

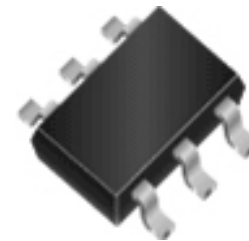
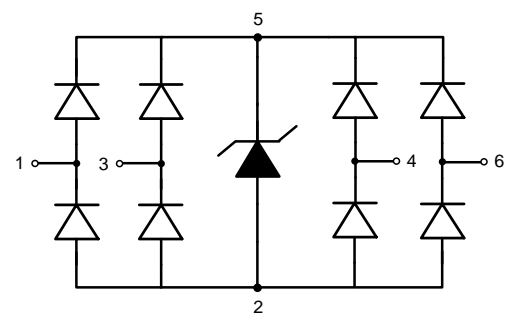
**ESD5465E**
**4-Lines, Uni-directional, Low Capacitance  
Transient Voltage Suppressors**
<http://www.sh-willsemi.com>
**Descriptions**

The ESD5465E is a low capacitance TVS (Transient Voltage Suppressor) array designed to protect high speed data interfaces. It has been specifically designed to protect sensitive electronic components which are connected to data and transmission lines from over-stress caused by ESD (Electrostatic Discharge).

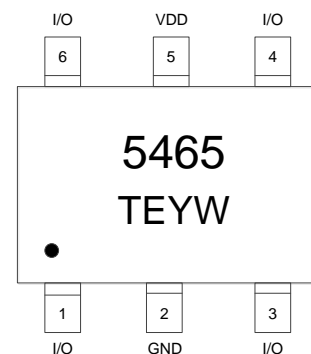
The ESD5465E incorporates four pairs of low capacitance steering diodes plus a TVS diode.

The ESD5465E may be used to provide ESD protection up to  $\pm 30\text{kV}$  (contact discharge) according to IEC61000-4-2, and withstand peak pulse current up to 40A (5/50ns) according to IEC61000-4-4, 15A (8/20 $\mu\text{s}$ ) according to IEC61000-4-5.

The ESD5465E is available in SOT23-6L package. Standard products are Pb-free and Halogen-free.


**SOT23-6L**

**Circuit diagram**
**Features**

- Reverse stand-off voltage: 5V max.
- Transient protection for each line according to  
IEC61000-4-2 (ESD):  $\pm 30\text{kV}$  (contact discharge)  
IEC61000-4-4 (EFT): 40A (5/50ns, Any I/O to GND)  
IEC61000-4-5 (surge): 15A (8/20 $\mu\text{s}$ , Any I/O to GND)  
50A (8/20 $\mu\text{s}$ , VDD to GND)
- Low capacitance:  $C_{I/O-GND} = 1.8\text{pF typ.}$
- Ultra-low leakage current:  $I_R < 10\text{nA typ.}$
- Low clamping voltage:  $V_{CL} = 13\text{V @ } I_{PP} = 16\text{A (TLP)}$
- Solid-state silicon technology



