TClamp0882S - TClamp2482S

Low Capacitance TransClamp® Surge Protection for DSL and G.Fast Interfaces

PROTECTION PRODUCTS

Description

TClamp®xx82S are specifically designed to provide secondary surge and ESD protection for G.Fast and other DSL circuit line drivers. These devices integrate low capacitance, surge-rated steering diodes with a high power transient voltage suppressor (TVS). The TVS utilizes snap-back or "crow-bar" technology to minimize device clamping voltage and features high surge current capability of 30A (tp=8/20us).

TClampxx82S capacitance is limited to 2.5pF maximum with a low typical capacitance variation over the operating voltage range. This ensures correct signal transmission on DSL lines. The biased bridge structure allows the device to be used in G.Fast, ADSL, and VDSL applications with with operating voltages 0f 8, 12, 20, and 24Vp-p.

TClampxx82S is in a 6-pin SOT-23 package. The leads are finished with lead-free matte tin. The flow- through package design simplifies PCB layout.

Features

- Transient Protection to
  - IEC 61000-4-2 (ESD) 30kV (Air), 30kV (Contact)
  - IEC 61000-4-4 (EFT) 2kV (5/50ns)
  - IEC 61000-4-5 (Lightning) 30A (8/20µs)
- Bias diodes prevent charging of TVS capacitance
- Working Voltage Options: 8V, 12V, 20V, 24V
- Low Capacitance: 2.5pF Maximum
- Low Capacitance Variation (1V to V_{RWM})
- Solid-State Silicon-Avalanche Technology

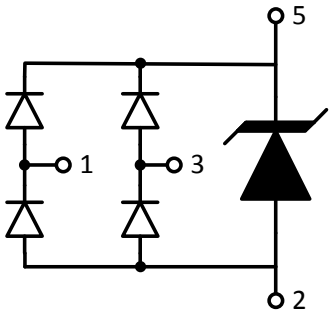
Mechanical Characteristics

- JEDEC SOT-23 6L package
- Pb-Free, Halogen Free, RoHS/WEEE Compliant
- Lead Finish: Matte Tin
- Molding Compound Flammability Rating: UL 94V-0
- Marking : Marking Code + Date Code
- Packaging : Tape and Reel

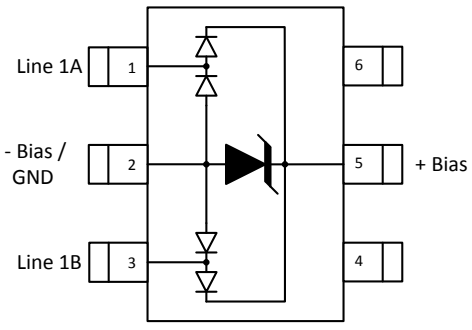
Applications

- ADSLx / VDSLx Secondary Protection
- G.Fast Line Driver Secondary Protection
- VDSL2 Class-H Line Driver Secondary Protection
- Modems
- Access Equipment
- Central Office Equipment
- Customer Premise Equipment

Circuit Diagram



Pin Configuration



Absolute Maximum Ratings

Rating	Symbol	Value	Units
Peak Pulse Power (tp = 8/20µs)	P_{PK}	300	W
Peak Pulse Current (tp = 8/20µs)	I_{PP}	30	A
ESD per IEC 61000-4-2 (Contact)(1), (3)	V_{ESD}	±30	kV
Operating Temperature	T_J	-40 to +85	°C
Storage Temperature	T_{STG}	-55 to +150	°C

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

TClamp0882S							
Parameter	**Symbol**	**Conditions**		**Min.**	**Typ.**	**Max.**	**Units**
Reverse Stand-Off Voltage	V_{RWM}	-40°C to 85°C Pin 1 or 3 to Pin 2, Pin 1 to Pin 3				8	V
Reverse Breakdown Voltage	V_{BR}	I_{BR} = 10mA, T = -40°C to 85°C Pin 1 to Pin 3		13.5	15.5	18	V
Reverse Leakage Current	I_R	V_{RWM} = 8V	T = 25°C		0.01	0.100	µA
			T = 85°C		0.02	0.100	µA
Holding Current(3)	I_H			50	125		mA
Clamping Voltage(2), (3)	V_C	I_{PP} = 30A, tp = 1.2/50µs, 8/20µs Combination Waveform Pin 1 to Pin 3			9.5		V
Breakover Voltage(3)	V_{BO}	I_{BO} = 50mA Pin 1 to Pin 3				23	V
Junction Capacitance	C_J	V_R = 0V, f = 1MHz Pin 1 to 3	T = 25°C		1.2	2.5	pF
Variation in Junction Capacitance(3)	ΔC_J	V_R = 1V - 8V, f = 1MHz Pin 1 to Pin 3			0.15		pF

