

## PROTECTION PRODUCTS

### Description

μClamp® TVS diodes are designed 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.

The μClamp®xx71P series are in 2-pin SGP1610N2 package measuring 1.6 x 1.0 mm with a nominal height of 0.57mm. The leads are finished with leadfree NiPdAu. They may be used to protect 5V, 8V, 10V, 12V, 15V, 18V, 22V, 26V, and 36V systems. They feature high surge current capability and low clamping voltage making them ideal for use in harsh transient environments.

### Features

- Transient protection for high-speed data lines to
- IEC 61000-4-2 (ESD) 30kV (air), 30kV (contact)
- IEC 61000-4-4 (EFT) 40A (5/50ns)
- IEC 61000-4-5 (Lightning) 20 - 80A (8/20μs)
- Protects one data or power line
- Low leakage current
- High peak pulse current capability
- Operating voltage options: 5V, 8V, 10V, 12V, 15V, 18V, 22V, 26V, 36V
- Solid-state silicon-avalanche technology

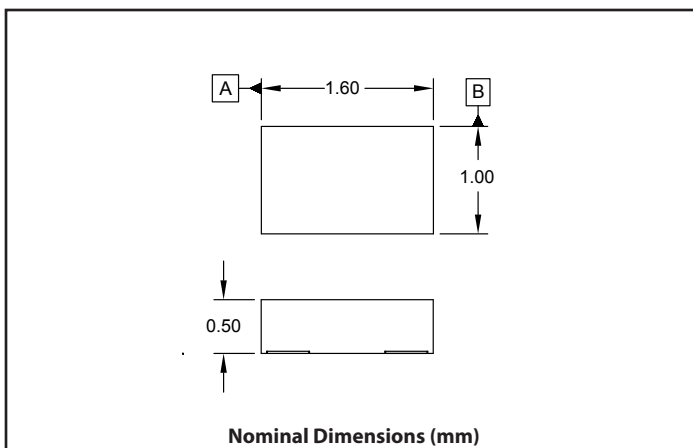
### Mechanical Characteristics

- SGP1610N2 package
- Pb-Free, Halogen Free, RoHS/WEEE Compliant
- Nominal Dimensions: 1.6 x 1.0 x 0.57 mm
- Lead Finish: NiPdAu
- Marking: Marking code
- Packaging: Tape and Reel

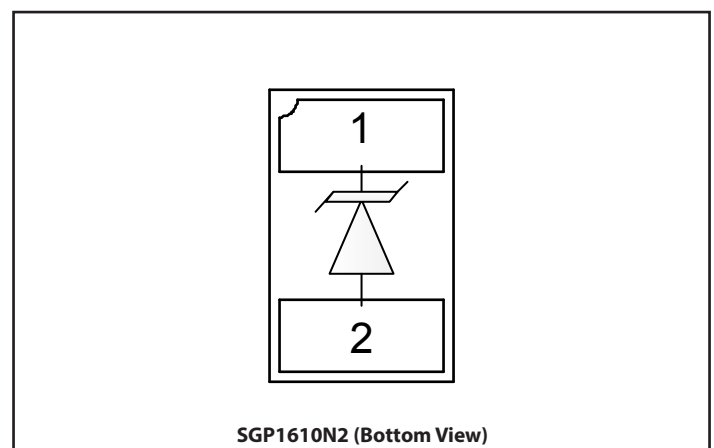
### Applications

- Cellular Handsets & Accessories
- USB Voltage Bus
- Battery Protection
- Digital Lines
- Proximity Sensors

### Package Dimension



### Schematic & Pin Configuration



## Absolute Maximum Rating

Rating	Symbol	Value	Units
Peak Pulse Power (tp = 8/20μs)	P <sub>PK</sub>	1200-1500	W
ESD per IEC 61000-4-2 (Air) <sup>1</sup> ESD per IEC 61000-4-2 (Contact) <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)

μClamp0571P						
Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Reverse Stand-Off Voltage	V <sub>RWM</sub>	Pin 1 to 2			5	V
Reverse Breakdown Voltage	V <sub>BR</sub>	I <sub>BR</sub> = 1mA, Pin 1 to 2	6	7	9	V
Reverse Leakage Current	I <sub>R</sub>	V <sub>RWM</sub> = 5V T = 25°C		<10	100	nA
Peak Pulse Current	I <sub>pp</sub>	tp = 8/20μs, Pin 1 to 2			80	A
Clamping Voltage	V <sub>C</sub>	tp = 8/20μs			10	V
					15	
Dynamic Resistance <sup>2,3</sup>	R <sub>DYN</sub>	tp = 0.2/100ns		0.05		Ω
Junction Capacitance	C <sub>J</sub>	V <sub>R</sub> = 0V, f = 1MHz			675	pF

μClamp0871P						
Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Reverse Stand-Off Voltage	V <sub>RWM</sub>	Pin 1 to 2			8	V
Reverse Breakdown Voltage	V <sub>BR</sub>	I <sub>BR</sub> = 1mA, Pin 1 to 2	9.5	11	13	V
Reverse Leakage Current	I <sub>R</sub>	V <sub>RWM</sub> = 8V T = 25°C		<10	100	nA
Peak Pulse Current	I <sub>pp</sub>	tp = 8/20μs, Pin 1 to 2			65	A
Clamping Voltage	V <sub>C</sub>	tp = 8/20μs			15	V
					23	
Dynamic Resistance <sup>2,3</sup>	R <sub>DYN</sub>	tp = 0.2/100ns		0.05		Ω
Junction Capacitance	C <sub>J</sub>	V <sub>R</sub> = 0V, f = 1MHz			475	pF

