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SEMTECH

# RClamp0504PA
## RailClamp®
## Low Capacitance TVS Array

**PROTECTION PRODUCTS - RailClamp®**

## Description

RailClamp® TVS diodes are specifically designed to protect sensitive components which are connected to high-speed data and transmission lines from overvoltage caused by ESD (electrostatic discharge), CDE (cable discharge events), and EFT (electrical fast transients).

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®0504PA is in a 6-pin SLP1616P6 package. It measures 1.6 x 1.6 x 0.60mm. The leads are spaced at a pitch of 0.5mm and are finished with lead-free NiPdAu. They may be used to meet the ESD immunity requirements of IEC 61000-4-2, Level 4 (15kV air, 8kV contact discharge). The combination of small size, low capacitance, and high ESD surge capability makes them ideal for use in portable applications such as cellular phones, next generation color LCD displays, USB, and multi media card interfaces.

## 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 (1.6 x 1.6mm) saves board space
- Protects up to four I/O lines & power line
- Low capacitance **(<3pF)** for high-speed interfaces
- No insertion loss to **2.0GHz**
- Low leakage current and clamping voltage
- Low operating voltage: 5.0V
- Solid-state silicon-avalanche technology

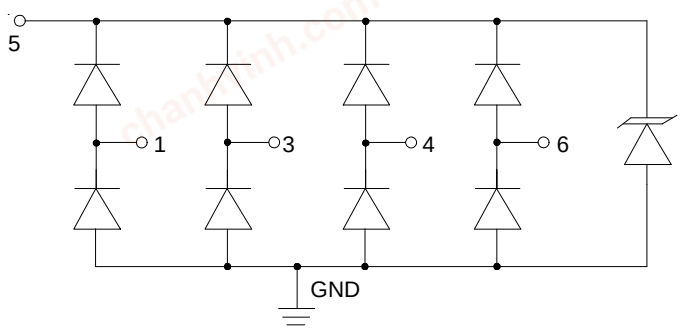
## Mechanical Characteristics

- SLP1616P6 6L package
- Pb-Free, Halogen Free, RoHS/WEEE Compliant
- Nominal Dimensions: 1.6 x 1.6 x 0.60 mm
- Lead Finish: NiPdAu
- Molding compound flammability rating: UL 94V-0
- Packaging : Tape and Reel

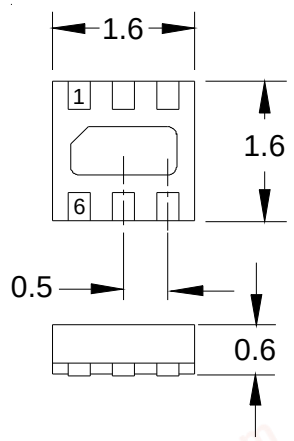
## Applications

- USB 2.0 and USB OTG
- Multi Media Card (MMC) Interfaces
- SD Card Interfaces
- MDDI Ports
- SIM Ports
- Key Pads
- Gigabit Ethernet

## 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) | $P_{pk}$ | 150 | Watts |
| Peak Pulse Current (tp = 8/20μs) | $I_{PP}$ | 6 | A |
| ESD per IEC 61000-4-2 (Air)<br>ESD per IEC 61000-4-2 (Contact) | $V_{ESD}$ | 15<br>8 | kV |
| Operating Temperature | $T_J$ | -55 to +125 | °C |
| Storage Temperature | $T_{STG}$ | -55 to +150 | °C |