Notes:
(1): ESD Gun return path to Ground Reference Plane (GRP)
(2): Measured using a 1.2/50us voltage, 8/20us current combination waveform, RS = 2 Ohms. Clamping is defined as the peak voltage across the device after the device snaps back to a conducting state.
(3): Guaranteed by design. Not production tested

Absolute Maximum Ratings

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

TClamp1282S							
Parameter	**Symbol**	**Conditions**		**Min.**	**Typ.**	**Max.**	**Units**
Reverse Stand-Off Voltage	V_{RWM}	-40°C to 85°C Pin 1 or 3 to Pin 2, Pin 1 to Pin 3				12	V
Reverse Breakdown Voltage	V_{BR}	I_{BR} = 10mA, T = -40°C to 85°C Pin 1 to Pin 3		15.5	18.5	22	V
Reverse Leakage Current	I_R	V_{RWM} = 12V	T = 25°C		0.01	0.100	µA
			T = 85°C		0.02	0.100	µA
Holding Current(3)	I_H			50	125		mA
Clamping Voltage(2), (3)	V_C	I_{PP} = 30A, tp = 1.2/50µs, 8/20µs Combination Waveform Pin 1 to Pin 3			9.5		V
Junction Capacitance	C_J	V_R = 0V, f = 1MHz Pin 1 to 3	T = 25°C		1.2	2.5	pF
Variation in Junction Capacitance(3)	ΔC_J	V_R = 1V - 12V, f = 1MHz Pin 1 to Pin 3			0.15		pF

Notes:
(1): ESD Gun return path to Ground Reference Plane (GRP)
(2): Measured using a 1.2/50us voltage, 8/20us current combination waveform, RS = 2 Ohms. Clamping is defined as the peak voltage across the device after the device snaps back to a conducting state.
(3): Guaranteed by design. Not production tested

Absolute Maximum Ratings

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

TClamp2082S							
Parameter	**Symbol**	**Conditions**		**Min.**	**Typ.**	**Max.**	**Units**
Reverse Stand-Off Voltage	V_{RWM}	-40°C to 85°C Pin 1 or 3 to Pin 2, Pin 1 to Pin 3				20	V
Reverse Breakdown Voltage	V_{BR}	I_{BR} = 10mA, T = -40°C to 85°C Pin 1 to Pin 3		23	26.5	30	V
Reverse Leakage Current	I_R	V_{RWM} = 20V	T = 25°C		0.01	0.100	µA
			T = 85°C		0.02	0.100	µA
Holding Current(3)	I_H			50	125		mA
Clamping Voltage(2), (3)	V_C	I_{PP} = 30A, tp = 1.2/50µs, 8/20µs Combination Waveform Pin 1 to Pin 3			9.5		V
Breakover Voltage(3)	V_{BO}	I_{BO} = 50mA Pin 1 to Pin 3				23	V
Junction Capacitance	C_J	V_R = 0V, f = 1MHz Pin 1 to 3	T = 25°C		1.2	2.5	pF
Variation in Junction Capacitance(3)	ΔC_J	V_R = 1V - 20V, f = 1MHz Pin 1 to Pin 3			0.4		pF

Notes:
(1): ESD Gun return path to Ground Reference Plane (GRP)
(2): Measured using a 1.2/50us voltage, 8/20us current combination waveform, RS = 2 Ohms. Clamping is defined as the peak voltage across the device after the device snaps back to a conducting state.
(3): Guaranteed by design. Not production tested

