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RClamp2504P & RClamp3304P
RailClamp®
2.5V & 3.3V TVS Arrays

PROTECTION PRODUCTS - RailClamp®

Description

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 **EFT** (electrical fast transients).

The monolithic design incorporates surge rated, low capacitance steering diodes and a TVS diode in a single package. Each line has a maximum capacitance of < 0.8pF to ground. The capacitance of each line is well matched for consistant signal balance. This device is optimized for ESD protection of portable electronics. It may be used to meet the ESD immunity requirements of IEC 61000-4-2, Level 4 (±15kV air, ±8kV contact discharge).

The RClamp™2504P and RClamp™3304P are constructed using Semtech's proprietary EPD process technology. The EPD process provides low standoff 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 6-pin, RoHS/WEEE compliant, SLP1616P6 package measuring 1.6 x 1.6 x 0.58mm. The leads are spaced at a pitch of 0.5mm and are finished with lead-free NiPdAu.

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)**
- Array of surge rated diodes with internal TVS Diode
- Small package saves board space
- Protects up to four I/O lines
- Low capacitance **(<0.8pF)** for high-speed interfaces
- Minimal insertion loss to **3.0GHz**
- Low operating voltage: **2.5V and 3.3V**
- Low leakage current and clamping voltage
- Solid-state silicon-avalanche technology

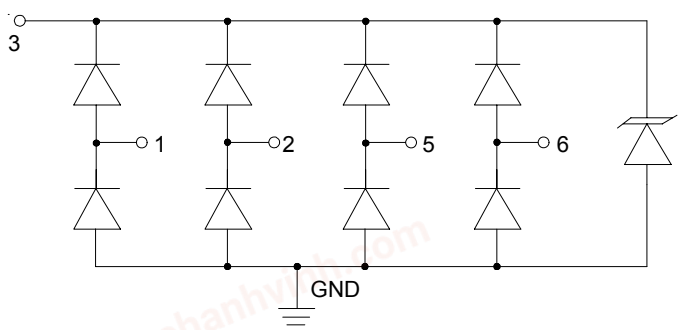
Mechanical Characteristics

- SLP1616P6 package
- RoHS/WEEE Compliant
- Nominal Dimensions: 1.6 x 1.6 x 0.58 mm
- Lead Finish: NiPdAu
- Molding compound flammability rating: UL 94V-0
- Marking: Marking Code + Date Code
- Packaging: Tape and Reel per EIA 481

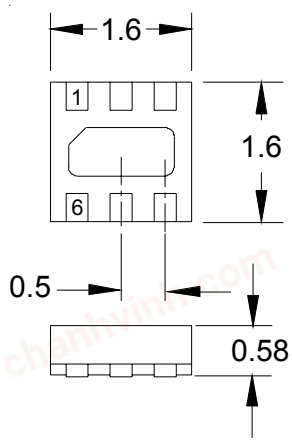
Applications

- Multi Media Card (MMC) Interfaces
- SATA Interfaces
- SD Card Interfaces
- SIM Ports
- MDDI Ports
- MPPI Ports

Circuit Diagram



Pin Configuration



SLP1616P6 (Bottom View)
Nominal Dimensions in mm

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Absolute Maximum Rating

Rating	Symbol	Value	Units
Peak Pulse Power (tp = 8/20µs)	P_{pk}	80	Watts
Peak Pulse Current (tp = 8/20µs)	I_{PP}	5	A
ESD per IEC 61000-4-2 (Air) ESD per IEC 61000-4-2 (Contact)	V_{ESD}	20 12	kV
Operating Temperature	T_J	-40 to +85	°C
Storage Temperature	T_{STG}	-55 to +150	°C

Electrical Characteristics (T=25°C)

RClamp2504P

Parameter	Symbol	Conditions	Minimum	Typical	Maximum	Units
Reverse Stand-Off Voltage	V_{RWM}	Pin 3 to GND			2.5	V
Punch-Through Voltage	V_{PT}	I_{PT} = 2µA	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°C			0.5	µA
Clamping Voltage	V_C	I_{PP} = 1A, t_p = 8/20µs			6.5	V
Clamping Voltage	V_C	I_{PP} = 5A, t_p = 8/20µs			13	V
Junction Capacitance	C_j	VR = 0V, f = 1MHz Any I/O pin to GND			0.8	pF
		VR = 0V, f = 1MHz Between I/O pins		0.4		pF