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

<b>μClamp1071P</b>						
Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Reverse Stand-Off Voltage	$V_{RWM}$	Pin 1 to 2			10	V
Reverse Breakdown Voltage	$V_{BR}$	$I_{BR} = 1\text{mA}$ , Pin 1 to 2	12	13.5	15.5	V
Reverse Leakage Current	$I_R$	$V_{RWM} = 10\text{V}$ , Pin 1 to 2   T = 25°C		<10	100	nA
Peak Pulse Current	$I_{PP}$	tp = 8/20μs, Pin 1 to 2			60	A
Clamping Voltage	$V_C$	tp = 8/20μs			17	V
					25	
Dynamic Resistance <sup>2,3</sup>	$R_{DYN}$	tp = 0.2/100ns		0.05		Ω
Junction Capacitance	$C_J$	$V_R = 0\text{V}$ , f = 1MHz			350	pF

<b>μClamp1271P</b>						
Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Reverse Stand-Off Voltage	$V_{RWM}$	Pin 1 to 2			12	V
Reverse Breakdown Voltage	$V_{BR}$	$I_{BR} = 1\text{mA}$ , Pin 1 to 2	14	16	19	V
Reverse Leakage Current	$I_R$	$V_{RWM} = 12\text{V}$ , Pin 1 to 2   T = 25°C		<10	100	nA
Peak Pulse Current	$I_{PP}$	tp = 8/20μs, Pin 1 to 2			45	A
Clamping Voltage	$V_C$	tp = 8/20μs			22	V
					30	
Dynamic Resistance <sup>2,3</sup>	$R_{DYN}$	tp = 0.2/100ns		0.05		Ω
Junction Capacitance	$C_J$	$V_R = 0\text{V}$ , f = 1MHz			275	pF

<b>μClamp1571P</b>							
<b>Parameter</b>	<b>Symbol</b>	<b>Conditions</b>	<b>Min.</b>	<b>Typ.</b>	<b>Max.</b>	<b>Units</b>	
Reverse Stand-Off Voltage	$V_{RWM}$	Pin 1 to 2			15	V	
Reverse Breakdown Voltage	$V_{BR}$	$I_{BR} = 1\text{mA}$ , Pin 1 to 2	17.5	20	23	V	
Reverse Leakage Current	$I_R$	$V_{RWM} = 15\text{V}$ , Pin 1 to 2	$T = 25^\circ\text{C}$		<10	100	nA
Peak Pulse Current	$I_{PP}$	$t_p = 8/20\mu\text{s}$ , Pin 1 to 2				40	A
Clamping Voltage	$V_C$	$t_p = 8/20\mu\text{s}$ Pin 1 to 2	$I_{PP} = 10\text{A}$			25	V
			$I_{PP} = 40\text{A}$			40	
Dynamic Resistance <sup>2,3</sup>	$R_{DYN}$	$t_p = 0.2/100\text{ns}$			0.05		$\Omega$
Junction Capacitance	$C_J$	$V_R = 0\text{V}$ , $f = 1\text{MHz}$				220	pF

<b>μClamp1871P</b>							
<b>Parameter</b>	<b>Symbol</b>	<b>Conditions</b>	<b>Min.</b>	<b>Typ.</b>	<b>Max.</b>	<b>Units</b>	
Reverse Stand-Off Voltage	$V_{RWM}$	Pin 1 to 2			18	V	
Reverse Breakdown Voltage	$V_{BR}$	$I_{BR} = 1\text{mA}$ , Pin 1 to 2	20	22	25	V	
Reverse Leakage Current	$I_R$	$V_{RWM} = 18\text{V}$ , Pin1 to 2	$T = 25^\circ\text{C}$		<10	100	nA
Peak Pulse Current	$I_{PP}$	$t_p = 8/20\mu\text{s}$ , Pin 1 to 2				35	A
Clamping Voltage	$V_C$	$t_p = 8/20\mu\text{s}$	$I_{PP} = 10\text{A}$			28	V
			$I_{PP} = 35\text{A}$			45	
Dynamic Resistance <sup>2,3</sup>	$R_{DYN}$	$t_p = 0.2/100\text{ns}$			0.10		$\Omega$
Junction Capacitance	$C_J$	$V_R = 0\text{V}$ , $f = 1\text{MHz}$				225	pF

**μClamp2271P**

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units	
Reverse Stand-Off Voltage	$V_{RWM}$	Pin 1 to 2			22	V	
Reverse Breakdown Voltage	$V_{BR}$	$I_{BR} = 1\text{mA}$ , Pin 1 to 2	25.5	29	33.5	V	
Reverse Leakage Current	$I_R$	$V_{RWM} = 22\text{V}$ , Pin 1 to 2	$T = 25^\circ\text{C}$		<10	100	nA
Peak Pulse Current	$I_{PP}$	$t_p = 8/20\mu\text{s}$ , Pin 1 to 2			25	A	
Clamping Voltage	$V_C$	$t_p = 8/20\mu\text{s}$ , Pin 1 to 2	$I_{PP} = 10\text{A}$		40	V	
			$I_{PP} = 25\text{A}$		55		
Dynamic Resistance <sup>2,3</sup>	$R_{DYN}$	$t_p = 0.2/100\text{ns}$		0.10		$\Omega$	
Junction Capacitance	$C_J$	$V_R = 0\text{V}$ , $f = 1\text{MHz}$			165	pF	

**μClamp2671P**

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units	
Reverse Stand-Off Voltage	$V_{RWM}$	Pin 1 to 2			26	V	
Reverse Breakdown Voltage	$V_{BR}$	$I_{BR} = 1\text{mA}$ , Pin 1 to 2	29	32	35	V	
Reverse Leakage Current	$I_R$	$V_{RWM} = 5\text{V}$	$T = 25^\circ\text{C}$		<10	100	nA
Peak Pulse Current	$I_{PP}$	$t_p = 8/20\mu\text{s}$ , Pin 1 to 2			23	A	
Clamping Voltage	$V_C$	$t_p = 8/20\mu\text{s}$	$I_{PP} = 10\text{A}$		50	V	
			$I_{PP} = 23\text{A}$		65		
Dynamic Resistance <sup>2,3</sup>	$R_{DYN}$	$t_p = 0.2/100\text{ns}$		0.15		$\Omega$	
Junction Capacitance	$C_J$	$V_R = 0\text{V}$ , $f = 1\text{MHz}$			155	pF	

