

## PROTECTION PRODUCTS

### Description

P Clamp TVS diodes are designed for use in harsh transient environments to protect sensitive electronics from damage or latch-up due to EOS, lightning, CDE, and ESD. They feature large cross-sectional area junctions for conducting high transient currents. These devices offer desirable characteristics for board level protection including fast response time, low operating and clamping voltage, and no device degradation.

They feature extremely good protection characteristics highlighted by high surge current capability (180A,  $t_p = 8/20\mu s$ ), low peak ESD clamping voltage, and high ESD withstand voltage (+/- 30kV per IEC 61000-4-2). Each device will protect power line operating up to 13.5V.

P Clamp1211P is in a 6-pin SLP2018P6 package measuring 2.0 x 1.8 mm with a nominal height of 0.57mm. The leads are finished with lead-free NiPdAu. High surge current capability and low clamping voltage making them ideal for protecting VBus, battery, and other power lines in portable electronics, industrial, and automotive applications.

### Features

- Transient Protection to
  - ♦ IEC 61000-4-2 (ESD) 30kV (Air), 30kV (Contact)
  - ♦ IEC 61000-4-4 (EFT) 4kV (5/50ns)
  - ♦ IEC 61000-4-5 (Lightning) 180A (8/20 $\mu s$ )
  - ♦ ISO-10605 (ESD) 30kV (Air), 30kV (Contact)
- Protects power line
- Working Voltage: 13.5V
- Low leakage current
- Solid-state silicon-avalanche technology

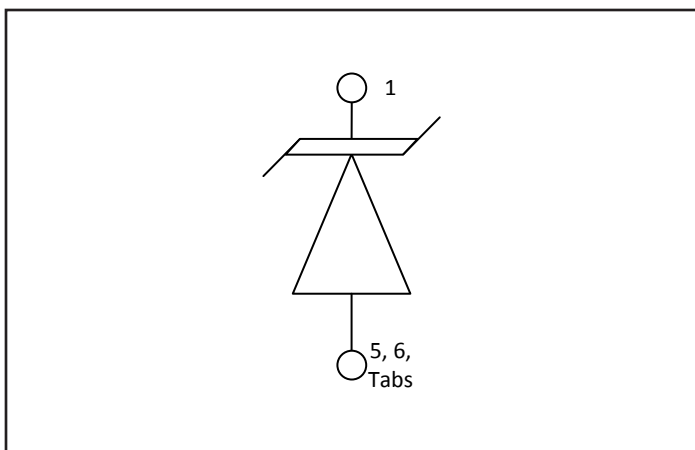
### Mechanical Characteristics

- SLP2018P6 package
- Pb-Free, Halogen Free, RoHS/WEEE compliant
- Nominal Dimensions: 2.0 x 1.8 x 0.57 mm
- Lead Finish: NiPdAu
- Marking: Marking code
- Packaging: Tape and Reel

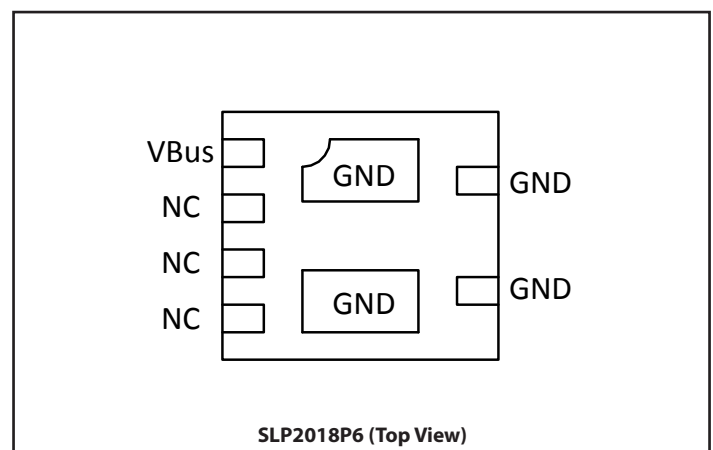
### Applications

- Cellular Handsets & Accessories
- Industrial Equipment
- Voltage Supply Lines
- Battery protection
- USB VBus