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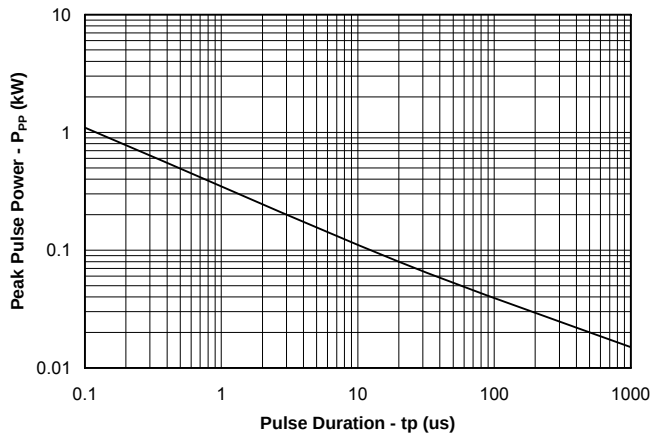
RClamp3304P

Parameter	Symbol	Conditions	Minimum	Typical	Maximum	Units
Reverse Stand-Off Voltage	V_{RWM}	Pin 3 to GND			3.3	V
Punch-Through Voltage	V_{PT}	I_{PT} = 2µA	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°C			0.5	µA
Clamping Voltage	V_C	I_{PP} = 1A, t_p = 8/20µs Any I/O GND			7.5	V
Clamping Voltage	V_C	I_{PP} = 5A, t_p = 8/20µs Any I/O to GND			16	V
Junction Capacitance	C_j	VR = 0V, f = 1MHz Any I/O pin to GND			0.8	pF
		VR = 0V, f = 1MHz Between I/O pins		0.4		pF

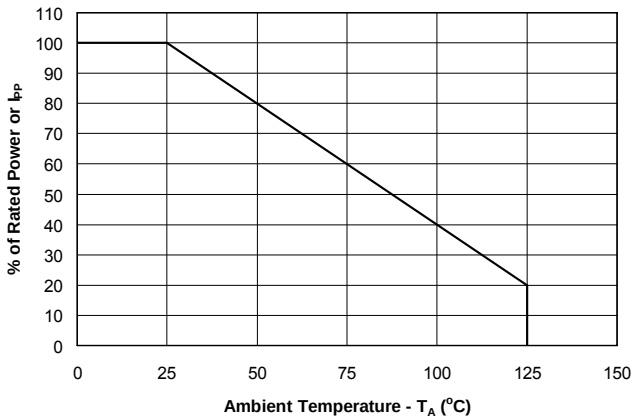
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Typical Characteristics

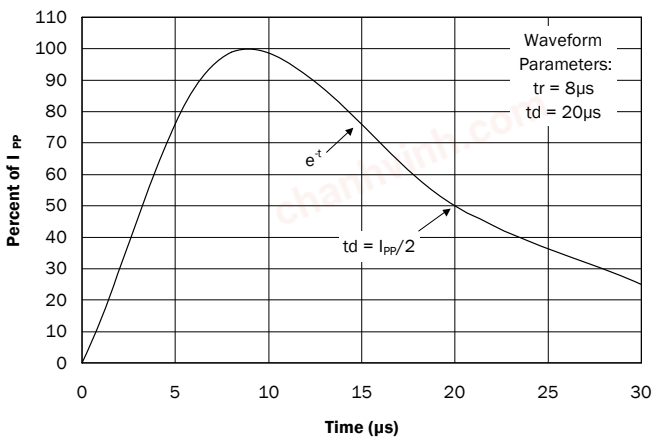
Non-Repetitive Peak Pulse Power vs. Pulse Time



