



DLP3V3DTZ

DUAL UNIDIRECTIONAL AND SINGLE BIDIRECTIONAL TVS

General Description

- This Transient Voltage Suppressor (TVS) diode is designed for dual uni-directional or single bi-directional protection for data lines, components or circuits from damage due to electrostatic discharge (ESD), cable discharge events (CDE) and lightning (see I_{PPM} below). It offers high ESD capability, low reverse leakage, low junction capacitance and low clamping voltage over range of temperature. They are suitable for computers, communication systems, hand held portables, high density PC boards and peripherals.

Features

- 372 Watts Peak Pulse Power ($t_p=8/20 \mu s$)
- AEC-Q101 (Human Body Model- 8kV, Machine Model-400V) and 25 KV(air)/ 8 KV(contact) as per IEC61000-4-2(ESD)
- Dual Unidirectional and Single Bidirectional Configuration
- Lead Free By Design/ROHS Compliant (Note 2)
- "Green" Device (Note 3)
- Surface Mount Package Suited for Automated Assembly

Mechanical Data

- Case: SOT-23
- Case Material: "Green Molding" Compound (Molded Plastic). UL Flammability Classification Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020C
- Terminal Connections: See Fig. 1
- Terminals: Finish - Matte Tin annealed over Alloy 42 leadframe. Solderable per MIL-STD-202, Method 208
- Marking & Type Code Information: See Last Page
- Ordering Information: See Page 6
- Weight: 0.008 grams (approximate)

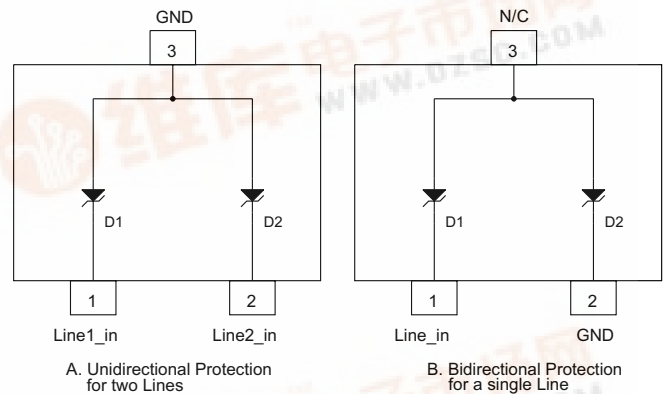
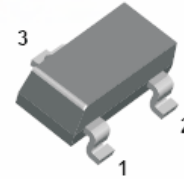


Fig. 1: Schematic and Pin Configuration

Absolute Maximum Ratings @ $T_A = 25^\circ C$ unless otherwise specified

Characteristic	Symbol	Value	Unit
Peak Pulse Power ($t_p=8/20\mu s$)	P_{pp}	372	W
		145	
Continuous Power Dissipation (Note1)	P_d	300	mW
Maximum Peak Pulse Current ($t_p=8/20 \mu s$)	I_{pp}	40	A
		15	
Forward Surge Current (8.3 ms half sine-wave)	I_{FSM}	10.5	A
ESD per IEC 6100-4-2(air)	V_{pp}	± 25	kV
ESD per IEC 6100-4-2(contact)		± 8	

Thermal Characteristics

Characteristic	Symbol	Value	Unit
Operating and Storage Junction Temperature Range	T_j, T_{stg}	-55 to +150	$^\circ C$
Thermal Resistance, Junction to Ambient Air (Note1)	$R_{\theta JA}$	420	$^\circ C/W$

Notes: 1. Device mounted on FR-4 PCB, 1 inch x 0.85 inch x 0.062 inch; as per Diodes Inc. suggested pad layout document AP02001 on our website at <http://www.diodes.com/datasheets/ap02001.pdf>.

