µClamp0561P - µClamp6061P

High Power MicroClamp®
1-Line ESD and Surge Protection

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.

µClamp®xx61P series are designed for for use in harsh transient environments. They feature extremely good protection characteristics highlighted by high surge current capability, low peak ESD clamping voltage, and high ESD withstand voltage. Device options are available for protecting data or power lines operating at 5V to 60V.

µClamp®xx61P are in a 2-pin SLP1608P2 package measuring 1.6 x 0.8 mm with a nominal height of 0.50mm. The leads are finished with lead-free NiAu. High surge current capability and low clamping voltage making them ideal for protecting VBus, battery, and other power lines in consumer and industrial electronics.

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) 8-80A (8/20µs)
- Protects one data or power line
- Working voltage options: 5V, 10V, 12V, 15V, 24V, 30V, 36V, 40V, 60V
- Low leakage current
- High peak pulse current capability
- Solid-state silicon-avalanche technology

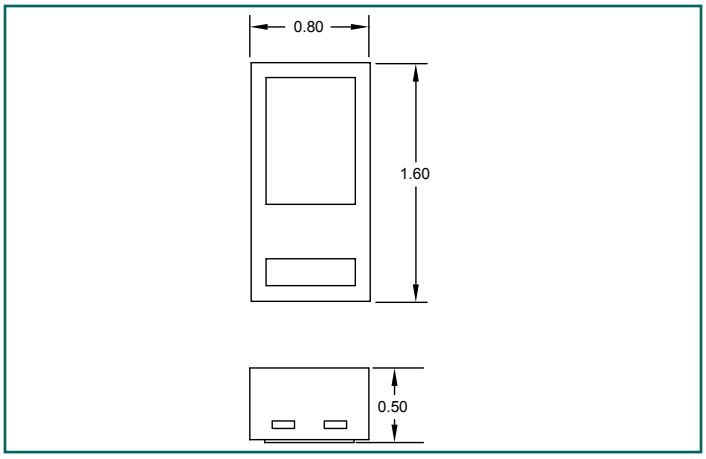
Mechanical Characteristics

- SLP1608P2 package
- Pb-Free, Halogen Free, RoHS/WEEE compliant
- Nominal Dimensions: 1.6 x 0.8 x 0.50 mm
- Lead Finish: NiAu
- Marking: Marking code
- Packaging: Tape and Reel

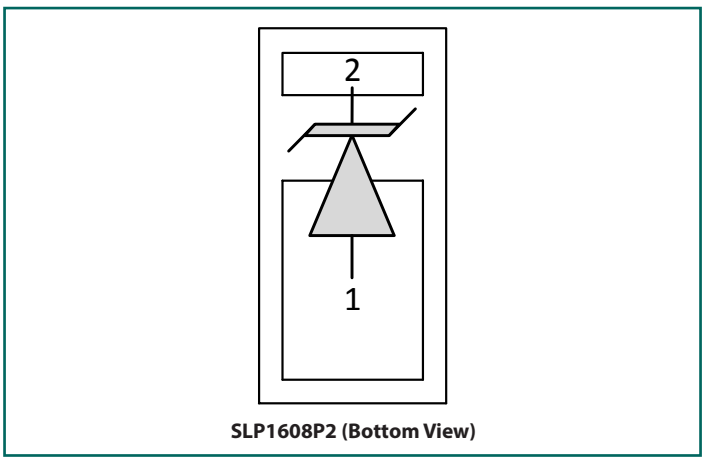
Applications

- Cellular Handsets
- Industrial Equipment
- Microcontroller RESET and IRQ Pins
- USB Voltage Bus
- Battery protection
- Tablet PC
- CCTV Cameras
- Instrumentation

Package Dimension



Schematic & Pin Configuration



SLP1608P2 (Bottom View)

Absolute Maximum Ratings

Rating	Symbol	Value	Units
Peak Pulse Power (tp = 8/20µs)	P_{PK}	1200-1600	W
Peak Pulse Current (tp = 8/20µs)	I_{PP}	8-80	A
ESD per IEC 61000-4-2 (Contact)(1) ESD per IEC 61000-4-2 (Air)(1)	V_{ESD}	±30 ±30	kV
Operating Temperature	T_J	-40 to +125	°C
Storage Temperature	T_{STG}	-55 to +150	°C