## Electrical Characteristics (T=25°C)

| Parameter | Symbol | Conditions | Minimum | Typical | Maximum | Units |
|---|---|---|---|---|---|---|
| Reverse Stand-Off Voltage | $V_{RWM}$ | Pin 5 to GND | | | 5 | V |
| Reverse Breakdown Voltage | $V_{BR}$ | $I_t$ = 1mA<br>Pin 5 to GND | 6 | | | V |
| Reverse Leakage Current | $I_R$ | $V_{RWM}$ = 5V, T=25°C<br>Pin 5 to GND | | | 3 | μA |
| Clamping Voltage | $V_C$ | $I_{PP}$ = 1A, tp = 8/20μs<br>Any I/O pin to GND | | | 15 | V |
| Clamping Voltage | $V_C$ | $I_{PP}$ = 6A, tp = 8/20μs<br>Any I/O pin to GND | | | 25 | V |
| Clamping Voltage | $V_C$ | $I_{PP}$ = 6A, tp = 8/20μs<br>Pin 5 to GND | | | 18 | V |
| Junction Capacitance | $C_j$ | $V_R$ = 0V, f = 1MHz<br>Any I/O pin to GND | | 1.9 | 3 | pF |
| | | $V_R$ = 0V, f = 1MHz<br>Between I/O pins | | 0.80 | 1 | pF |

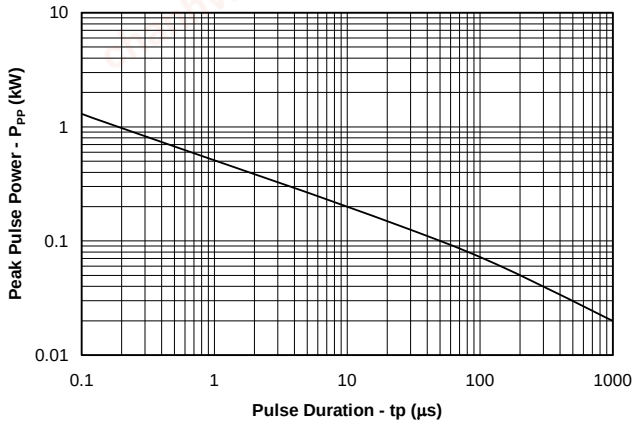
Note 1: I/O pins are pin 1, 3, 4, and 6

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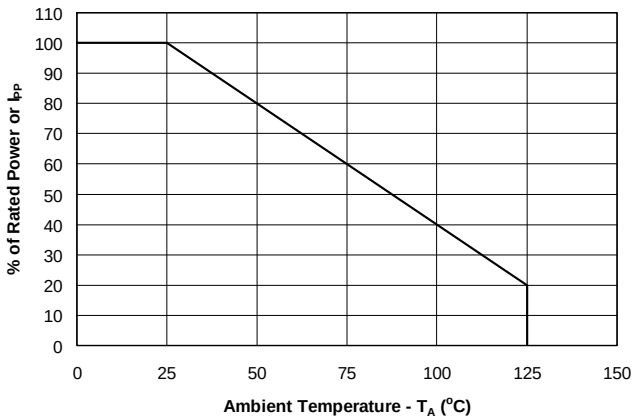


## Typical Characteristics

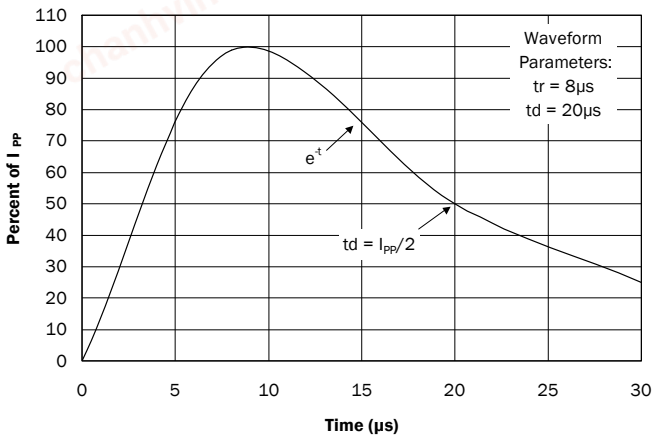
### Non-Repetitive Peak Pulse Power vs. Pulse Time



