

## PROTECTION PRODUCTS - RailClamp®

### Description

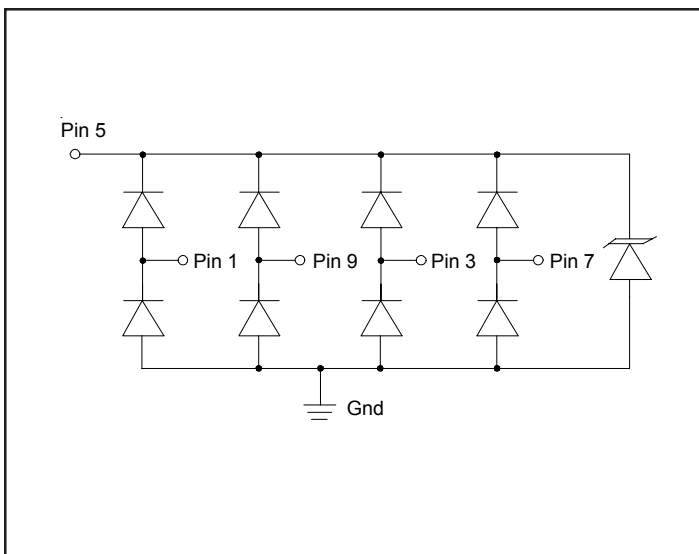
A RailClamp® is a low capacitance TVS array designed to protect high speed data interfaces. This series has been specifically designed to protect sensitive components which are connected to data and transmission lines from overvoltage caused by **ESD** (electrostatic discharge), **CDE** (Cable Discharge Events), and **Lightning**.

The unique design incorporates surge rated, low capacitance steering diodes and a TVS diode in a single package. During transient conditions, the steering diodes direct the transient current to ground. The internal TVS diode clamps the transient voltage to a safe level. The low capacitance array configuration allows the user to protect up to four high-speed data lines.

The RClamp™3304N and RClamp™2504N are constructed using Semtech's proprietary EPD process technology. The EPD process provides low stand-off voltages with significant reductions in leakage current and capacitance over silicon-avalanche diode processes. They feature a true operating voltage of 2.5 volts and 3.3 volts for superior protection.

These devices are in a 10-pin, RoHS/WEEE compliant, SLP2626P10 package. It measures 2.6 x 2.6 x 0.60mm. The leads are spaced at a pitch of 0.5mm and are finished with lead-free NiPdAu. The high surge capability ( $I_{pp}=25A$ ,  $t_p=8/20\mu s$ ) means it can be used in high threat environments in applications such as Gigabit Ethernet, telecommunication lines, and digital video.

### Circuit Diagram



### Features

- ◆ Transient protection for high-speed data lines to **IEC 61000-4-2 (ESD) 15kV (air), 8kV (contact)**
- ◆ **IEC 61000-4-4 (EFT) 40A (5/50ns)**
- ◆ **IEC 61000-4-5 (Lightning) 25A (8/20μs)**
- ◆ Array of surge rated diodes with internal TVS Diode
- ◆ Small package saves board space
- ◆ Protects up to four I/O lines
- ◆ Low capacitance (**<5pF**) for high-speed interfaces
- ◆ Low leakage current and clamping voltage
- ◆ Low operating voltage: **2.5V and 3.3V**
- ◆ Solid-state silicon-avalanche technology