### Schematic



### Pin Configuration



## Absolute Maximum Ratings

Rating	Symbol	Value	Units
Peak Pulse Power (tp = 8/20μs)	P <sub>PK</sub>	5000	W
Peak Pulse Current (tp = 8/20μs)	I <sub>PP</sub>	180	A
Peak Pulse Current (tp = 10/1000μs)	I <sub>PP</sub>	15	A
ESD per IEC 61000-4-2 (Contact) <sup>(1)</sup> ESD per IEC 61000-4-2 (Air) <sup>(1)</sup>	V <sub>ESD</sub>	±30 ±30	kV
Operating Temperature	T <sub>J</sub>	-40 to +125	°C
Storage Temperature	T <sub>STG</sub>	-55 to +150	°C

## Electrical Characteristics (T=25°C unless otherwise specified)

P Clamp1211P						
Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Reverse Stand-Off Voltage	V <sub>RWM</sub>	Pin 1 to Pin 5, 6 <sup>(5)</sup>			13.5	V
Reverse Breakdown Voltage	V <sub>BR</sub>	I <sub>t</sub> = 1mA, Pin 1 to Pin 5, 6 <sup>(5)</sup>	14.5	15	17.5	V
Reverse Leakage Current	I <sub>R</sub>	V <sub>RWM</sub> = 13.5V Pin 1 to Pin 5, 6 <sup>(5)</sup>		0.300	0.350	μA
Clamping Voltage <sup>(2)</sup>	V <sub>C</sub>	I <sub>PP</sub> = 100A, tp = 8/20μs, Pin 1 to Pin 5, 6 <sup>(5)</sup>		18	25	V
Clamping Voltage <sup>(2)</sup>	V <sub>C</sub>	I <sub>PP</sub> = 180A, tp = 8/20μs, Pin 1 to Pin 5, 6 <sup>(5)</sup>		23.5	28	V
Dynamic Resistance <sup>(3), (4)</sup>	R <sub>DYN</sub>	tp = 0.2/100ns (TLP) Pin 1 to Pin 5, 6 <sup>(5)</sup>		0.01		Ohms
Junction Capacitance	C <sub>J</sub>	V <sub>R</sub> = 0V, f = 1MHz Pin 1 to Pin 5, 6 <sup>(5)</sup>		1500	2500	pF

Notes:

(1): ESD Gun return path to Ground Reference Plane (GRP)

(2): Tested using a constant current source

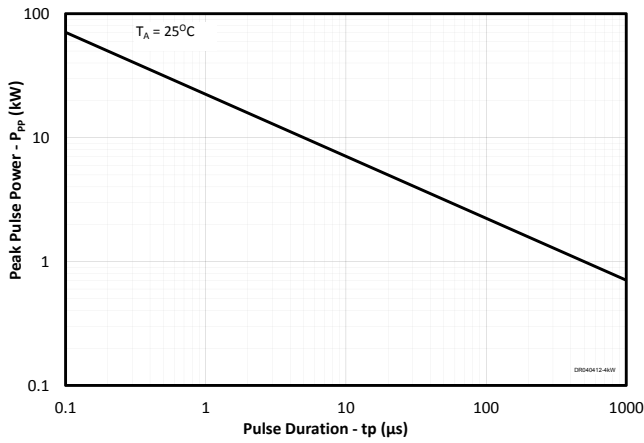
(3): Transmission Line Pulse Test (TLP) Settings: tp = 100ns, tr = 0.2ns, I<sub>TLP</sub> and V<sub>TLP</sub> averaging window: t<sub>1</sub> = 70ns to t<sub>2</sub> = 90ns.

(4): Dynamic resistance calculated from I<sub>TLP</sub> = 4A to I<sub>TLP</sub> = 16A

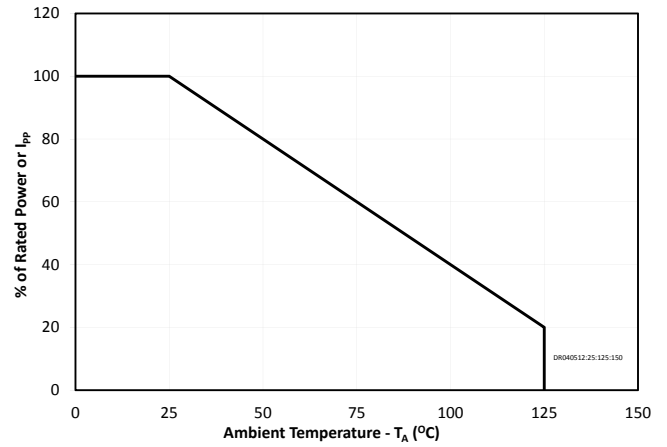
(5) Pins 5 and 6 are electrically connected to the center tabs