5465 = Device code  
TE = Special code  
YW = Date code

**Marking & Pin configuration (Top View)**
**Applications**

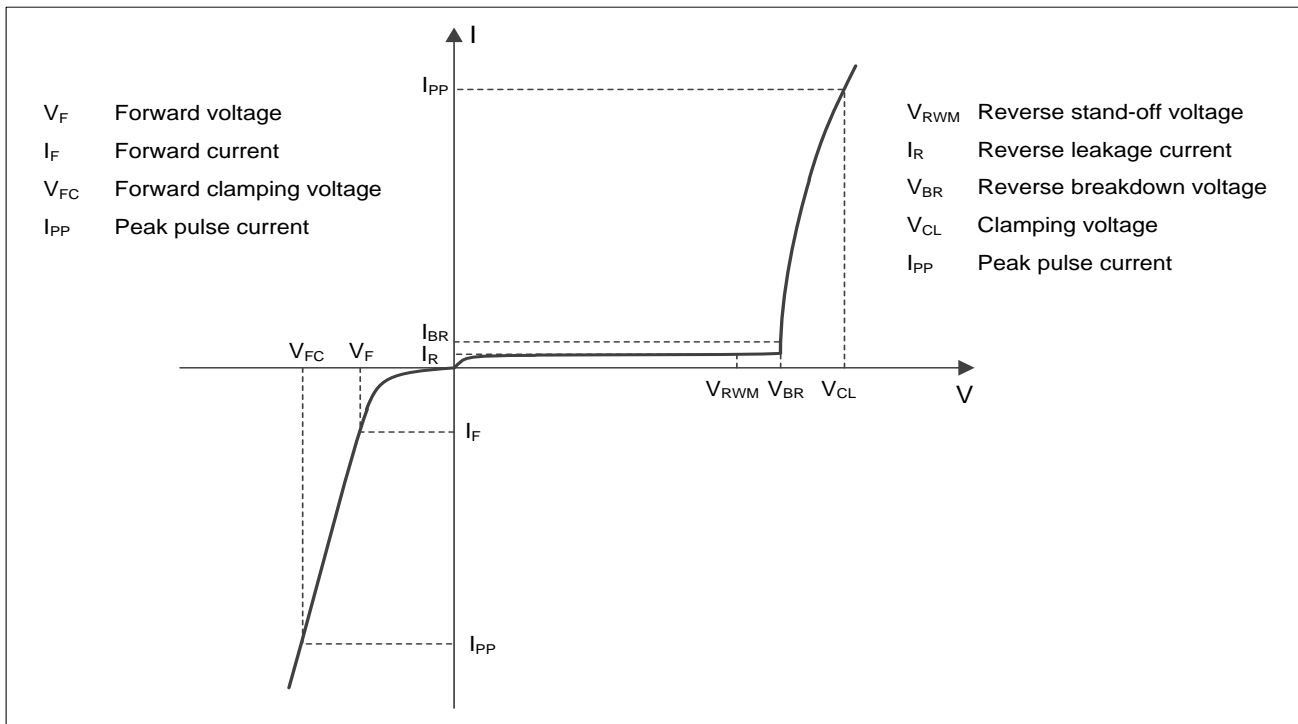
- USB 2.0
- Video Graphics Cards
- DVI
- IEEE 1394
- Monitors and Flat Panel Displays
- 10/100 Ethernet
- Notebooks

**Order information**

Device	Package	Shipping
ESD5465E-6/TR	SOT23-6L	3000/Tape&Reel

**Absolute maximum ratings**

Parameter	Symbol	Rating	Unit
<b>Any IO Pin</b>			
Peak pulse power ( $t_p = 8/20\mu s$ )	$P_{pk}$	240	W
Peak pulse current ( $t_p = 8/20\mu s$ )	$I_{PP}$	15	A
ESD according to IEC61000-4-2 air discharge	$V_{ESD}$	$\pm 30$	kV
ESD according to IEC61000-4-2 contact discharge		$\pm 30$	
Junction temperature	$T_J$	125	$^{\circ}C$
Operation temperature	$T_{OP}$	-40 to 85	$^{\circ}C$
Storage temperature	$T_{STG}$	-55 to 150	$^{\circ}C$
Lead temperature	$T_L$	260	$^{\circ}C$
<b>VDD Pin</b>			
Peak pulse power ( $t_p = 8/20\mu s$ )	$P_{pk}$	900	W
Peak pulse current ( $t_p = 8/20\mu s$ )	$I_{PP}$	50	A
ESD according to IEC61000-4-2 air discharge	$V_{ESD}$	$\pm 30$	kV
ESD according to IEC61000-4-2 contact discharge		$\pm 30$	
Junction temperature	$T_J$	125	$^{\circ}C$
Operation temperature	$T_{OP}$	-40 to 85	$^{\circ}C$
Storage temperature	$T_{STG}$	-55 to 150	$^{\circ}C$
Lead temperature	$T_L$	260	$^{\circ}C$