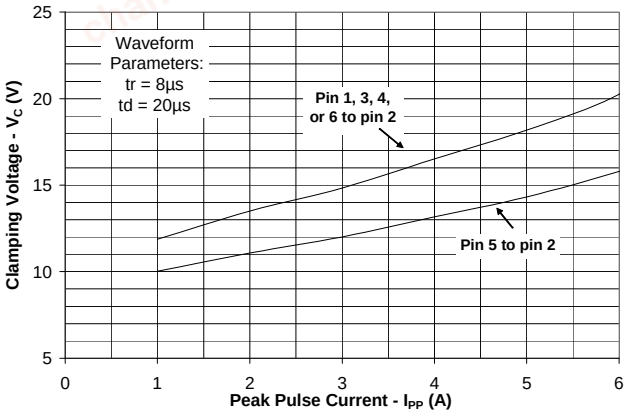

### Power Derating Curve



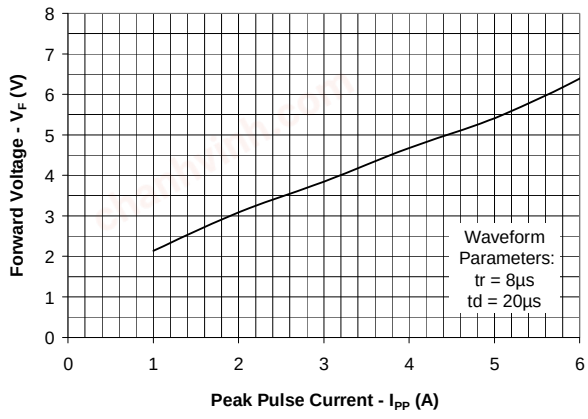

### Pulse Waveform



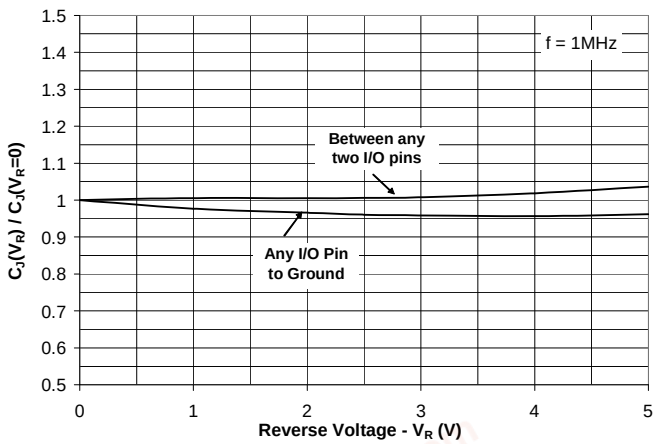

### Clamping Voltage vs. Peak Pulse Current




### Forward Voltage vs. Peak Pulse Current




### Normalized Capacitance vs. Reverse Voltage

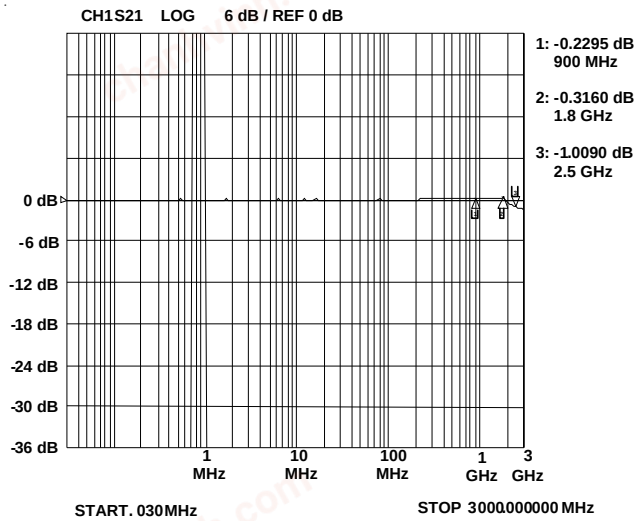


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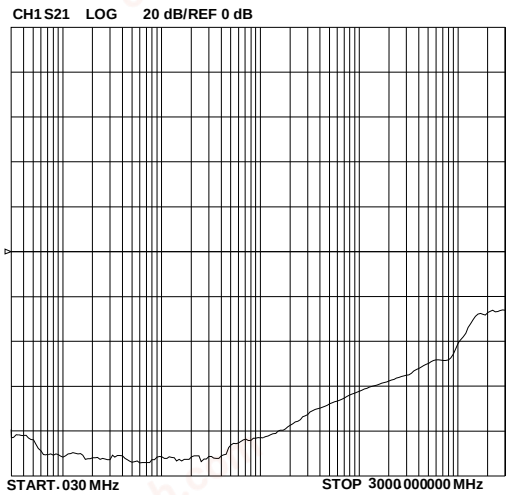


