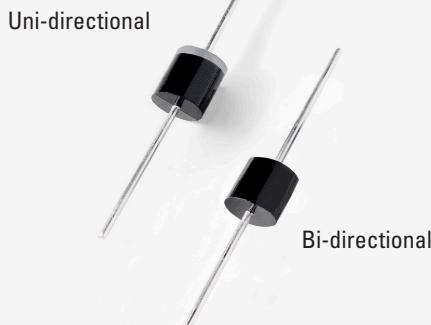


## TLP Series



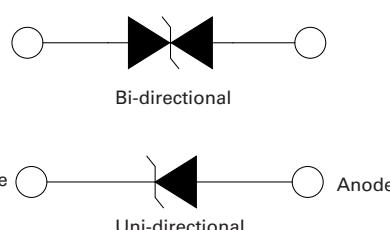
### Agency Approvals

AGENCY	AGENCY FILE NUMBER
	E230531

### Maximum Ratings and Thermal Characteristics ( $T_A=25^\circ\text{C}$ unless otherwise noted)

Parameter	Symbol	Value	Unit
Peak Pulse Power Dissipation 10/1000 $\mu\text{s}$ Test Waveform	$P_{PPM}$	5000	W
Steady State Power Dissipation on Infinite Heat Sink at $T_L=75^\circ\text{C}$ (Fig. 6)	$P_{M(AV)}$	8.0	W
Peak Forward Surge Current, 8.3ms Single Half Sine Wave (Note 3)	$I_{FSM}$	400	A
Maximum Instantaneous Forward Voltage at 100A for Unidirectional Only	$V_F$	3.5	V
Operating Junction and Storage Temperature Range	$T_J, T_{STG}$	-55 to 175	$^\circ\text{C}$
Typical Thermal Resistance Junction to Lead	$R_{eJL}$	8.0	$^\circ\text{C}/\text{W}$
Typical Thermal Resistance Junction to Ambient	$R_{eJA}$	40	$^\circ\text{C}/\text{W}$

### Functional Diagram



### Description

The TLP Series is packaged in a highly reliable industry standard P600 axial leaded package and is designed to provide precision overvoltage protection for sensitive electronics.

### Features

- High reliability application
- Glass passivated chip junction in P600 package
- Fast response time: typically less than 1.0ps from 0 Volts to  $V_{BR}$  min
- Excellent clamping capability
- Typical failure mode is short from over-specified voltage or current
- Whisker test is conducted based on JEDEC JESD201A per its table 4a and 4c
- ESD protection of data lines in accordance with IEC 61000-4-2, 30kV(Air), 30kV (Contact)
- EFT protection of data lines in accordance with IEC 61000-4-4
- Low incremental surge resistance
- High temperature soldering guaranteed: 260°C/10 seconds / 0.375"(9.5mm) lead length, 5 lbs., (2.3kg) tension
- $V_{BR} @ T_J = V_{BR} @ 25^\circ\text{C} \times (1 + 0.1\% \times (T_J - 25))$  (0.1%:Typical Temperature Coefficient)
- UL Recognized body that meets flammability rating V-0.
- UL Recognized to ANSI/UL 497B: Protectors for Data Communications and Fire-Alarm Circuits.
- Matte tin lead-free plated
- Halogen free and RoHS compliant
- Pb-free E3 means 2nd level interconnect is Pb-free and the terminal finish material is tin(Sn) (IPC/JEDEC J-STD-609A.01)

### Applications

Designed to protect sensitive electronics from:

- 50ms Square Test Waveform

**Electrical Characteristics (T<sub>A</sub>=25°C unless otherwise noted)**

Part Number (Uni)	Part Number (Bi)	Breakdown Voltage V <sub>BR</sub> @ I <sub>T</sub> (V)		Test Current I <sub>T</sub> (mA)	Reverse Stand off Voltage V <sub>R</sub> (Volts)	Maximum Reverse Leakage @ V <sub>R</sub> I <sub>R</sub> (μA)	Maximum Peak Pulse Current I <sub>PP</sub> (10/1000μS) (A)	Maximum Peak Pulse Current I <sub>PP</sub> (50ms Square) (A)	Maximum Clamping Voltage @ I <sub>PP</sub> (10/1000μS) V <sub>C</sub> (V)	Maximum Clamping Voltage @ I <sub>PP</sub> (50ms Square) V <sub>C</sub> (V)	Agency Approval 
		MIN	MAX								
TLP10A	TLP10CA	11.8	13.0	5.0	10	10	300.0	82	17.0	21	X
TLP11A	TLP11CA	12.2	13.5	5.0	11	10	280.0	78	18.2	22	X
TLP12A	TLP12CA	13.3	14.7	5.0	12	10	256.3	72	19.9	24	X
TLP13A	TLP13CA	14.4	15.9	5.0	13	10	237.2	68	21.5	25	X
TLP14A	TLP14CA	15.6	17.2	5.0	14	10	219.8	63	23.2	27	X
TLP15A	TLP15CA	16.7	18.5	5.0	15	10	209.0	61	24.4	28	X
TLP16A	TLP16CA	17.8	19.7	5.0	16	10	196.2	57	26.0	30	X
TLP17A	TLP17CA	18.9	20.9	5.0	17	10	184.8	54	27.6	32	X
TLP18A	TLP18CA	20.0	22.1	5.0	18	10	174.4	52	29.2	33	X
TLP20A	TLP20CA	22.2	24.5	5.0	20	10	157.4	48	32.4	36	X
TLP22A	TLP22CA	24.4	26.9	5.0	22	10	143.7	44	35.5	39	X
TLP24A	TLP24CA	26.7	29.5	5.0	24	10	131.1	41	38.9	42	X
TLP26A	TLP26CA	28.9	31.9	5.0	26	10	121.1	38	42.1	46	X
TLP28A	TLP28CA	31.1	34.4	5.0	28	10	112.3	35	45.4	49	X
TLP30A	TLP30CA	33.3	36.8	5.0	30	10	105.4	33	48.4	52	X
TLP33A	TLP33CA	36.7	40.6	5.0	33	10	95.7	30	53.3	57	X
TLP36A	TLP36CA	40.0	44.2	5.0	36	10	87.8	28	58.1	62	X
TLP40A	TLP40CA	44.4	49.1	5.0	40	10	79.1	25	64.5	68	X

## Notes:

 1. V<sub>BR</sub> measured after I<sub>R</sub> applied for 300μs, I<sub>T</sub>= square wave pulse or equivalent.

2. All terms and symbols are consistent with ANSI/IEEE C62.35.

**Screen Process**

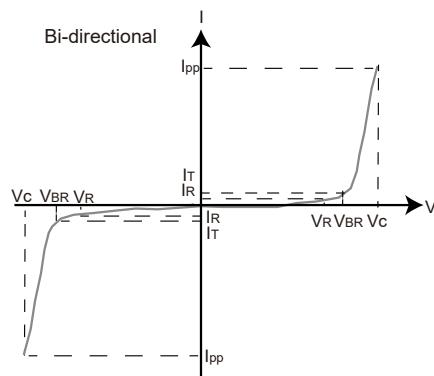
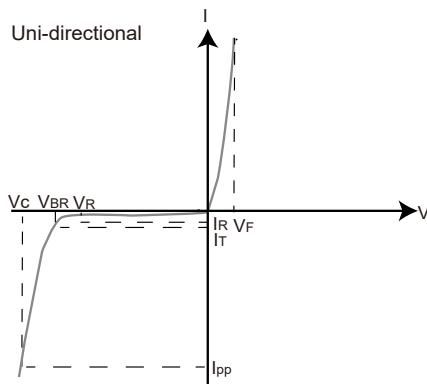
<b>100% Vision Inspection</b>	MIL-STD-750 method 2074
<b>100% High Temperature Storage Life (168hrs,175°C)</b>	MIL-STD-750 method 1031
<b>100% Temperature Cycle Test (-55 to 150°C, 20 cycles, dwell time 15 min)</b>	MIL-STD-750 method 1051
<b>100% Surge Test (2x)</b>	MIL-STD-750 method 4066
<b>100% HTRB 150°C Bias=VR(80% breakdown voltage, 96hrs, and each direction 96hrs for Bi-directional products)</b>	MIL-STD-750 method 1038
<b>Final Electrical Test( 100% 3 sigma limit, 100% dynamic test and PAT limit)</b>	MIL-STD-750 method 4016.4021.4011