# Typical Characteristics

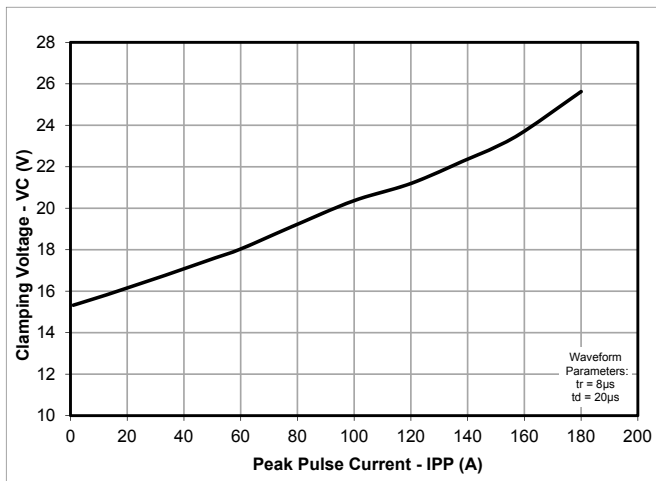
### Non-Repetitive Peak Pulse Power vs. Pulse Time



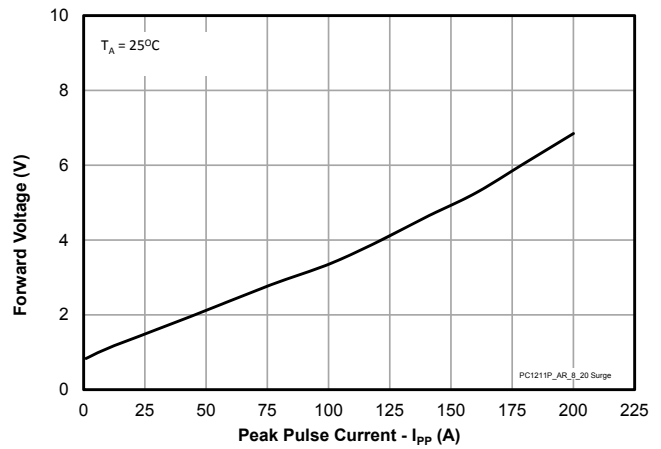
### Power Derating Curve



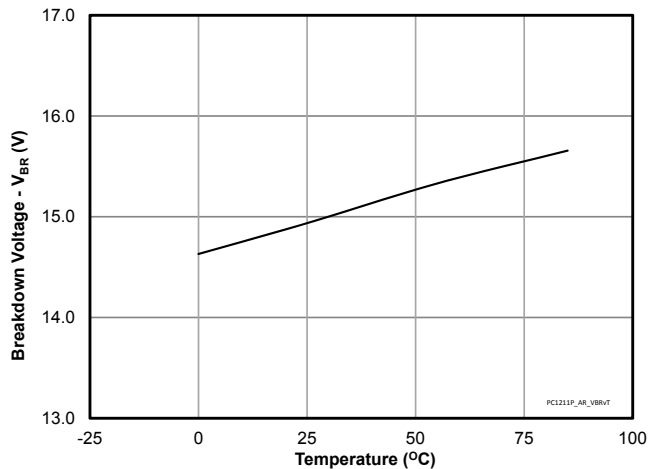
### Clamping Voltage vs. Peak Pulse Current ( $t_p=8/20\mu$ s)



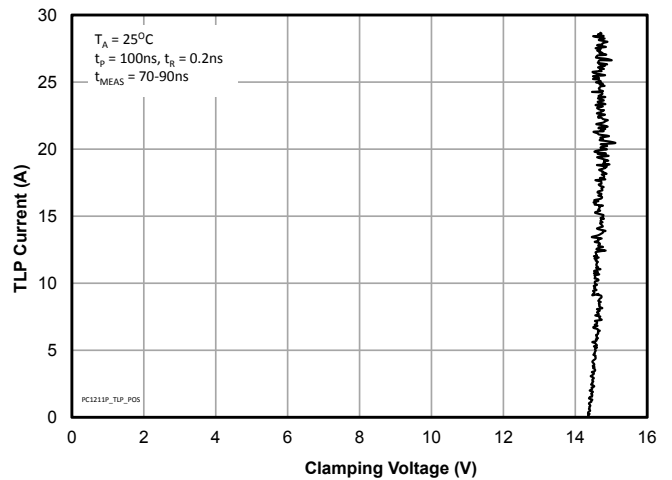
### Forward Voltage vs. Peak Pulse Current ( $t_p=8/20\mu$ s)