Absolute Maximum Ratings

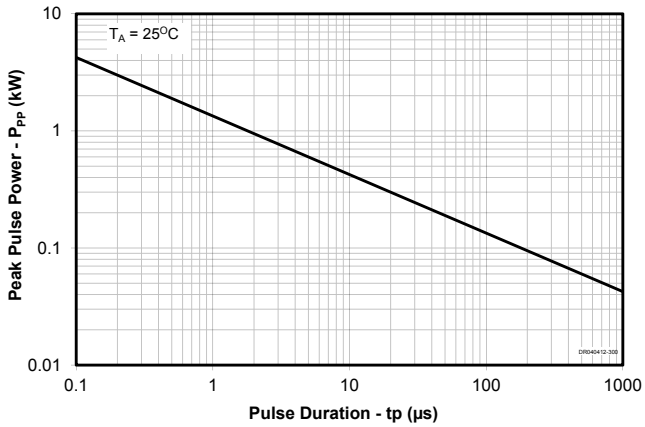
Electrical Characteristics (T=25°C unless otherwise specified)

TClamp2482S							
Parameter	**Symbol**	**Conditions**		**Min.**	**Typ.**	**Max.**	**Units**
Reverse Stand-Off Voltage	V_{RWM}	-40°C to 85°C Pin 1 or 3 to Pin 2, Pin 1 to Pin 3				24	V
Reverse Breakdown Voltage	V_{BR}	I_{BR} = 10mA, T = -40°C to 85°C Pin 1 to Pin 3		27	31	35	V
Reverse Leakage Current	I_R	V_{RWM} = 24V	T = 25°C		0.01	0.100	µA
			T = 85°C		0.02	0.100	µA
Holding Current(3)	I_H			50	125		mA
Clamping Voltage(2), (3)	V_C	I_{PP} = 30A, tp = 1.2/50µs, 8/20µs Combination Waveform Pin 1 to Pin 3			9.5		V
Breakover Voltage(3)	V_{BO}	I_{BO} = 50mA Pin 1 to Pin 3				35	V
Junction Capacitance	C_J	V_R = 0V, f = 1MHz Pin 1 to 3	T = 25°C		1.2	2.5	pF
Variation in Junction Capacitance(3)	ΔC_J	V_R = 1V - 24V, f = 1MHz Pin 1 to Pin 3			0.4		pF

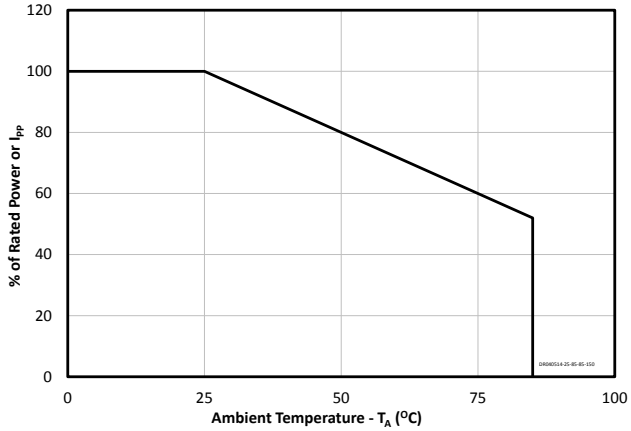
Notes:
(1): ESD Gun return path to Ground Reference Plane (GRP)
(2): Measured using a 1.2/50us voltage, 8/20us current combination waveform, RS = 2 Ohms. Clamping is defined as the peak voltage across the device after the device snaps back to a conducting state.
(3): Guaranteed by design. Not production tested

Typical Characteristics

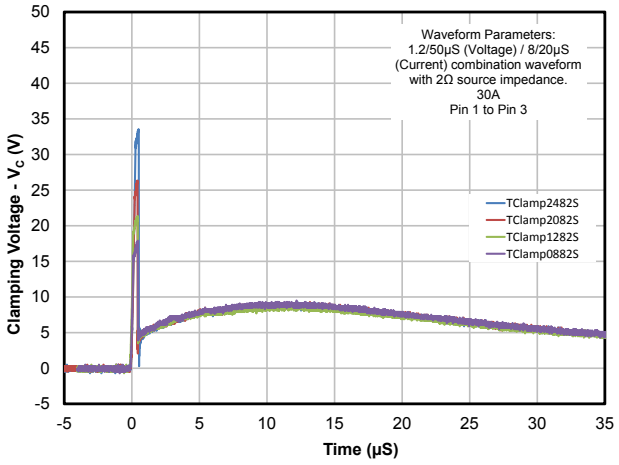
Non-Repetitive Peak Pulse Power vs. Pulse Time