Note: Up-screen program can be specified by customer's request by contacting Littelfuse customer service

**Group B Test Requirement**

Screen	Method	Condition	Requirement
Surge test	10/1000 μs Peak Pulse Waveform	Maximum clamping Voltage (V <sub>C</sub> ) @ Peak Pulse Current (I <sub>PP</sub> )	Sample Size 45 perform 10x Accept 0 failures
Burn - In (HTRB)	MIL-STD-750, Method 1038.5	Applied voltage 100% V <sub>R</sub> @150°C	Sample size 45 340 hours (680 hours for bi-direction products, each direction 340 hours) Accept 0 failures
Electrical test	–	I <sub>R</sub> @V <sub>R</sub> , V <sub>BR</sub> @I <sub>T</sub>	Sample size 45 Accept 0 failures

### I-V Curve Characteristics



**P<sub>ppm</sub>** **Peak Pulse Power Dissipation** ( $I_{pp} \times V_c$ ) – Max power dissipation

**V<sub>R</sub>** **Stand-off Voltage** – Maximum voltage that can be applied to the TVS without operation

**V<sub>BR</sub>** **Breakdown Voltage** – Maximum voltage that flows through the TVS at a specified test current ( $I_T$ )

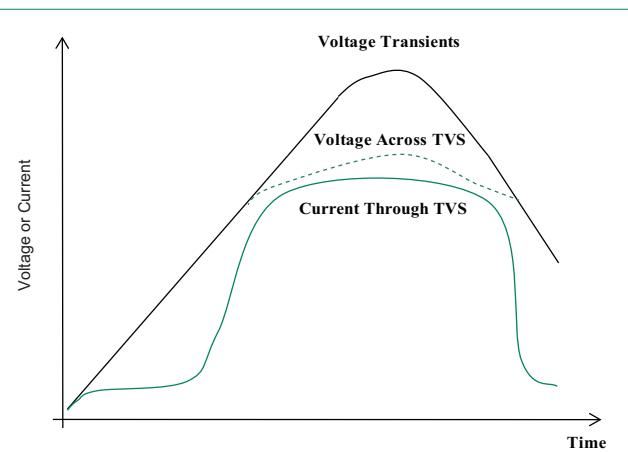
**V<sub>c</sub>** **Clamping Voltage** – Peak voltage measured across the TVS at a specified Ippm (peak impulse current)

**I<sub>R</sub>** **Reverse Leakage Current** – Current measured at  $V_R$

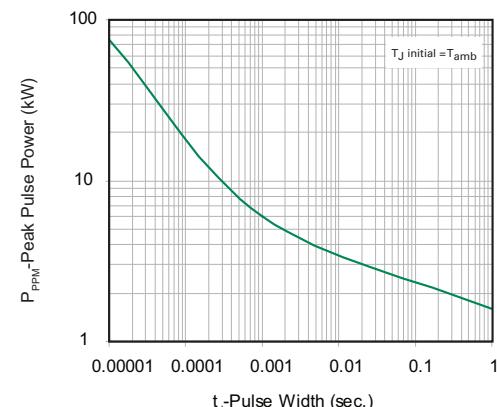
**V<sub>F</sub>** **Forward Voltage Drop for Uni-directional**

### Ratings and Characteristic Curves ( $T_A=25^\circ\text{C}$ unless otherwise noted)

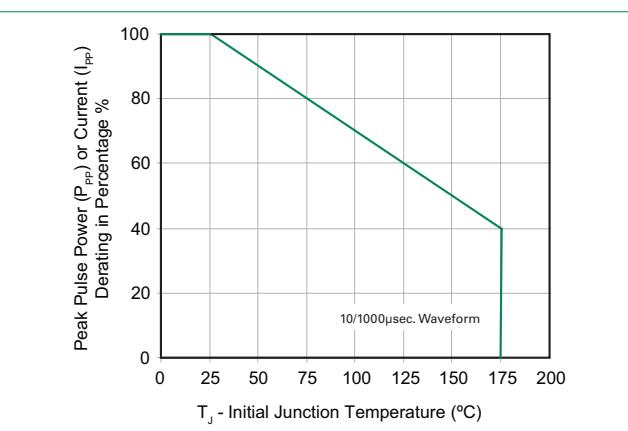
**Figure 1 - TVS Transients Clamping Waveform**



