

#### 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

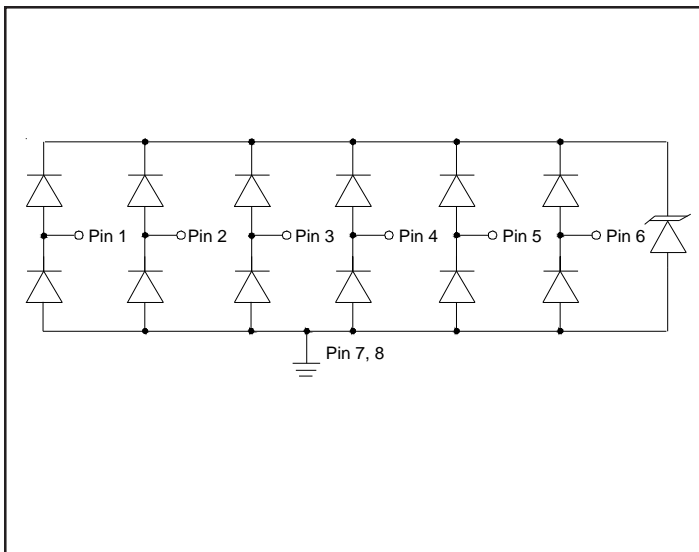
#### Mechanical Characteristics

- ◆ 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

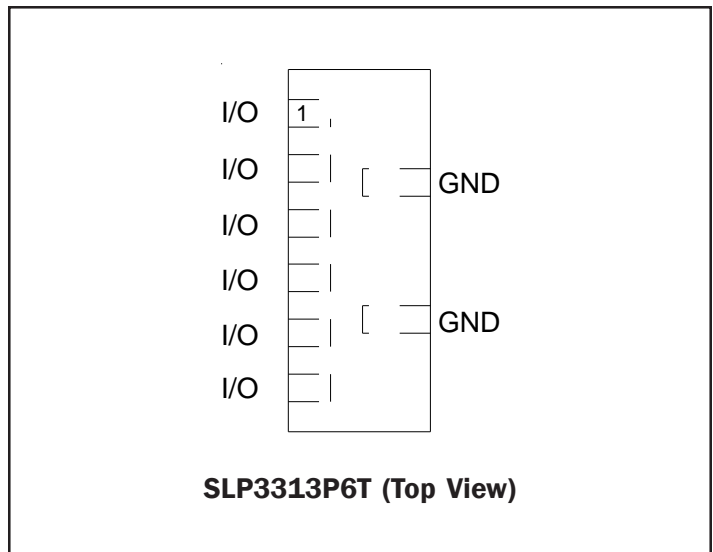
#### Applications

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

#### Circuit Diagram



#### PIN Configuration



**PROTECTION PRODUCTS**
**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

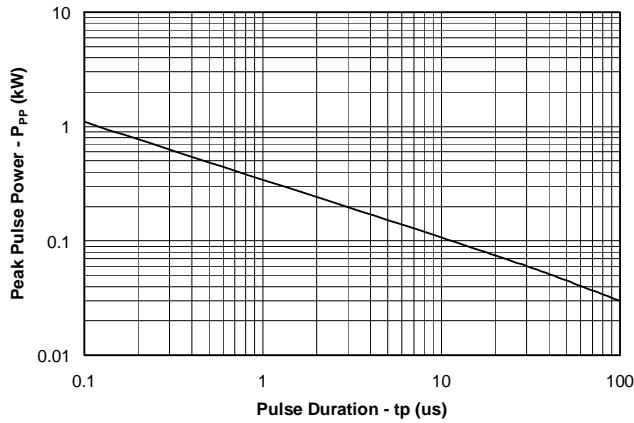
**Electrical Characteristics (T = 25°C)**