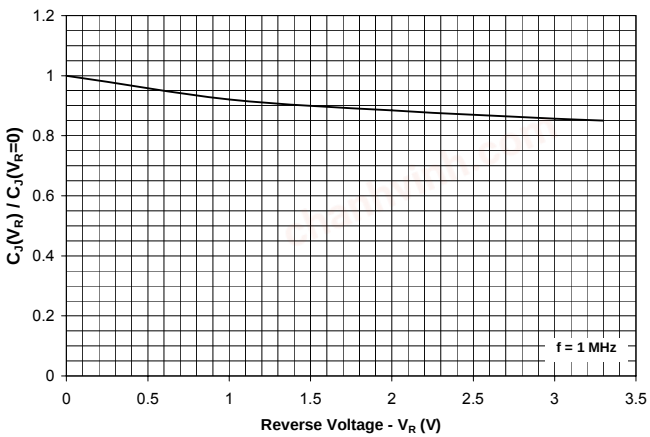
Power Derating Curve



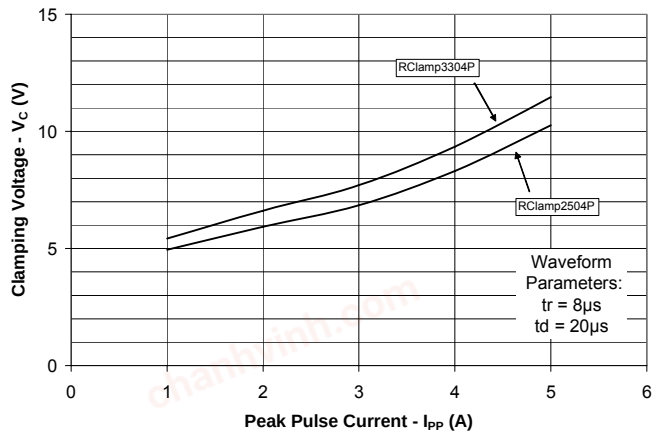
Pulse Waveform



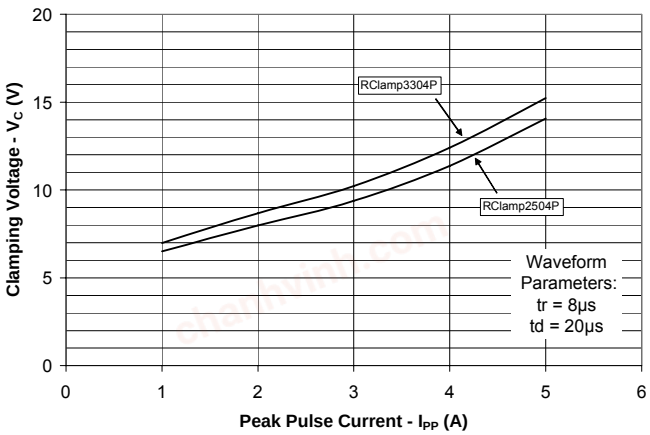
Junction Capacitance vs. Reverse Voltage



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



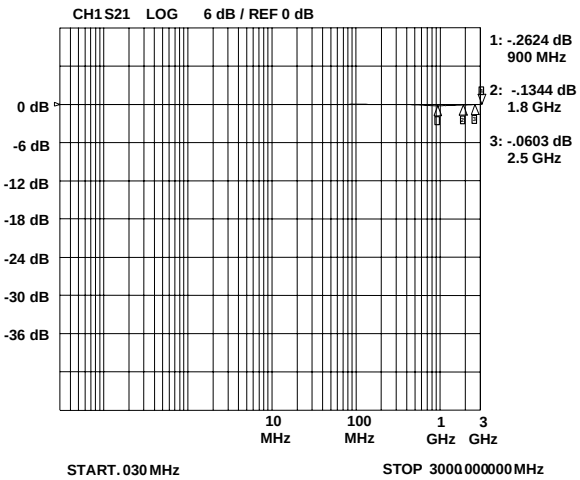
Clamping Voltage vs. Peak Pulse Current I/O to I/O



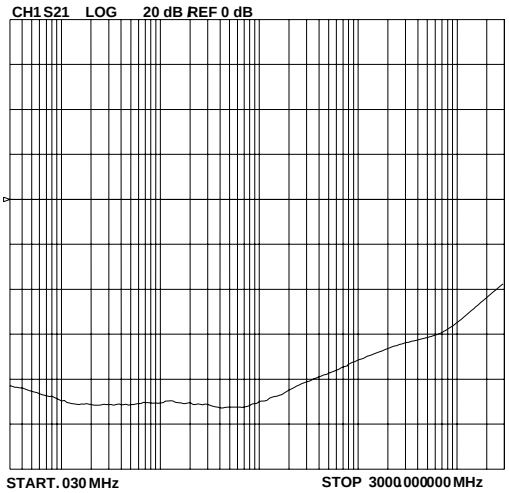
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Typical Characteristics