## **μClamp3671P**

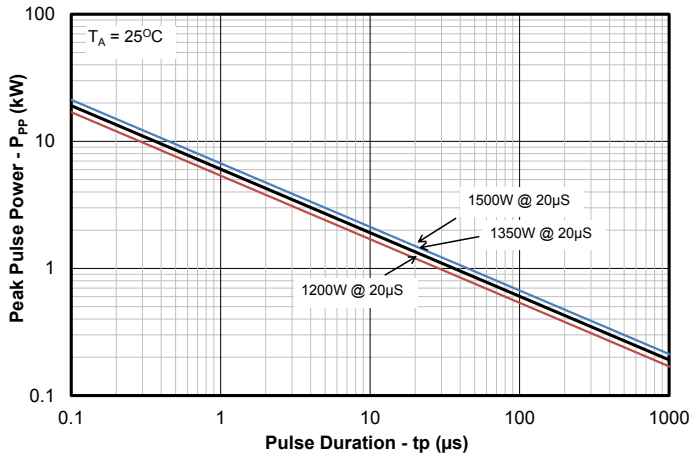
<b>Parameter</b>	<b>Symbol</b>	<b>Conditions</b>	<b>Min.</b>	<b>Typ.</b>	<b>Max.</b>	<b>Units</b>
Reverse Stand-Off Voltage	$V_{RWM}$	Pin 1 to 2			36	V
Reverse Breakdown Voltage	$V_{BR}$	$I_{BR} = 1\text{mA}$ , Pin 1 to 2	37		44	V
Reverse Leakage Current	$I_R$	$V_{RWM} = 36\text{V}$ $T = 25^\circ\text{C}$		<10	100	nA
Peak Pulse Current	$I_{pp}$	$t_p = 8/20\mu\text{s}$ , Pin 1 to 2			18	A
Clamping Voltage	$V_C$	$t_p = 8/20\mu\text{s}$			48	V
					80	
Dynamic Resistance <sup>2,3</sup>	$R_{DYN}$	$t_p = 0.2/100\text{ns}$		0.29		$\Omega$
Junction Capacitance	$C_J$	$V_R = 0\text{V}$ , $f = 1\text{MHz}$			150	pF

### Notes

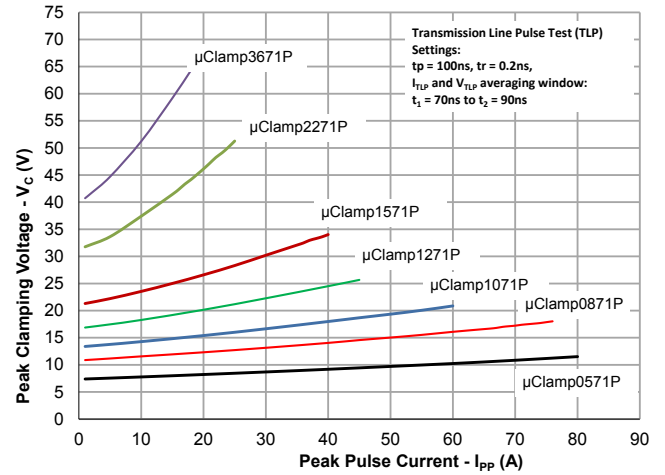
- 1) Measured with a 40dB attenuator, 50 Ohm scope input impedance, 2GHz bandwidth. ESD gun return path connected to ESD ground plane.
- 2) Transmission Line Pulse Test (TLP) Settings:  $t_p = 100\text{ns}$ ,  $t_r = 0.2\text{ns}$ ,  $I_{TLP}$  and  $V_{TLP}$  averaging window:  $t_1 = 70\text{ns}$  to  $t_2 = 90\text{ns}$ .
- 3) Dynamic resistance calculated from  $I_{TLP} = 4\text{A}$  to  $I_{TLP} = 16\text{A}$

# Typical Characteristics

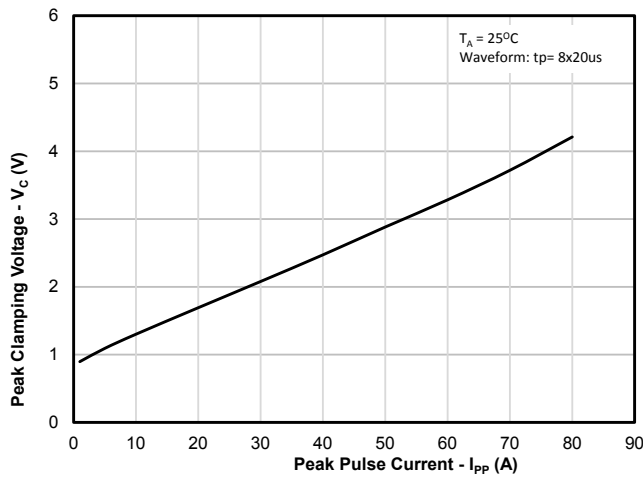
Non-Repetitive Peak Pulse Power vs. Pulse Time



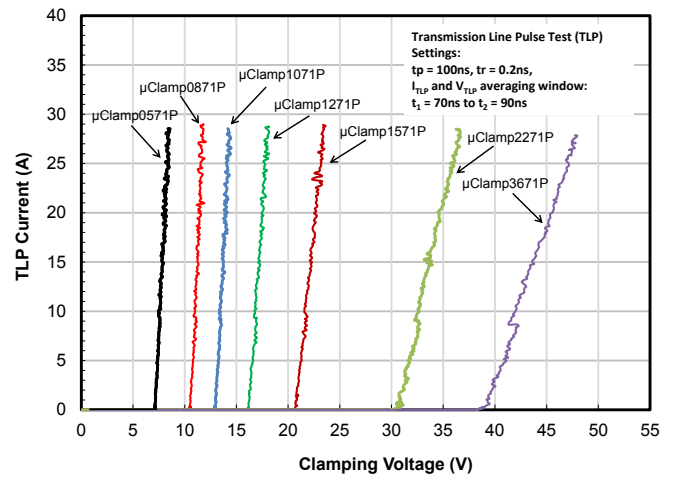
Clamping Voltage vs. Peak Pulse Current ( $t_p = 8/20 \mu\text{s}$ )



