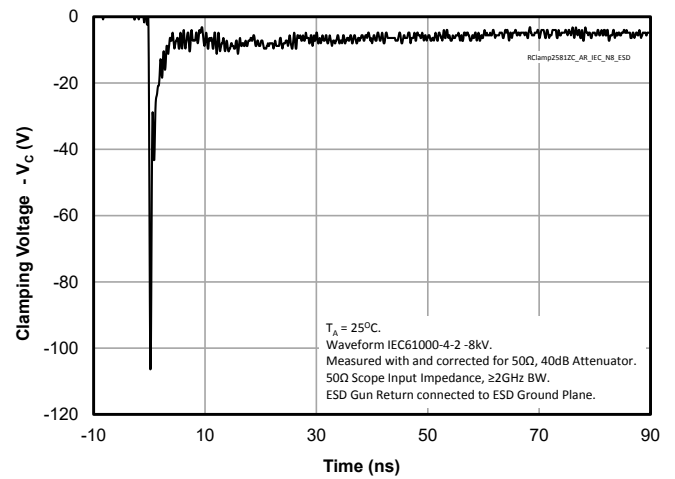
- (1): ESD gun return path connected to Ground Reference Plane (GRP).
- (2): Measured using a 1.2/50μs voltage, 8/20μs current combination waveform, R_s = 2 Ohms. Clamping is defined as the peak voltage across the device after the device snaps back to a conducting state.
- (3): Transmission Line Pulse 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
- (5): This device was tested and characterized for 9V DC operation.

Typical Characteristics

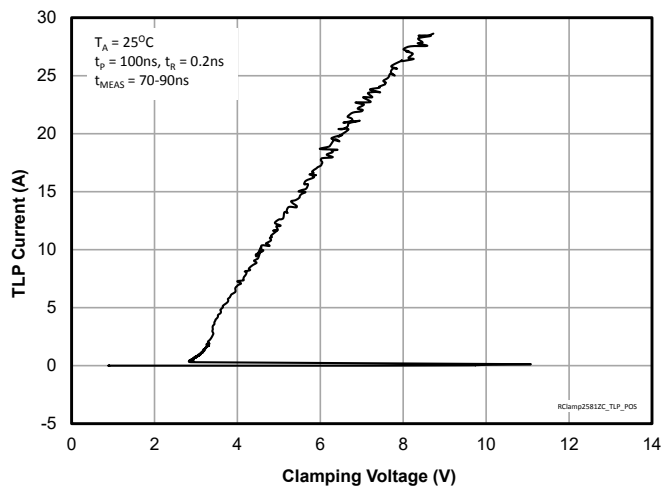
ESD Clamping (+8kV Contact per IEC 61000-4-2)



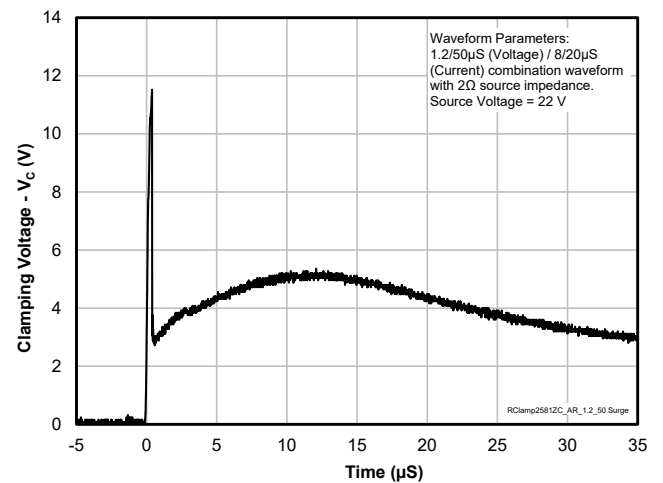
ESD Clamping (-8kV Contact per IEC 61000-4-2)