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

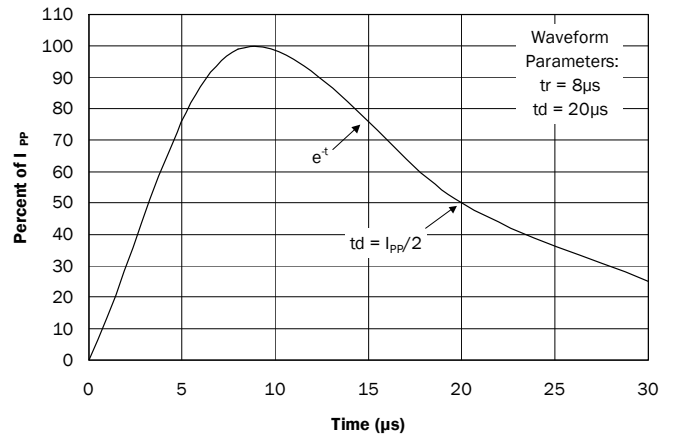
## PROTECTION PRODUCTS

### Typical Characteristics

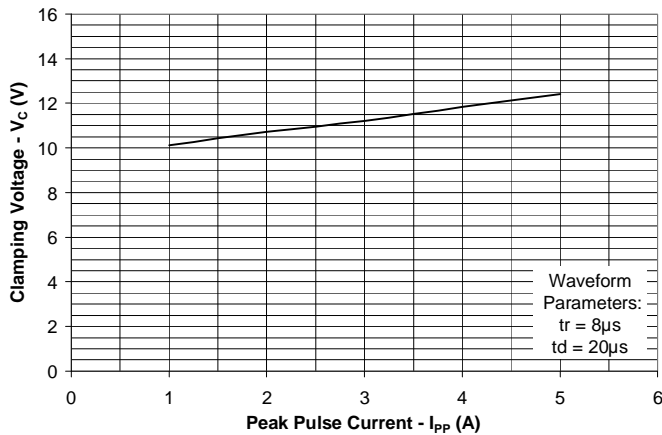
#### Non-Repetitive Peak Pulse Power vs. Pulse Time



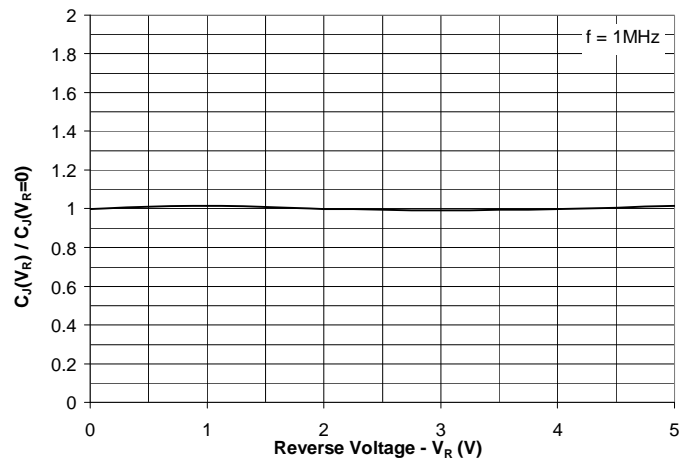
#### Pulse Waveform



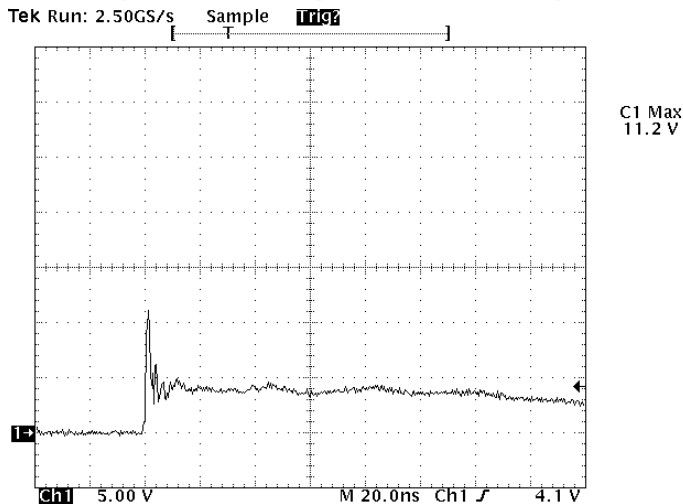
#### Clamping Voltage vs. Peak Pulse Current



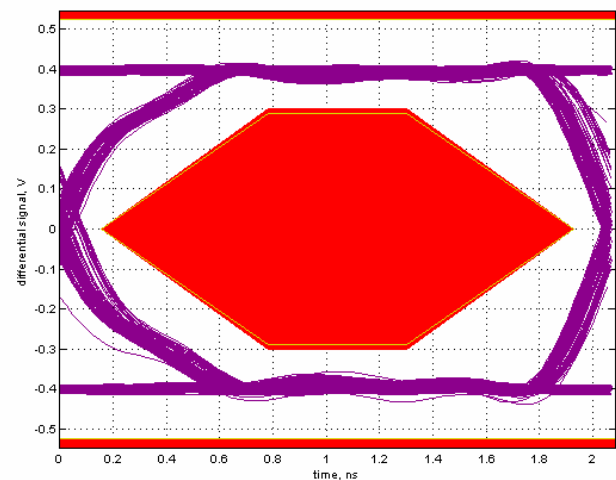
#### Normalized Capacitance vs. Reverse Voltage