2. No purposefully added lead.

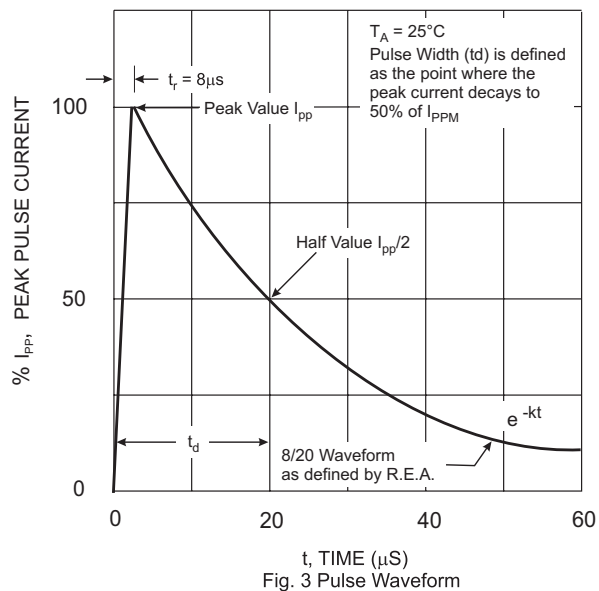
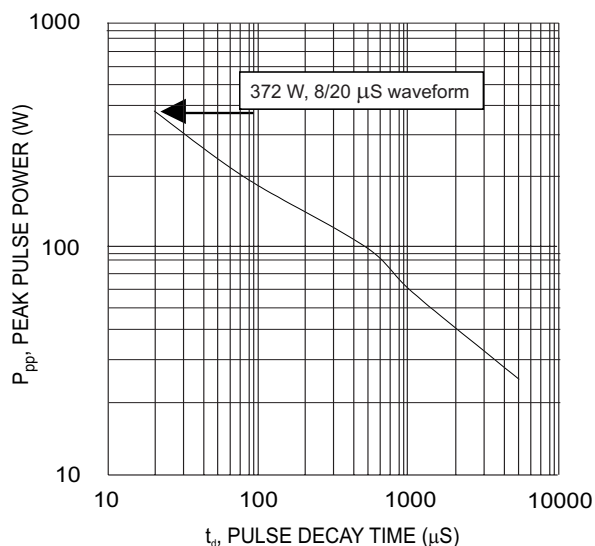
3. Diodes Inc.'s "Green" policy can be found on our website at http://www.diodes.com/products/lead_free/index.php.

Electrical Characteristics @ $T_A = 25^\circ\text{C}$ unless otherwise specified

Characteristic	Symbol	Min	Typ	Max	Unit	Test Condition
Rated Reverse Standoff Voltage	V_{RWM}	—	—	3.3	V	Pin 1 to 3 or Pin 2 to 3
Breakdown Voltage	V_{BR}	4.5	—	—	V	Pin 1 to 3 or Pin 2 to 3 @ $I_T = 1\text{mA}$
Forward Voltage	V_F	—	0.8	—	V	Pin 3 to 1 or Pin 3 to 2, $I_F = 10\text{mA}$
Reverse Leakage Current @ V_{RWM}	I_R	—	—	0.095	mA	Pin 1 to 3 or Pin 2 to 3
Clamping Voltage (Note 4)	Unidirectional	—	—	6.0	V	$I_{pp} = 1\text{A}$ (Pin 1 to 3 or Pin 2 to 3)
	Bidirectional	—	—	7.0		$I_{pp}=1\text{A}$ (Pin 1 to 2 or Pin 2 to 1, Pin 3 = nc)
	Unidirectional	—	—	9.3	V	$I_{pp} = 40\text{A}$ (Pin 1 to 3 or Pin 2 to 3)
	Bidirectional	—	—	9.666		$I_{pp}=15\text{A}$ (Pin 1 to 2 or Pin 2 to 1, Pin 3 = nc)
Junction Capacitance	Unidirectional	—	—	420	pF	$V_R = 0\text{V}$, $f = 1\text{MHz}$
	Bidirectional	—	—	210		
	Unidirectional	—	—	230	pF	$V_R = 3.3\text{V}$, $f = 1\text{MHz}$
	Bidirectional	—	—	115		
Dynamic Resistance @ I_{pp} (large signal)	Unidirectional	R_d	0.115	—	Ω	$I_{pp}=40\text{A}$, $V_c = 9.3\text{V}$, $V_{BR} = 4.5\text{V}$ (Pin 1 to 3 or 2 to 3)
Dynamic Impedance (small signal)	Unidirectional	Z_{zt}	380	—	Ω	$I_R=1\text{mA}$, $f = 1\text{KHz}$ (Pin 1 to 3 or 2 to 3)
			47	—	Ω	$I_R = 5\text{mA}$, $f = 1\text{KHz}$ (Pin 1 to 3 or 2 to 3)
Temperature Coefficient	Unidirectional	θ_{vz}	—	-1.07	mV/ $^\circ\text{C}$	$I_R=5\text{mA}$ (Pin 1 to 3 or 2 to 3)