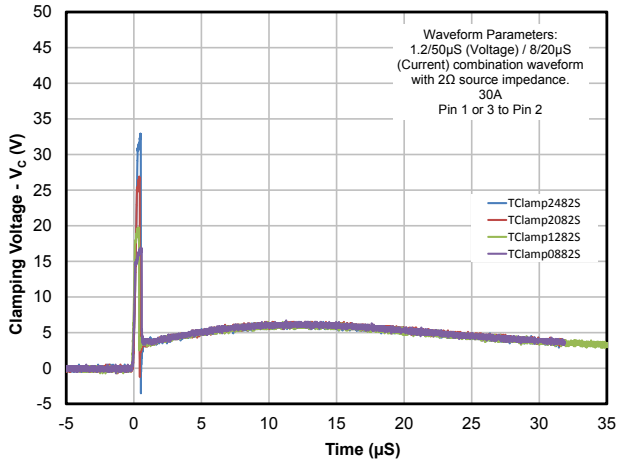
Power Derating Curve



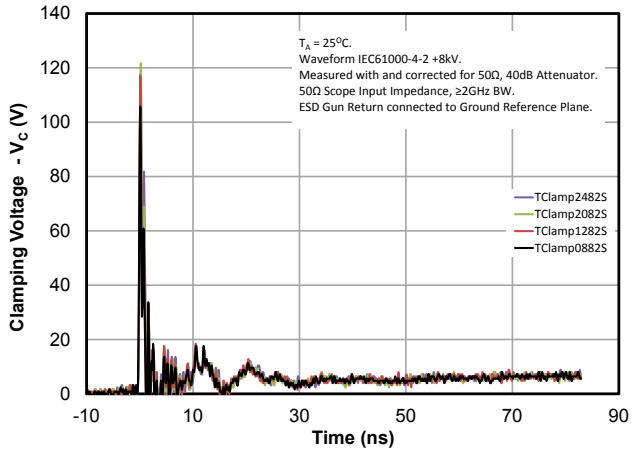
Clamping Characteristic (I/O to I/O, Pin 1-3)



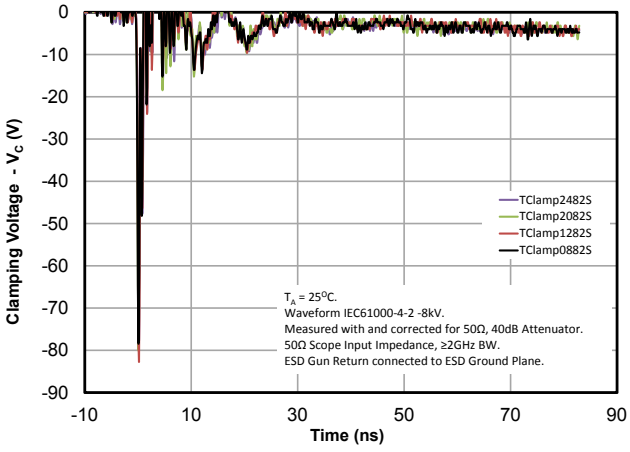
Clamping Characteristic (I/O to GND, Pin 1 or 3 to 2)



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

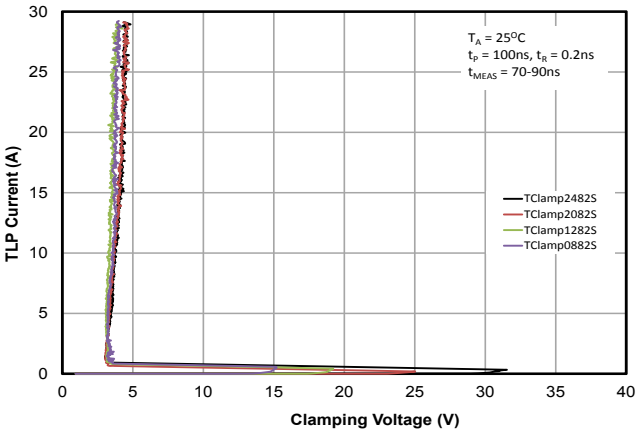


ESD Clamping (-8kV Contact per IEC 61000-4-2)