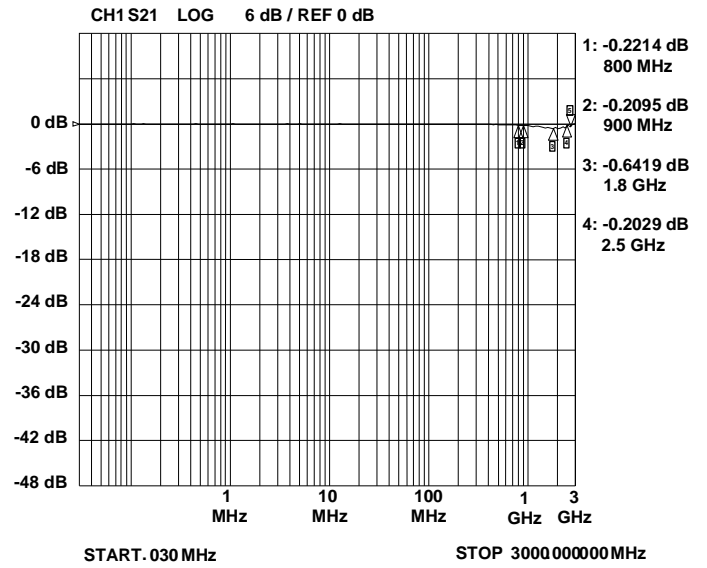
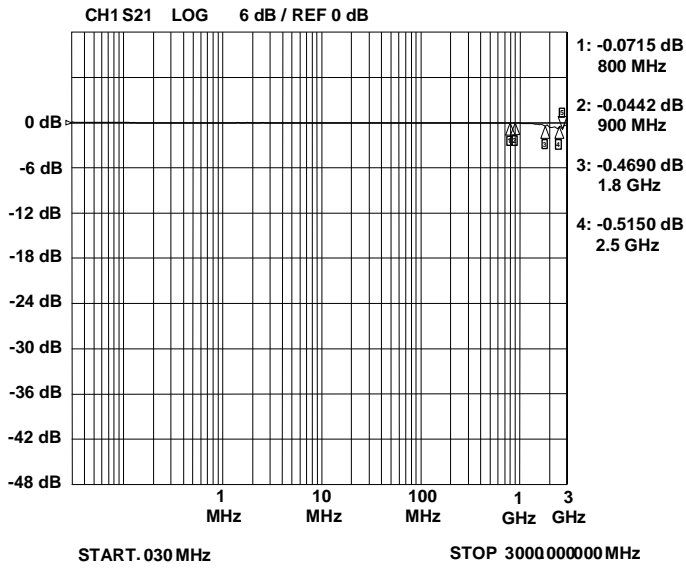
#### ESD Clamping (Any I/O to GND) (+8kV Contact per IEC 61000-4-2)



#### 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**


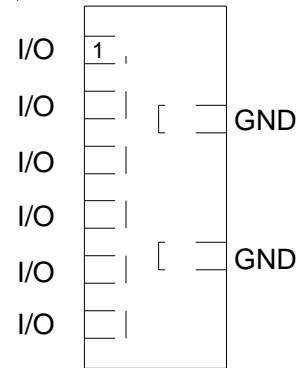
**PROTECTION PRODUCTS**

**Applications Information**

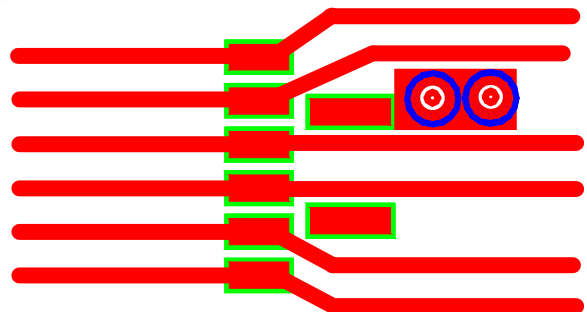
**Device Connection and Layout Options for Protecting 6 High-Speed Lines**