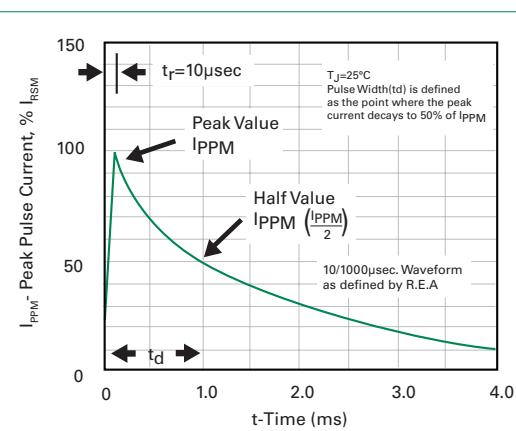
**Figure 2 - Peak Pulse Power Rating Curve**

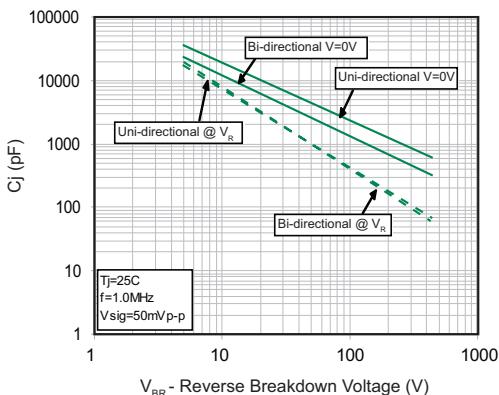
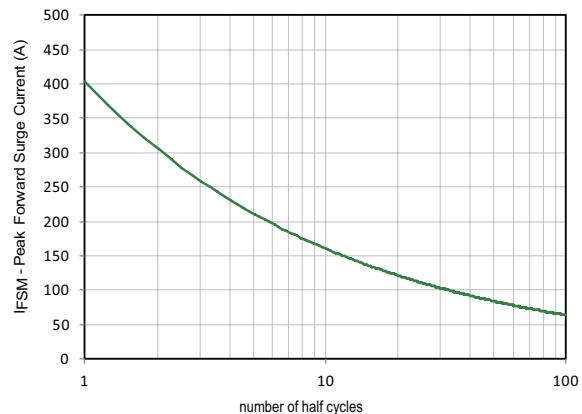


**Figure 3 - Pulse Derating Curve**



**Figure 4 - Pulse Waveform**



**Figure 5 - Typical Junction Capacitance**

**Figure 6 - Maximum Non-Repetitive Peak Forward Surge Current Uni-Directional Only**

**Physical Specifications**

<b>Weight</b>	0.07oz., 2.1g
<b>Case</b>	P600 molded plastic body over passivated junction.
<b>Polarity</b>	Color band denotes cathode for unidirectional components
<b>Terminal</b>	Matte Tin axial leads, solderable per JESD22-B102.

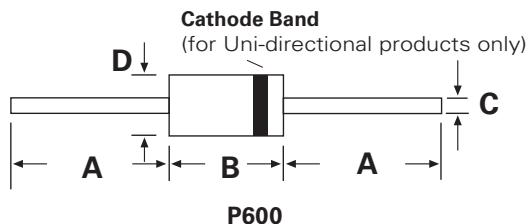
**Flow/Wave Soldering (Solder Dipping)**

<b>Peak Temperature :</b>	265°C
<b>Dipping Time :</b>	10 seconds
<b>Soldering :</b>	1 time

**Environmental Specifications**

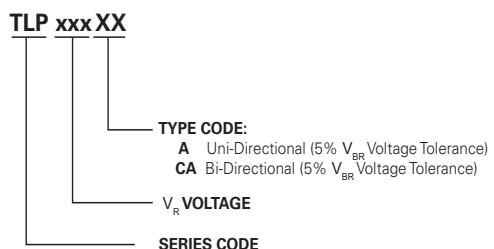
<b>High Temp. Storage</b>	JESD22-A103
<b>HTRB</b>	JESD22-A108
<b>Temperature Cycling</b>	JESD22-A104
<b>H3TRB</b>	JESD22-A101
<b>RSH</b>	JESD22-B106