## Typical Characteristics

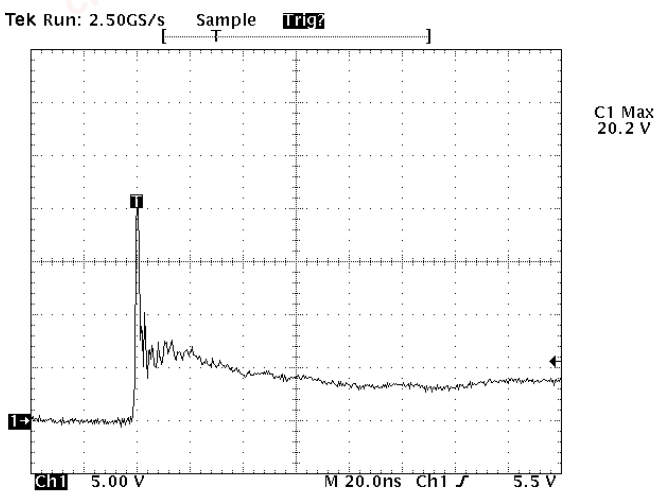
### Insertion Loss S21 (I/O to Gnd)




### Analog Crosstalk




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




Note: Data is taken with a 10x attenuator

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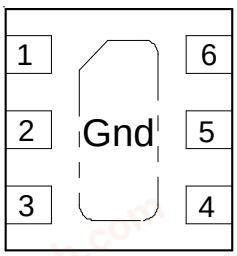
## Applications Information

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

This device is designed to protect data lines by clamping them to a fixed reference. 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, 4 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. Pin 2 is not connected. The positive reference is connected at pin 5. The options for connecting the positive reference are as follows:

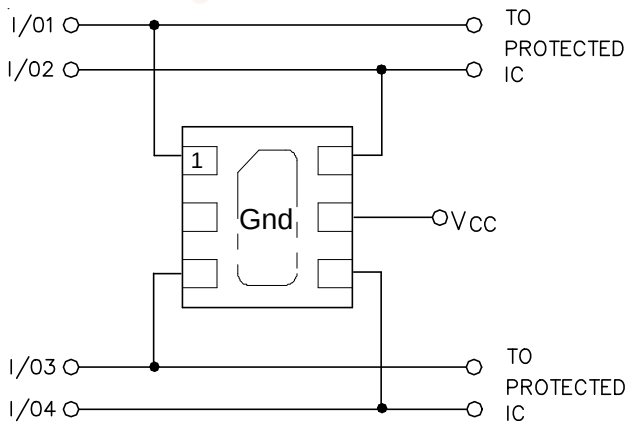
1. To protect data lines and the power line, connect pin 5 directly to the positive supply rail ($V_{CC}$). In this configuration the data lines are referenced to the supply voltage. The internal TVS diode prevents over-voltage on the supply rail.
2. In applications where the supply rail does not exit the system, the internal TVS may be used as the reference. In this case, pin 5 is not connected. The steering diodes will begin to conduct when the voltage on the protected line exceeds the working voltage of the TVS (plus one diode drop).