Notes: 4. Clamping voltage value is based on a $t_p = 8/20\text{ }\mu\text{s}$ peak pulse current (I_{pp}) waveform.

Typical Characteristics @ $T_{amb} = 25^\circ\text{C}$ unless otherwise specified



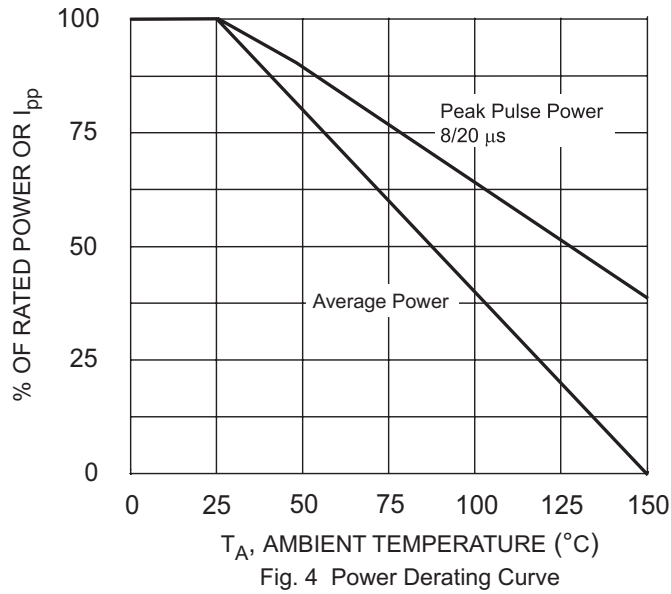


Fig. 4 Power Derating Curve

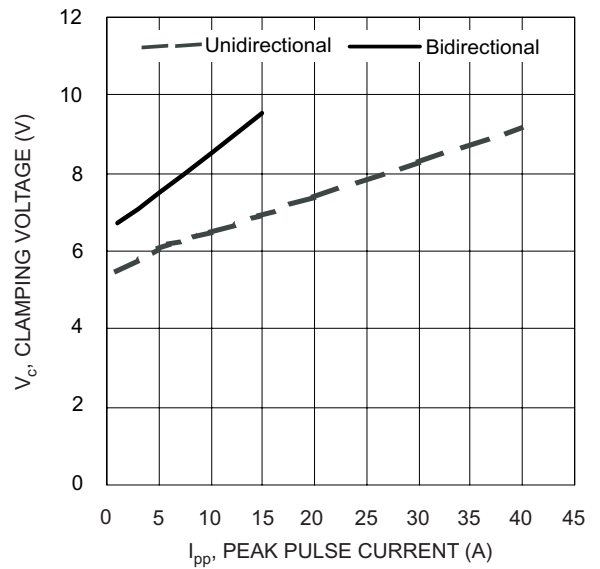


Fig. 5 Clamping Voltage vs. Peak Pulse Current

Single TVS Diode Characteristics:

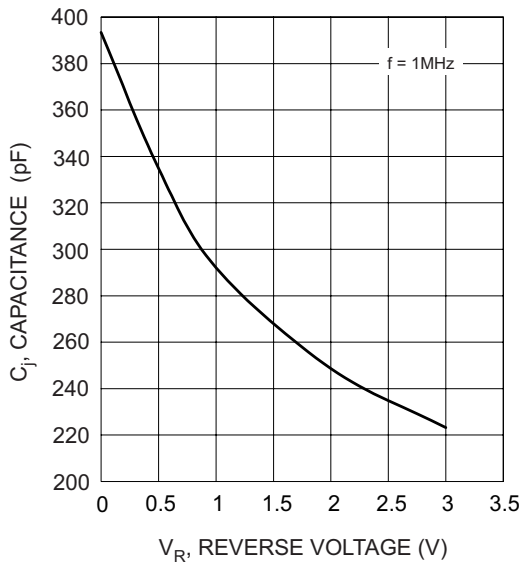


Fig. 6 Junction Capacitance vs. Reverse Voltage

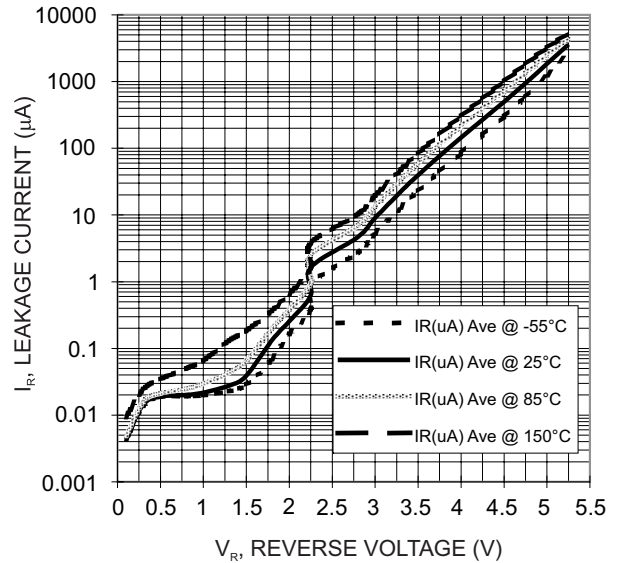


Fig. 7 Leakage Current vs. Reverse Voltage

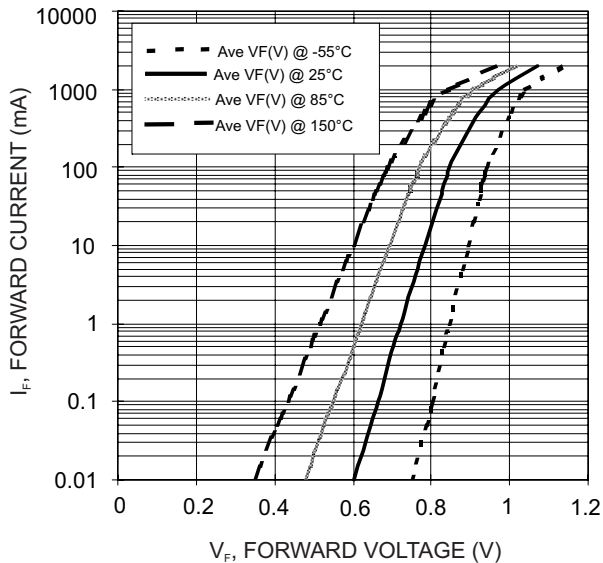


Fig. 8 Typical Forward Characteristic