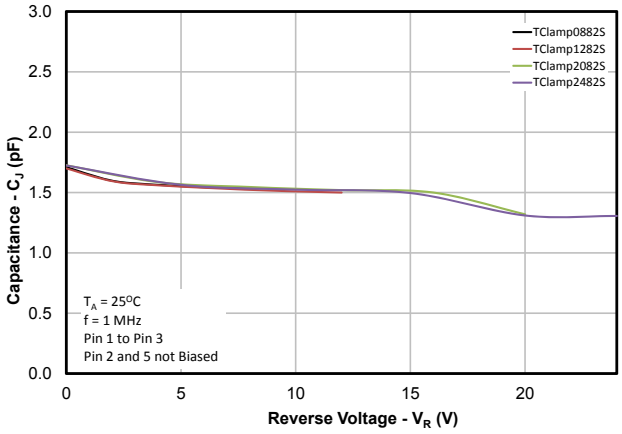


Typical Characteristics

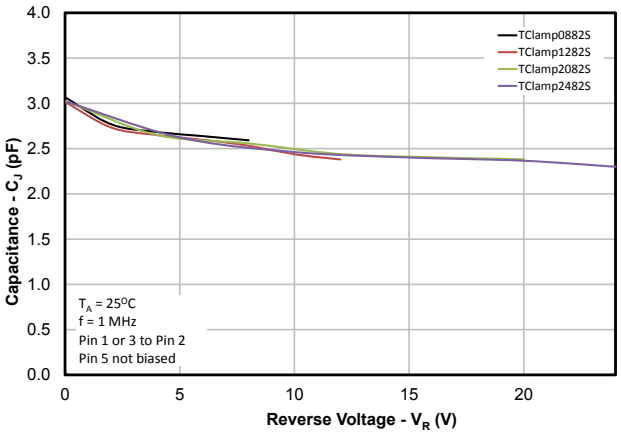
TLP Characteristic



Capacitance vs. Reverse Voltage (Pin 1 to 3)



Capacitance vs. Reverse Voltage (Pin 1 or 3 to Pin 2)