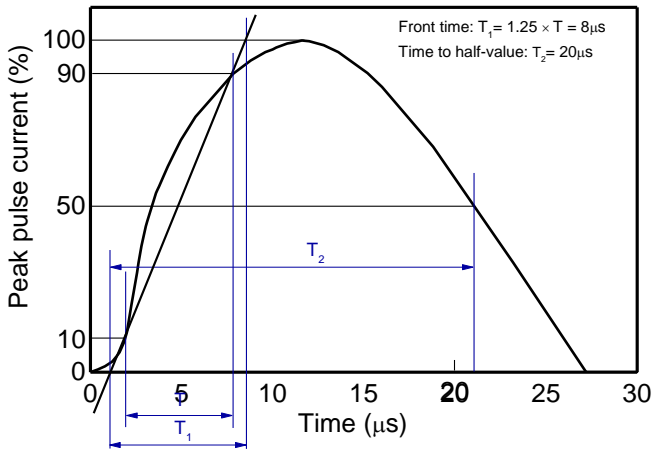
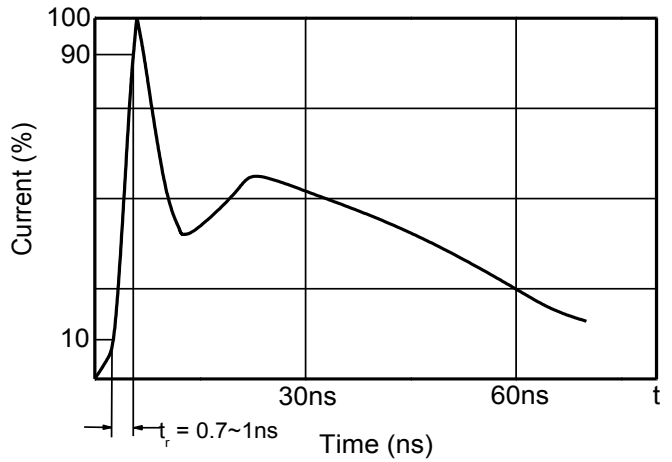
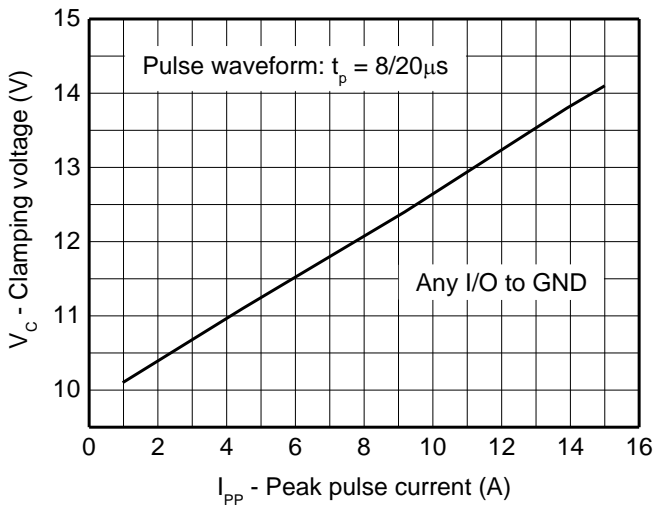
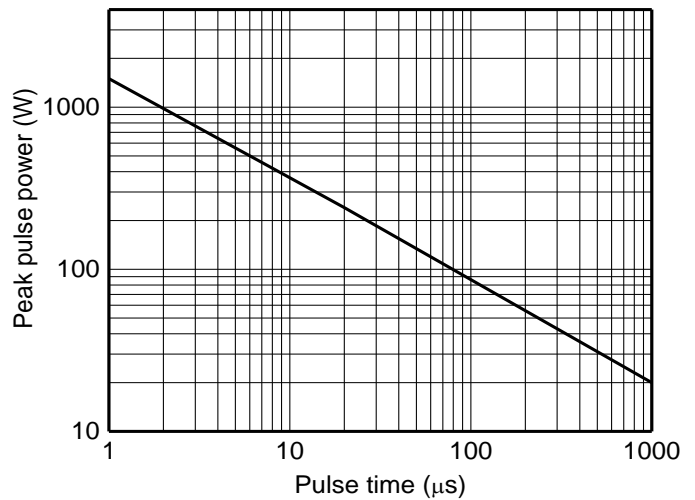
