

# ESD Protection Diodes

## Micro-packaged Diodes for ESD Protection

### ESD5101, ESD5111

The ESD51x1 Series is designed to protect voltage sensitive components from ESD. Excellent clamping capability, low leakage, and fast response time provide best in class protection on designs that are exposed to ESD. Because of its small size, it is suited for use in smartphone, smart-watch, or many other portable / wearable applications where board space comes at a premium.

#### Features

- Low Capacitance (5 pF Max, I/O to GND)
- Small Body Outline Dimensions
  - ◆ 01005 Size: 0.435 x 0.23 mm
  - ◆ 0201 Size: 0.6 x 0.3 mm
- Protection for the Following IEC Standards:  
IEC 61000-4-2 (Level 4)
- Low ESD Clamping Voltage
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

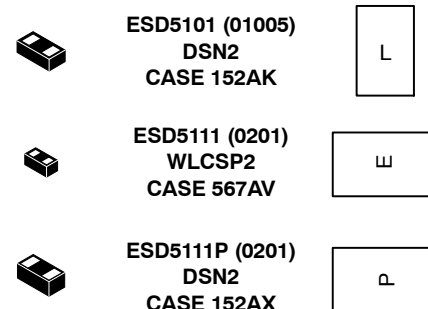
#### MAXIMUM RATINGS (T<sub>J</sub> = 25°C unless otherwise noted)

| Rating                                         | Symbol           | Value       | Unit |
|------------------------------------------------|------------------|-------------|------|
| Operating Junction Temperature Range           | T <sub>J</sub>   | -55 to +125 | °C   |
| Storage Temperature Range                      | T <sub>stg</sub> | -55 to +150 | °C   |
| Lead Solder Temperature – Maximum (10 Seconds) | T <sub>L</sub>   | 260         | °C   |
| IEC 61000-4-2 Contact (ESD)                    | ESD              | ±15         | kV   |
| IEC 61000-4-2 Air (ESD)                        | ESD              | ±15         | kV   |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

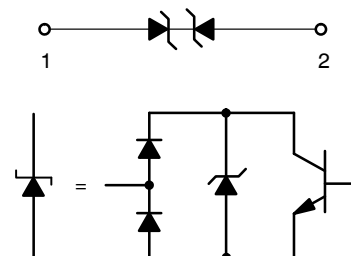
See Application Note AND8308/D for further description of survivability specs.

#### MARKING DIAGRAMS



L, E, P = Device Code

#### PIN CONFIGURATION AND SCHEMATIC



#### ORDERING INFORMATION

See detailed ordering and shipping information on page 2 of this data sheet.

# ESD5101, ESD5111

## ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25°C unless otherwise specified)

| Parameter                                            | Symbol           | Conditions                                                                               | Min  | Typ | Max | Unit |
|------------------------------------------------------|------------------|------------------------------------------------------------------------------------------|------|-----|-----|------|
| Reverse Working Voltage                              | V <sub>RWM</sub> | I/O Pin to GND                                                                           |      |     | 3.3 | V    |
| Breakdown Voltage                                    | V <sub>BR</sub>  | I <sub>T</sub> = 1 mA, I/O Pin to GND                                                    | 3.68 | 5.0 | 6.5 | V    |
| Reverse Leakage Current                              | I <sub>R</sub>   | V <sub>RWM</sub> = 3.3 V, I/O Pin to GND                                                 |      |     | 0.1 | μA   |
| ESD5101, ESD5111<br>Clamping Voltage<br>TLP (Note 1) | V <sub>C</sub>   | I <sub>PP</sub> = 8 A } IEC 61000-4-2 Level 2 equivalent<br>(±4 kV Contact, ±4 kV Air)   |      | 5.5 |     | V    |
|                                                      |                  | I <sub>PP</sub> = 16 A } IEC 61000-4-2 Level 2 equivalent<br>(±8 kV Contact, ±15 kV Air) |      | 6.5 |     |      |
| Junction Capacitance                                 | C <sub>J</sub>   | V <sub>R</sub> = 0 V, f = 1 MHz                                                          |      |     | 5.5 | pF   |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

1. ANSI/ESD STM5.5.1 – Electrostatic Discharge Sensitivity Testing using Transmission Line Pulse (TLP) Model.

TLP conditions: Z<sub>0</sub> = 50 Ω, t<sub>p</sub> = 100 ns, t<sub>r</sub> = 4 ns, averaging window; t<sub>1</sub> = 30 ns to t<sub>2</sub> = 60 ns.

