RClamp2451ZA
Ultra Small RClamp®
1-Line, 24V ESD Protection

PROTECTION PRODUCTS

Description

RailClamp® TVS diodes are ultra low capacitance devices designed to protect sensitive electronics from damage or latch-up due to ESD, EFT, and EOS. They are designed for use on high speed ports in applications such as cell phones, notebook computers, and other portable electronics. These devices offer desirable characteristics for board level protection including fast response time, low operating and clamping voltage, and no device degradation.

RClamp®2451ZA is specifically designed for protection of Near Field Communications (NFC) interfaces. It features extremely good ESD protection characteristics including a low typical dynamic resistance of 0.16 Ohms (typical), low peak ESD clamping voltage, and high ESD withstand voltage (+/-14kV contact per IEC 61000-4-2). Low typical capacitance (0.35pF at V_R=0V) means that RClamp2451ZA will not create harmonic distortion in the RF signal. This device is bidirectional and has a working voltage of 24V for use on NFC resonator circuits without signal clipping.

RClamp2451ZA is in a DFN 0.60x0.30x0.25 mm 2-Lead package. The combination of working voltage, low dynamic resistance, and low capacitance makes this device ideal for use on NFC antenna circuits, RF signal lines, and FM antennas in portable devices.

Features

- High ESD withstand voltage: +/-14kV (contact) and +/-18kV (air) per IEC 61000-4-2
- Able to withstand over 1000 ESD strikes per IEC 61000-4-2 Level 4
- Ultra-small 0201 package
- Protects one high speed data line
- Low ESD clamping voltage
- Working voltage: +/- 24V
- Low capacitance: 0.35pF Typical
- Low leakage current
- Low dynamic resistance: 0.16 Ohms Typical
- Solid-state silicon-avalanche technology

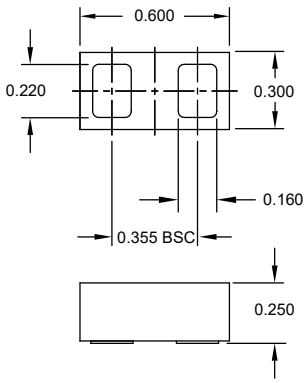
Mechanical Characteristics

- Package: DFN 0.60x0.30x0.25 mm 2-Lead
- Pb-Free, Halogen Free, RoHS/WEEE compliant
- Lead Finish: Lead Free
- Marking: Marking code
- Packaging: Tape and Reel

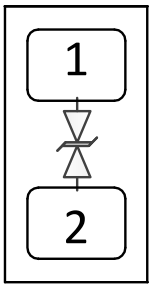
Applications

- Near Field Communication (NFC) lines
- RF signal lines
- FM Antenna

Package Dimension



Schematic & Pin Configuration



DFN 0.60x0.30x0.25 mm - 2 Lead (Bottom View)

Absolute Maximum Rating

Rating	Symbol	Value	Units
Peak Pulse Power (tp = 8/20µs)	P_{PK}	32	W
Peak Pulse Current (tp = 8/20µs)	I_{PP}	4	A
ESD per IEC 61000-4-2 (Air)(1) ESD per IEC 61000-4-2 (Contact)(1)	V_{ESD}	±18 ±14	kV
Operating Temperature	T_{OP}	-40 to +85	°C
Junction Temperature and Storage Temperature	T_J & 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}	Pin 1 to 2 or Pin 2 to 1			24	V
Breakdown Voltage	V_{BR}	I_{BR} = 10 µA	25.5	27.5	31	V
Reverse Leakage Current	I_R	V_{RWM} = 24V		<1	50	nA
Clamping Voltage[2]	V_C	I_{PP} = 1A, tp = 1.2/50µs (Voltage), 8/20µs (Current) Combination Waveform, R_S = 12 Ω		4.5	7	V
Clamping Voltage[2]	V_C	I_{PP} = 4A, tp = 1.2/50µs (Voltage), 8/20µs (Current) Combination Waveform, R_S = 12 Ω		5.5	8	
ESD Clamping Voltage[3]	V_C	I = 4A, tp = 0.2/100ns		5		V
		I = 16A, tp = 0.2/100ns		7		
Dynamic Resistance[3,4]	R_{DYN}	tp = 0.2/100ns		0.16		Ω
Junction Capacitance	C_J	V_R = 0V, f = 1MHz		0.35	0.45	pF

