



General Descriptions

- This Transient Voltage Suppressor (TVS) diode is designed for dual unidirectional or single bidirectional protection for data lines, components or circuits from damage due to electrostatic discharge (ESD), cable discharge events (CDE) and lightning (see IPPM 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 ($t_p=8/20 \mu\text{s}$)
- 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 & 4)**
- 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-020
- 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 Page 6
- Ordering Information: See Page 6
- Weight: 0.008 grams (approximate)

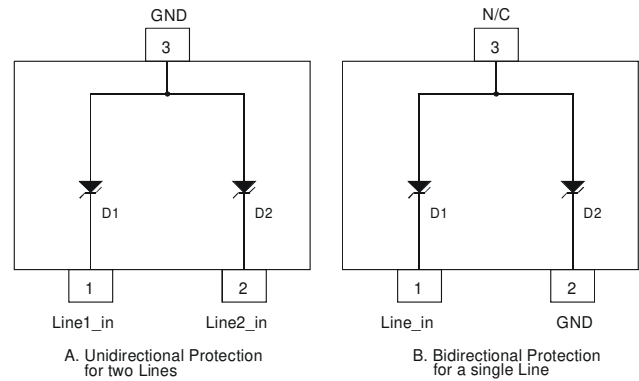


Fig. 1: Schematic and Pin Configuration

Absolute Maximum Ratings @T_A = 25°C unless otherwise specified

| Characteristic | Symbol | Value | Unit |
|---|----------------|----------|------|
| Peak Pulse Power ($t_p=8/20\mu\text{s}$) | Unidirectional | 372 | W |
| | Bidirectional | 145 | |
| Continuous Power Dissipation (Note1) | P_D | 300 | mW |
| Maximum Peak Pulse Current ($t_p=8/20 \mu\text{s}$) | Unidirectional | 40 | A |
| | Bidirectional | 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 | °C |
| Thermal Resistance, Junction to Ambient Air (Note1) | $R_{\theta JA}$ | 420 | °C/W |

- Notes:
- 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>.
 - No purposefully added lead.
 - Diodes Inc.'s "Green" policy can be found on our website at http://www.diodes.com/products/lead_free/index.php.
 - Product manufactured with Date Code 0627 (week 27, 2006) and newer are built with Green Molding Compound. Product manufactured prior to Date Code 0627 are built with Non-Green Molding Compound and may contain Halogens or Sb2O3 Fire Retardants.

Electrical Characteristics

@T_A = 25°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 = 1mA | |
| Forward Voltage | V _F | — | 0.8 | — | V | Pin 3 to 1 or Pin 3 to 2, I _F = 10mA | |
| Reverse Leakage Current @V _{RWM} | I _R | — | — | 0.095 | mA | Pin 1 to 3 or Pin 2 to 3 | |
| Clamping Voltage (Note 5) | Unidirectional | — | — | 6.0 | v | I _{pp} = 1A (Pin 1 to 3 or Pin 2 to 3) | |
| | Bidirectional | — | — | 7.0 | v | I _{pp} = 1A (Pin 1 to 2 or Pin 2 to 1, Pin 3 = nc) | |
| | Unidirectional | — | — | 9.3 | v | I _{pp} = 40A (Pin 1 to 3 or Pin 2 to 3) | |
| | Bidirectional | — | — | 9.666 | v | I _{pp} = 15A (Pin 1 to 2 or Pin 2 to 1, Pin 3 = nc) | |
| Junction Capacitance | Unidirectional | — | — | 420 | pF | V _R = 0V, f = 1 MHz | |
| | Bidirectional | — | — | 210 | pF | | |
| | Unidirectional | — | — | 230 | pF | V _R = 3.3V, f = 1 MHz | |
| | Bidirectional | — | — | 115 | pF | | |
| Dynamic Resistance @ I _{pp} (large signal) | Unidirectional | R _d | — | 0.115 | Ω | I _{pp} = 40A, V _c = 9.3V, V _{BR} = 4.5V (Pin 1 to 3 or 2 to 3) | |
| Dynamic Impedance (small signal) | Unidirectional | Z _{Zt} | — | 380 | — | Ω | I _R = 1 mA, f = 1 KHz (Pin 1 to 3 or 2 to 3) |
| | | | — | 47 | — | Ω | I _R = 5 mA, f = 1 KHz (Pin 1 to 3 or 2 to 3) |
| Temperature Coefficient | Unidirectional | θ _{vz} | — | -1.07 | — | mV/°C I _R = 5 mA (Pin 1 to 3 or 2 to 3) | |

Notes: 5. Clamping voltage value is based on a t_p = 8/20 μs peak pulse current (I_{pp}) waveform.