## ORDERING INFORMATION

| Device        | Package             | Shipping <sup>†</sup> |
|---------------|---------------------|-----------------------|
| ESD5101FCT5G  | DSN2<br>(Pb-Free)   | 10,000 / Tape & Reel  |
| ESD5111FCT5G  | WLCSP2<br>(Pb-Free) | 10,000 / Tape & Reel  |
| ESD5111PFCT5G | DSN2<br>(Pb-Free)   | 10,000 / Tape & Reel  |

<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

# ESD5101, ESD5111

## TYPICAL CHARACTERISTICS

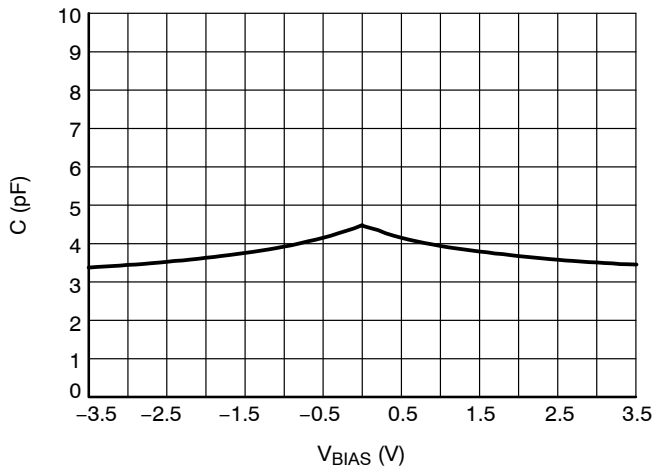


Figure 1. ESD5101 CV Characteristics

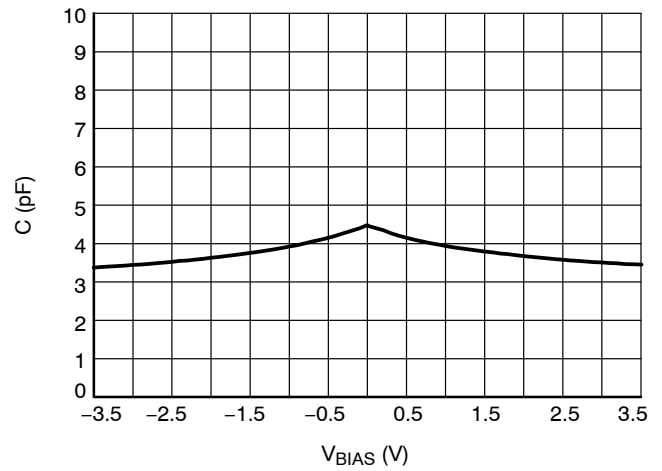


Figure 2. ESD5111 CV Characteristics

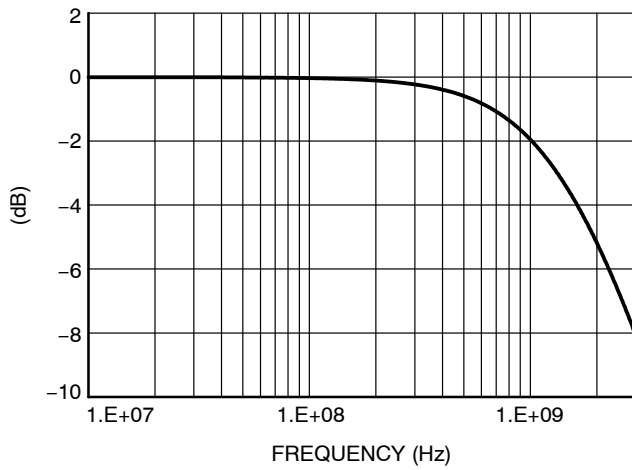


Figure 3. ESD5101 S21 Insertion Loss

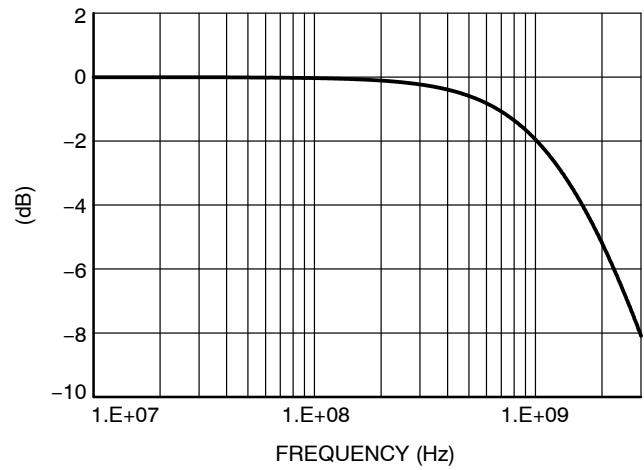


Figure 4. ESD5111 S21 Insertion Loss

