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RClamp0506T RailClamp® 6-Line ESD Protection

PROTECTION PRODUCTS - RailClamp®

Description

RailClamp® TVS diode arrays are specifically designed to protect sensitive components which are connected to high-speed data and transmission lines from over-voltage caused by **ESD** (electrostatic discharge), **CDE** (Cable Discharge Events), and **EFT** (electrical fast transients).

The RClamp®0506T has a maximum capacitance of only 0.80pF. This allows it to be used on circuits operating in excess of 2.0GHz without signal attenuation. They may be used to meet the ESD immunity requirements of IEC 61000-4-2, Level 4 ($\pm 15\text{kV}$ air, $\pm 8\text{kV}$ contact discharge). Each device is designed to protect six lines operating up to 5 volts.

The RClamp0506T is in a 8-pin SLP3313P6T package. It measures 3.3 x 1.3 x 0.4mm. The leads are spaced at a pitch of 0.5mm and are finished with lead-free NiPdAu. They are designed for easy PCB layout by allowing the traces to run straight through the device. The combination of small size, low capacitance, and high level of ESD protection makes them a flexible solution for applications such as HDMI, USB 3.0, MDDI, and multimedia card interfaces.

Features

- ◆ Transient protection for high-speed data lines to **IEC 61000-4-2 (ESD) $\pm 15\text{kV}$ (air), $\pm 8\text{kV}$ (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 6-Lines operating at 5V
- ◆ Low capacitance (**$< 0.8\text{pF}$**)
- ◆ No insertion loss to **2.0GHz**
- ◆ Low leakage current
- ◆ Low clamping voltage
- ◆ Innovative package for easy pcb layout
- ◆ Solid-state silicon-avalanche technology

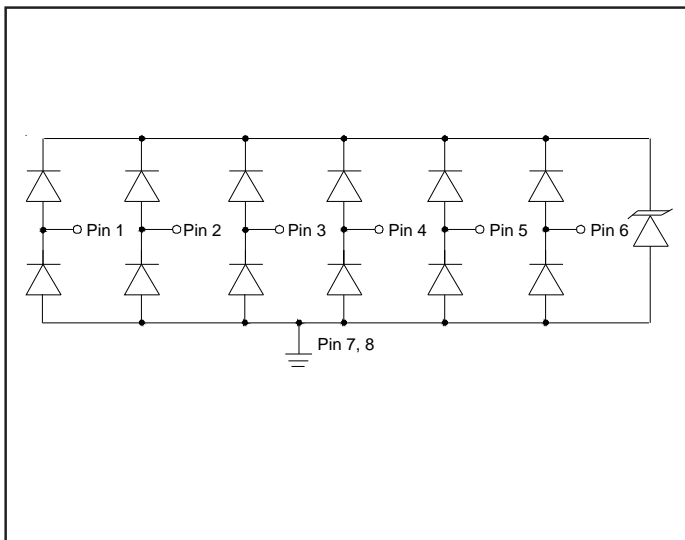
Mechanical Characteristics

- ◆ SLP3313P6T 8L package
- ◆ Pb-Free, Halogen Free, RoHS/WEEE Compliant
- ◆ Nominal Dimensions: 3.3 x 1.3 x 0.40 mm
- ◆ Lead Finish: NiPdAu
- ◆ Molding compound flammability rating: UL 94V-0
- ◆ Marking: Marking code
- ◆ Packaging: Tape and Reel