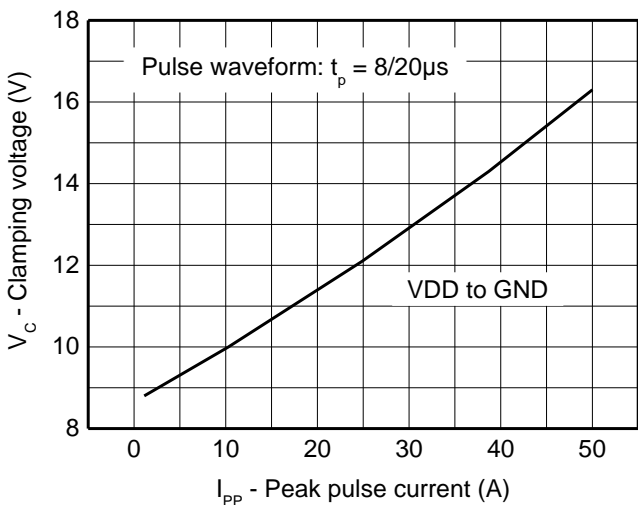
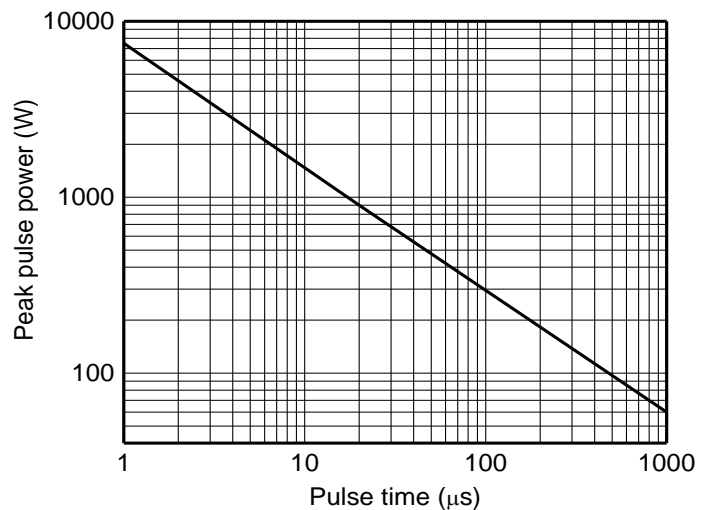
**Electrical characteristics ( $T_A = 25^{\circ}C$ , unless otherwise noted)**