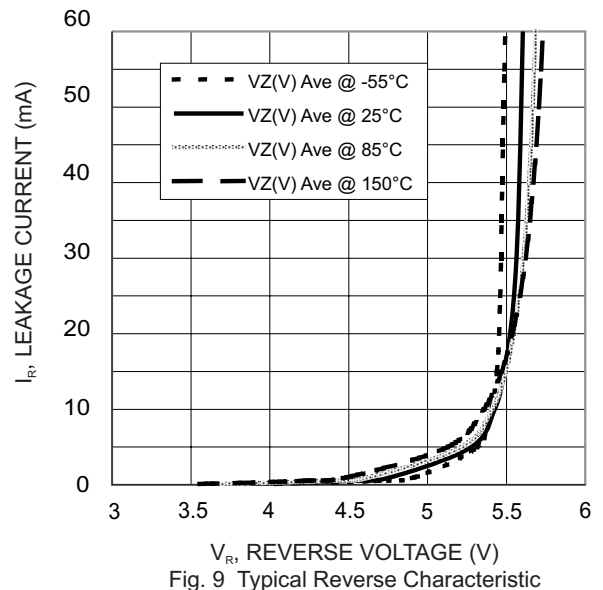


Fig. 9 Typical Reverse Characteristic

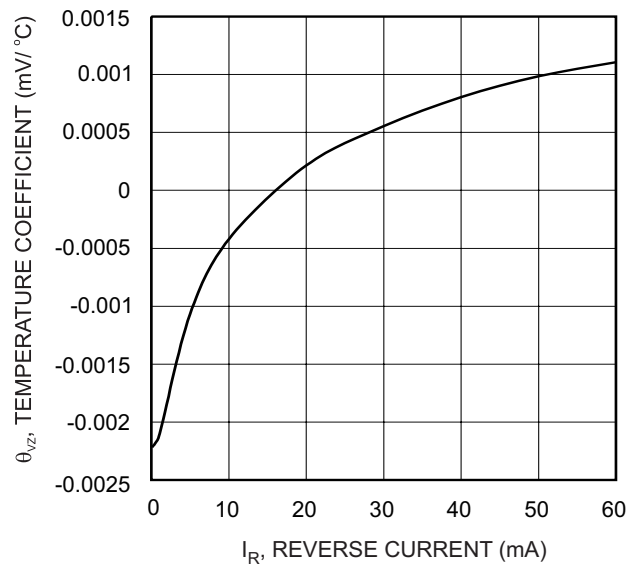


Fig. 10 Temperature Coefficient vs. Reverse Current

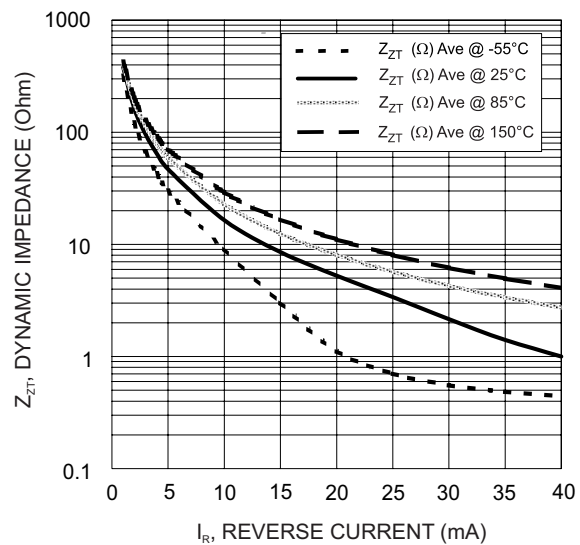


Fig. 11 Dynamic Impedance vs. Reverse Current (Small Signal)