Typical Characteristics

@T_{amb} = 25°C unless otherwise specified

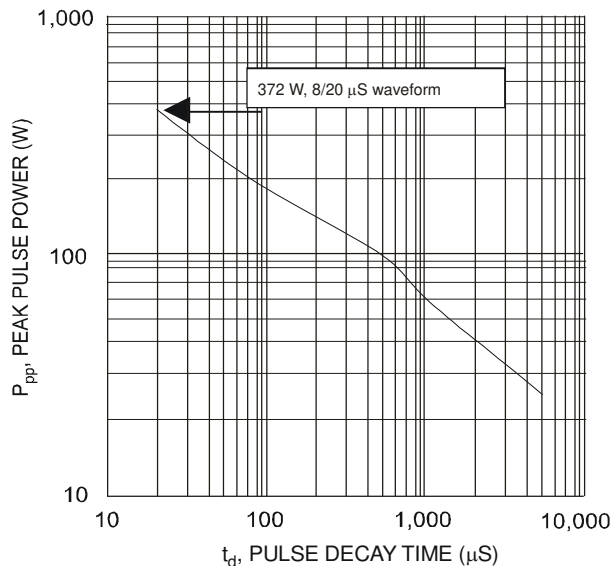


Fig. 2 Unidirectional Non-Repetitive Peak Pulse Power vs. Pulse Duration or Pulse Width