**Definitions of electrical characteristics**

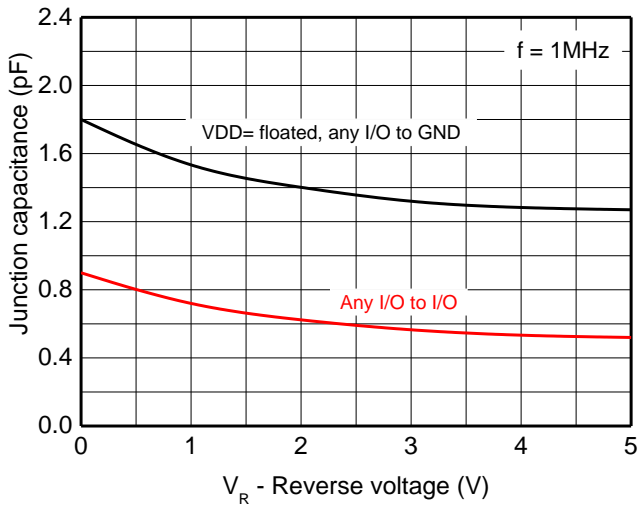
**Electrical characteristics (T<sub>A</sub> = 25°C, unless otherwise noted)**

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
<b>Any IO Pin</b>						
Reverse stand-off voltage	V <sub>RWM</sub>				5.0	V
Reverse leakage current	I <sub>R</sub>	V <sub>RWM</sub> = 5V		<10	100	nA
Reverse breakdown voltage	V <sub>BR</sub>	I <sub>BR</sub> = 1mA	7.0	8.5	10.0	V
Forward voltage	V <sub>F</sub>	I <sub>F</sub> = 10mA	0.6	0.9	1.2	V
Clamping voltage <sup>1)</sup>	V <sub>CL</sub>	I <sub>PP</sub> = 16A, t <sub>p</sub> = 100ns		13		V
Dynamic resistance <sup>1)</sup>	R <sub>DYN</sub>	t <sub>p</sub> = 100ns		0.2		Ω
Clamping voltage <sup>2)</sup>	V <sub>CL</sub>	V <sub>ESD</sub> = 8kV		14		V
Clamping voltage <sup>3)</sup>	V <sub>CL</sub>	I <sub>PP</sub> = 1A, t <sub>p</sub> = 8/20μs			12	V
		I <sub>PP</sub> = 15A, t <sub>p</sub> = 8/20μs			16	V
Junction capacitance	C <sub>I/O - GND</sub>	V <sub>R</sub> = 0V, f = 1MHz, VDD = floated, any I/O to GND		1.8	3.0	pF
	C <sub>I/O - I/O</sub>	V <sub>R</sub> = 0V, f = 1MHz, any I/O to I/O		0.9	1.8	pF
<b>VDD Pin</b>						
Reverse stand-off voltage	V <sub>RWM</sub>				5	V
Reverse leakage current	I <sub>R</sub>	V <sub>RWM</sub> = 5V		<10	100	nA
Reverse breakdown voltage	V <sub>BR</sub>	I <sub>BR</sub> = 1mA	6.5	8.0	9.5	V
Forward voltage	V <sub>F</sub>	I <sub>F</sub> = 10mA	0.5	0.8	1.1	V
Clamping voltage <sup>3)</sup>	V <sub>CL</sub>	I <sub>PP</sub> = 1A, t <sub>p</sub> = 8/20μs			10	V
		I <sub>PP</sub> = 50A, t <sub>p</sub> = 8/20μs			18	V
Junction capacitance	C <sub>J</sub>	V <sub>R</sub> = 0V, f = 1MHz, VDD to GND		300	450	pF

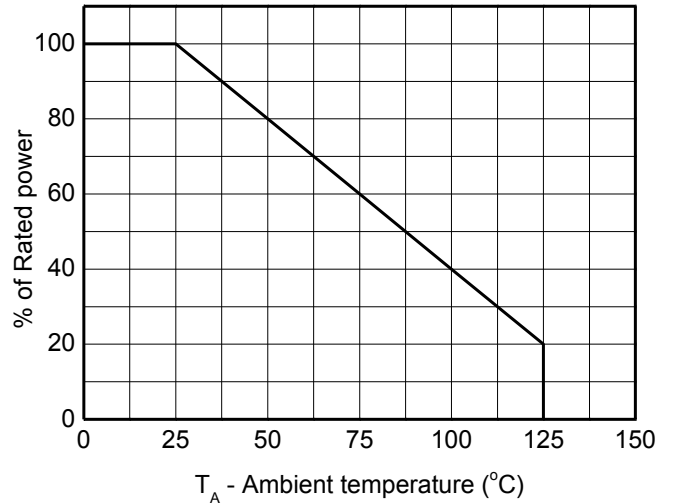
**Notes:**

- 1) TLP parameter: Z<sub>0</sub> = 50Ω, t<sub>p</sub> = 100ns, t<sub>r</sub> = 2ns, averaging window from 60ns to 80ns. R<sub>DYN</sub> is calculated from 4A to 16A.
- 2) Contact discharge mode, according to IEC61000-4-2.
- 3) Non-repetitive current pulse, according to IEC61000-4-5.