Applications Information

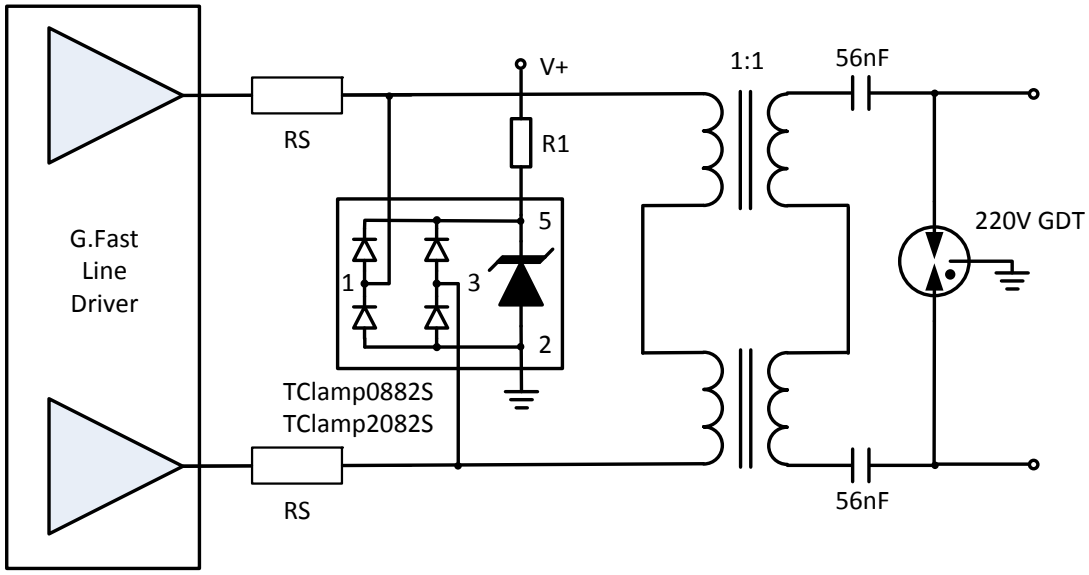


Figure 1 - Typical G.Fast Protection Circuit

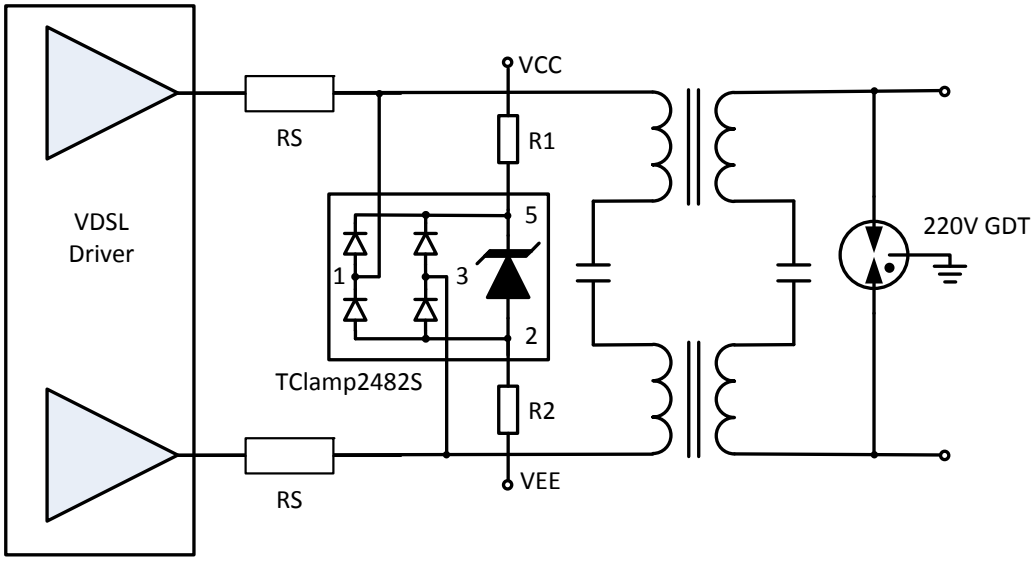


Figure 2 - Typical VDSL Class-H Protection Circuit

Applications Information

Device Connection and PCB Routing

The flow-through design of TClampxx82S simplifies board layout and PCB trace routing. The device can be configured for single ended applications such as G.Fast CPE (Figure 3) or dual voltage applications such as VDSL (Figure 4). Line 1A is connected at pin1 and its trace can continue under the part and connect to pin 6, which is not connected internally to the part. A similar connection can be made for Line 1B. This layout makes it easy to keep the differential signal traces symmetrical.

Bias

The device uses an internal bridge structure to effectively hide the capacitance of the TVS diode. However, in high voltage applications such as DSL, the initial signal will charge the capacitance of the TVS causing signal distortion and transmission errors. This distortion is only present until the TVS capacitance becomes charged and stabilizes. The solution is to pre-bias the TVS capacitance by connecting it to the external supply voltage (Figure 5). In the case of TClampxx82s, positive bias voltage should be connected at pin 5. For single ended applications, pin 2 is connected to ground (as shown in Figure 3). For dual voltage applications, pin 2 should be connected to negative polarity bias voltage. The bias resistors (R1, R2) should be large enough value as to minimize leakage current and minimize voltage drop over temperature (typically 100K Ohms to 1 Meg Ohm).

Surge and Power Induction Testing

DSL interfaces are wired telecom networks which are exposed to EOS from lightning surges and AC power line induction. DSL circuits are normally tested to the immunity requirements of ITU-T K.20, K.21, and K.44. TClampxx82S is designed to provide secondary protection to xDSL and G.Fast line drivers. They have been tested and passed the above requirements when used in conjunction with 220V gas discharge tubes (GDT). For more details, reference Semtech application note SI16-03 "Protecting G.Fast Circuits from Power Induction and Lightning Surges".