### Breakdown Voltage ( $V_{BR}$ ) vs. Temperature

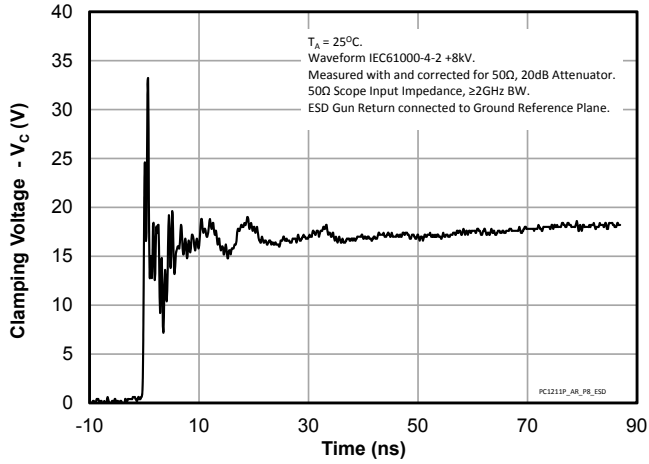


### TLP Characteristic

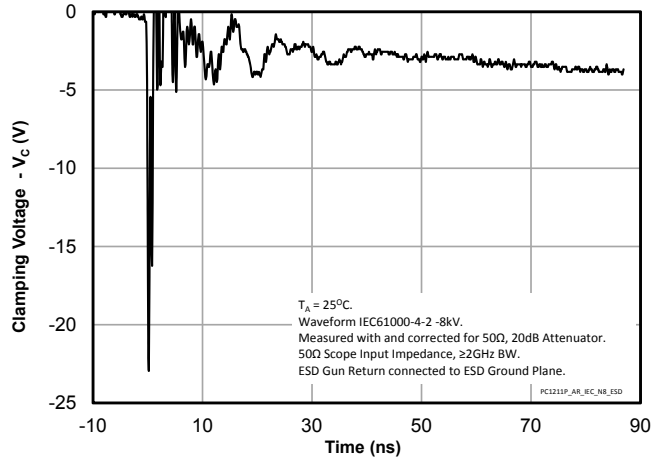


# Typical Characteristics

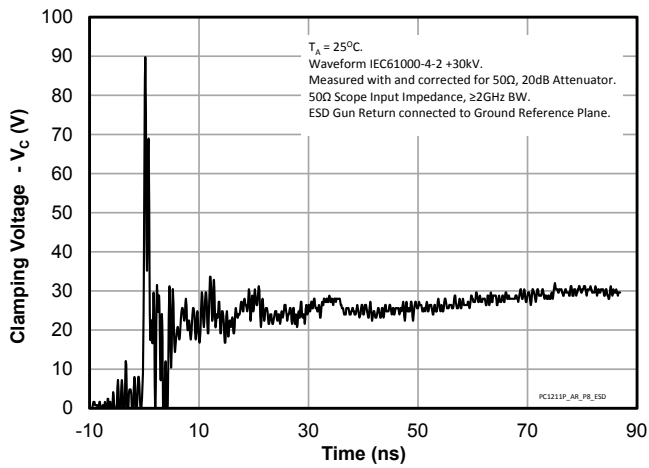
ESD Clamping (8kV Contact per IEC 61000-4-2)