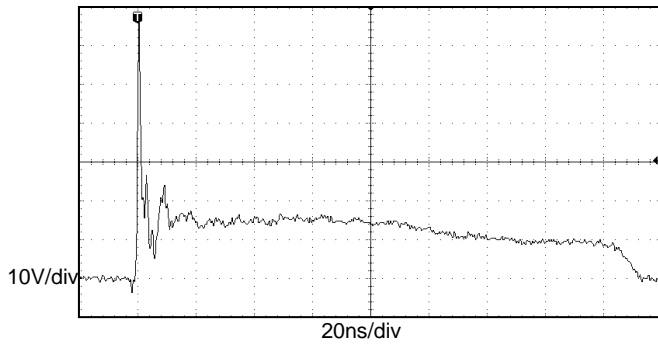
**Typical characteristics ( $T_A = 25^\circ\text{C}$ , unless otherwise noted)**

**8/20 $\mu\text{s}$  waveform per IEC61000-4-5**

**Contact discharge current waveform per IEC61000-4-2**

**Clamping voltage vs. Peak pulse current  
(Any IO Pin)**

**Non-repetitive peak pulse power vs. Pulse time  
(Any IO Pin)**

**Clamping voltage vs. Peak pulse current  
(VDD Pin)**

**Non-repetitive peak pulse power vs. Pulse time  
(VDD Pin)**

**Typical characteristics ( $T_A = 25^\circ\text{C}$ , unless otherwise noted)**


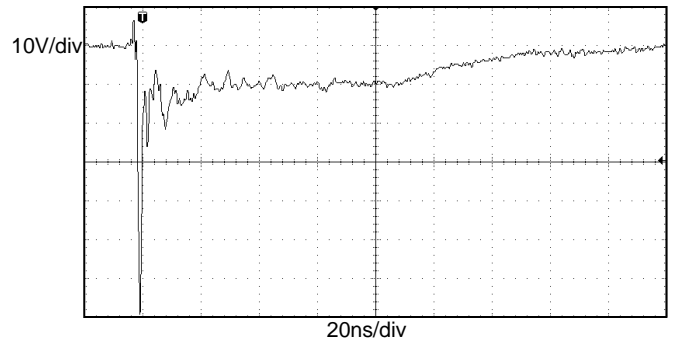
**Capacitance vs. Reverse voltage  
(Any IO Pin)**



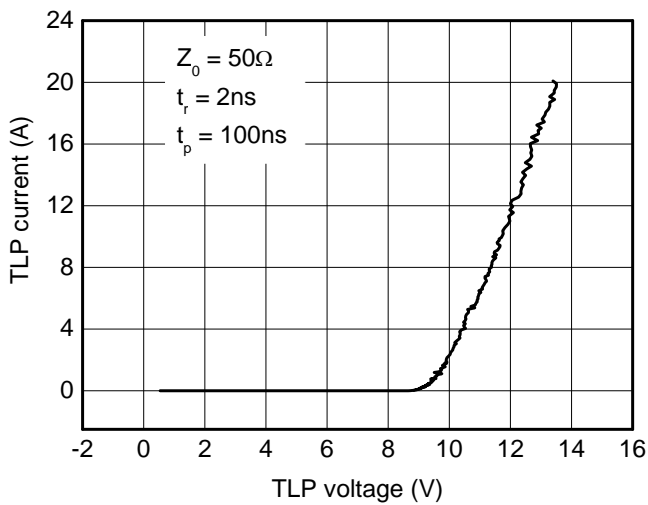
**Power derating vs. Ambient temperature**