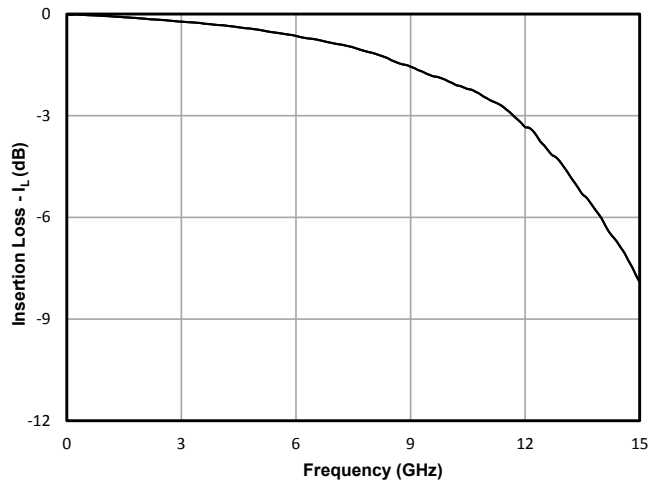
TLP IV Curve



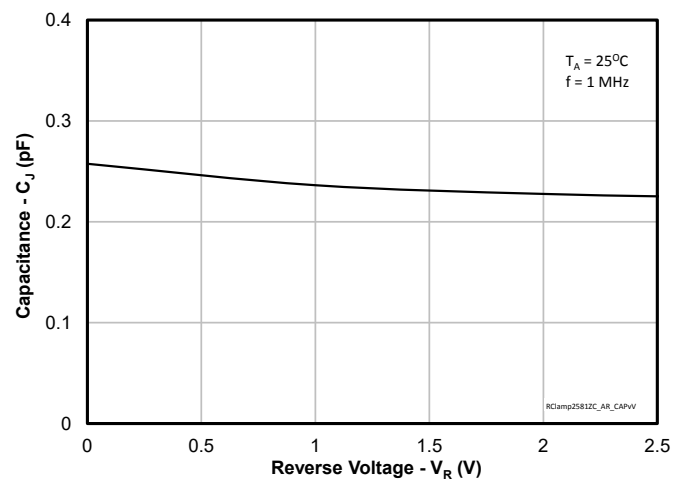
Clamping Characteristic (1.2/50 μs Waveform)



Insertion Loss (S21)



Capacitance vs. Reverse Voltage

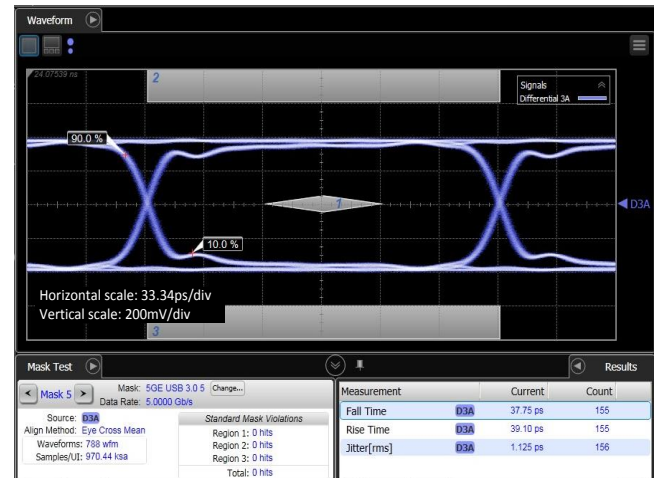


Typical Characteristics (Continued)

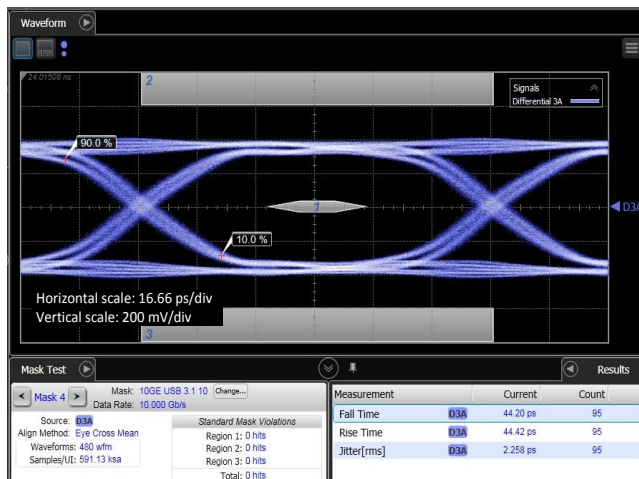
5Gb/s (USB 3.0) Eye Diagram with RClamp2581ZC



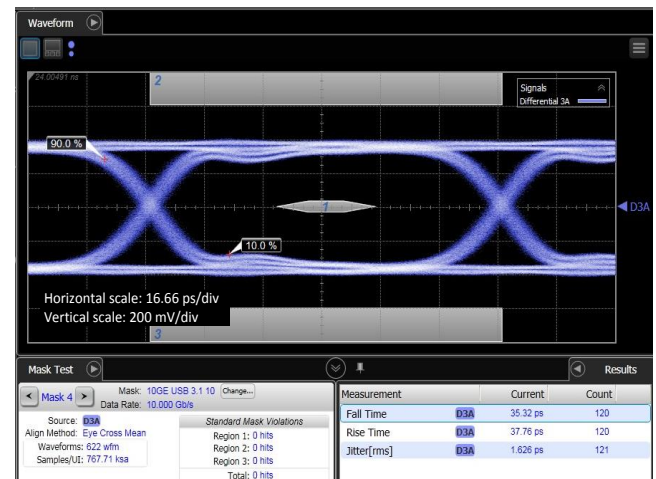
5Gb/s (USB 3.0) Eye Diagram without RClamp2581ZC