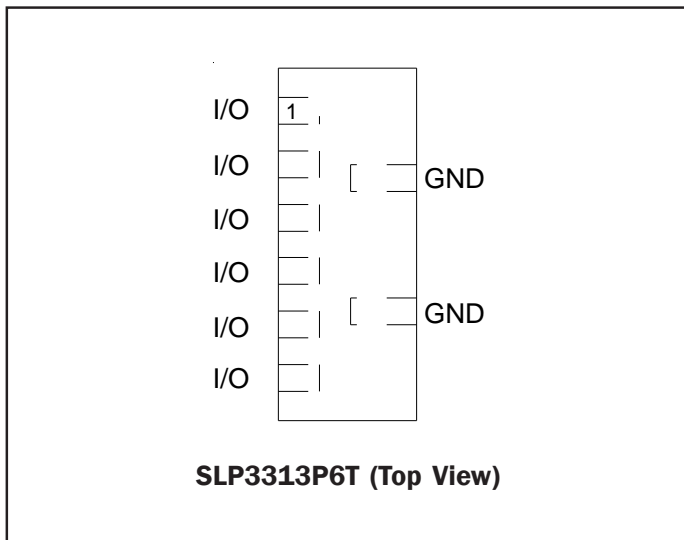
Applications

- ◆ USB 3.0
- ◆ HDMI 1.4
- ◆ uSD Card Interfaces
- ◆ MMC Card Interfaces
- ◆ MDDI / mipi Interfaces

Circuit Diagram



PIN Configuration





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Absolute Maximum Rating

| Rating | Symbol | Value | Units |
|--|-----------|------------------|-------|
| Peak Pulse Power (tp = 8/20μs) | P_{pk} | 75 | 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} | +/- 18 +/- 12 | kV |
| Operating Temperature | T_J | -55 to +125 | °C |
| Storage Temperature | T_{STG} | -55 to +150 | °C |

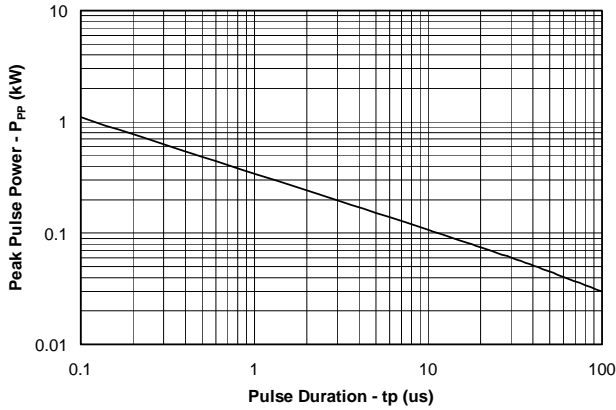
Electrical Characteristics (T = 25°C)

| Parameter | Symbol | Conditions | Minimum | Typical | Maximum | Units |
|---------------------------|-----------|---|---------|---------|---------|-------|
| Reverse Stand-Off Voltage | V_{RWM} | Any I/O to GND | | | 5 | V |
| Reverse Breakdown Voltage | V_{BR} | $I_t = 1mA$, Any I/O to GND | 6.5 | 8 | 11 | V |
| Reverse Leakage Current | I_R | $V_{RWM} = 5.0V$, Any I/O to GND | | 0.005 | 0.100 | μA |
| Forward Voltage | V_F | $I_f = 15mA$ Any I/O to GND | 0.6 | | 1.2 | V |
| Clamping Voltage | V_C | $I_{pp} = 1A$, tp = 8/20μs Any I/O to GND | | | 12 | V |
| Clamping Voltage | V_C | $I_{pp} = 5A$, tp = 8/20μs Any I/O to GND | | | 15 | V |
| Junction Capacitance | C_j | $V_R = 0V$, f = 1MHz, Any I/O to GND | | 0.7 | 0.80 | pF |
| | | $V_R = 0V$, f = 1MHz, Between I/O pins | | | 0.4 | pF |

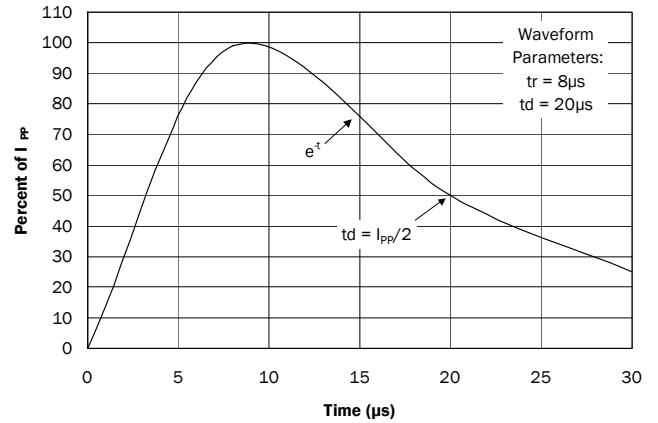
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Typical Characteristics