Notes:

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

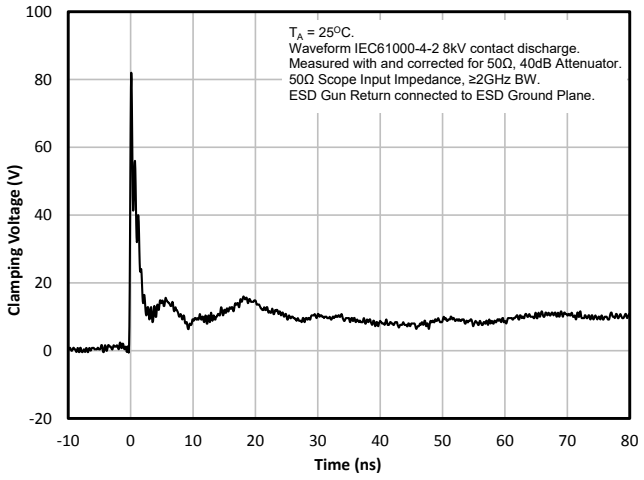
(2) Measured using a 1.2/50µs voltage, 8/20µs current combination waveform, R_S = 12Ω. Clamping is defined as the peak voltage across the device after the device snaps back to a conducting state.

(3) Transmission Line Pulse Test (TLP) Settings: tp = 100ns, tr = 0.2ns, I_{TLP} and V_{TLP} averaging window: t_1 = 70ns to t_2 = 90ns.

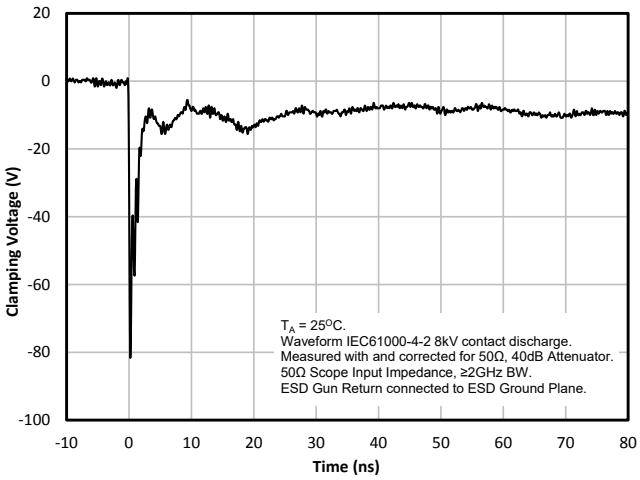
(4) Dynamic resistance calculated from I_{TLP} = 4A to I_{TLP} = 16A.

Typical Characteristics

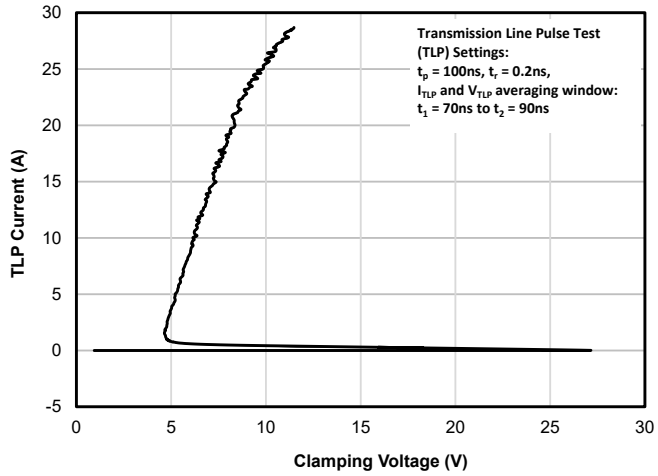
ESD Clamping (8kV Contact per IEC 61000-4-2)