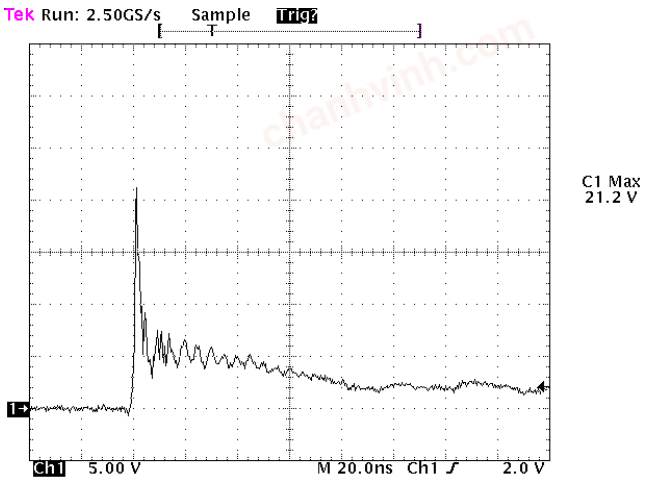
Insertion Loss S21 (I/O to Gnd)



Analog Crosstalk



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



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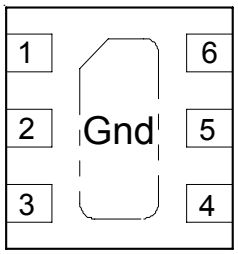
Applications Information

Device Connection 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 TVS working voltage, the steering diodes are forward biased, conducting the transient current away from the sensitive circuitry, through the internal TVS to ground. Data lines are connected at pins 1, 2, 5 and 6. The center pin should be connected directly to a ground plane. The path length is kept as short as possible to minimize parasitic inductance. For best results, multiple micro-vias connected to ground are recommended. Pins 3 and 4 are not connected.

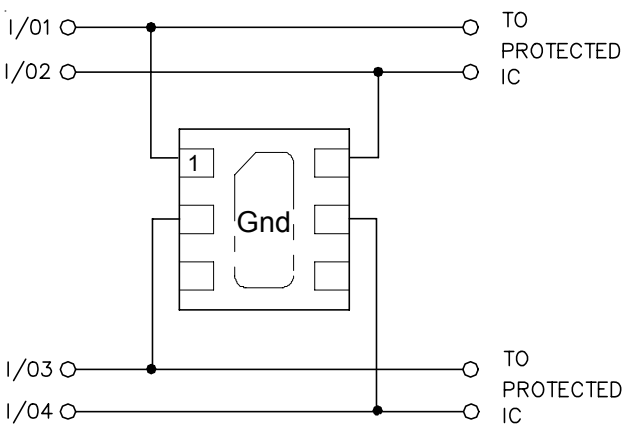
Note that pin 3 is connected internally to the cathode of the low voltage TVS. However, due to the snap-back characteristics of the EPD TVS, this pin should not be directly connected to a DC supply voltage.

Figure 1. Pin Configuration (Top Side View)



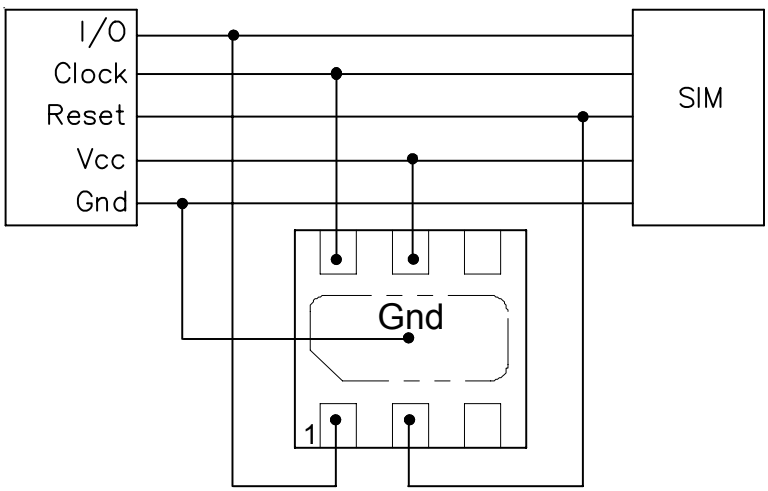
Pin	Identification
1, 2, 5, 6	Input/Output Lines
4	Not Connected
3	2.5V or 3.3V (Do not connect this pin to a DC supply)
Center Tab	Ground