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

µClamp0561P

Parameter	Symbol	Conditions		Min.	Typ.	Max.	Units
Reverse Stand-Off Voltage	V_{RWM}	-40°C to 125°C Pin 2 to Pin 1				5	V
Reverse Breakdown Voltage	V_{BR}	I_t = 1mA, Pin 2 to Pin 1		6	7	9	V
Reverse Leakage Current	I_R	V_{RWM} = 5V	T = 25°C		50	300	nA
Peak Pulse Current	I_{PP}	tp = 8/20µs				80	A
Clamping Voltage(2)	V_C	I_{PP} = 40A, tp = 8/20µs, Pin 2 to Pin 1				12	V
Clamping Voltage(2)	V_C	I_{PP} = 80A, tp = 8/20µs, Pin 2 to Pin 1				15	V
Dynamic Resistance(3), (4)	R_{DYN}	tp = 0.2/100ns (TLP) Pin 2 to Pin 1			0.05		Ohms
Junction Capacitance	C_J	V_R = 0V, f = 1MHz Pin 2 to Pin 1	T = 25°C			800	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_{TLP} and V_{TLP} averaging window: t_1 = 70ns to t_2 = 90ns.

(4): Dynamic resistance calculated from I_{TLP} = 4A to I_{TLP} = 16A

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

µClamp1061P							
Parameter	**Symbol**	**Conditions**		**Min.**	**Typ.**	**Max.**	**Units**
Reverse Stand-Off Voltage	V_{RWM}	-40°C to 125°C Pin 2 to Pin 1				10	V
Reverse Breakdown Voltage	V_{BR}	I_t = 1mA, Pin 2 to Pin 1		12	13.5	15.5	V
Reverse Leakage Current	I_R	V_{RWM} = 10V	T = 25°C		<10	100	nA
Peak Pulse Current	I_{PP}	tp = 8/20µs				60	A
Clamping Voltage(2)	V_C	I_{PP} = 10A, tp = 8/20µs, Pin 2 to Pin 1				17	V
Clamping Voltage(2)	V_C	I_{PP} = 60A, tp = 8/20µs, Pin 2 to Pin 1				25	V
Dynamic Resistance(3), (4)	R_{DYN}	tp = 0.2/100ns (TLP) Pin 2 to Pin 1			0.05		Ohms
Junction Capacitance	C_J	V_R = 0V, f = 1MHz Pin 2 to Pin 1	T = 25°C			350	pF

µClamp1261P							
Parameter	**Symbol**	**Conditions**		**Min.**	**Typ.**	**Max.**	**Units**
Reverse Stand-Off Voltage	V_{RWM}	-40°C to 125°C Pin 2 to Pin 1				12	V
Reverse Breakdown Voltage	V_{BR}	I_t = 1mA, Pin 2 to Pin 1		14	16.5	19	V
Reverse Leakage Current	I_R	V_{RWM} = 12V	T = 25°C		<10	100	nA
Peak Pulse Current	I_{PP}	tp = 8/20µs				45	A
Clamping Voltage(2)	V_C	I_{PP} = 10A, tp = 8/20µs, Pin 2 to Pin 1				25	V
Clamping Voltage(2)	V_C	I_{PP} = 45A, tp = 8/20µs, Pin 2 to Pin 1				33	V
Dynamic Resistance(3), (4)	R_{DYN}	tp = 0.2/100ns (TLP) Pin 2 to Pin 1			0.05		Ohms
Junction Capacitance	C_J	V_R = 0V, f = 1MHz Pin 2 to Pin 1	T = 25°C			275	pF

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

µClamp1561P							
Parameter	**Symbol**	**Conditions**		**Min.**	**Typ.**	**Max.**	**Units**
Reverse Stand-Off Voltage	V_{RWM}	-40°C to 125°C Pin 2 to Pin 1				15	V
Reverse Breakdown Voltage	V_{BR}	I_t = 1mA, Pin 2 to Pin 1		17.5	20	23	V
Reverse Leakage Current	I_R	V_{RWM} = 15V	T = 25°C		<10	100	nA
Peak Pulse Current	I_{PP}	tp = 8/20µs				40	A
Clamping Voltage(2)	V_C	I_{PP} = 10A, tp = 8/20µs, Pin 2 to Pin 1				28	V
Clamping Voltage(2)	V_C	I_{PP} = 40A, tp = 8/20µs, Pin 2 to Pin 1				40	V
Dynamic Resistance(3), (4)	R_{DYN}	tp = 0.2/100ns (TLP) Pin 2 to Pin 1			0.05		Ohms
Junction Capacitance	C_J	V_R = 0V, f = 1MHz Pin 2 to Pin 1	T = 25°C			220	pF