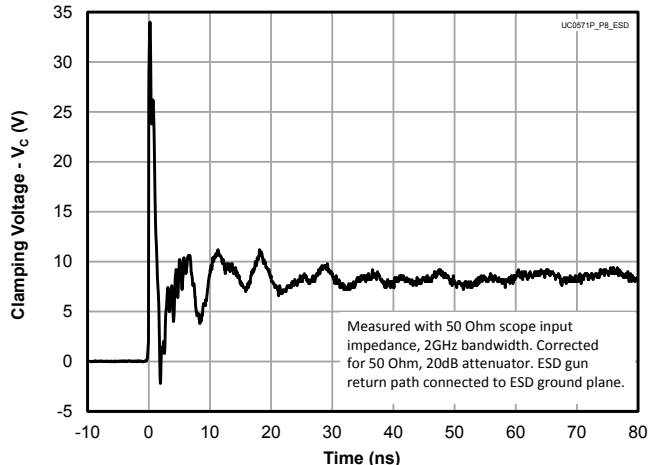
Forward Voltage vs. Peak Pulse Current ( $t_p = 8/20 \mu\text{s}$ )



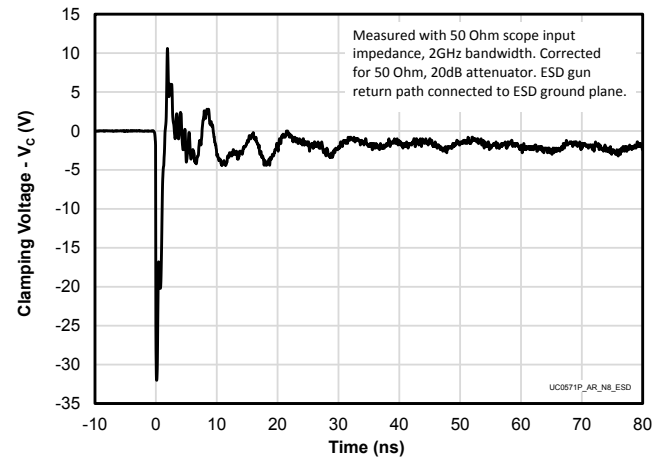
TLP Characteristic



ESD Clamping -  $\mu\text{Clamp0571P}$   
(+8kV Contact per IEC 61000-4-2)

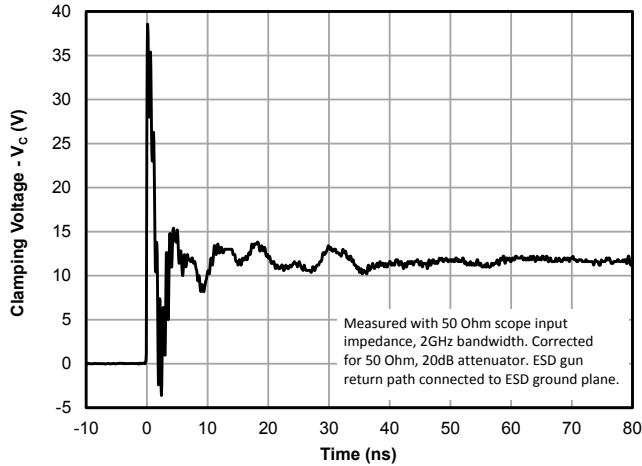


ESD Clamping -  $\mu\text{Clamp0571P}$   
(-8kV Contact per IEC 61000-4-2)

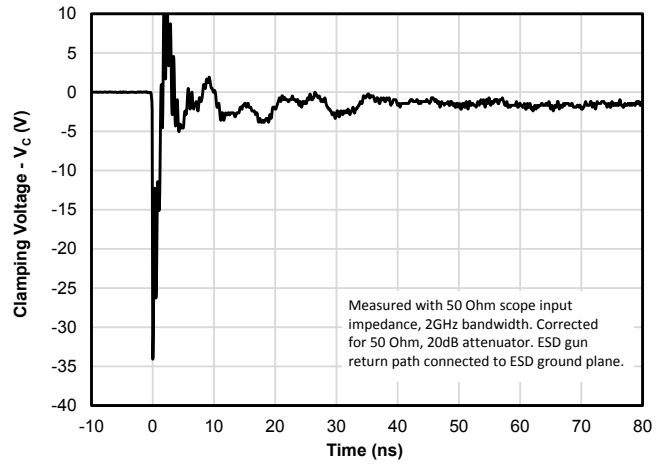


# Typical Characteristics (Continued)

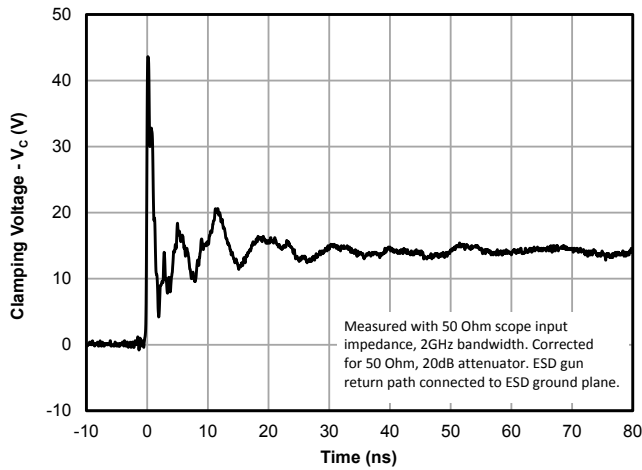
**ESD Clamping -  $\mu$ Clamp0871P**  
 (+8kV Contact per IEC 61000-4-2)