### Dimensions

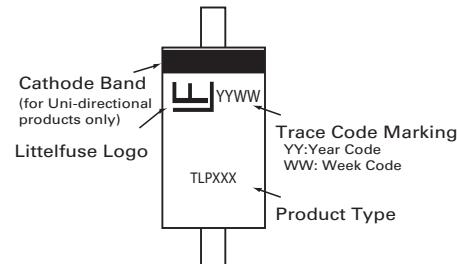


Dimensions	Inches		Millimeters	
	Min	Max	Min	Max
A	1.000	-	25.40	-
B	0.340	0.360	8.60	9.10
C	0.048	0.054	1.22	1.36
D	0.340	0.360	8.60	9.10

### Part Numbering System



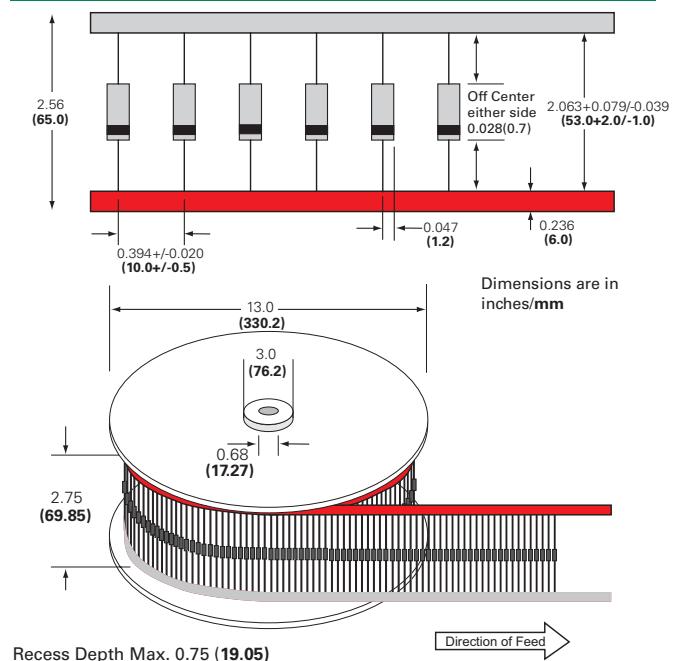
### Part Marking System



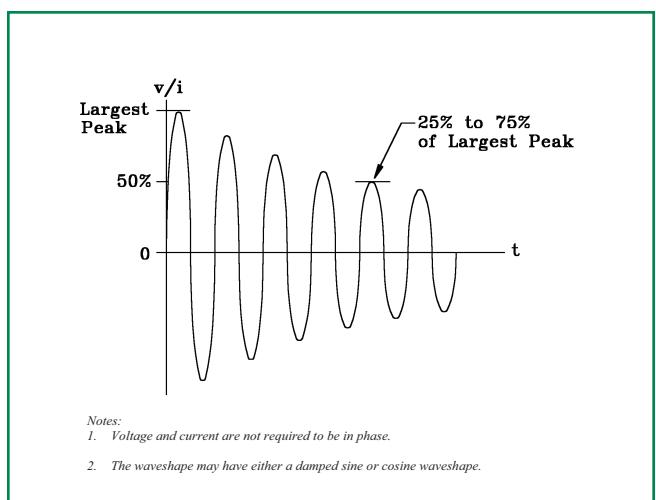
### Packing Options

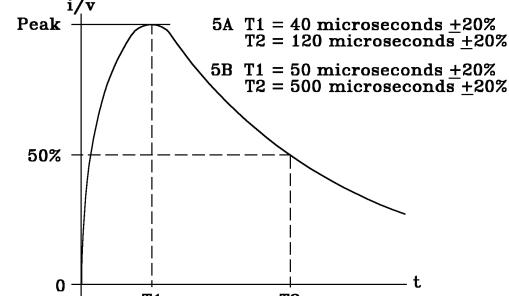
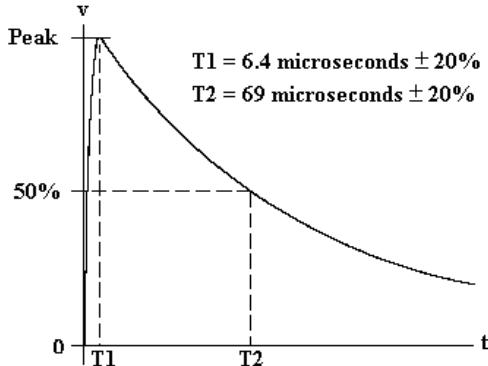
Part Number	Component Package	Quantity	Packaging Option	Packaging Specification
TLPxxXXX	P600	800	Tape & Reel	EIA STD RS-296

### Tape and Reel Specification



### RTCA/DO-160G Wave 3



**RTCA/DO-160G Wave 4 and Wave 5**

**Pin Injection Protection Per RTCA/DO-160G**

Part Number (Uni)	Part Number (Bi)	25C						70C						120C						
		Wave 3		Wave 4 (6.4/69us)		Wave 5a (40/120us)		Wave 3		Wave 4 (6.4/69us)		Wave 5a (40/120us)		Wave 3		Wave 4 (6.4/69us)		Wave 5a (40/120us)		
		L5	L3	L4	L5	L3	L4	L5	L5	L3	L4	L5	L3	L4	L5	L3	L4	L5	L3	L4
TLPA10A	TLPA10CA	pass	pass	pass	pass	pass	pass	-	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass
TLPA11A	TLPA11CA	pass	pass	pass	pass	pass	pass	-	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass
TLPA12A	TLPA12CA	pass	pass	pass	pass	pass	pass	-	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	-
TLPA13A	TLPA13CA	pass	pass	pass	pass	pass	pass	-	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	-
TLPA14A	TLPA14CA	pass	pass	pass	pass	pass	pass	-	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	-