Circuit Diagram

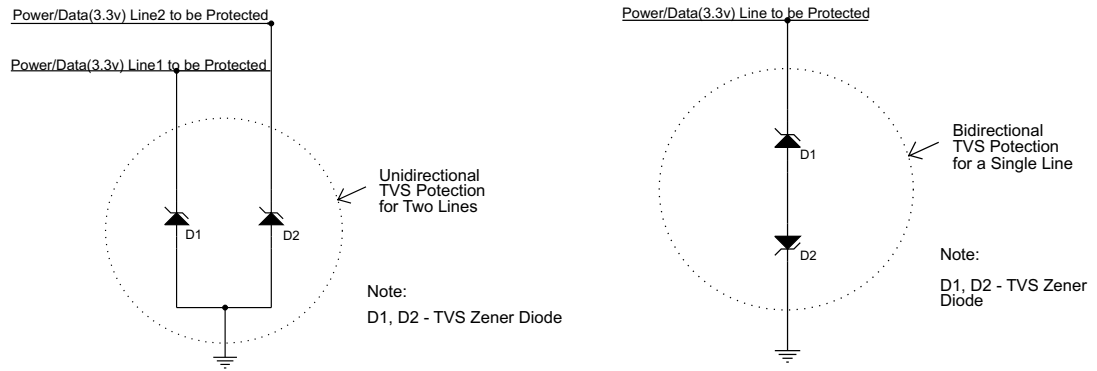


Fig. 12

Typical Application Circuit

Unidirectional Protection for Two 3.3V Dataline

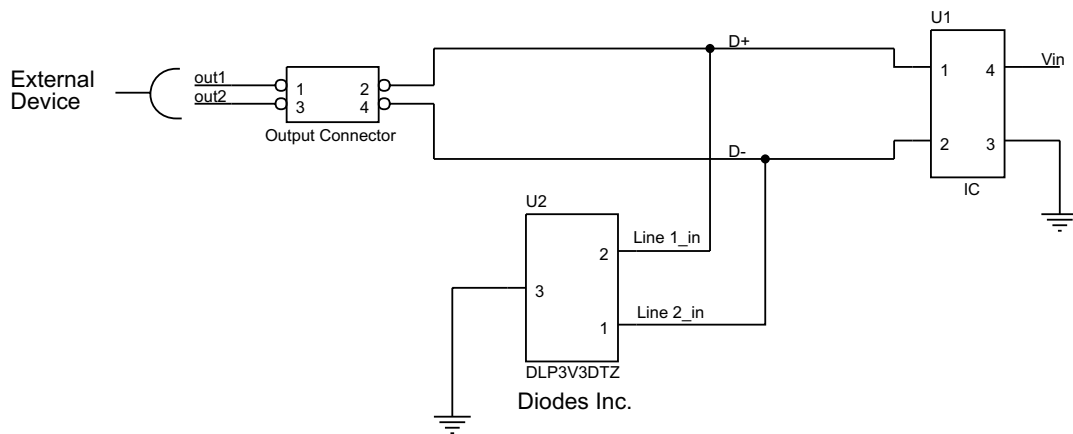


Fig. 13

Bidirectional Protection for 3.3v Power Supply Bus

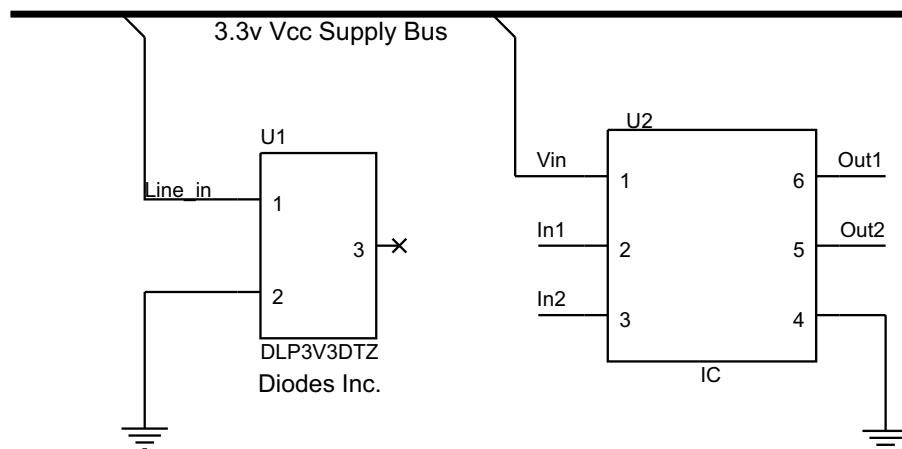


Fig. 14

Application Information

Protection from ESD

It is a fact that ESD is the primary cause of failure in electronic systems. Transient Voltage Suppressors (TVS) are an ideal choice for using as ESD protection devices. They have the capability to clamp the incoming transient to such a low level that the damage to the circuit beyond the device is prevented. Surface mount TVS are the best choice for minimum lead inductance. DLP3V3DTZ is designed to be used as two uni-directional or single bi-directional protection device in a circuit. They serve as parallel protection elements, connected between the signal line to ground. It will present a high impedance to the protected line up to 3.3 volts. As the transient rises above the operating voltage which is the breakdown voltage of the device, the TVS diode becomes a low impedance path diverting the transient current to ground.

Dynamic Resistance to Calculate Clamping Voltage

At times PCB designers need to calculate the clamping voltage V_{CL} . For this reason the dynamic resistance in addition to the typical parameters is listed here. The voltage across the protected circuitry can be calculated as following:

$$V_{CL} = V_{BR} + R_d \cdot I_{pp} \quad (\text{also } V_{CL} = V_z + R_d \cdot I_{pp} \dots \text{for accuracy})$$

e.g. If $I_{pp}=1A$, $V_{CL} = V_z + R_d \cdot I_{pp} = 5.6 \text{ V (from fig. 9)} + 1A \cdot 0.115 \text{ Ohm} = (5.6 + 0.115)V = 5.715 \text{ V}$ (close to actual measured Value)

Where I_{pp} is the peak current through the TVS Diode. The short duration of the ESD has led us to a widely adapted classical test wave, 8/20 μs and 10/1000 μs surges. Since Z_{zt} remains stable for a surge duration less than 20 μs , the 2.5 μs rectangular surge is sufficient for use.