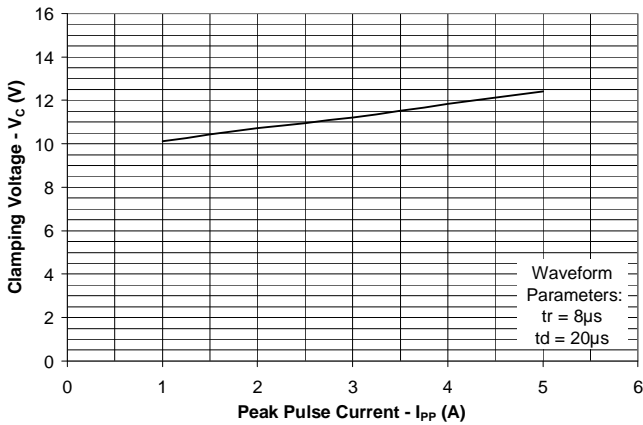
Non-Repetitive Peak Pulse Power vs. Pulse Time



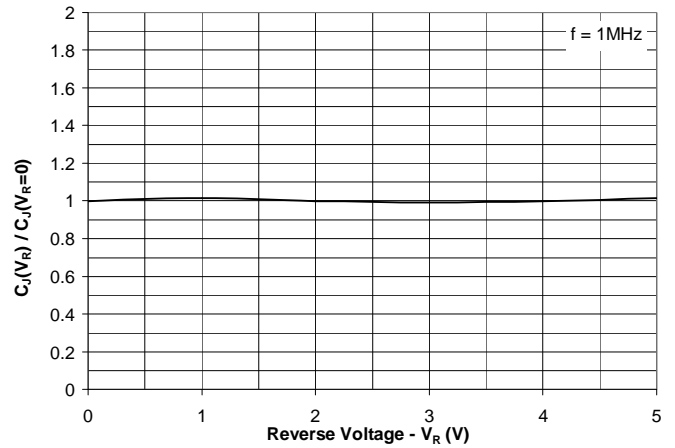
Pulse Waveform



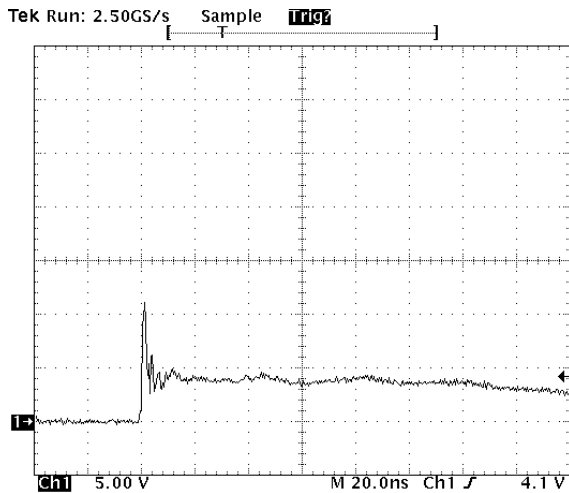
Clamping Voltage vs. Peak Pulse Current



Normalized Capacitance vs. Reverse Voltage

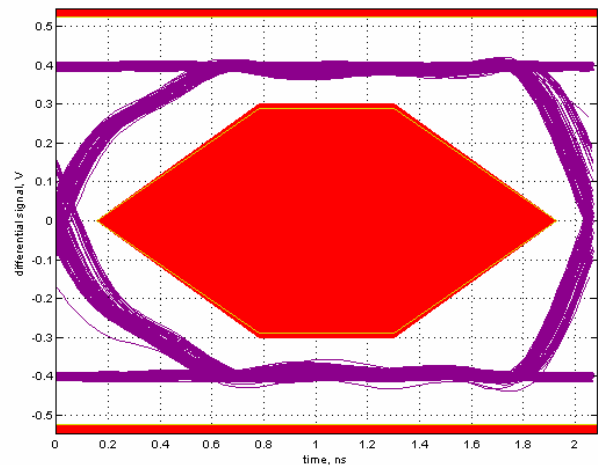


**ESD Clamping (Any I/O to GND)
 (+8kV Contact per IEC 61000-4-2)**



C1 Max
11.2 V

USB 2.0 Eye Pattern with RClamp0506T

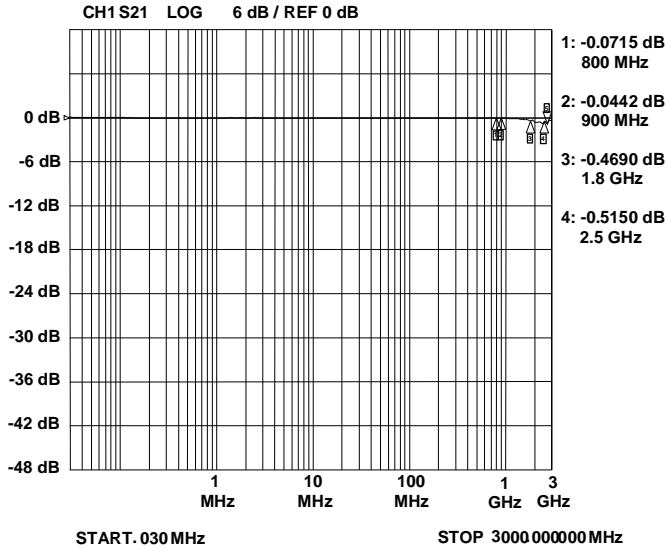


Note: Data is taken with a 10x attenuator

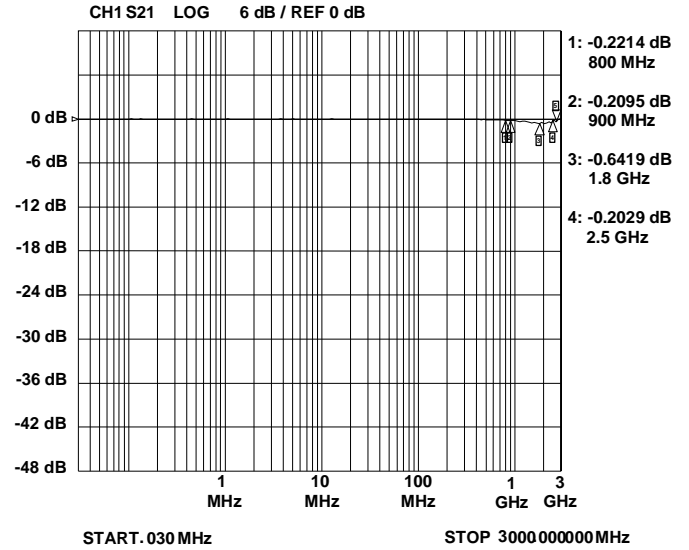
PROTECTION PRODUCTS

Typical Characteristics

Insertion Loss S21 - I/O to I/O



Insertion Loss S21 - I/O to GND



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Applications Information

Device Connection and Layout Options for Protecting 6 High-Speed Lines

The RClamp0506T is optimized for use on high-speed lines. Data lines are connected at pins 1, 2, 3, 4, 5, and 6. These inputs are referenced to an internal 5 volt TVS protection device. When the voltage on these lines exceed 5 volts, the TVS will conduct. Ground connection is made at either pin 7 or pin 8. It is not necessary to connect both ground pins of the device as they are connected internally. Multiple micro vias connected to ground are recommended for best ESD performance. This will reduce parasitic inductance in the ground path and minimize the clamping voltage seen by the protected device. The package is designed for easy trace routing as shown in Figure 2.