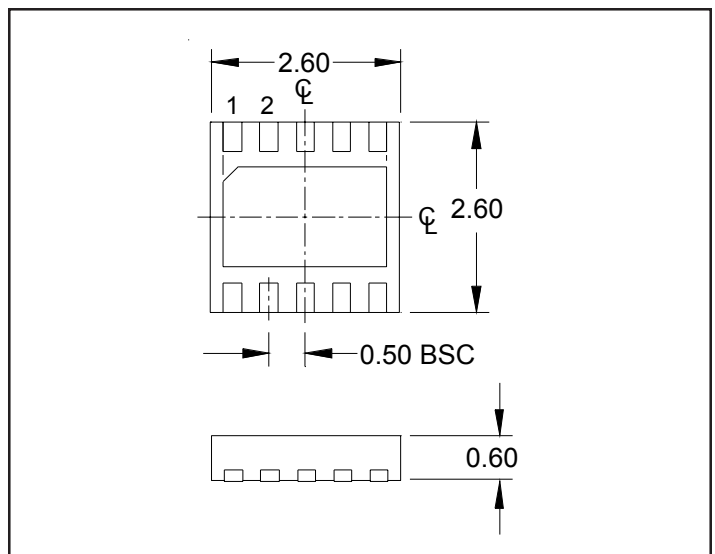
### Mechanical Characteristics

- ◆ SLP2626P10 10L package
- ◆ RoHS/WEEE Compliant
- ◆ Nominal Dimensions: 2.6 x 2.6 x 0.60 mm
- ◆ Lead Finish: NiPdAu
- ◆ Molding compound flammability rating: UL 94V-0
- ◆ Marking : Marking Code + Date Code
- ◆ Packaging : Tape and Reel per EIA 481

### Applications

- ◆ USB 2.0
- ◆ 10/100/1000 Ethernet
- ◆ Digital Visual Interface (DVI)
- ◆ T1/E1 Secondary Protection
- ◆ T3/E3 Secondary Protection
- ◆ Analog Video

### Package Configuration



## PROTECTION PRODUCTS

### Absolute Maximum Rating

Rating	Symbol	Value	Units
Peak Pulse Power (tp = 8/20μs)	$P_{pk}$	450	Watts
Peak Pulse Current (tp = 8/20μs)	$I_{pp}$	25	A
ESD per IEC 61000-4-2 (Air) ESD per IEC 61000-4-2 (Contact)	$V_{ESD}$	25 15	kV
Operating Temperature	$T_J$	-55 to +125	°C
Storage Temperature	$T_{STG}$	-55 to +150	°C

### Electrical Characteristics (T=25°C)

RClamp2504N						
Parameter	Symbol	Conditions	Minimum	Typical	Maximum	Units
Reverse Stand-Off Voltage	$V_{RWM}$				2.5	V
Punch-Through Voltage	$V_{PT}$	$I_{PT} = 2\mu A$	2.7			V
Snap-Back Voltage	$V_{SB}$	$I_{SB} = 50mA$	2.0			V
Reverse Leakage Current	$I_R$	$V_{RWM} = 2.5V, T=25^\circ C$			0.5	μA
Clamping Voltage	$V_C$	$I_{pp} = 1A, t_p = 8/20\mu s$			4.5	V
Clamping Voltage	$V_C$	$I_{pp} = 10A, t_p = 8/20\mu s$			7.5	V
Clamping Voltage	$V_C$	$I_{pp} = 25A, t_p = 8/20\mu s$			15	V
Junction Capacitance	$C_j$	Between I/O pins and Ground $V_R = 0V, f = 1MHz$		3.8	5	pF
		Between I/O pins $V_R = 0V, f = 1MHz$		2.0		pF