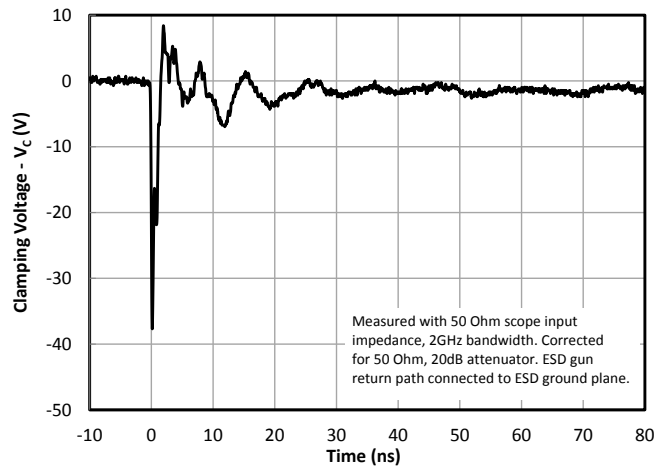
**ESD Clamping -  $\mu$ Clamp0871P**  
 (-8kV Contact per IEC 61000-4-2)



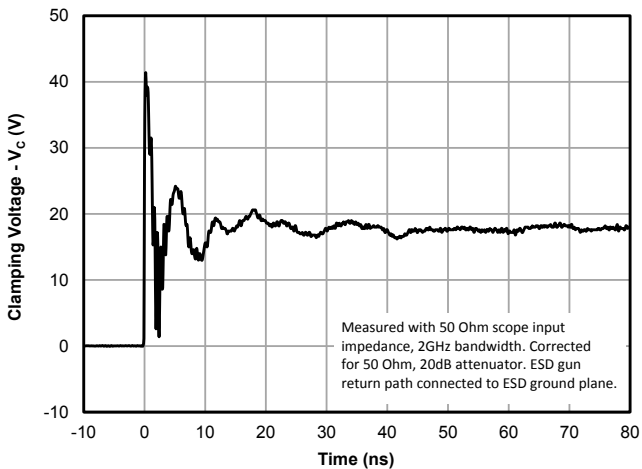
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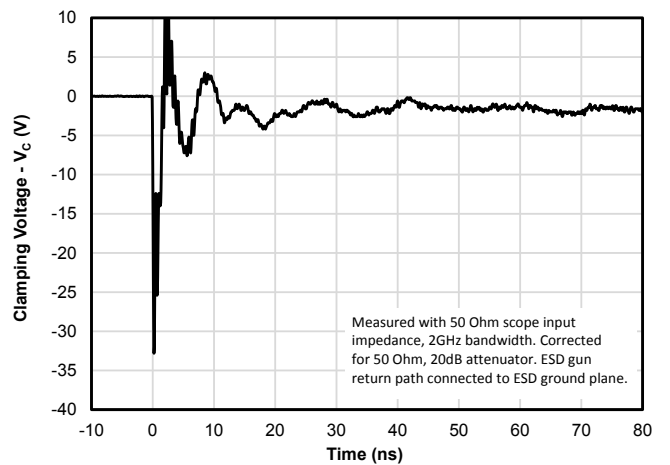
**ESD Clamping -  $\mu$ Clamp1071P**  
 (-8kV Contact per IEC 61000-4-2)



**ESD Clamping -  $\mu$ Clamp1271P**  
 (+8kV Contact per IEC 61000-4-2)



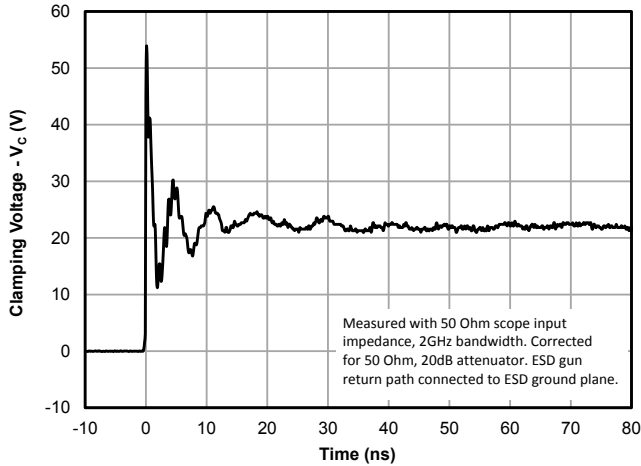
**ESD Clamping -  $\mu$ Clamp1271P**  
 (-8kV Contact per IEC 61000-4-2)



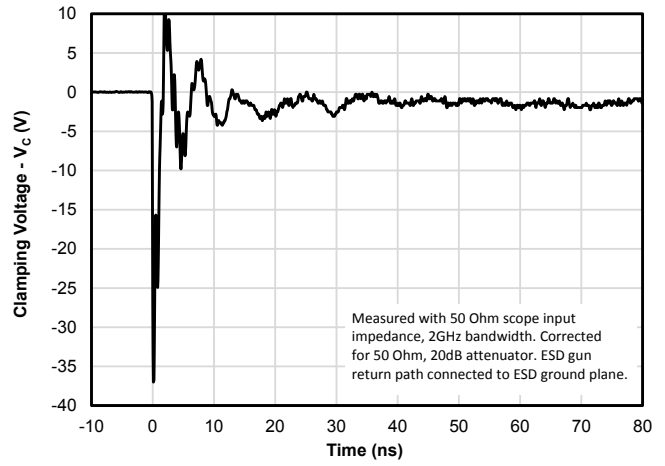


# Typical Characteristics (Continued)

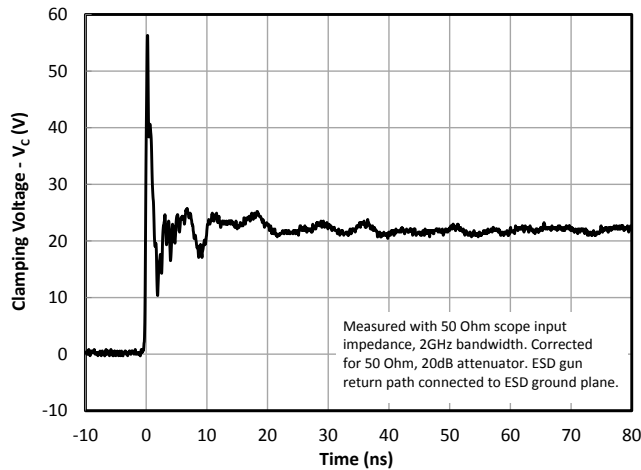
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 (+8kV Contact per IEC 61000-4-2)