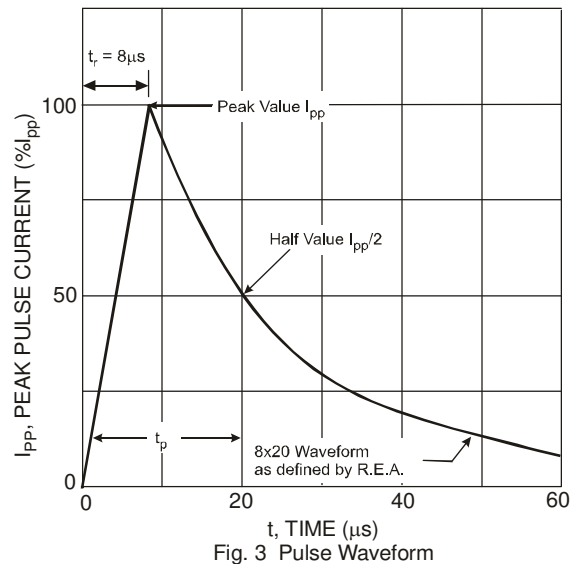


Fig. 3 Pulse Waveform

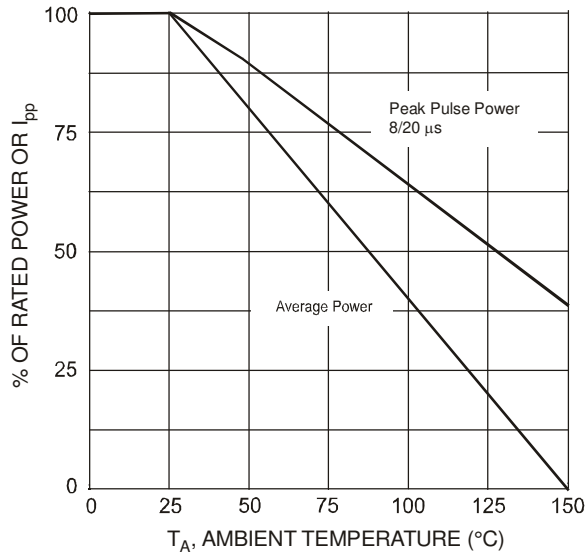


Fig. 4 Power Derating Curve

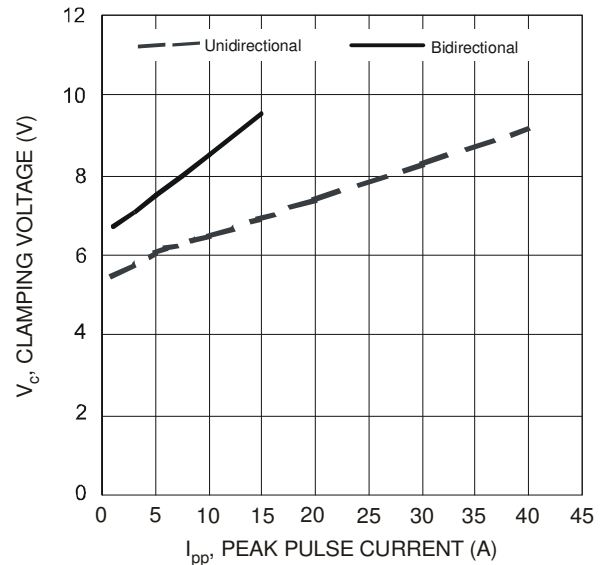


Fig. 5 Clamping Voltage vs. Peak Pulse Current

Single TVS Diode Characteristics:

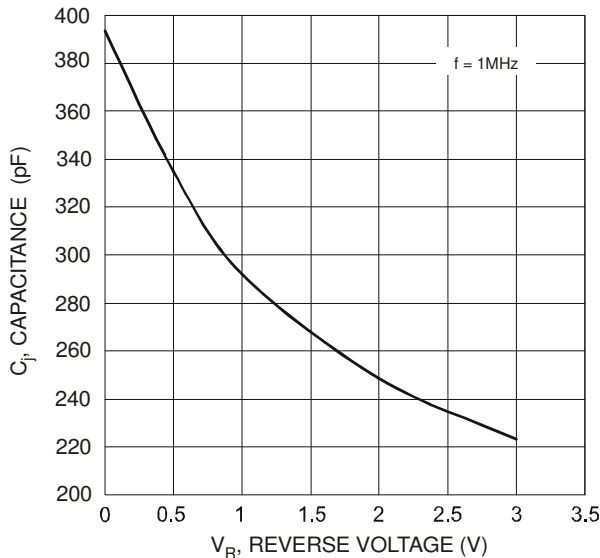


Fig. 6 Junction Capacitance vs. Reverse Voltage

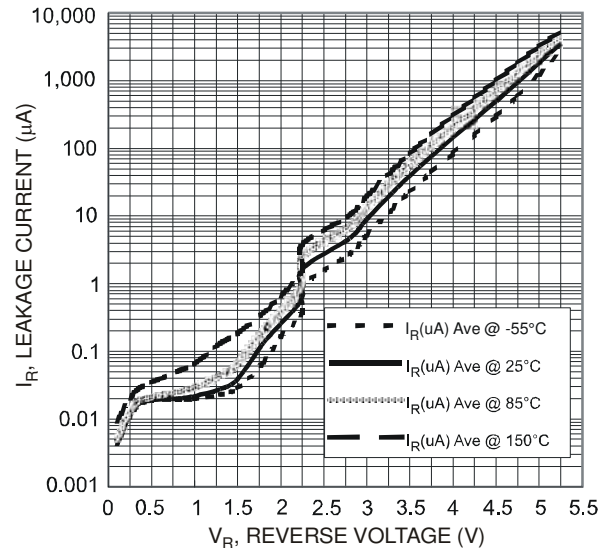


Fig. 7 Leakage Current vs. Reverse Voltage

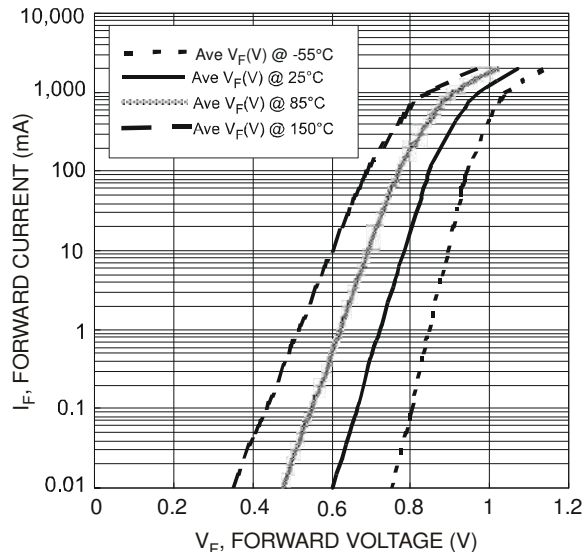


Fig. 8 Typical Forward Characteristic

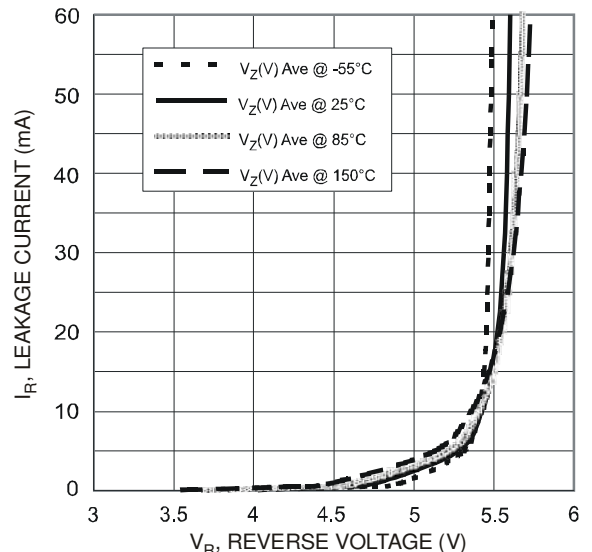


Fig. 9 Typical Reverse Characteristic

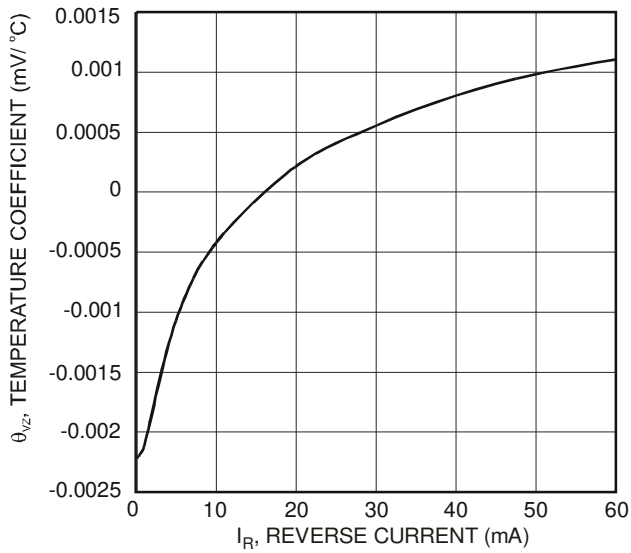


Fig. 10 Temperature Coefficient vs. Reverse Current

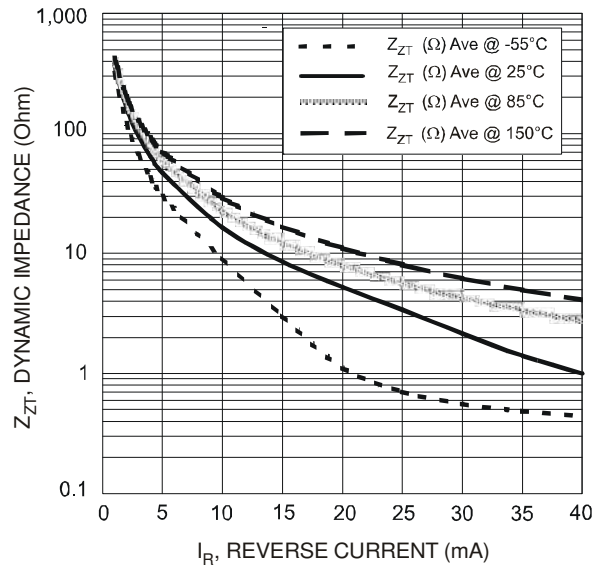


Fig. 11 Dynamic Impedance vs. Reverse Current (Small Signal)