Figure 1- Pin Configuration

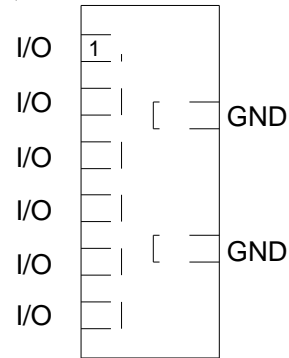
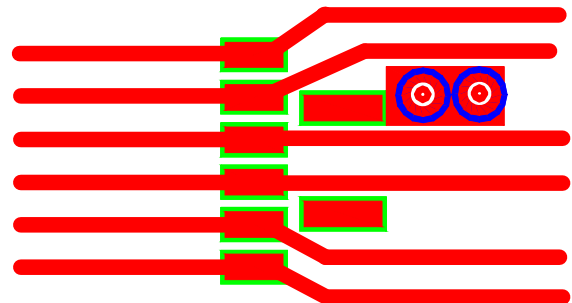
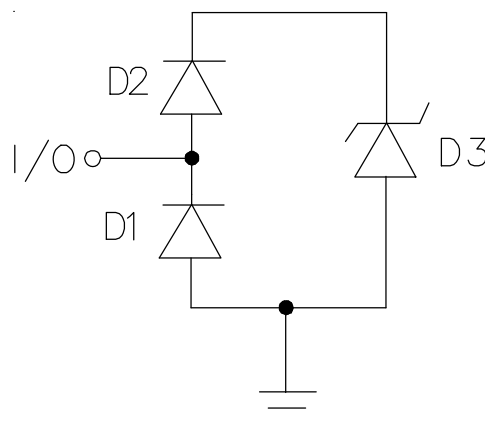


Figure 2 - Layout Example



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Applications Information - Spice Model

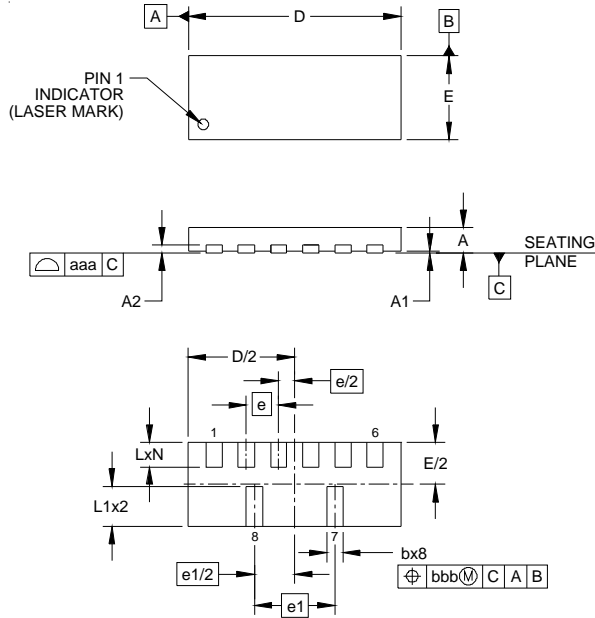


Spice Model

| RClamp0506T Spice Parameters | | | | |
|------------------------------|-------|----------|----------|----------|
| Parameter | Unit | D1 | D2 | D3 |
| IS | Amp | 1E-20 | 1E-20 | 2E-12 |
| BV | Volt | 100 | 100 | 8.2 |
| VJ | Volt | 0.83 | 0.83 | 0.6 |
| RS | Ohm | 1.5 | 0.6 | 0.2 |
| IBV | Amp | 1E-3 | 1E-3 | 1E-3 |
| CJO | Farad | 0.25E-12 | 0.25E-12 | 56E-12 |
| TT | sec | 2.541E-9 | 2.541E-9 | 2.541E-9 |
| M | -- | 0.01 | 0.01 | 0.23 |
| N | -- | 1.1 | 1.1 | 1.1 |
| EG | eV | 1.11 | 1.11 | 1.11 |