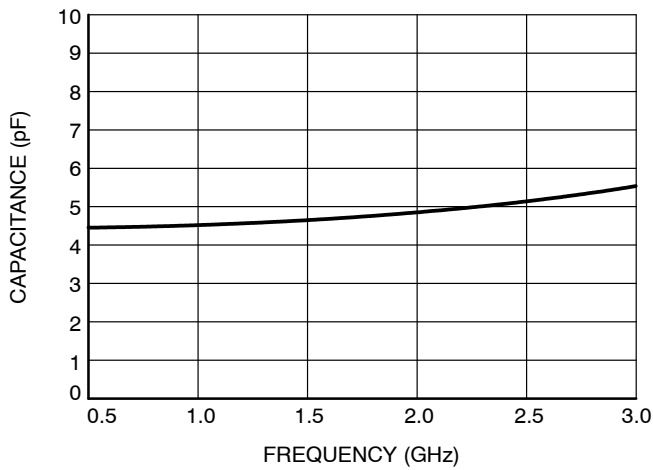


Figure 5. ESD5101 Capacitance over Frequency

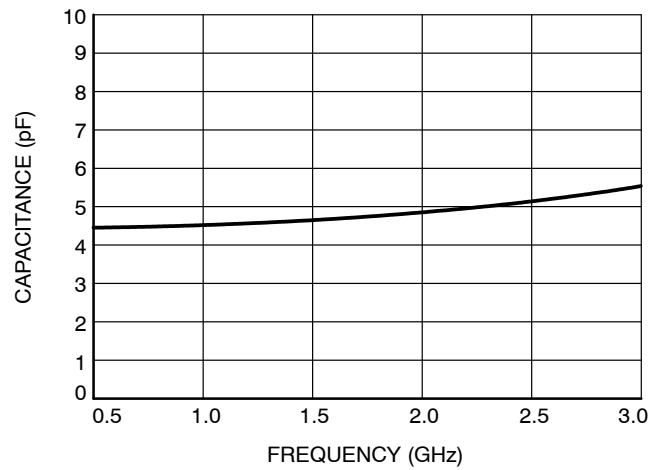


Figure 6. ESD5111 Capacitance over Frequency

# ESD5101, ESD5111

## TYPICAL CHARACTERISTICS

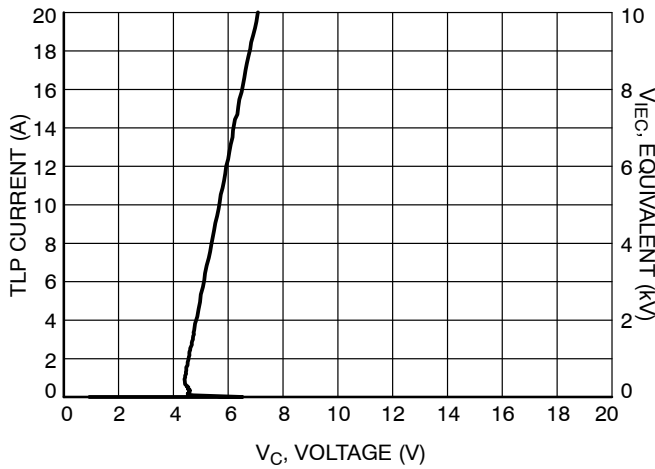


Figure 7. ESD5101 Positive TLP I-V Curve

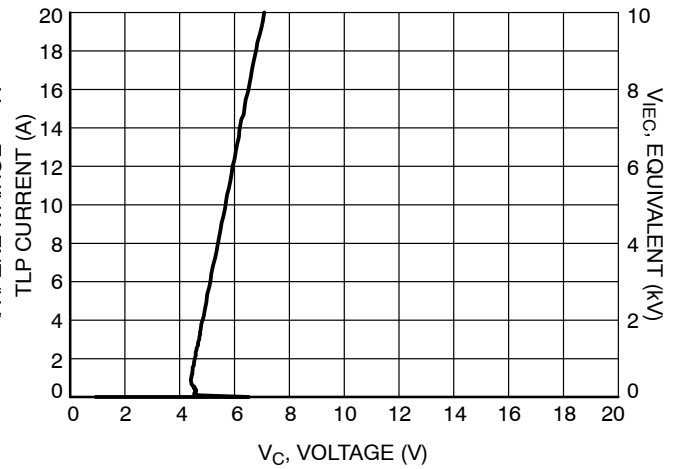


Figure 8. ESD5111 Positive TLP I-V Curve

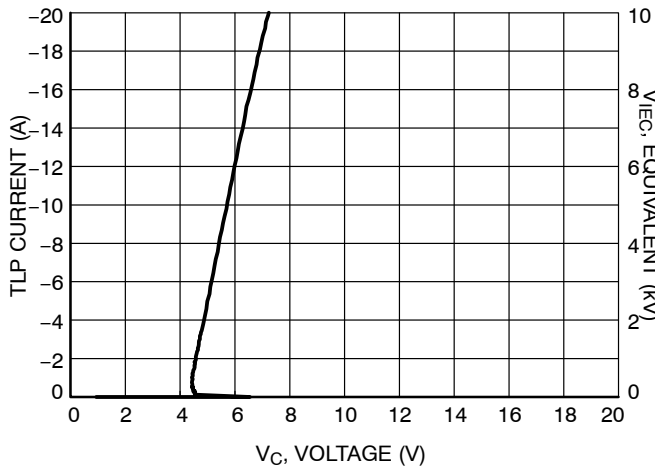


Figure 9. ESD5101 Negative TLP I-V Curve

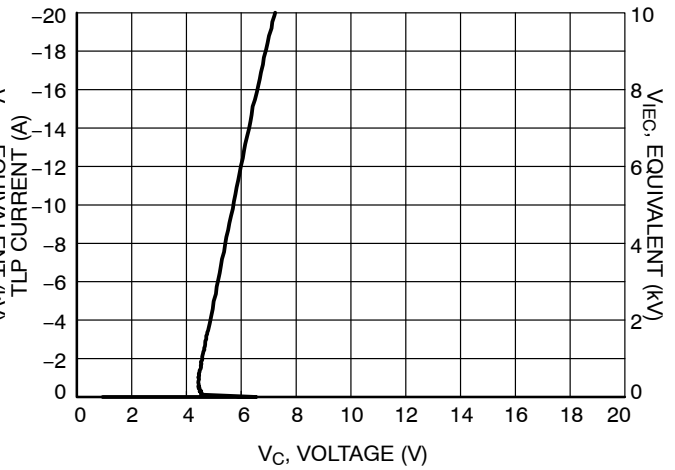


Figure 10. ESD5111 Negative TLP I-V Curve

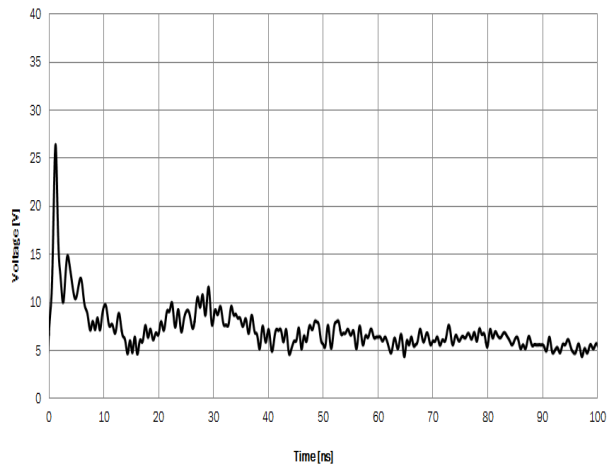


Figure 11. ESD5111 Positive 8 kV ESD Contact Discharge

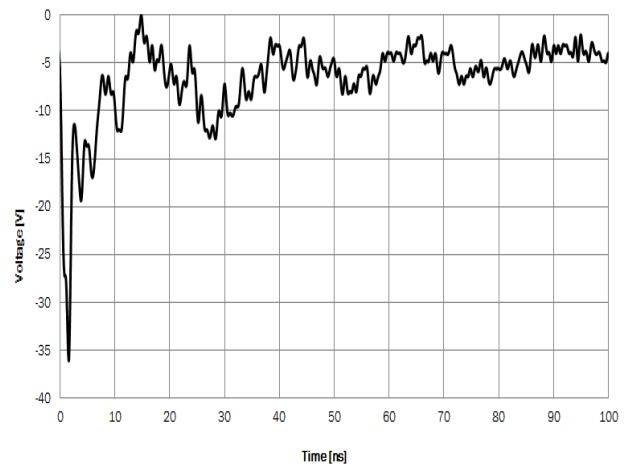


Figure 12. ESD5111 Negative 8 kV ESD Contact Discharge