TLPA15A	TLPA15CA	pass	pass	pass	pass	pass	pass	-	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass	-
TLPA16A	TLPA16CA	pass	pass	pass	pass	pass	pass	-	pass	pass	pass	pass	pass	pass	-	pass	pass	pass	pass	-
TLPA17A	TLPA17CA	pass	pass	pass	pass	pass	pass	-	-	pass	pass	pass	pass	pass	-	pass	pass	pass	pass	-
TLPA18A	TLPA18CA	pass	pass	pass	pass	pass	pass	-	-	pass	pass	pass	pass	pass	-	pass	pass	pass	pass	-
TLPA20A	TLPA20CA	pass	pass	pass	pass	pass	pass	-	-	pass	pass	pass	pass	pass	-	pass	pass	pass	pass	-
TLPA22A	TLPA22CA	pass	pass	pass	pass	pass	pass	-	-	pass	pass	pass	pass	pass	-	pass	pass	pass	pass	-
TLPA24A	TLPA24CA	pass	pass	pass	pass	pass	pass	-	-	pass	pass	pass	pass	pass	-	-	pass	pass	pass	-
TLPA26A	TLPA26CA	pass	pass	pass	pass	pass	pass	-	-	pass	pass	pass	pass	pass	-	-	pass	pass	pass	-
TLPA28A	TLPA28CA	pass	pass	pass	pass	pass	pass	-	-	pass	pass	pass	pass	pass	-	-	pass	pass	pass	-
TLPA30A	TLPA30CA	pass	pass	pass	pass	pass	pass	-	-	pass	pass	pass	pass	pass	-	-	pass	pass	pass	-
TLPA33A	TLPA33CA	pass	pass	pass	pass	pass	pass	-	-	pass	pass	pass	pass	pass	-	-	pass	pass	pass	-
TLPA36A	TLPA36CA	pass	pass	pass	pass	pass	pass	-	-	pass	pass	pass	pass	pass	-	-	pass	pass	pass	-
TLPA40A	TLPA40CA	pass	pass	pass	pass	pass	pass	-	-	pass	pass	pass	pass	pass	-	-	pass	pass	pass	-

Note:

1. L1 = Level1, L2 = Level 2, L3 = Level 3, L4 = Level 4, L5 = Level 5

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