10Gb/s (USB 3.1) Eye Diagram with RClamp2581ZC



10Gb/s (USB 3.1) Eye Diagram without RClamp2581ZC



Application Information

Assembly Guidelines

The small size of this device means that some care must be taken during the mounting process to insure reliable solder joints. The figure at the right details Semtech's recommended mounting pattern. Recommended assembly guidelines are shown in Table 1. 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. Exact manufacturing parameters will require some experimentation to get the desired solder application.

Solder Stencil

Stencil design is one of the key factors which will determine the volume of solder paste which is deposited onto the land pad. The area ratio of the stencil aperture will determine how well the stencil will print. The area ratio takes into account the aperture shape, aperture size, and stencil thickness. A minimum area ratio of 0.66 is preferred for the subject package. The area ratio of a rectangular aperture is given as:

$$\text{Area Ratio} = (L * W) / (2 * (L + W) * T)$$

Where:

L = Aperture Length

W = Aperture Width

T = Stencil Thickness

Semtech recommends a stencil with square aperture and rounded corners for consistent solder release. The stencil should be laser cut with electropolished finish. A stencil thickness of 0.075mm (0.003") is recommended. A 0.100mm (0.004") stencil may be used, however the stencil opening may need to be increased slightly to achieve the desired area ratio to ensure proper solder coverage on the pad.

Recommended Mounting Pattern

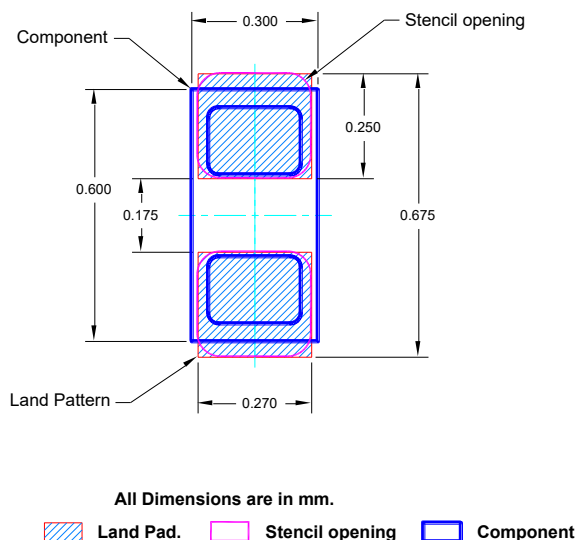
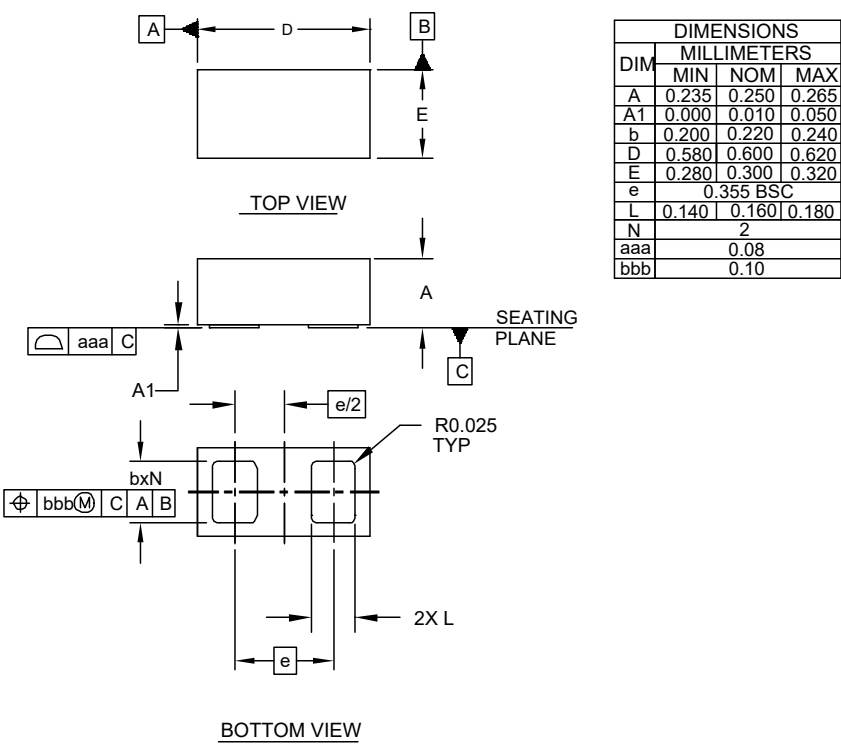