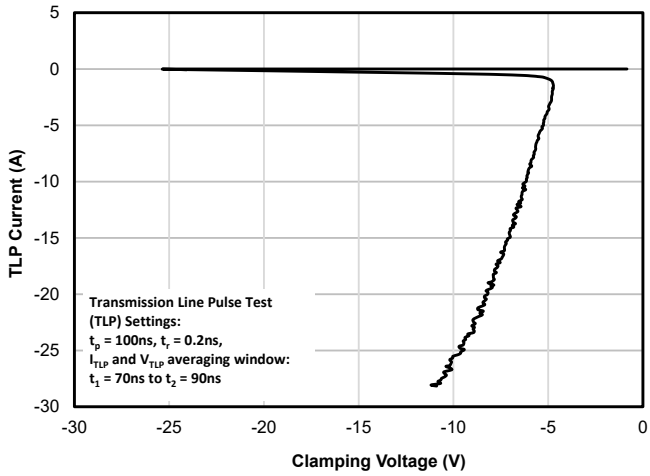
ESD Clamping (-8kV Contact per IEC 61000-4-2)



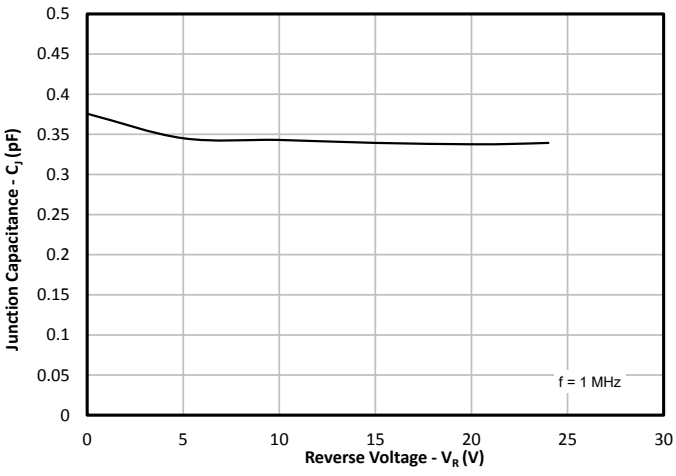
TLP Characteristic (Positive Pulse)



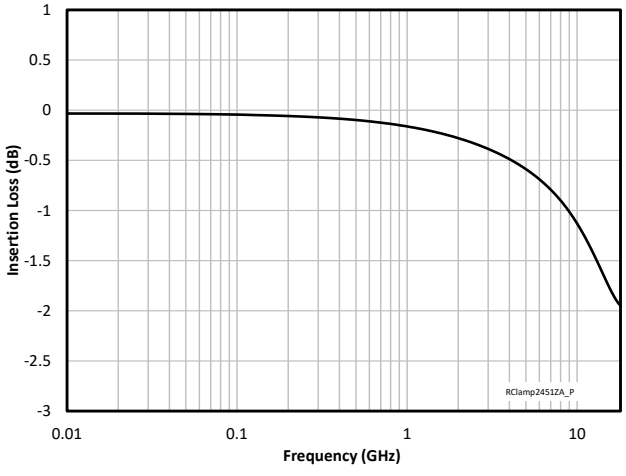
TLP Characteristic (Negative Pulse)



Junction Capacitance vs. Reverse Voltage



Typical Insertion Loss -S21



Application Information

ESD Protection of NFC Interfaces

The Near Field Communication (NFC) antenna is usually connected to the NFC controller IC via contact points on the phone. These contact points are user accessible and therefore may be subjected to ESD strikes. External protection (TVS) devices should be placed between the antenna and the NFC chip interface. The working voltage of the TVS should be high enough as not to clip the NFC signal. Additionally, the capacitance of the device should be minimized in order to avoid harmonic distortion of the RF signal.