Note 1: I/O pins are pin 1, 3, 7, and 9

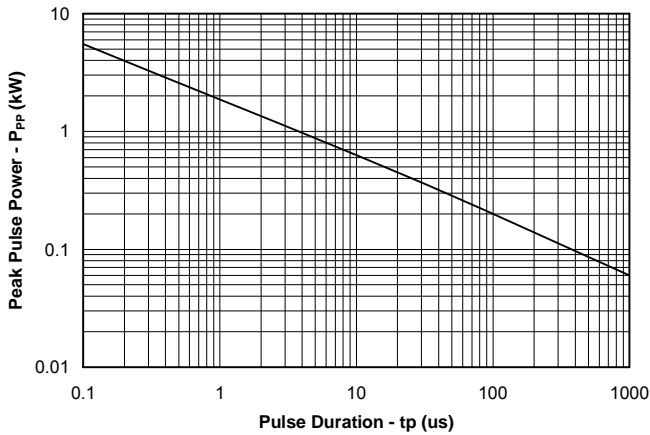
## PROTECTION PRODUCTS

RClamp3304N						
Parameter	Symbol	Conditions	Minimum	Typical	Maximum	Units
Reverse Stand-Off Voltage	$V_{RWM}$				3.3	V
Punch-Through Voltage	$V_{PT}$	$I_{PT} = 5\mu A$	3.5			V
Snap-Back Voltage	$V_{SB}$	$I_{SB} = 50mA$	2.8			V
Reverse Leakage Current	$I_R$	$V_{RWM} = 3.3V, T=25^\circ C$			5	$\mu A$
Clamping Voltage	$V_C$	$I_{PP} = 1A, t_p = 8/20\mu s$			5.5	V
Clamping Voltage	$V_C$	$I_{PP} = 10A, t_p = 8/20\mu s$			10.5	V
Clamping Voltage	$V_C$	$I_{PP} = 25A, t_p = 8/20\mu s$			18	V
Junction Capacitance	$C_j$	Between I/O pins and Ground $V_R = 0V, f = 1MHz$		3.8	5	pF
		Between I/O pins $V_R = 0V, f = 1MHz$		2.0		pF

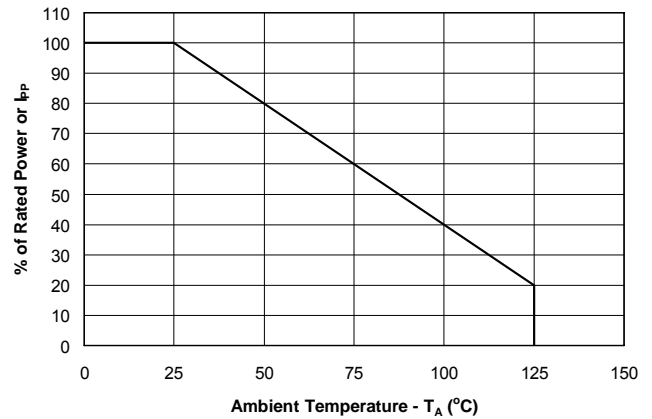
## PROTECTION PRODUCTS

### Typical Characteristics

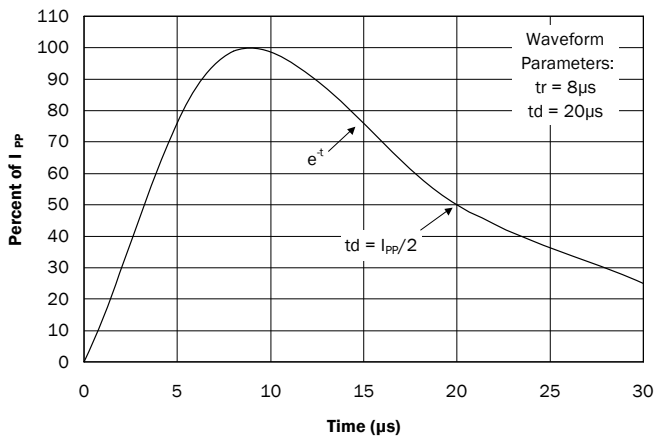
#### Non-Repetitive Peak Pulse Power vs. Pulse Time