µClamp2461P							
Parameter	**Symbol**	**Conditions**		**Min.**	**Typ.**	**Max.**	**Units**
Reverse Stand-Off Voltage	V_{RWM}	-40°C to 125°C Pin 2 to Pin 1				24	V
Reverse Breakdown Voltage	V_{BR}	I_t = 1mA, Pin 2 to Pin 1		27	32	36	V
Reverse Leakage Current	I_R	V_{RWM} = 24V	T = 25°C		<10	100	nA
Peak Pulse Current	I_{PP}	tp = 8/20µs				23	A
Clamping Voltage(2)	V_C	I_{PP} = 10A, tp = 8/20µs, Pin 2 to Pin 1				50	V
Clamping Voltage(2)	V_C	I_{PP} = 23A, tp = 8/20µs, Pin 2 to Pin 1				65	V
Dynamic Resistance(3), (4)	R_{DYN}	tp = 0.2/100ns (TLP) Pin 2 to Pin 1			0.20		Ohms
Junction Capacitance	C_J	V_R = 0V, f = 1MHz Pin 2 to Pin 1	T = 25°C			165	pF

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

µClamp3061P							
Parameter	**Symbol**	**Conditions**		**Min.**	**Typ.**	**Max.**	**Units**
Reverse Stand-Off Voltage	V_{RWM}	-40°C to 125°C Pin 2 to Pin 1				30	V
Reverse Breakdown Voltage	V_{BR}	I_t = 1mA, Pin 2 to Pin 1		34	40	42	V
Reverse Leakage Current	I_R	V_{RWM} = 30V	T = 25°C		<10	100	nA
Peak Pulse Current	I_{PP}	tp = 8/20µs				18	A
Clamping Voltage(2)	V_C	I_{PP} = 10A, tp = 8/20µs, Pin 2 to Pin 1				55	V
Clamping Voltage(2)	V_C	I_{PP} = 18A, tp = 8/20µs, Pin 2 to Pin 1				65	V
Dynamic Resistance(3), (4)	R_{DYN}	tp = 0.2/100ns (TLP) Pin 2 to Pin 1			0.25		Ohms
Junction Capacitance	C_J	V_R = 0V, f = 1MHz Pin 2 to Pin 1	T = 25°C			155	pF

µClamp3661P							
Parameter	**Symbol**	**Conditions**		**Min.**	**Typ.**	**Max.**	**Units**
Reverse Stand-Off Voltage	V_{RWM}	-40°C to 125°C Pin 2 to Pin 1				36	V
Reverse Breakdown Voltage	V_{BR}	I_t = 1mA, Pin 2 to Pin 1		37	40	44	V
Reverse Leakage Current	I_R	V_{RWM} = 36V	T = 25°C		<10	100	nA
Peak Pulse Current	I_{PP}	tp = 8/20µs				18	A
Clamping Voltage(2)	V_C	I_{PP} = 2A, tp = 8/20µs, Pin 2 to Pin 1				48	V
Clamping Voltage(2)	V_C	I_{PP} = 18A, tp = 8/20µs, Pin 2 to Pin 1				70	V
Dynamic Resistance(3), (4)	R_{DYN}	tp = 0.2/100ns (TLP) Pin 2 to Pin 1			0.25		Ohms
Junction Capacitance	C_J	V_R = 0V, f = 1MHz Pin 2 to Pin 1	T = 25°C			150	pF

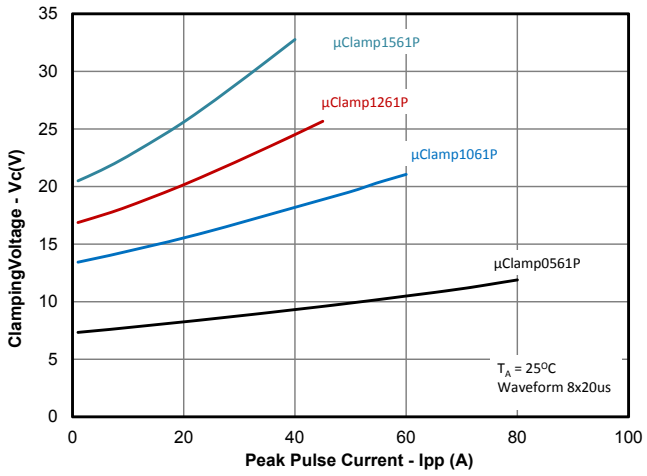
Electrical Characteristics (T=25°C unless otherwise specified)