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

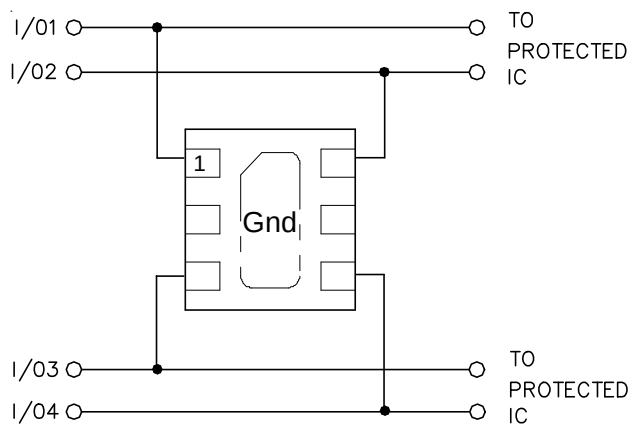



| Pin | Identification |
|---|---|
| 1, 3, 4, 6 | Input/Output Lines |
| 2 | Not Connected |
| 5 | 5V (Optional) or N/C |
| Center Tab | Ground |

### Protection of Four Data Lines and Power Supply Line



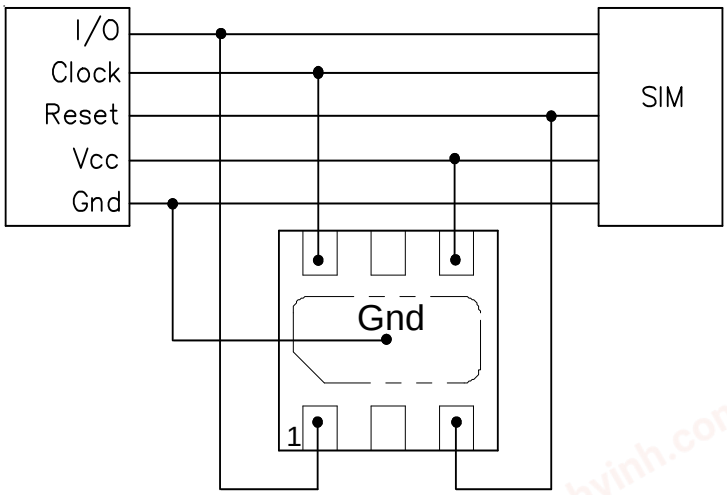

### Protection of Four Data Lines Using Internal TVS Diode as Reference



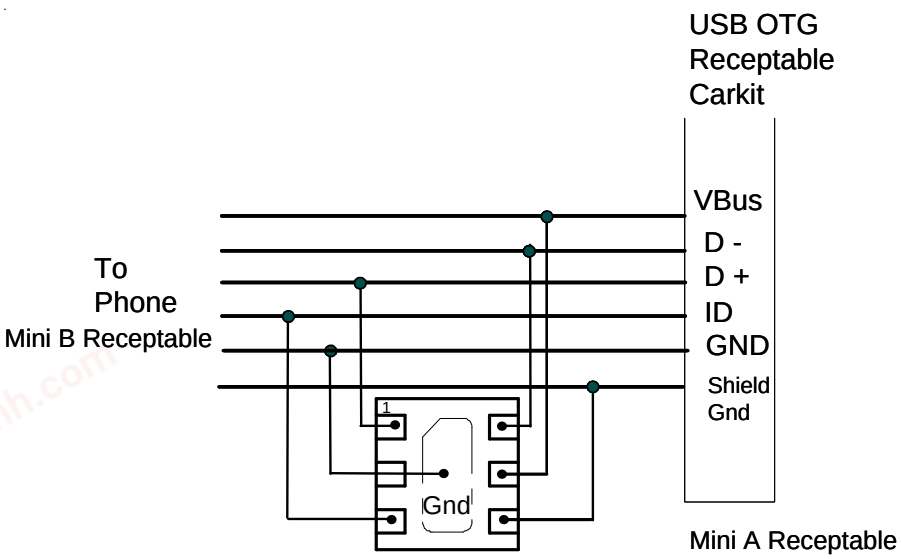
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## Typical Applications