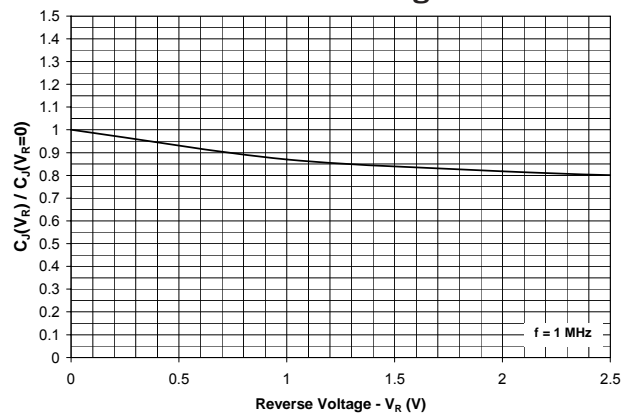
#### Power Derating Curve



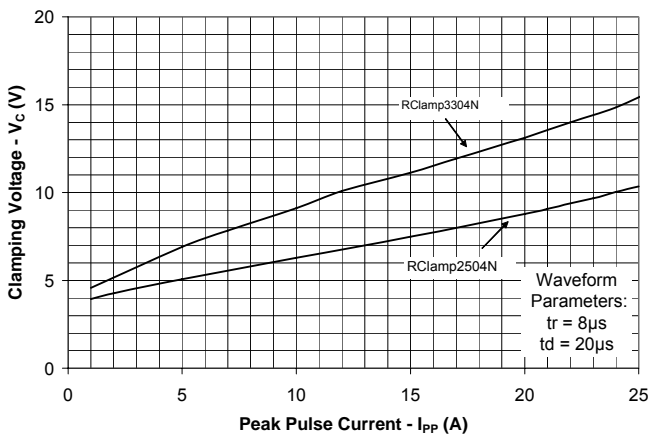
#### Pulse Waveform



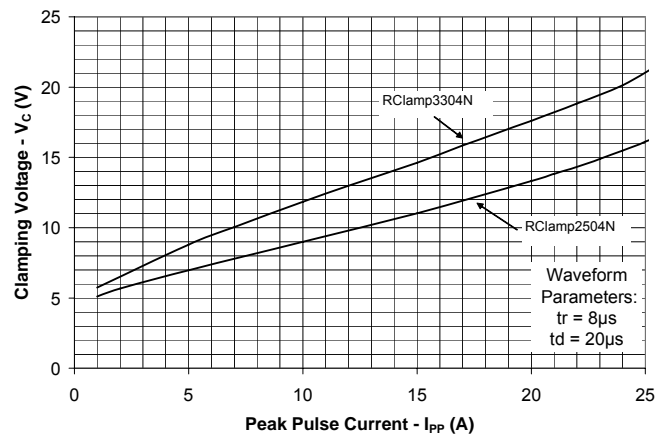
#### Normalized Junction Capacitance vs. Reverse Voltage



#### Clamping Voltage vs. Peak Pulse Current I/O to GND



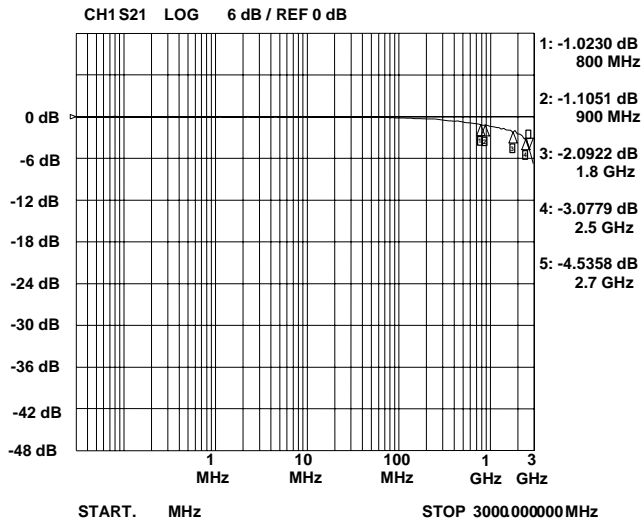
#### Clamping Voltage vs. Peak Pulse Current I/O to I/O