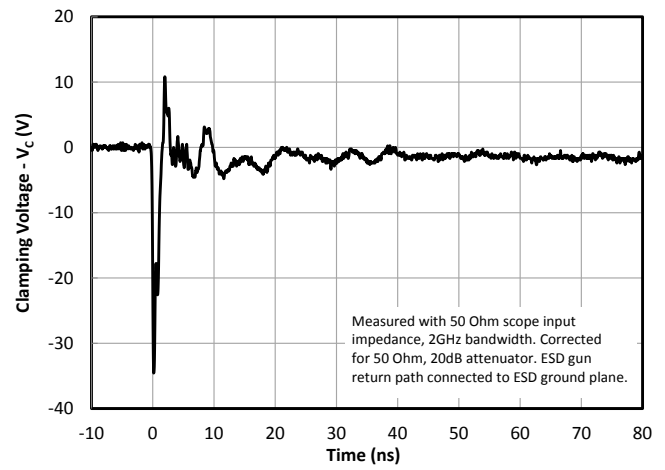
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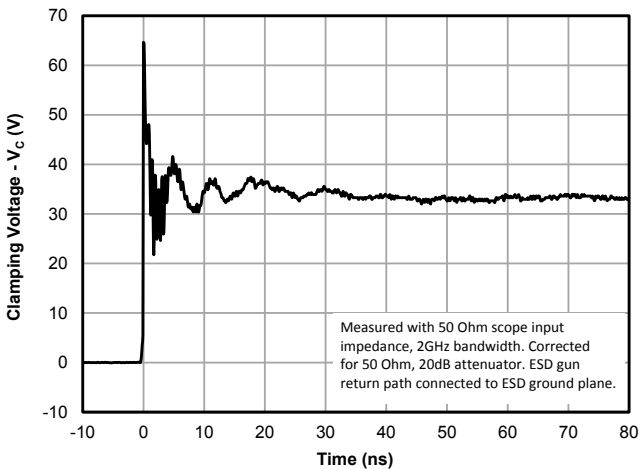
**ESD Clamping -  $\mu$ Clamp1871P**  
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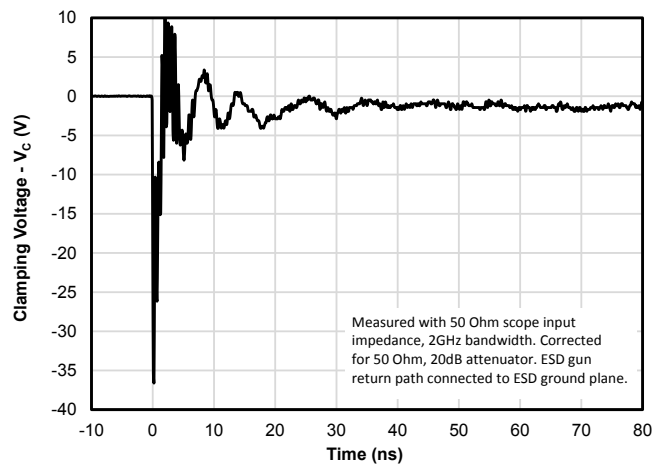
**ESD Clamping -  $\mu$ Clamp1871P**  
 (-8kV Contact per IEC 61000-4-2)