µClamp4061P							
Parameter	**Symbol**	**Conditions**		**Min.**	**Typ.**	**Max.**	**Units**
Reverse Stand-Off Voltage	V_{RWM}	-40°C to 125°C Pin 2 to Pin 1				40	V
Reverse Breakdown Voltage	V_{BR}	I_t = 1mA, Pin 2 to Pin 1		45	50	55	V
Reverse Leakage Current	I_R	V_{RWM} = 40V	T = 25°C		<10	100	nA
Peak Pulse Current	I_{PP}	tp = 8/20µs				12	A
Clamping Voltage(2)	V_C	I_{PP} = 12A, tp = 8/20µs, Pin 2 to Pin 1				80	V
Dynamic Resistance(3), (4)	R_{DYN}	tp = 0.2/100ns (TLP) Pin 2 to Pin 1			0.35		Ohms
Junction Capacitance	C_J	V_R = 0V, f = 1MHz Pin 2 to Pin 1	T = 25°C			125	pF

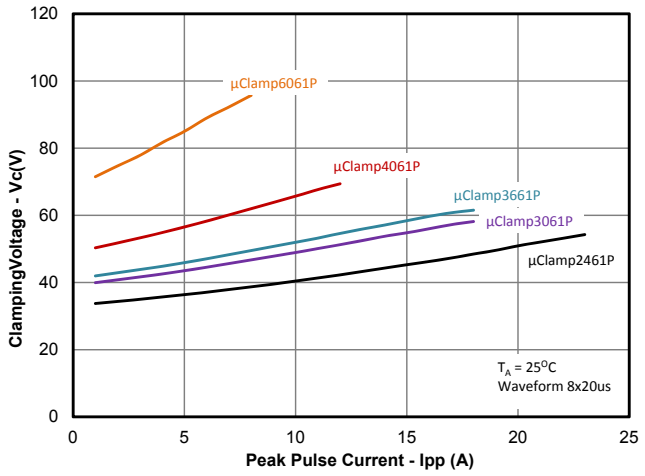
µClamp6061P							
Parameter	**Symbol**	**Conditions**		**Min.**	**Typ.**	**Max.**	**Units**
Reverse Stand-Off Voltage	V_{RWM}	-40°C to 125°C Pin 2 to Pin 1				60	V
Reverse Breakdown Voltage	V_{BR}	I_t = 1mA, Pin 2 to Pin 1		65	70	85	V
Reverse Leakage Current	I_R	V_{RWM} = 60V	T = 25°C		<10	100	nA
Peak Pulse Current	I_{PP}	tp = 8/20µs				8	A
Clamping Voltage(2)	V_C	I_{PP} = 8A, tp = 8/20µs, Pin 2 to Pin 1				105	V
Dynamic Resistance(3), (4)	R_{DYN}	tp = 0.2/100ns (TLP) Pin 2 to Pin 1			0.45		Ohms
Junction Capacitance	C_J	V_R = 0V, f = 1MHz Pin 2 to Pin 1	T = 25°C			110	pF

Typical Characteristics

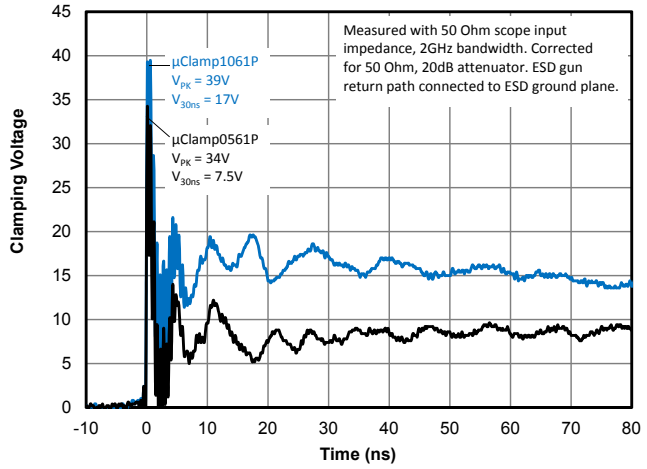
Clamping Voltage vs. Peak Pulse Current (V_{RWM} = 5V - 15V)