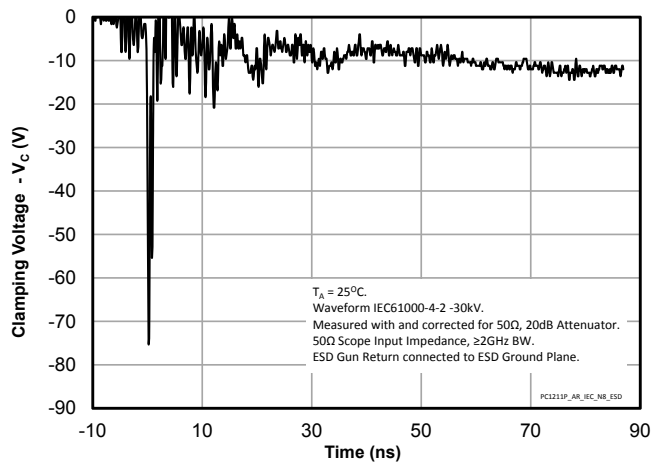
ESD Clamping (-8kV Contact per IEC 61000-4-2)



ESD Clamping (30kV Contact per IEC 61000-4-2)



ESD Clamping (-30kV Contact per IEC 61000-4-2)



# Application Information

## Assembly Guidelines

The figure at the right details Semtech’s recommended mounting pattern. Recommended assembly guidelines are shown in Table 1. Note that these are only recommendations and should serve only as a starting point for design since there are many factors that affect the assembly process. Exact manufacturing parameters will require some experimentation to get the desired solder application. Semtech’s recommended mounting pattern is based on the following design guidelines:

### Land Pattern

The recommended land pattern follows IPC standards and is designed for maximum solder coverage. Detailed dimensions are shown elsewhere in this document.

### Solder Stencil

Stencil design is one of the key factors which will determine the volume of solder paste deposited onto the land pad. The area ratio of the stencil aperture will determine how well the stencil will print. The area ratio takes into account the aperture shape, aperture size, and stencil thickness. An area ratio of 0.70 – 0.75 is preferred for the subject package. The area ratio of a rectangular aperture is given as:

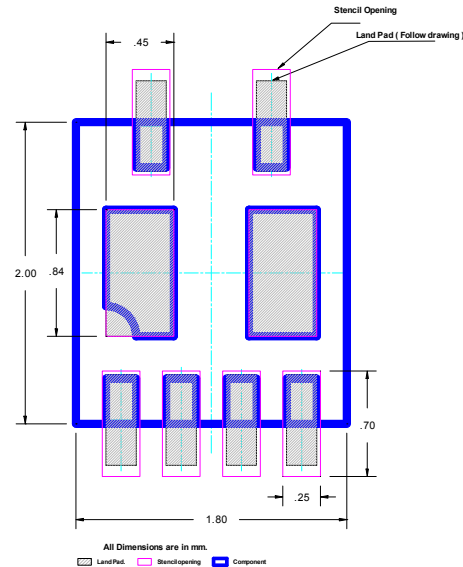
$$\text{Area Ratio} = (L * W) / (2 * (L + W) * T)$$

Where:

- L = Aperture Length
- W = Aperture Width
- T = Stencil Thickness

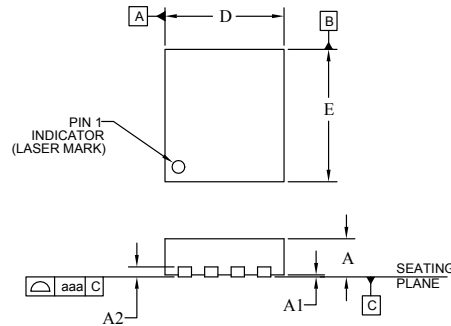
Semtech recommends a stencil thickness of 0.125mm for this device. The stencil should be laser cut with electro-polished finish. The stencil should have a positive taper of approximately 5 degrees. Electro polishing and tapering the walls results in reduced surface friction and better paste release. Solder paste with Type 3 or smaller particles are recommended. Assuming a 125µm thick stencil, the aperture dimensions shown will yield an area ratio of approximately 0.75.

## Recommended Mounting Pattern

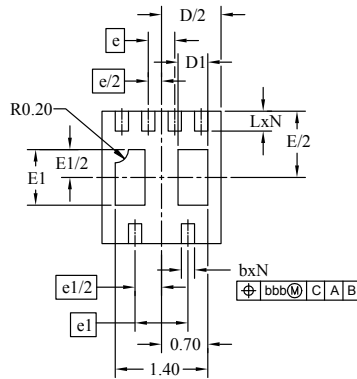


Assembly Parameter	Recommendation
Solder Stencil Design	Laser Cut, Electro-Polished
Aperture Shape	Rectangular
Solder Stencil Thickness	0.125mm (0.005")
Solder Paste Type	Type 3 size sphere or smaller
Solder Reflow Profile	Per JEDEC J-STD-020
PCB Solder pad Design	Non-Solder Mask Defined
PCB Pad Finish	OSP or NiAu