## ESD5101, ESD5111

### IEC 61000-4-2 Spec.

| Level | Test Voltage (kV) | First Peak Current (A) | Current at 30 ns (A) | Current at 60 ns (A) |
|-------|-------------------|------------------------|----------------------|----------------------|
| 1     | 2                 | 7.5                    | 4                    | 2                    |
| 2     | 4                 | 15                     | 8                    | 4                    |
| 3     | 6                 | 22.5                   | 12                   | 6                    |
| 4     | 8                 | 30                     | 16                   | 8                    |

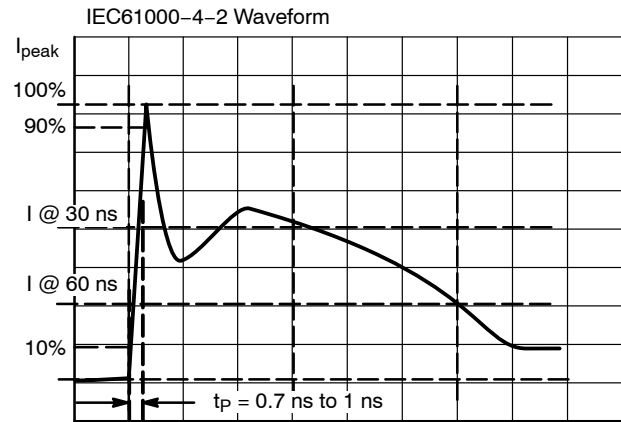


Figure 13. IEC61000-4-2 Spec

### Transmission Line Pulse (TLP) Measurement

Transmission Line Pulse (TLP) provides current versus voltage (I-V) curves in which each data point is obtained from a 100 ns long rectangular pulse from a charged transmission line. A simplified schematic of a typical TLP system is shown in Figure 14. TLP I-V curves of ESD protection devices accurately demonstrate the product's ESD capability because the 10s of amps current levels and under 100 ns time scale match those of an ESD event. This is illustrated in Figure 15 where an 8 kV IEC 61000-4-2 current waveform is compared with TLP current pulses at 8 A and 16 A. A TLP I-V curve shows the voltage at which the device turns on as well as how well the device clamps voltage over a range of current levels.