Protection of Four Data Lines



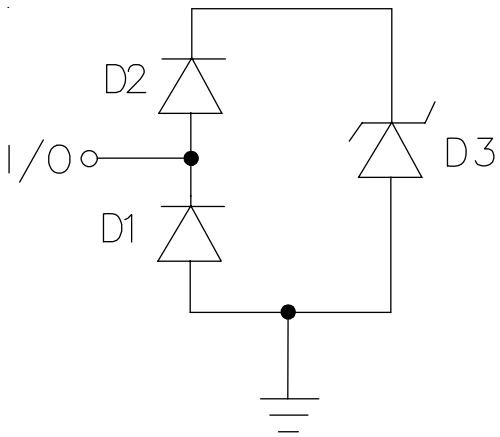
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Typical Applications



SIM Port - Protection of Three Data Lines and VCC

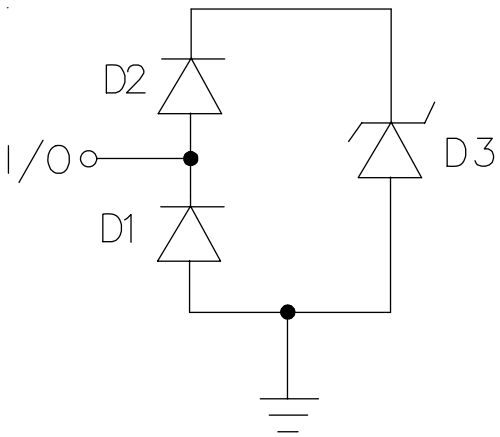
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RClamp2504P Spice Model

RClamp2504P Spice Parameters				
Parameter	**Unit**	**D1 (LCRD)**	**D2 (LCRD)**	**D3 (TVS)**
IS	Amp	1E-20	1E-20	2.19E-12
BV	Volt	100	100	2.88
VJ	Volt	0.7	0.7	0.6
RS	Ohm	0.456	0.714	0.195
IBV	Amp	1E-3	1E-3	1E-3
CJO	Farad	0.3E-12	0.3E-12	63E-12
TT	sec	2.541E-9	2.541E-9	2.541E-9
M	--	0.01	0.01	0.16
N	--	1.1	1.1	1.1
EG	eV	1.11	1.11	1.11

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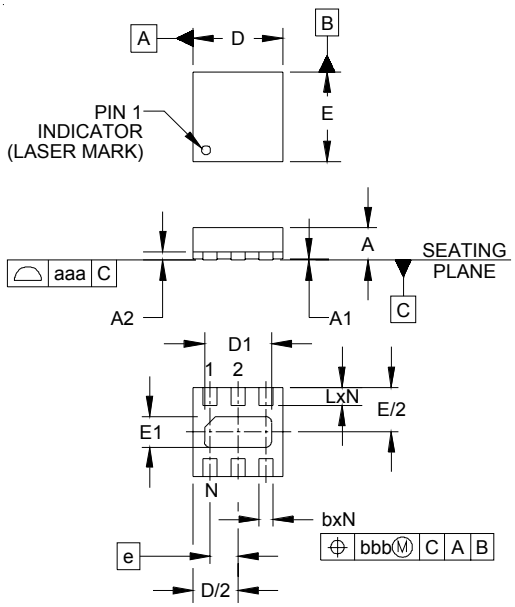
RClamp3304P Spice Model

RClamp3304P Spice Parameters				
Parameter	**Unit**	**D1 (LCRD)**	**D2 (LCRD)**	**D3 (TVS)**
IS	Amp	1E-20	1E-20	2.19E-12
BV	Volt	100	100	3.3
VJ	Volt	0.70	0.70	0.62
RS	Ohm	0.456	0.714	0.36
IBV	Amp	1E-3	1E-3	1E-3
CJO	Farad	0.3E-12	0.3E-12	73E-12
TT	sec	2.541E-9	2.541E-9	2.541E-9
M	--	0.01	0.01	0.18
N	--	1.1	1.1	1.1
EG	eV	1.11	1.11	1.11