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**

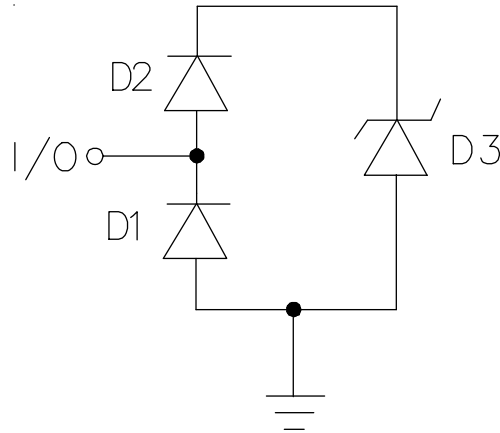


**Figure 2 - Layout Example**



PROTECTION PRODUCTS

Applications Information - Spice Model

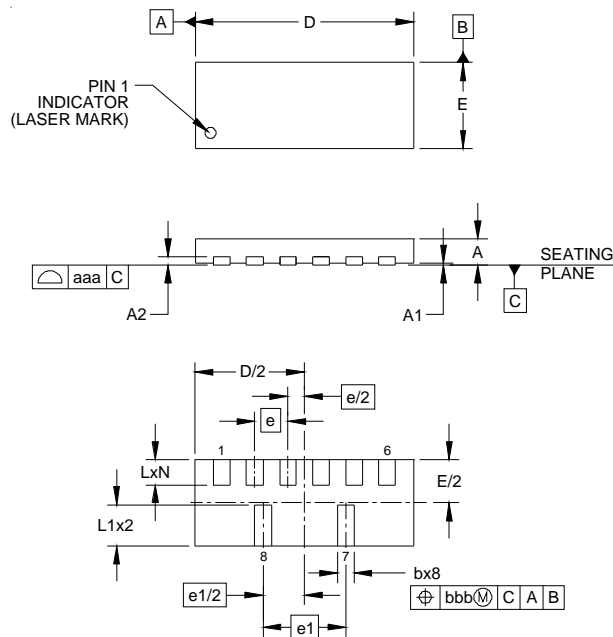


Spice Model

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

## PROTECTION PRODUCTS

### Outline Drawing - SLP3313P6T

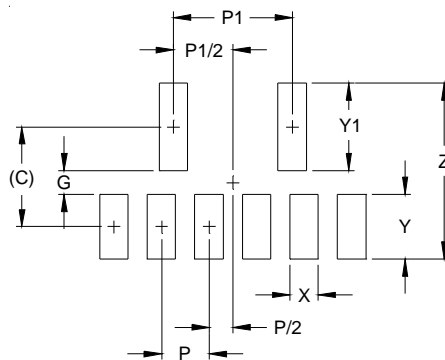


DIM	MILLIMETERS		
	MIN	NOM	MAX
A	0.37	0.40	0.43
A1	0.00	0.02	0.05
A2	(0.13)		
b	0.20	0.25	0.30
D	3.25	3.30	3.38
E	1.25	1.30	1.38
e	0.50 BSC		
e1	1.25 BSC		
L	0.30	0.38	0.43
L1	0.54	0.62	0.67
N	6		
aaa	0.08		
bbb	0.10		

**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



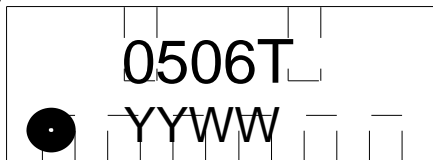
DIM	MILLIMETERS
	C
G	0.25
P	0.50
P1	1.25
X	0.30
Y	0.68
Y1	0.92
Z	1.85

**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.

## PROTECTION PRODUCTS

### Marking



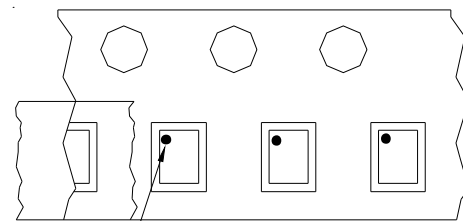
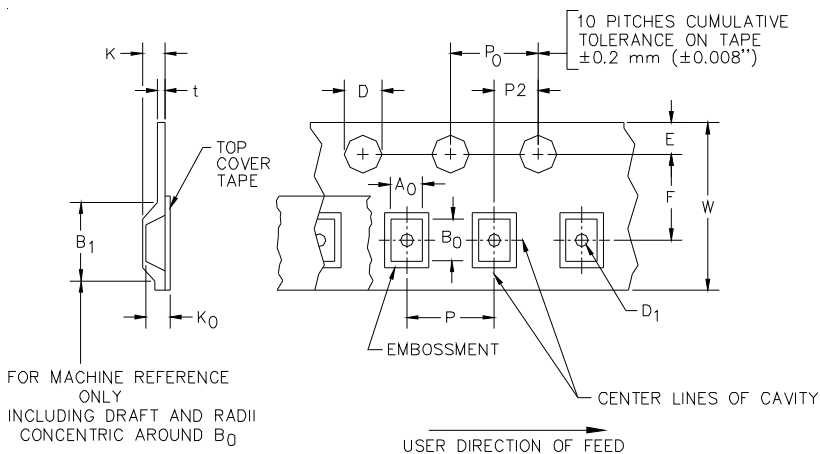
### Ordering Information

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

RailClamp and RClamp are marks of Semtech Corporation

YYWW = Date Code

### 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

### Contact Information

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