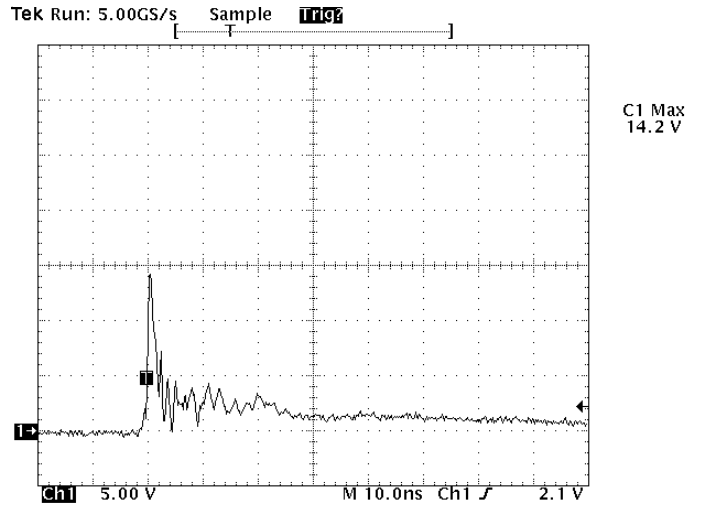
## PROTECTION PRODUCTS

### Typical Characteristics

**Insertion Loss S21 (I/O to Ground)**



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



Note: Data is taken with a 10x attenuator

## PROTECTION PRODUCTS

### Applications Information

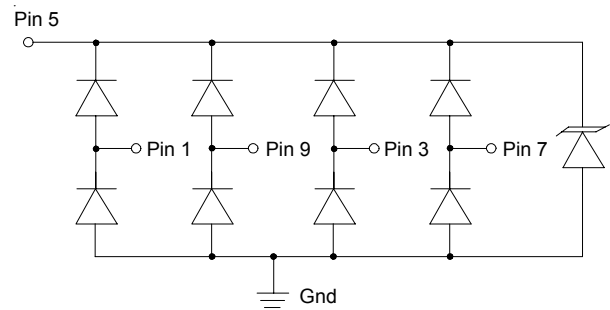
#### Device Connection Options for Protection of Four High-Speed Data Lines

These devices are designed to protect low voltage data lines operating at 2.5 volts or 3.3 volts. When the voltage on the protected line exceeds the reference voltage the steering diodes are forward biased, conducting the transient current away from the sensitive circuitry.

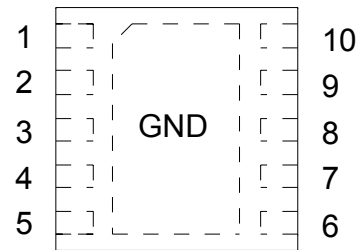
Data lines are connected at pins 1, 3, 7 and 9. The center pin should be connected directly to a ground plane. The path length is kept as short as possible to minimize parasitic inductance. Pins 2, 4, 6, 8, and 10 are not connected.

Note that pin 5 is connected internally to the cathode of the low voltage TVS. However, due to the snap-back characteristics of the EPD TVS, this pin should not be directly connected to a DC supply voltage.

#### Circuit Diagram



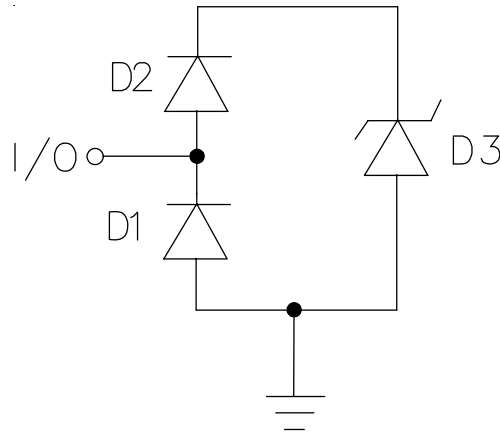
**Figure 1. Pin Configuration (Top Side View)**



Pin	Identification
1, 3, 7, 9	Input/Output Lines
2, 4, 6, 8, 10	No Connect
5	No Connect (Do not connect this pin to a DC supply)
Center Tab	Ground