**ESD Clamping -  $\mu$ Clamp2271P**  
 (+8kV Contact per IEC 61000-4-2)

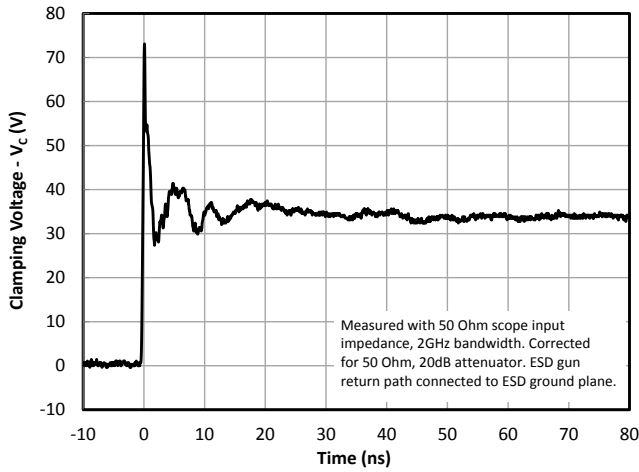


**ESD Clamping -  $\mu$ Clamp2271P**  
 (-8kV Contact per IEC 61000-4-2)

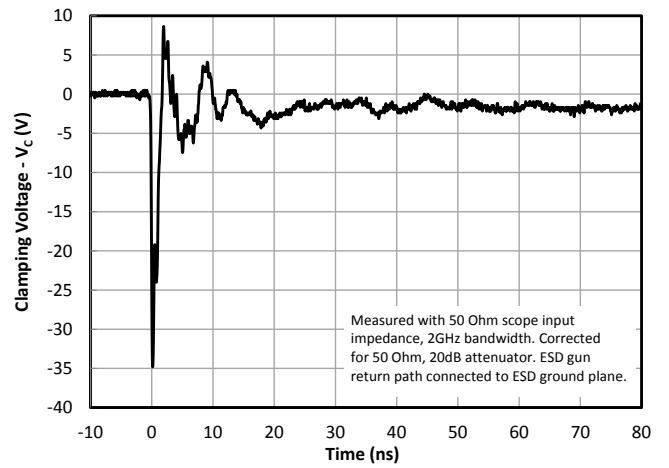


# Typical Characteristics (Continued)

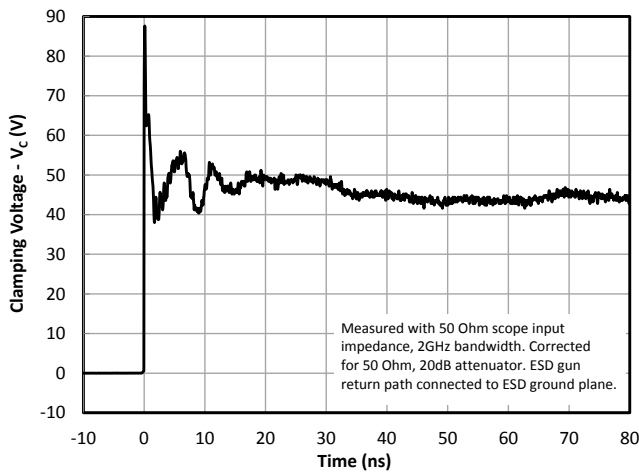
**ESD Clamping -  $\mu$ Clamp2671P**  
 (+8kV Contact per IEC 61000-4-2)



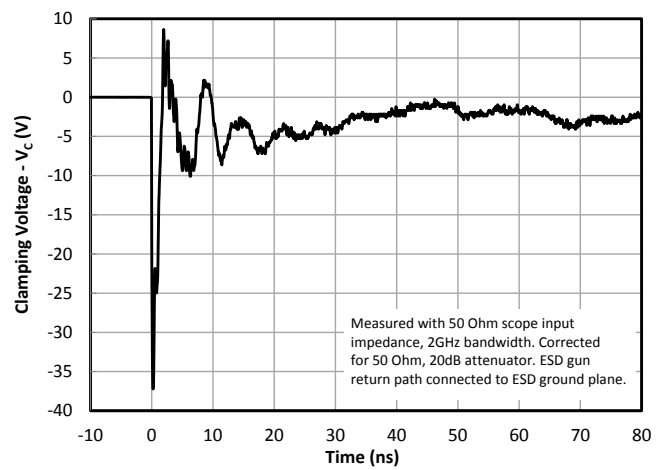
**ESD Clamping -  $\mu$ Clamp2671P**  
 (-8kV Contact per IEC 61000-4-2)



**ESD Clamping -  $\mu$ Clamp3671P**  
 (+8kV Contact per IEC 61000-4-2)



**ESD Clamping -  $\mu$ Clamp3671P**  
 (-8kV Contact per IEC 61000-4-2)

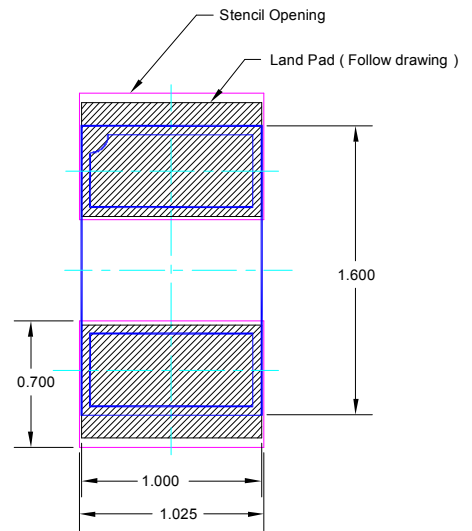


# Application Information

## Assembly Guidelines

The table below provides Semtech’s recommended assembly guidelines for mounting this device. The figure at the right details Semtech’s recommended aperture based on the below recommendations. 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. The exact manufacturing parameters will require some experimentation to get the desired solder application.

Assembly Parameter	Recommendation
Solder Stencil Design	Laser cut, Electro-polished
Aperture shape	Rectangular with rounded corners
Solder Stencil Thickness	0.125 mm (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

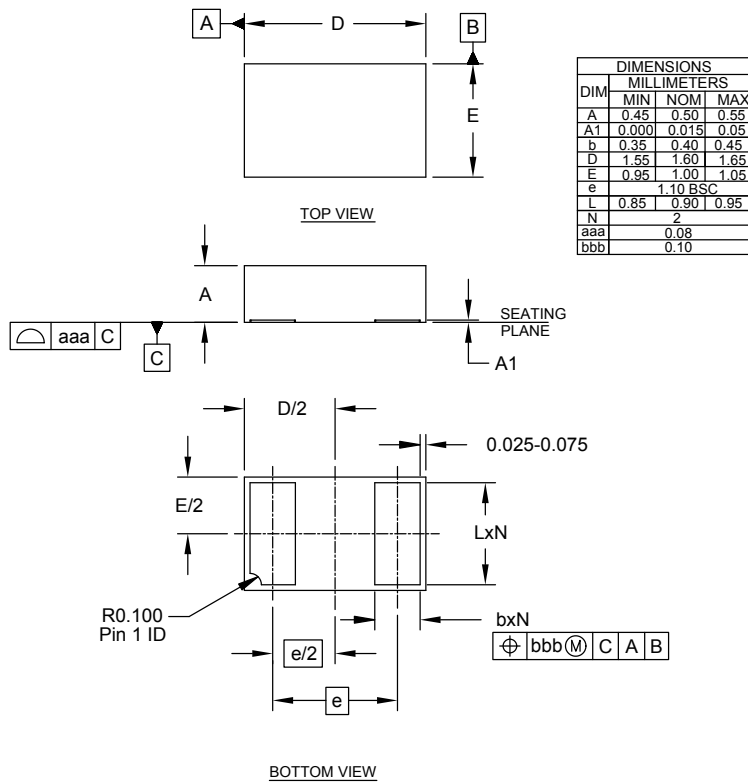


All Dimensions are in mm.