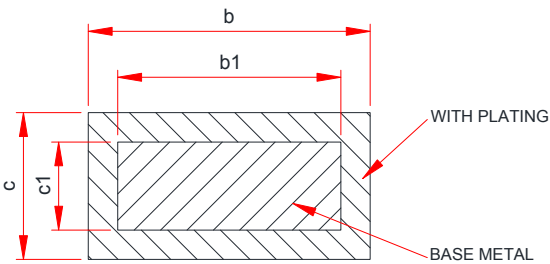
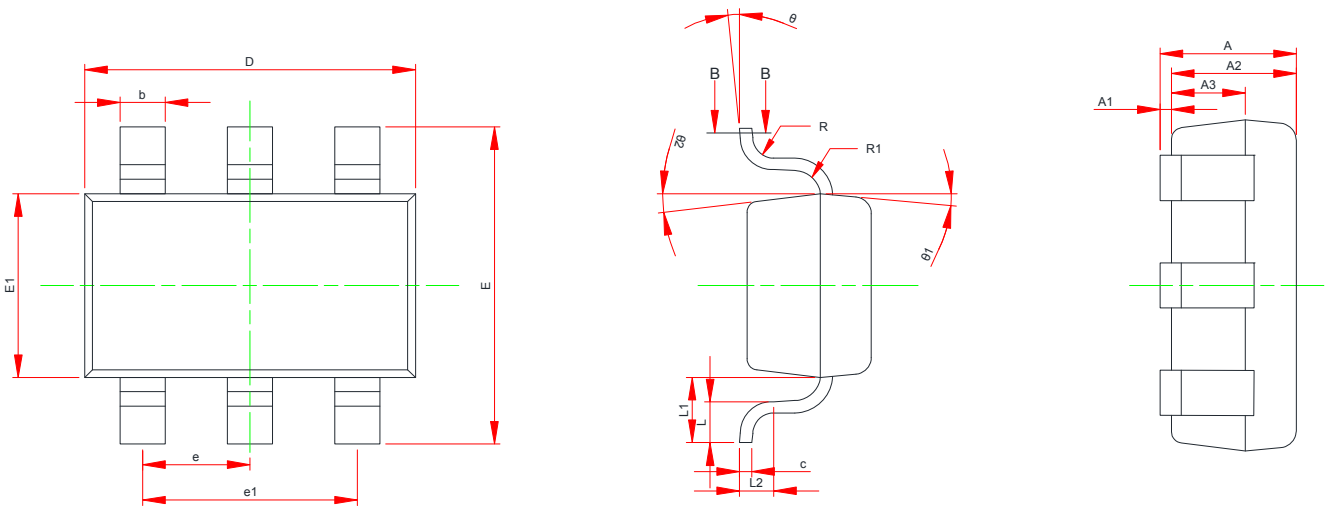
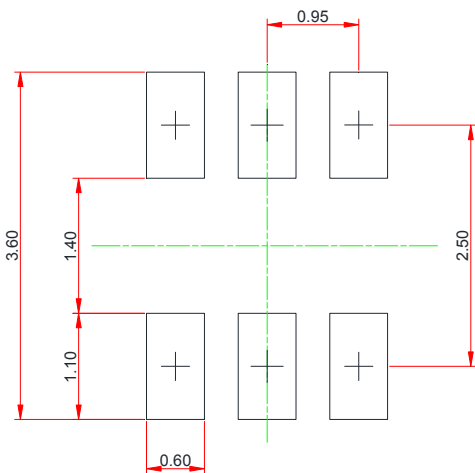
**ESD clamping  
(+8kV contact discharge per IEC61000-4-2)  
(Any IO Pin)**



**ESD clamping  
(-8kV contact discharge per IEC61000-4-2)  
(Any IO Pin)**



**TLP Measurement  
(Any IO Pin)**

**Package outline dimensions**
**SOT23-6L**

**SECTION B-B**
**Recommended land pattern (Unit: mm)**

**Notes:**

This recommended land pattern is for reference purposes only. Please consult your manufacturing group to ensure your PCB design guidelines are met.

Symbol	Dimensions In Millimeters		
	Min.	Typ.	Max.
A	--	--	1.250
A1	0.000	--	0.150
A2	1.000	1.100	1.200
A3	0.600	0.650	0.700
b	0.360	--	0.500
b1	0.360	0.380	0.450
c	0.140	--	0.200
c1	0.140	0.150	0.160
D	2.826	2.926	3.026
E	2.600	2.800	3.000
E1	1.526	1.626	1.726
e	0.900	0.950	1.000
e1	1.800	1.900	2.000
L	0.350	0.450	0.600
L1	0.590REF		
L2	0.250BSC		
R	0.100	--	--
R1	0.100	--	0.200
θ	0°	--	8°
θ1	3°	5°	7°
θ2	6°	--	14°