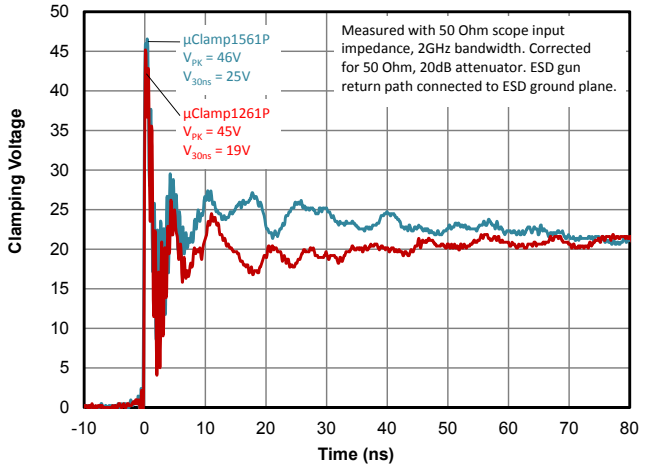
Clamping Voltage vs. Peak Pulse Current (V_{RWM} = 24V - 60V)



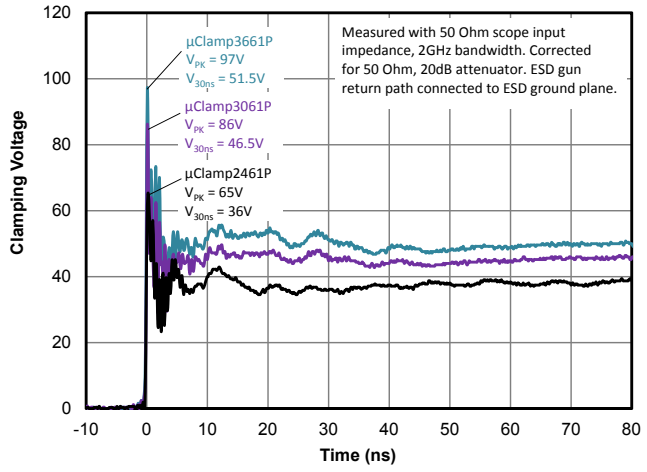
ESD Clamping (8kV Contact per IEC 61000-4-2)



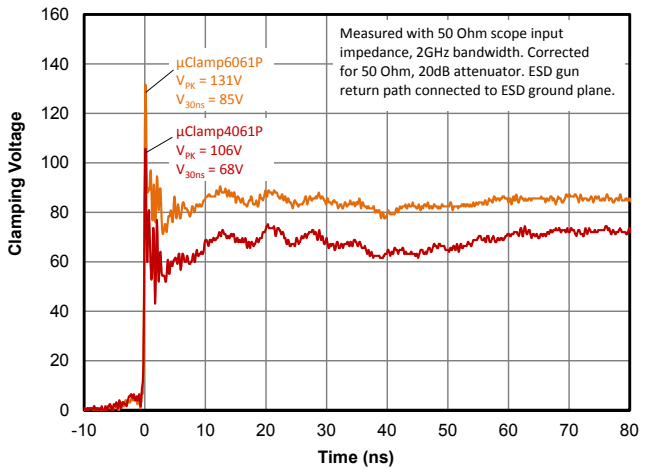
ESD Clamping (8kV Contact per IEC 61000-4-2)



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

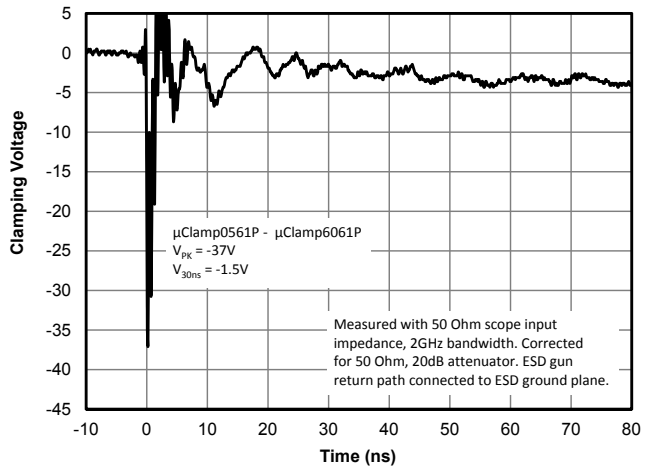


ESD Clamping (8kV Contact per IEC 61000-4-2)