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Outline Drawing - SLP3313P6T

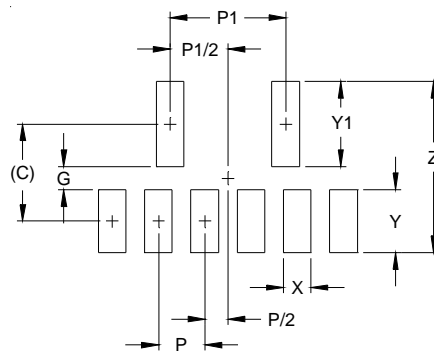


| DIM | MILLIMETERS | | |
|-----|-------------|--------|------|
| | MIN | NOM | MAX |
| A | 0.37 | 0.40 | 0.43 |
| A1 | 0.00 | 0.02 | 0.05 |
| A2 | | (0.13) | |
| b | 0.20 | 0.25 | 0.30 |
| D | 3.25 | 3.30 | 3.38 |
| E | 1.25 | 1.30 | 1.38 |
| e | 0.50 BSC | | |
| e1 | 1.25 BSC | | |
| L | 0.30 | 0.38 | 0.43 |
| L1 | 0.54 | 0.62 | 0.67 |
| N | 6 | | |
| aaa | 0.08 | | |
| bbb | 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 - SLP3313P6T



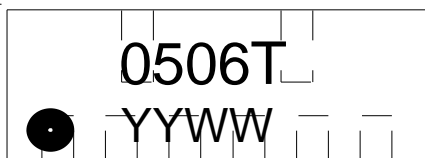
| DIM | MILLIMETERS |
|-----|-------------|
| | C |
| G | 0.25 |
| P | 0.50 |
| P1 | 1.25 |
| X | 0.30 |
| Y | 0.68 |
| Y1 | 0.92 |
| Z | 1.85 |

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.

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Marking



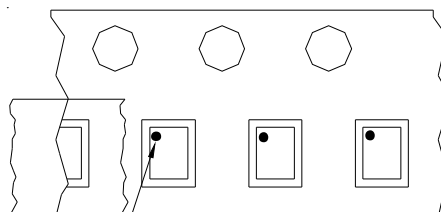
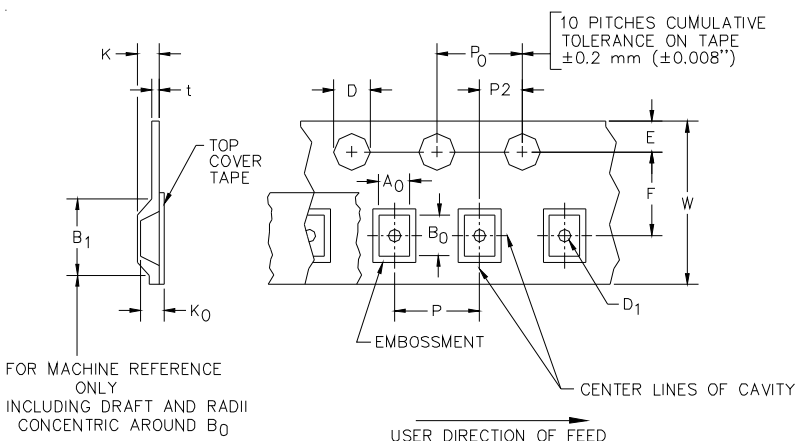
YYWW = Date Code

Ordering Information

| Part Number | Lead Finish | Qty per Reel | Reel Size |
|-----------------|-------------|--------------|-----------|
| RClamp0506T.TCT | Pb Free | 3,000 | 7 Inch |

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Tape and Reel Specification



Pin 1 Location

User Direction of feed

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

| A0 | B0 | K0 |
|-----------------|-----------------|-----------------|
| 1.51 +/-0.10 mm | 3.51 +/-0.10 mm | 0.66 +/-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 |

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