Land Pad.
  Stencil opening
  Component

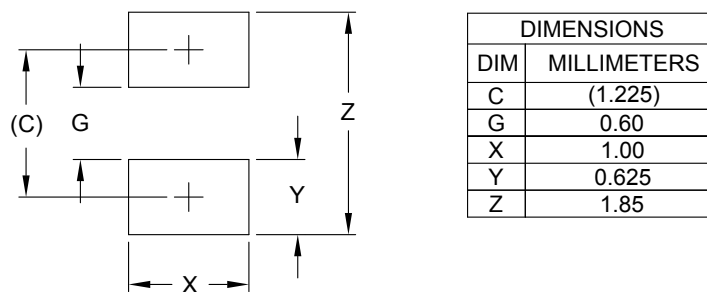
### Recommended Mounting Pattern

# Outline Drawing - SGP1610N2



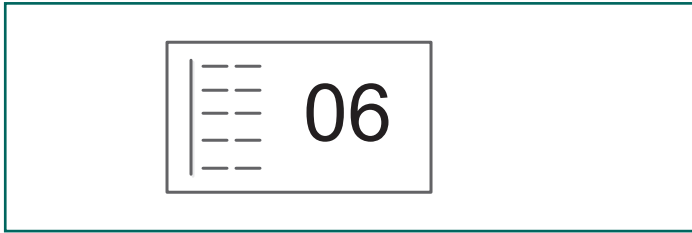
NOTES:  
1. CONTROLLING DIMENSIONS ARE IN MILLIMETERS (ANGLES IN DEGREES).

# Land Pattern - SGP1610N2

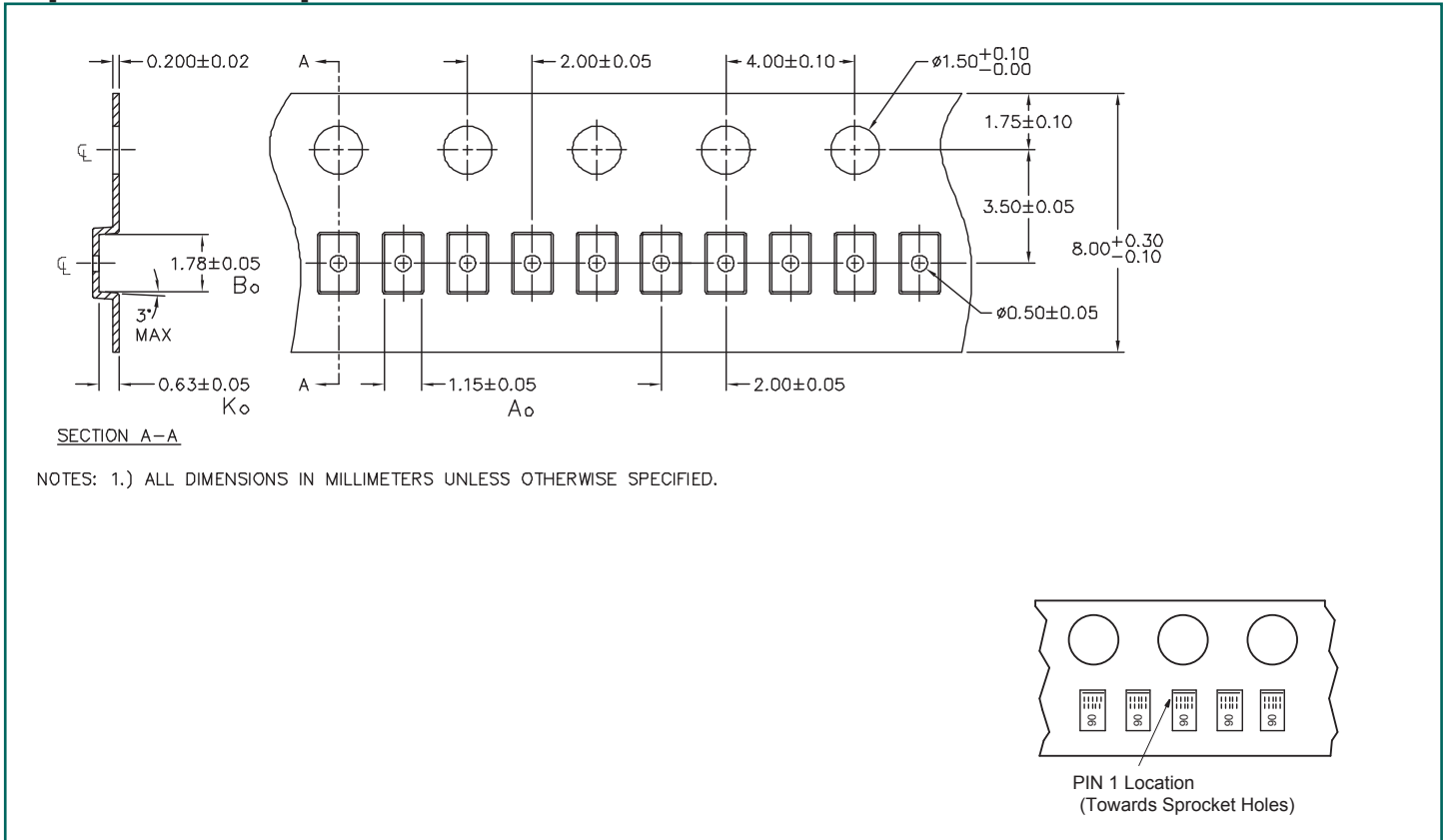


NOTES:  
1. CONTROLLING DIMENSIONS ARE IN MILLIMETERS (ANGLES IN DEGREES).  
2. THIS LAND PATTERN IS FOR REFERENCE PURPOSES ONLY. CONSULT YOUR MANUFACTURING GROUP TO ENSURE YOUR COMPANY'S MANUFACTURING GUIDELINES ARE MET.

## Marking Code



## Tape and Reel Specification



## Ordering Information

Part Number	Marking Code	Working Voltage	Qty per Reel
μClamp0571P.TNT	06	5V	10,000
μClamp0871P.TNT	11	8V	10,000
μClamp1071P.TNT	12	10V	10,000
μClamp1271P.TNT	16	12V	10,000
μClamp1571P.TNT	18	15V	10,000
μClamp1871P.TNT	24	18V	10,000
μClamp2271P.TNT	26	22V	10,000
μClamp2671P.TNT	30	26V	10,000
μClamp3671P.TNT	37	36V	10,000



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