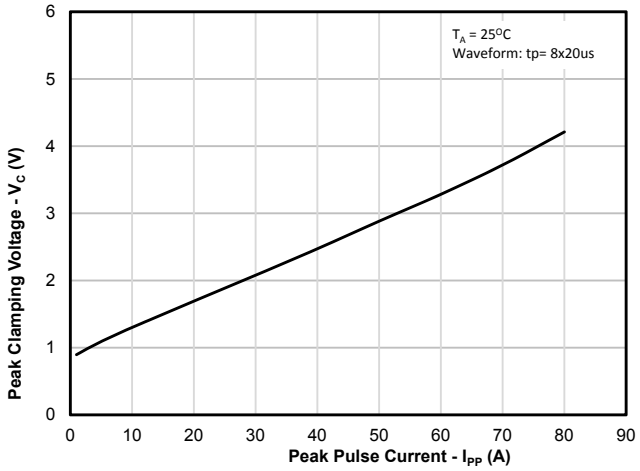


Typical Characteristics

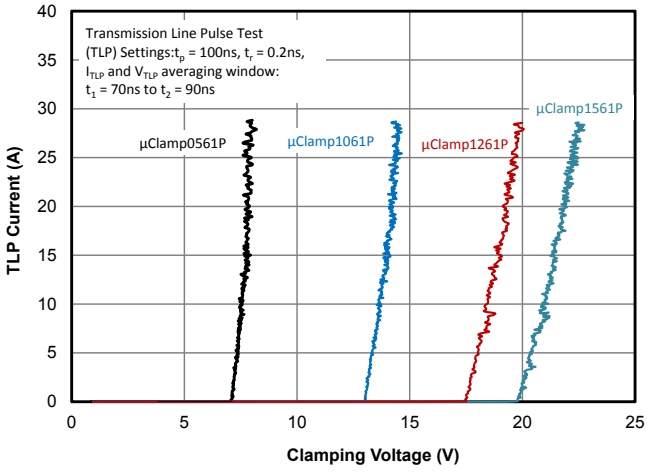
ESD Clamping (-8kV Contact per IEC 61000-4-2)



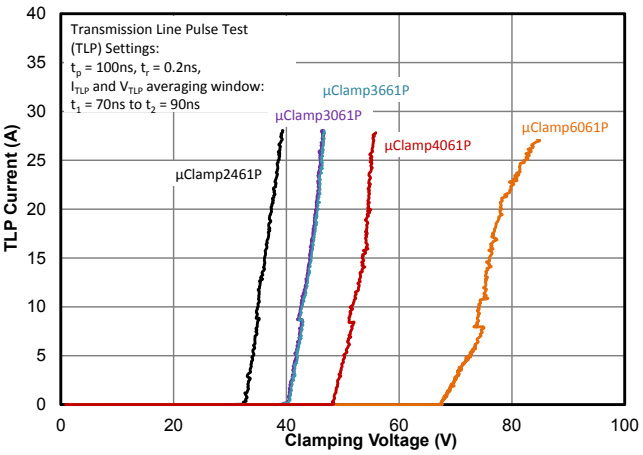
Forward Voltage vs. Peak Pulse Current (V_{RWM} = 5V - 60V)



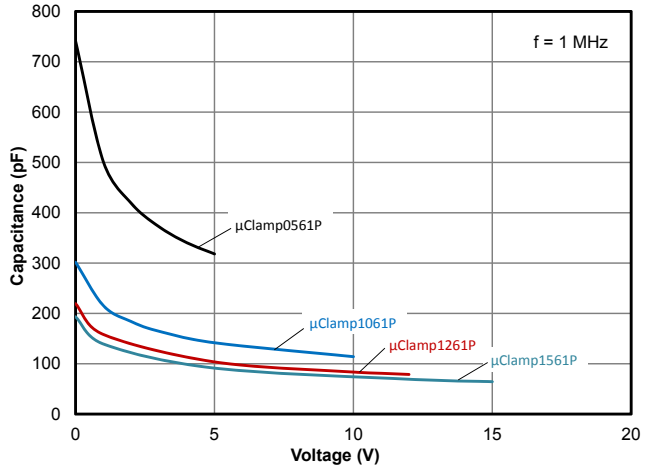
TLP Characteristic (Positive Pulse) - (V_{RWM} = 5V - 15V)