# Outline Drawing - SLP2018P6

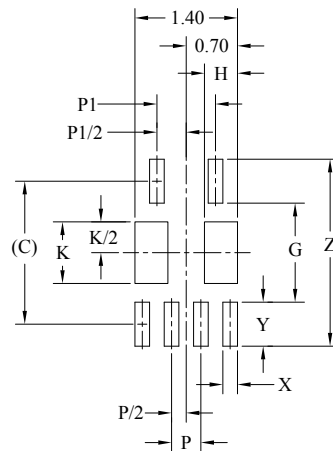


DIMENSIONS			
DIM	MILLIMETERS		
	MIN	NOM	MAX
A	0.50	0.575	0.65
A1	0.00	0.03	0.05
A2	(0.127)		
b	0.15	0.20	0.25
D	1.70	1.80	1.90
E	1.90	2.00	2.10
D1	0.30	0.45	0.55
E1	0.69	0.84	0.94
e	0.40 BSC		
e1	0.80 BSC		
L	0.25	0.30	0.35
N	6		
aaa	0.08		
bbb	0.10		



NOTES:  
1. CONTROLLING DIMENSIONS ARE IN MILLIMETERS (ANGLES IN DEGREES).

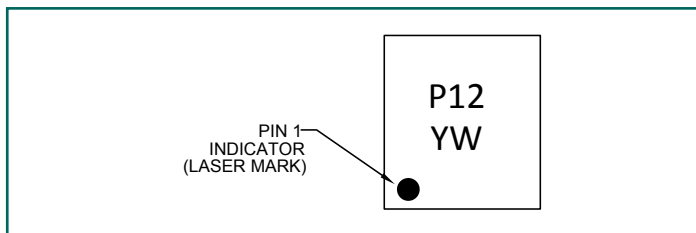
# Land Pattern - SLP2018P6



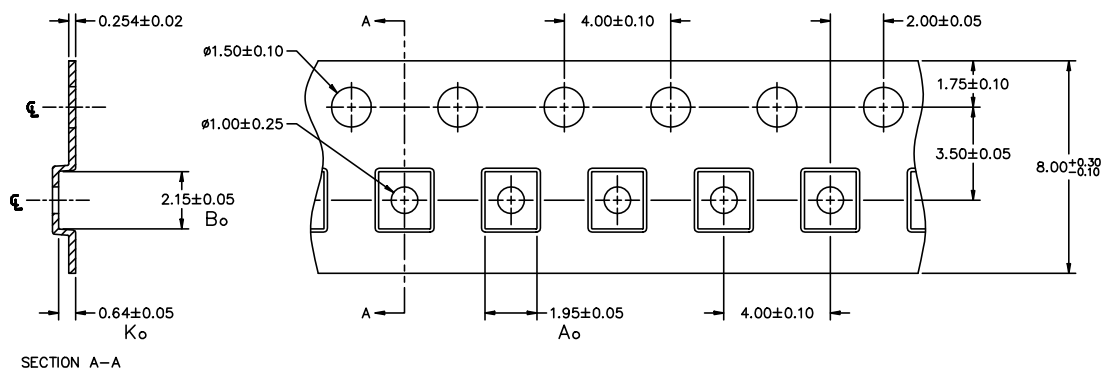
DIMENSIONS	
DIM	MILLIMETERS
C	(1.95)
G	1.35
H	0.45
K	0.84
P	0.40
P1	0.80
X	0.20
Y	0.60
Z	2.55

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.

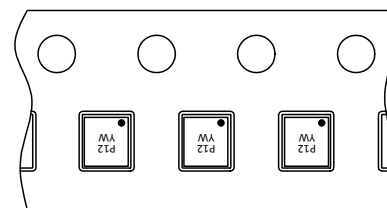
## Marking Example



## Tape and Reel Specification



NOTE: ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.



Pin 1 Located Towards Sprocket Holes

## Ordering Information

Part Number	Working Voltage	Qty per Reel	Reel Size
P Clamp1211P.TGT	12V	10,000	13"
P Clamp and MicroClamp are trademarks of Semtech Corporation			



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