RClamp2451ZA meets these requirements and also features extremely low dynamic resistance (<0.2Ω) resulting in low ESD clamping voltage. The low dynamic resistance also helps insure protection for Schottky diodes that may be used in the NFC circuit. RClamp2451ZA is designed to work on NFC circuits with AC signals as high as 24V. An example protection circuit using RClamp2451ZA is shown below in Figure 1.

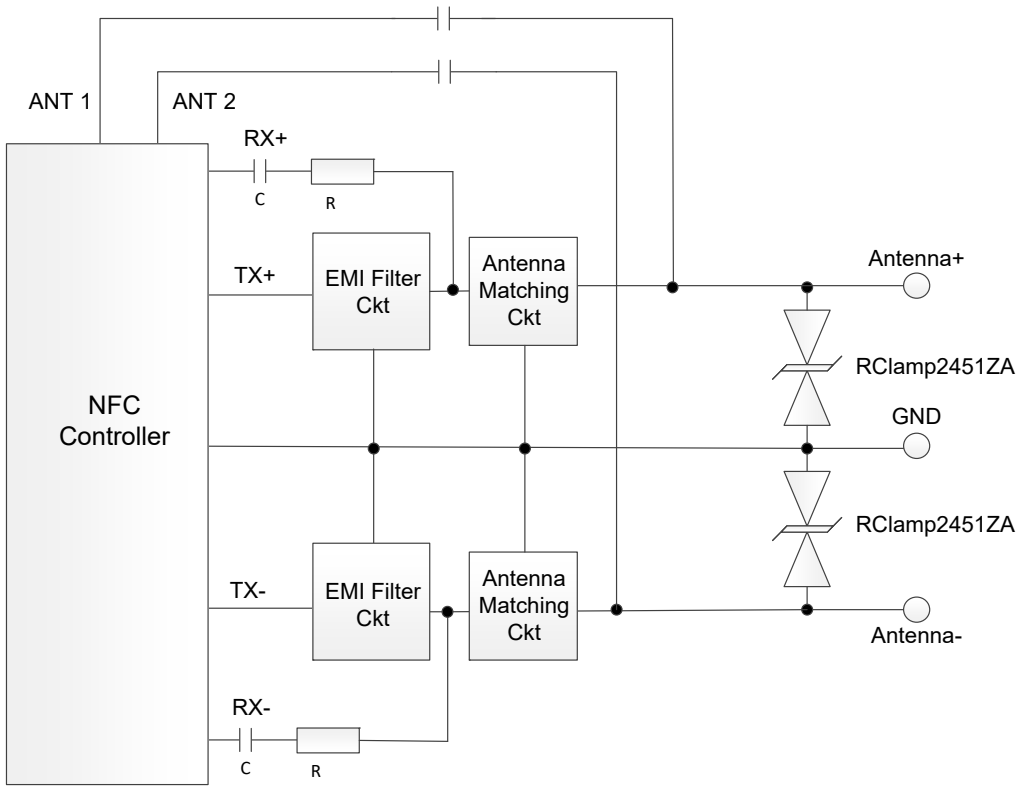


Figure 1 - NFC Protection Example

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:

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 electro-polished 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