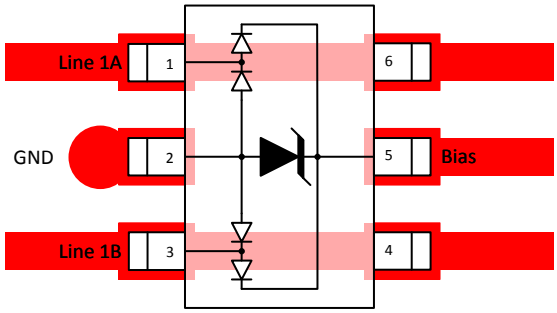


Figure 3 - Single Ended Layout Diagram

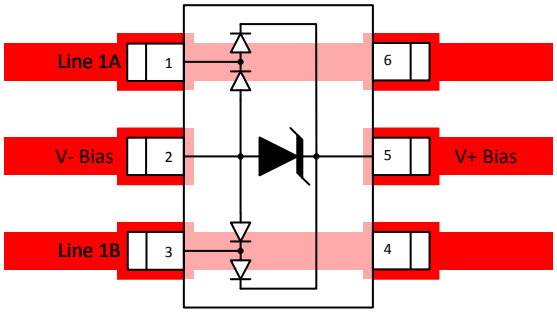


Figure 4 - Dual Voltage Layout Diagram

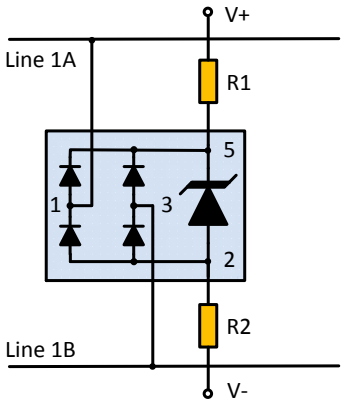
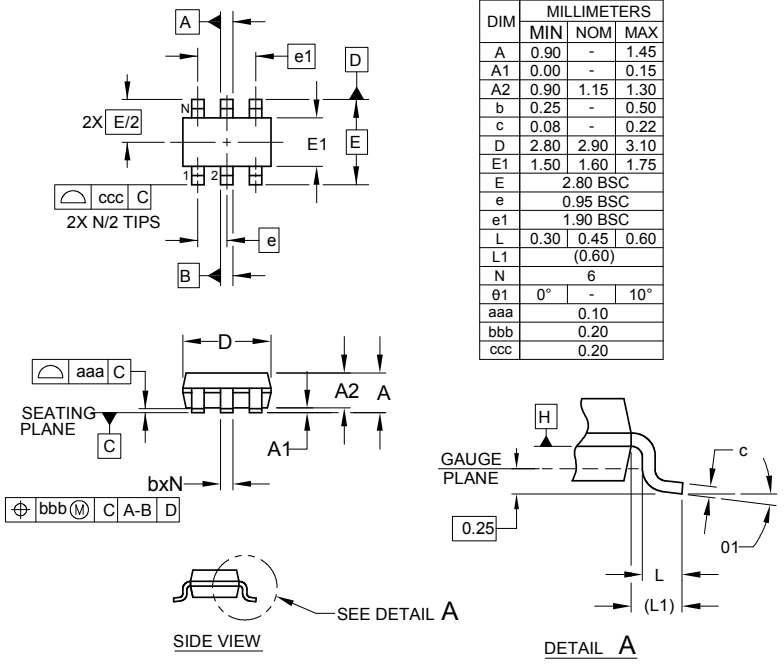


Figure 5 - External Bias Resistors

Outline Drawing - SOT-23 6L

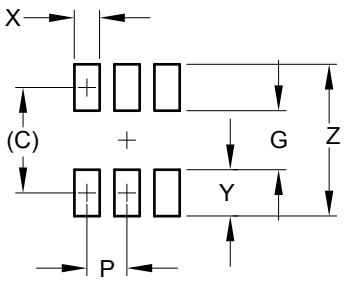


DIMENSIONS			
DIM	MILLIMETERS		
	MIN	NOM	MAX
A	0.90	-	1.45
A1	0.00	-	0.15
A2	0.90	1.15	1.30
b	0.25	-	0.50
c	0.08	-	0.22
D	2.80	2.90	3.10
E1	1.50	1.60	1.75
E	2.80 BSC		
e	0.95 BSC		
e1	1.90 BSC		
L	0.30	0.45	0.60
L1	(0.60)		
N	6		
θ1	0°	-	10°
aaa	0.10		
bbb	0.20		
ccc	0.20		

NOTES:

1. CONTROLLING DIMENSIONS ARE IN MILLIMETERS (ANGLES IN DEGREES).
2. DATUMS -A- AND -B- TO BE DETERMINED AT DATUM PLANE -H-
3. DIMENSIONS "E1" AND "D" DO NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS.