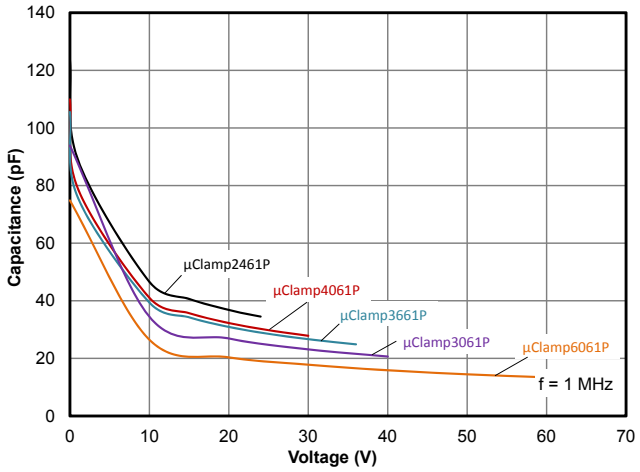
TLP Characteristic (Positive Pulse) - (V_{RWM} = 24V - 60V)



Capacitance vs. Reverse Voltage - (V_{RWM} = 5V - 15V)



Capacitance vs. Reverse Voltage - (V_{RWM} = 24V - 60V)



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:

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. Since this device has uneven pad sizes, the recommended stencil opening is 10% smaller than the size of the large pad and 25um larger than the size of the small pad. This is done to control solder height and keep the part planar during reflow. Solder paste with Type 3 or smaller particles are recommended.

Recommended Mounting Pattern

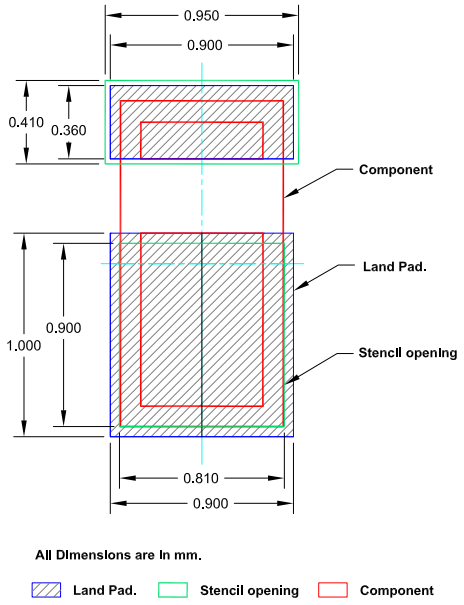
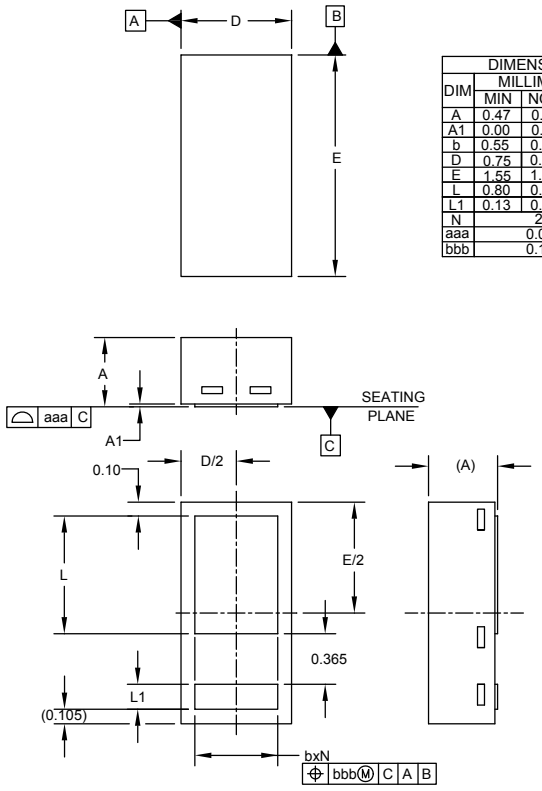