Peak Pulse Power Calculation

The following relation fits well for pulse width less than 10 mS.

$$P_{pp} = K (td)^{-0.5}$$

e.g. $P_{pp} = 372 \text{ watts}$ for pulse width (td) of 20 μs , then $372 \text{ watts} = K (20)^{-0.5}$ and $K = 372 / (20)^{-0.5} = 372 \cdot \sqrt{20} = 1663.63$

Now, P_{pp} when $td = 50 \mu\text{s}$: $P_{pp} = 1663.63 (50)^{-0.5} = 1663.63 / (\sqrt{50}) = 235.27 \text{ watts}$ (close to measured value see fig. 2)

Tips for Circuit Board Layout

Correct layout of the circuit board plays a critical role in preventing ESD induced failures. Some of useful guidelines are given below:

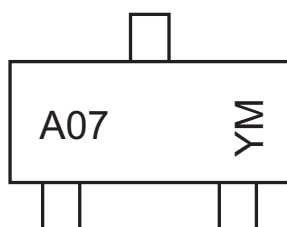
- Trace length between the TVS diode and the circuit or line to be protected should be kept to a minimum.
- Always place a TVS diode as close as possible to the input terminals or connectors if one is required.
- Try to avoid or minimize power and ground loops or any other conductive loops.
- Try to use ground planes whenever feasible rather than a simple ground trace.
- The path to ground for the ESD transient return should be as short as possible.

Ordering Information (Note 5)

Device	Marking Code	Packaging	Shipping
DLP3V3DTZ-7	A07	SOT-23	3000/Tape & Reel

Notes: 5. For Packaging Details, go to our website at <http://www.diodes.com/datasheets/ap02007.pdf>.

Marking Information



A07 = Product Type Marking Code
 YM = Date Code Marking
 Y = Year e.g., T = 2006
 M = Month e.g., 1 = January

Fig. 15

Date Code Key

Year						2005	2006		2007	2008	2009	
Code						S	T		U	V	W	
Month	Jan	Feb	March	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Code	1	2	3	4	5	6	7	8	9	O	N	D

Mechanical Details

NEW PRODUCT

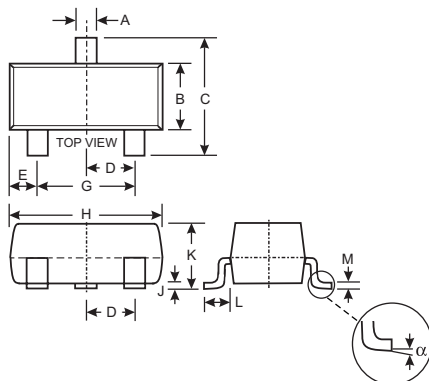


Fig. 16

SOT-23		
Dim	Min	Max
A	0.37	0.51
B	1.20	1.40
C	2.30	2.50
D	0.89	1.03
E	0.45	0.60
G	1.78	2.05
H	2.80	3.00
J	0.013	0.10
K	0.903	1.10
L	0.45	0.61
M	0.085	0.180
α	0°	8°
All Dimensions in mm		

Suggested Pad Layout: (Based on IPC-SM-782)

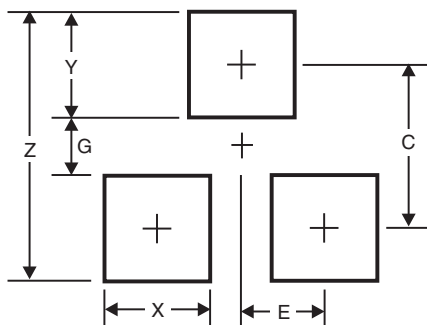


Fig. 17

Fig. 17 Dimensions	SOT-23*
Z	3.4
G	0.7
X	0.9
Y	1.4
C	2.0
E	0.9
All Dimensions in mm	

* Typical values in mm

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