Land Pattern - SOT-23 6L

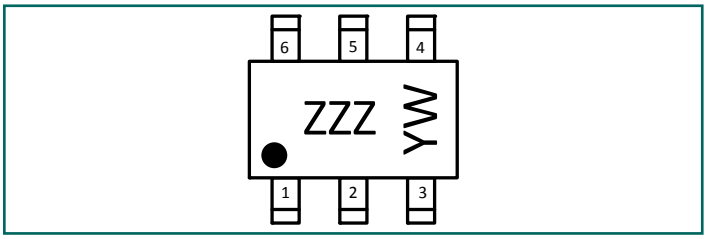


DIMENSIONS	
DIM	MILLIMETERS
C	(2.50)
G	1.40
P	0.95
X	0.60
Y	1.10
Z	3.60

NOTES:

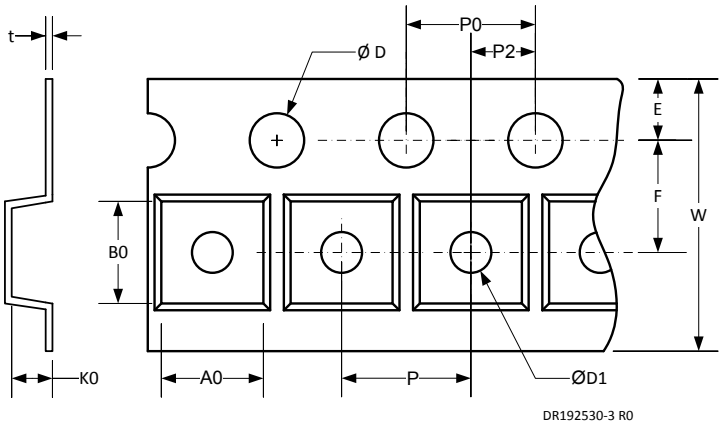
1. CONTROLLING DIMENSIONS ARE IN MILLIMETERS (ANGLES IN DEGREES).
2. THIS LAND PATTERN IS FOR REFERENCE PURPOSES ONLY. CONSULT YOUR MANUFACTURING GROUP TO ENSURE YOUR COMPANY'S MANUFACTURING GUIDELINES ARE MET.

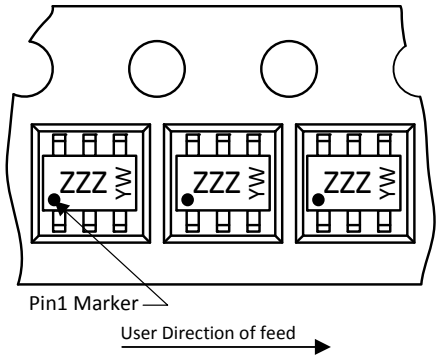
Marking Example



Notes:
ZZZ = Marking Code
YW = Alphanumeric character Date Code
See ordering information for part specific marking codes

Tape and Reel Specification





Tape Width	D	D1	E	F	K (Max)	P	P0	P2	T (Max)	W
	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
8	1.55 ±0.05	1.0 ±0.25	1.75 ±0.10	3.50 ±0.05	2.40	4.0 ±0.10	4.0 ±0.10	2.00 ±0.05	0.40	8.0 +0.3 −0.1

Ordering Information

Part Number	Working Voltage	Marking Code	Qty per 7 InchReel
TClamp0882S.TCT	8V	088	3000
TClamp1282S.TCT	12V	128	3000
TClamp2082S.TCT	20V	208	3000
TClamp2482S.TCT	24V	248	3000

Contact Information

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