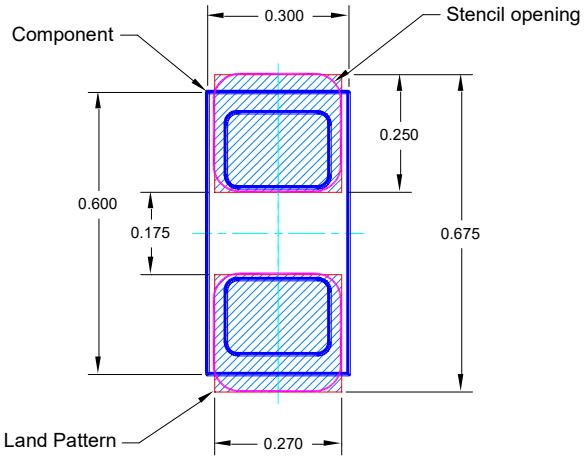
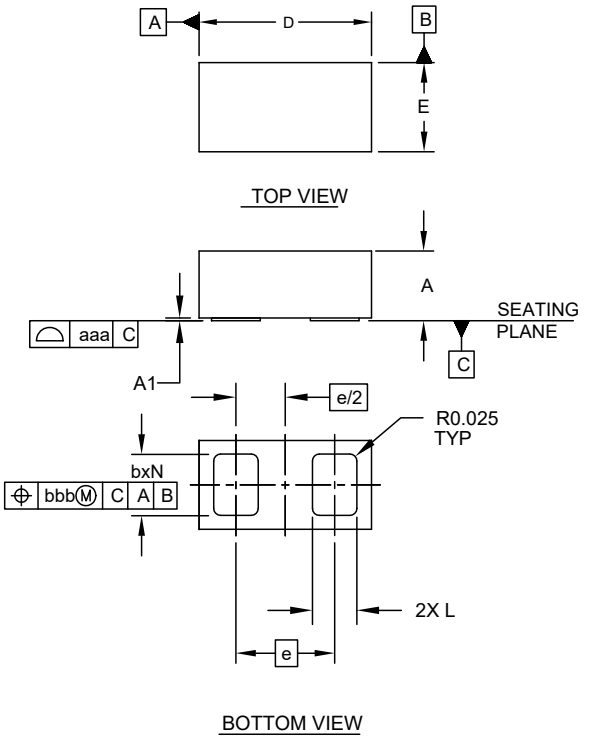


Table 1 - Assembly Guidelines

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 or Non Solder Mask Defined
PCB Pad Finish	OSP or NiAu

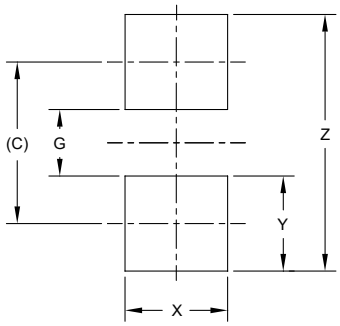
Outline Drawing - DFN 0.60x0.30x0.25 mm 2-Lead



DIMENSIONS			
DIM	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).

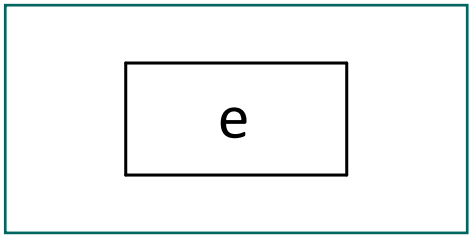
Land Pattern - DFN 0.60x0.30x0.25 mm 2-Lead



DIMENSIONS	
DIM	MILLIMETERS
(C)	(0.425)
G	0.175
X	0.270
Y	0.250
Z	0.675

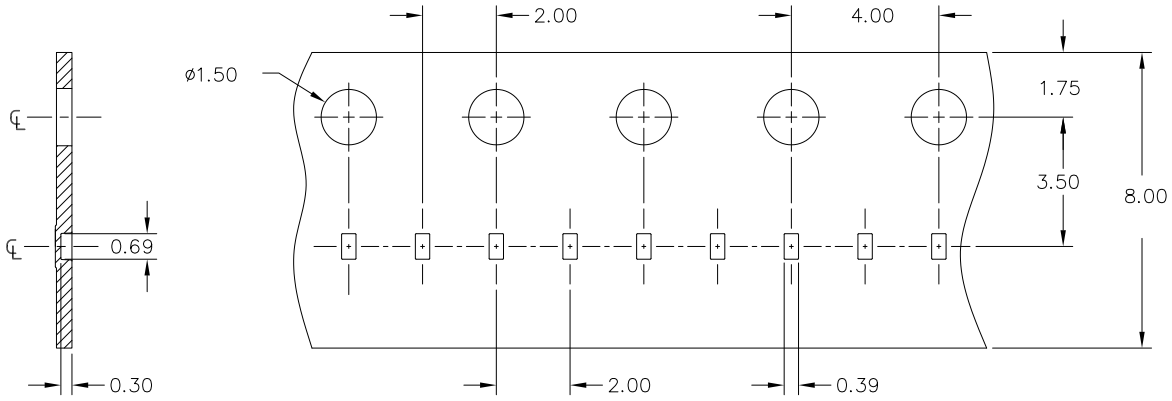
NOTES:
1. CONTROLLING DIMENSIONS ARE IN MILLIMETERS (ANGLES IN DEGREES).
2. THIS LAND PATTERN IS FOR REFERENCE PURPOSES ONLY. CONSULT YOUR MANUFACTURING GROUP TO ENSURE YOUR COMPANY'S MANUFACTURING GUIDELINES ARE MET.