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PROTECTION PRODUCTS

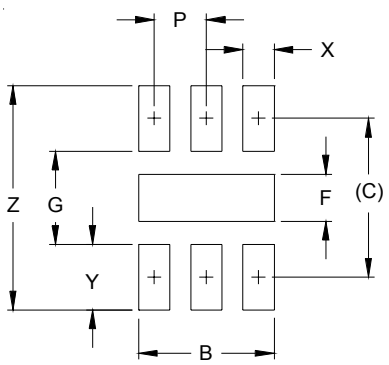
Outline Drawing - SLP1616P6



DIM	DIMENSIONS					
	INCHES			MILLIMETERS		
	MIN	NOM	MAX	MIN	NOM	MAX
A	.020	.023	.026	0.50	0.58	0.65
A1	0.00	.001	.002	0.00	0.03	0.05
A2		(.006)			(0.15)	
b	.007	.010	.012	0.20	0.25	0.30
D	.059	.063	.067	1.50	1.60	1.70
D1	.041	.047	.051	1.05	1.20	1.30
E	.059	.063	.067	1.50	1.60	1.70
E1	.016	.022	.026	0.40	0.55	0.65
e		.020 BSC			0.50 BSC	
L	.013	.013	.016	0.25	0.33	0.40
N		6			6	
aaa		.004			0.09	
bbb		.004			0.09	

NOTES:
1. CONTROLLING DIMENSIONS ARE IN MILLIMETERS (ANGLES IN DEGREES).
2. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.

Land Pattern - SLP1616P6



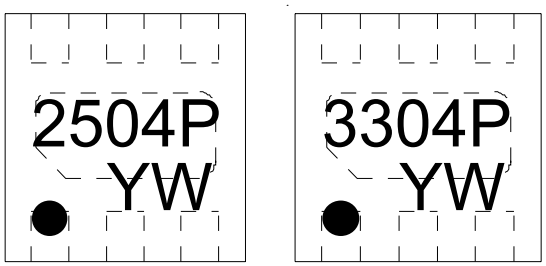
DIM	DIMENSIONS	
	INCHES	MILLIMETERS
B	.051	1.30
C	.060	1.52
P	.020	0.50
F	.018	0.45
G	.035	0.89
X	.012	0.30
Y	.025	0.63
Z	.085	2.15

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

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PROTECTION PRODUCTS

Marking



RClamp2504P RClamp3304P

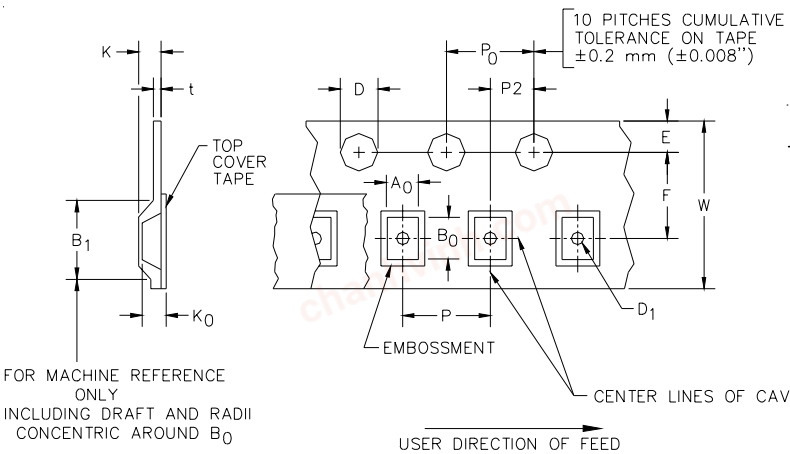
YW = Date Code

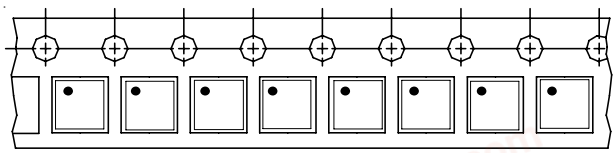
Ordering Information

Part Number	Working Voltage	Qty per Reel	Reel Size
RClamp2504P.TCT	2.5 Volts	3,000	7 Inch
RClamp3304P.TCT	3.3 Volts	3,000	7 Inch

RailClamp and RClamp are marks of Semtech Corporation

Tape and Reel Specification





Device Orientation in Tape
(Pin 1 upper left towards sprocket holes)

A0	B0	K0
1.78 +/-0.05 mm	1.78 +/-0.05 mm	0.69 +/-0.05 mm

Tape Width	B, (Max)	D	D1	E	F	K (MAX)	P	P0	P2	T(MAX)	W
8 mm	4.2 mm	1.5 + 0.1 mm - 0.0 mm)	0.5 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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