## PROTECTION PRODUCTS

### Applications Information - Spice Model

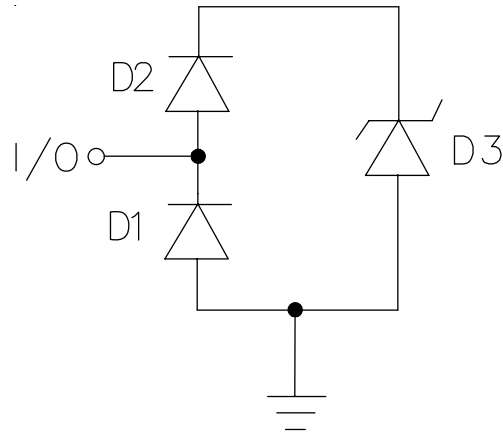


**RClamp2504N Spice Model**

RClamp2504N Spice Parameters				
Parameter	Unit	D1 (LCRD)	D2 (LCRD)	D3 (TVS)
IS	Amp	1E-20	1E-20	1.66E-13
BV	Volt	100	100	2.89
VJ	Volt	0.63	0.59	0.53
RS	Ohm	0.138	0.241	0.06
IBV	Amp	1E-3	1E-3	1E-3
CJO	Farad	1.5E-12	1.5E-12	288E-12
TT	sec	2.541E-9	2.541E-9	2.541E-9
M	--	0.01	0.01	0.17
N	--	1.1	1.1	1.1
EG	eV	1.11	1.11	1.11

## PROTECTION PRODUCTS

### Applications Information - Spice Model



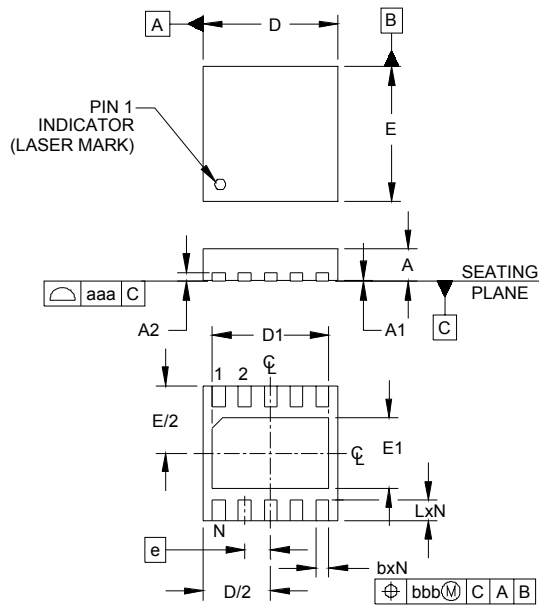
**RClamp3304N Spice Model**

RClamp3304N Spice Parameters				
Parameter	Unit	D1 (LCRD)	D2 (LCRD)	D3 (TVS)
IS	Amp	1E-20	1E-20	1.66E-13
BV	Volt	100	100	3.55
VJ	Volt	0.62	0.59	0.6
RS	Ohm	0.138	0.241	0.182
IBV	Amp	1E-3	1E-3	1E-3
CJO	Farad	1.5E-12	1.5E-12	253E-12
TT	sec	2.541E-9	2.541E-9	2.541E-9
M	--	0.01	0.01	0.205
N	--	1.1	1.1	1.1
EG	eV	1.11	1.11	1.11