Circuit Diagram

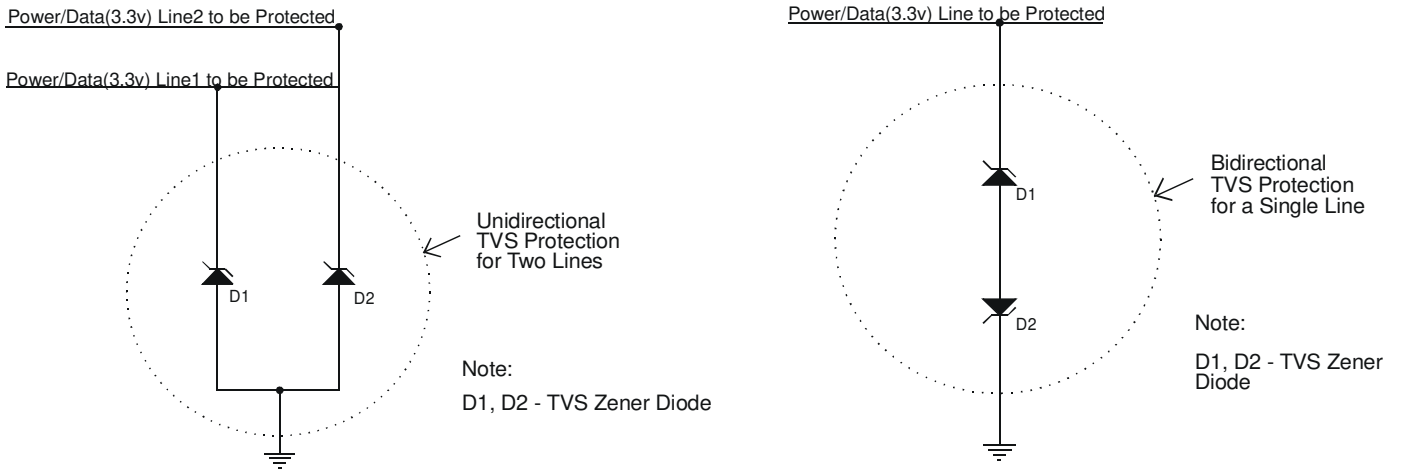


Fig. 12

Typical Application Circuit

Unidirectional Protection for Two 3.3V Dataline

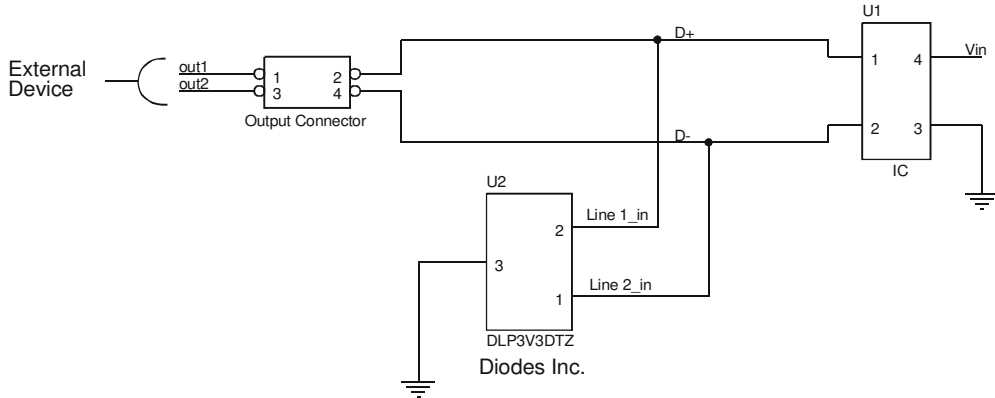


Fig. 13

Bidirectional Protection for 3.3v Power Supply Bus

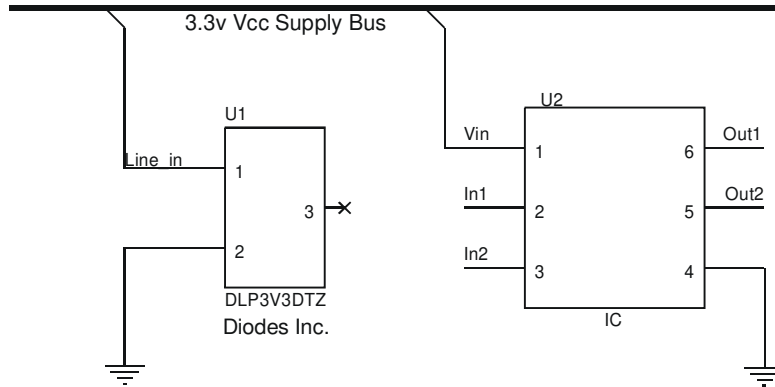


Fig. 14

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 unidirectional or single bidirectional 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:

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

e.g. If $I_{pp} = 1A$, $V_{CL} = V_z + R_d * I_{pp} = 5.6 V$ (from fig. 9) + $1A * 0.115 \text{ Ohm} = (5.6 + 0.115)V = 5.715 V$ (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 $K = 372 / (20)^{-0.5} = 372 * \sqrt{20} = 1663.63$

Now, P_{pp} when $td = 50 \mu S$: $P_{pp} = 1663.63 (50)^{-0.5} = 1663.63 / (\sqrt{50}) = 235.27 \text{ watts}$ (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:

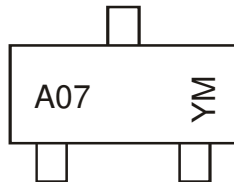
- Trace length between the TVS diode and the circuit or line to be protected should be kept to a minimum.
- Always place a TVS diode as close as possible to the input terminals or connectors if one is required.
- Try to avoid or minimize power and ground loops or any other conductive loops.
- Try to 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 4 & 6)

| Device | Packaging | Shipping |
|-------------|-----------|------------------|
| DLP3V3DTZ-7 | SOT-23 | 3000/Tape & Reel |

Notes: 6. For packaging details, go to our website at <http://www.diodes.com/datasheets/ap02007.pdf>.

Marking Information



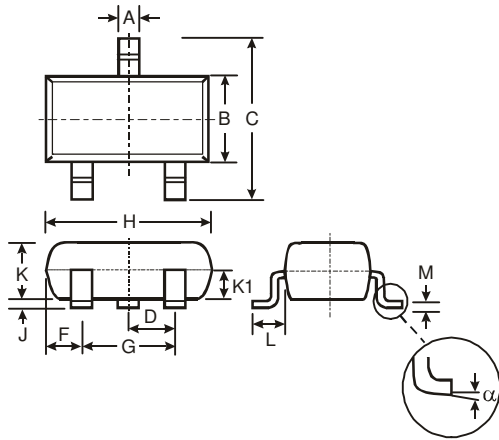
A07 = Product Type Marking Code
 YM = Date Code Marking
 Y = Year (e.g., T = 2006)
 M = Month (e.g., 1 = January)

Date Code Key

| Year | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|------|------|------|------|------|------|------|------|
| Code | T | U | V | W | X | Y | Z |

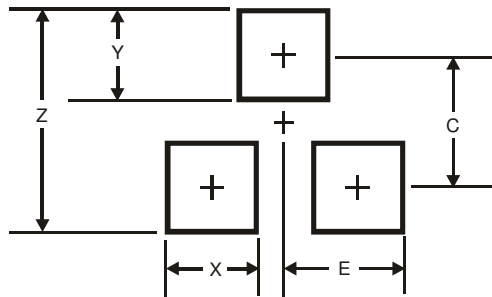
| Month | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|-------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Code | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | O | N | D |

Package Outline Dimensions



| SOT-23 | | | |
|----------------------|-------|------|-------|
| Dim | Min | Max | Typ |
| A | 0.37 | 0.51 | 0.40 |
| B | 1.20 | 1.40 | 1.30 |
| C | 2.30 | 2.50 | 2.40 |
| D | 0.89 | 1.03 | 0.915 |
| F | 0.45 | 0.60 | 0.535 |
| G | 1.78 | 2.05 | 1.83 |
| H | 2.80 | 3.00 | 2.90 |
| J | 0.013 | 0.10 | 0.05 |
| K | 0.903 | 1.10 | 1.00 |
| K1 | - | - | 0.400 |
| L | 0.45 | 0.61 | 0.55 |
| M | 0.085 | 0.18 | 0.11 |
| α | 0° | 8° | - |
| All Dimensions in mm | | | |

Suggested Pad Layout



| Dimensions | Value (in mm) |
|------------|---------------|
| Z | 2.9 |
| X | 0.8 |
| Y | 0.9 |
| C | 2.0 |
| E | 1.35 |

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