Table 1 - Recommended Assembly Guidelines

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

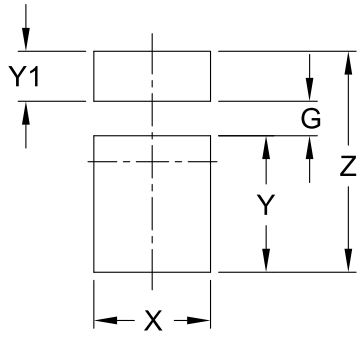
Outline Drawing - SLP1608P2



DIMENSIONS			
DIM	MILLIMETERS		
	MIN	NOM	MAX
A	0.47	0.50	0.53
A1	0.00	0.02	0.05
b	0.55	0.60	0.65
D	0.75	0.80	0.85
E	1.55	1.60	1.65
L	0.80	0.85	0.90
L1	0.13	0.18	0.23
N	2		
aaa	0.08		
bbb	0.10		

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

Land Pattern - SLP1608P2

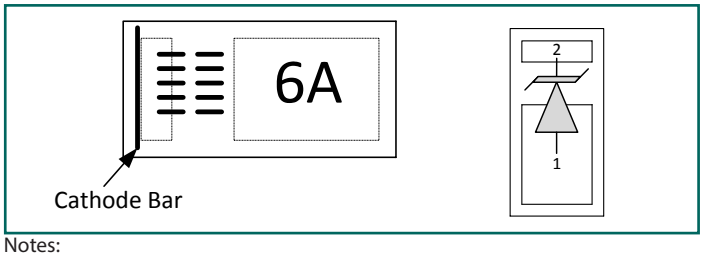


DIMENSIONS	
DIM	MILLIMETERS
G	0.265
X	0.90
Y	1.05
Y1	0.385
Z	1.70

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



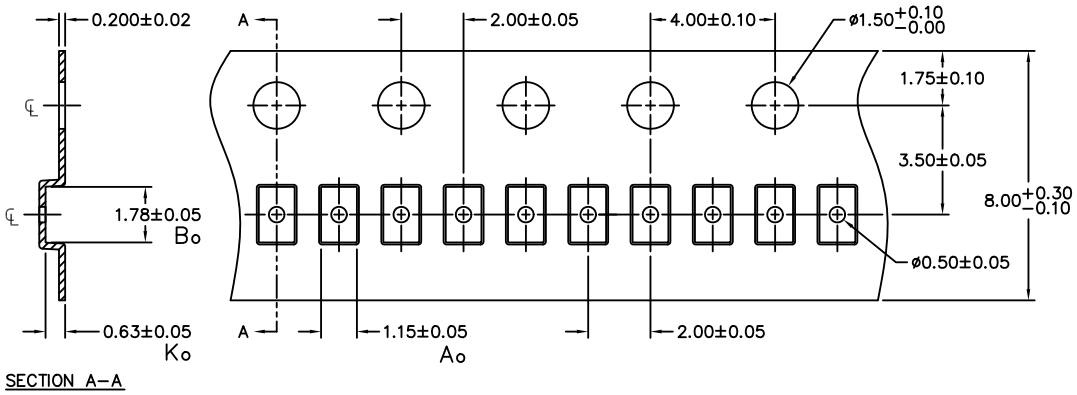
Notes:
1) Dashes represent matrix date code
2) See ordering information for part specific marking codes

Ordering Information

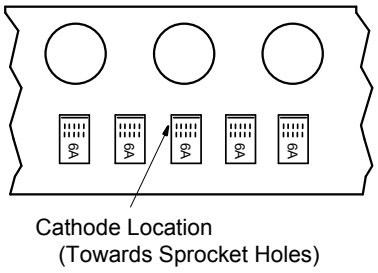
Part Number	Marking Code	Working Voltage	Qty per 7" Reel
µClamp0561P.TNT	6A	5V	10,000
µClamp1061P.TNT	6B	10V	10,000
µClamp1261P.TNT	6C	12V	10,000
µClamp1561P.TNT	6D	15V	10,000
µClamp2461P.TNT	6F	24V	10,000
µClamp3061P.TNT	6G	30V	10,000
µClamp3661P.TNT	6H	36V	10,000
µClamp4061P.TNT	6J	40V	10,000
µClamp6061P.TNT	6K	60V	10,000

Notes:
1) MicroClamp, uClamp and µClamp are trademarks of Semtech Corporaton

Tape and Reel Specification



NOTES: 1.) ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.



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