## PROTECTION PRODUCTS

### Outline Drawing - SLP2626P10

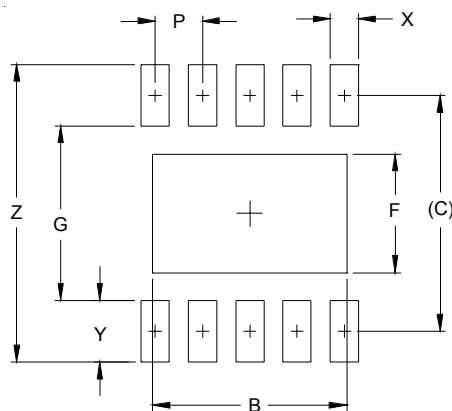


DIM	DIMENSIONS					
	INCHES			MILLIMETERS		
	MIN	NOM	MAX	MIN	NOM	MAX
A	.020	.024	.026	0.50	0.60	0.65
A1	.000	.001	.002	0.00	0.03	0.05
A2	(.007)			(0.17)		
b	.007	.010	.012	0.20	0.25	0.30
D	.098	.102	.106	2.50	2.60	2.70
D1	.079	.085	.089	2.00	2.15	2.25
E	.098	.102	.106	2.50	2.60	2.70
E1	.044	.050	.054	1.11	1.26	1.36
e	.020 BSC			0.50 BSC		
L	.011	.014	.016	0.30	0.35	0.40
N	10			10		
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 - SLP2626P10



DIM	DIMENSIONS	
	INCHES	MILLIMETERS
B	.081	2.05
C	.100	2.50
F	.050	1.26
G	.073	1.85
P	.020	0.50
X	.012	0.30
Y	.025	0.65
Z	.124	3.15

**NOTES:**

1. THIS LAND PATTERN IS FOR REFERENCE PURPOSES ONLY. CONSULT YOUR MANUFACTURING GROUP TO ENSURE YOUR COMPANY'S MANUFACTURING GUIDELINES ARE MET.

## PROTECTION PRODUCTS

### Marking

2504N  
YYWW



RClamp2504N

3304N  
YYWW



RClamp3304N

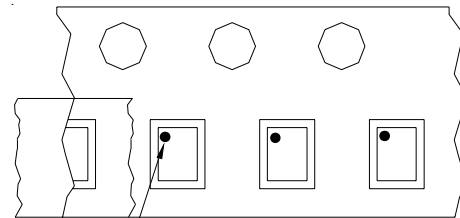
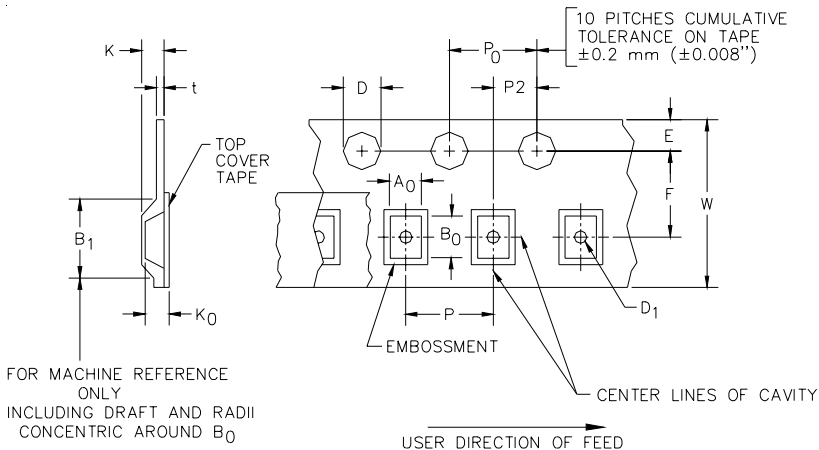
YYWW = Date Code

### Ordering Information

Part Number	Working Voltage	Qty per Reel	Reel Size
RClamp2504N.TCT	2.5 Volts	3,000	7 Inch
RClamp3304N.TCT	3.3 Volts	3,000	7 Inch

RailClamp and RClamp are marks of Semtech Corporation

### Tape and Reel Specification



Pin 1 Location

User Direction of feed

### Device Orientation in Tape

A0	B0	K0
2.77 +/-0.05 mm	2.77 +/-0.05 mm	0.80 +/-0.05 mm

Tape Width	B, (Max)	D	D1	E	F	K (MAX)	P	P0	P2	T(MAX)	W
8 mm	4.2 mm (.165)	1.5 + 0.1 mm - 0.0 mm	1.0 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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