Marking Code

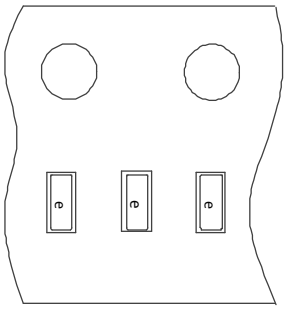


Notes: Device is electrically symmetrical.

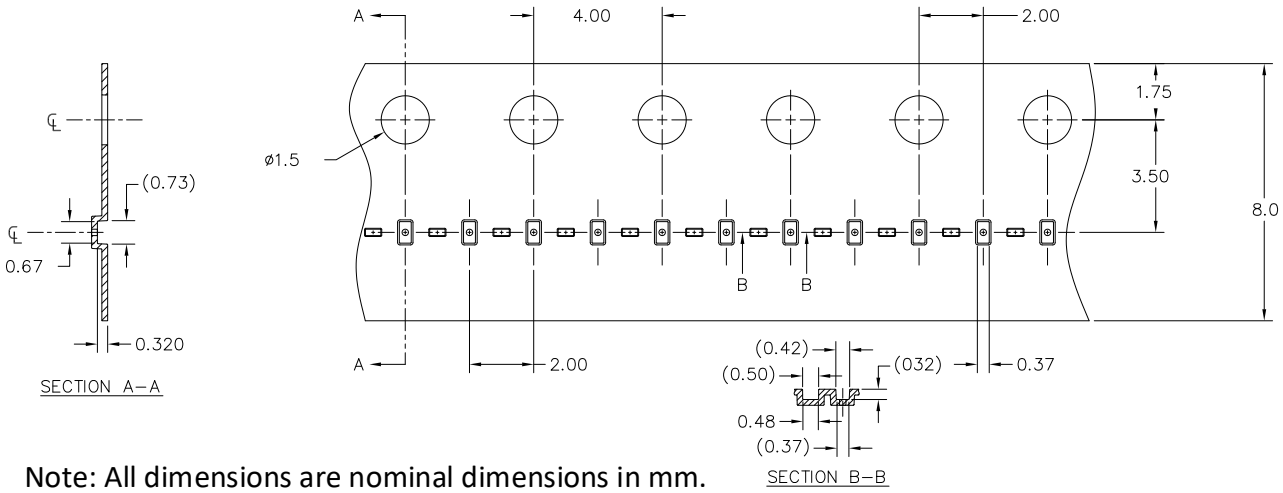
Tape and Reel Specification- Paper Tape



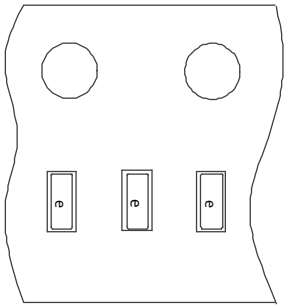
Note: All dimensions are nominal dimensions in mm.



Tape and Reel Specification - Plastic Tape



Note: All dimensions are nominal dimensions in mm.



Ordering Information

Part Number	Tape Material	Qty per Reel	Reel Size
RClamp2451ZATNT	Plastic	10000	7 Inch
RClamp2451ZATFT	Paper	15000	7 Inch

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Contact Information

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

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