Table 1 - Assembly Guidelines

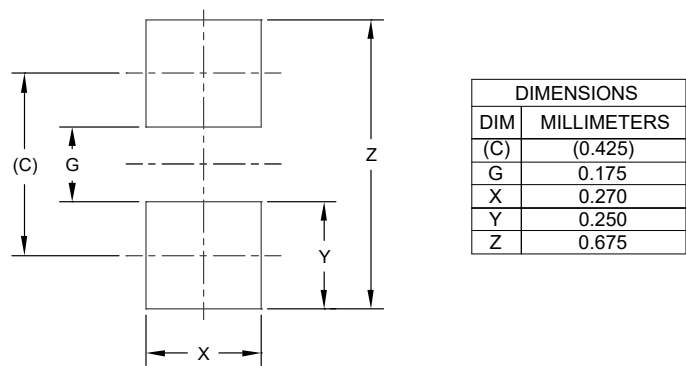
Assembly Parameter	Recommendation
Solder Stencil Design	Laser Cut, Electro-Polished
Aperture Shape	Rectangular with Rounded Corners
Solder Stencil Thickness	0.075mm (0.003") or 0.100mm (0.004")
Solder Paste Type	Type 4 Size Sphere or Smaller
Solder Reflow Profile	Per JEDEC J-STD-020
PCB Solder Pad Design	Solder Mask Defined
PCB Pad Finish	OSP or NiAu

Outline Drawing - SLP0603P2X3J



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

Land Pattern - SLP0603P2X3J



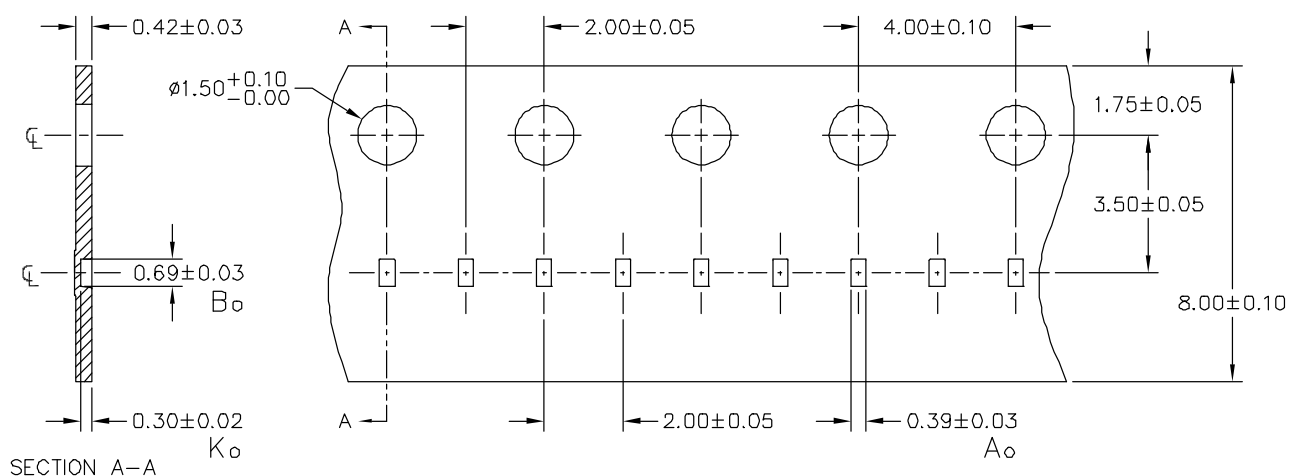
NOTES:
1. CONTROLLING DIMENSIONS ARE IN MILLIMETERS (ANGLES IN DEGREES).
2. THIS LAND PATTERN IS FOR REFERENCE PURPOSES ONLY.
CONSULT YOUR MANUFACTURING GROUP TO ENSURE YOUR COMPANY'S MANUFACTURING GUIDELINES ARE MET.

Marking Code

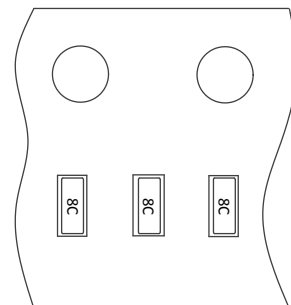
8C

Notes: Device is electrically symmetrical

Tape and Reel Specification



NOTES: ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.



Ordering Information

Part Number	Qty per Reel	Reel Size
RClamp2581ZCTFT	15000	7 Inch
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