**SIM Port - Protection of Three Data Lines and VCC**

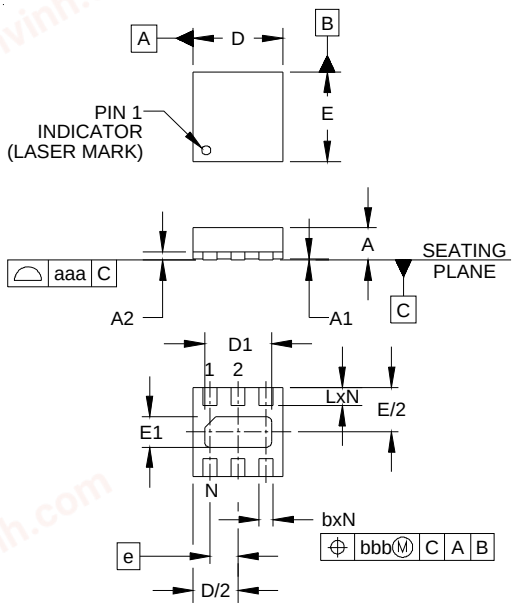



**USB OTG Carkit Protection**

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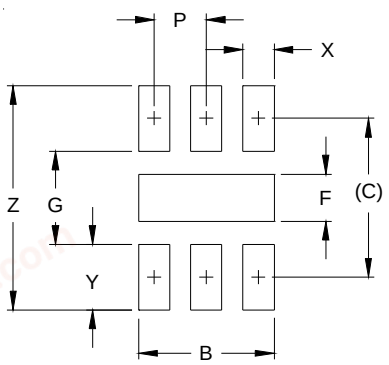
## Outline Drawing - SLP1616P6




| DIM | 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 | 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 |

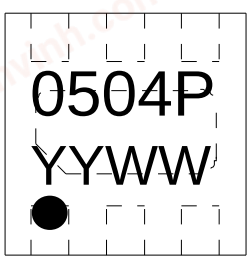
NOTES:
1. THIS LAND PATTERN IS FOR REFERENCE PURPOSES ONLY. CONSULT YOUR MANUFACTURING GROUP TO ENSURE YOUR COMPANY'S MANUFACTURING GUIDELINES ARE MET.

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## PROTECTION PRODUCTS

## Marking



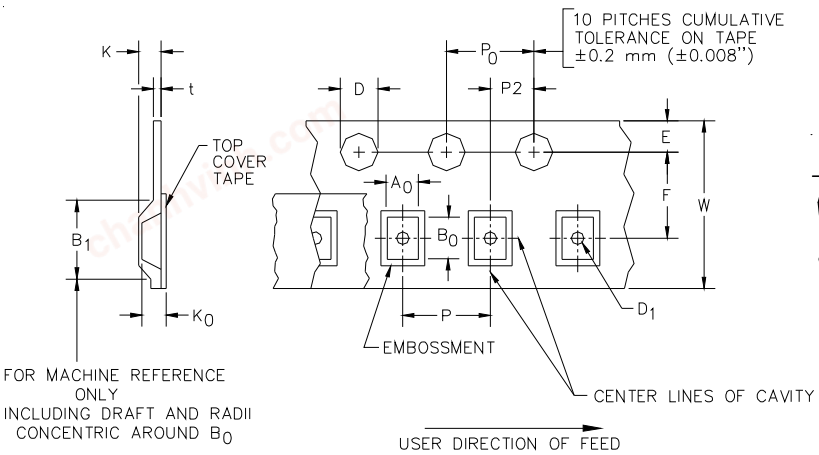

YYWW = Date Code

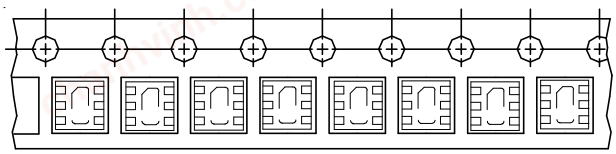
## Ordering Information

| Part Number | Lead Finish | Qty per Reel | Reel Size |
|---|---|---|---|
| RClamp0504PATCT | Pb Free | 3,000 | 7 Inch |

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## Tape and Reel Specification



**Device Orientation in Tape**
**Pin 1 in upper left towards sprocket holes**

| A0 | B0 | K0 |
|---|---|---|
| 1.78 +/-0.10 mm | 1.78 +/-0.10 mm | 0.69 +/-0.10 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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