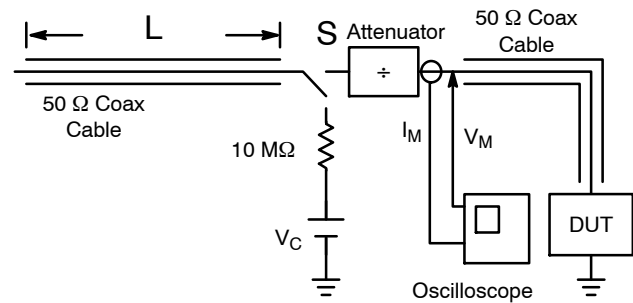


Figure 14. Simplified Schematic of a Typical TLP System

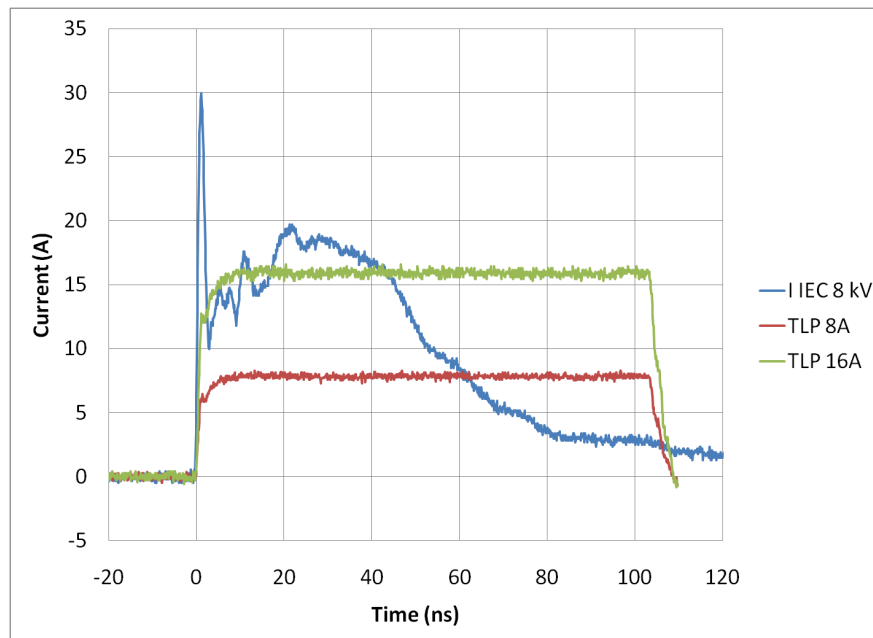


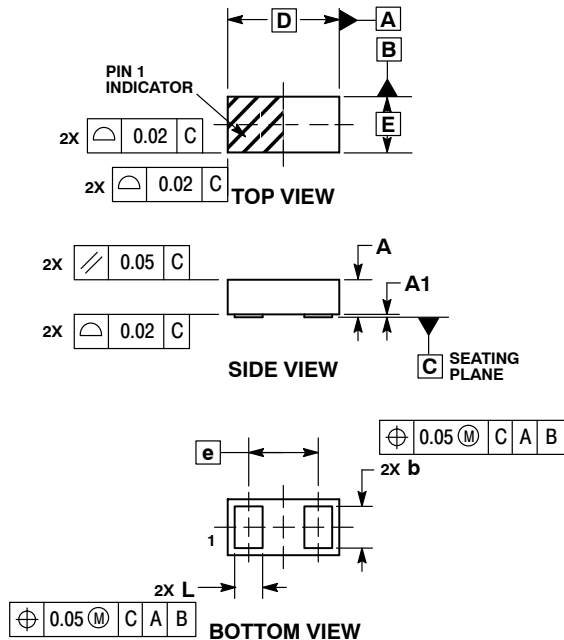
Figure 15. Comparison Between 8 kV IEC 61000-4-2 and 8 A and 16 A TLP Waveforms



SCALE 16:1

**DSN2, 0.435x0.23, 0.27P, (01005)**  
CASE 152AK  
ISSUE A

DATE 17 FEB 2015



## NOTES:

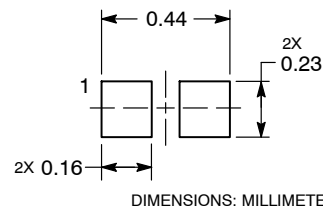
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.

| MILLIMETERS |           |       |
|-------------|-----------|-------|
| DIM         | MIN       | MAX   |
| A           | 0.165     | 0.195 |
| A1          | ---       | 0.030 |
| b           | 0.177     | 0.193 |
| D           | 0.435 BSC |       |
| E           | 0.230 BSC |       |
| e           | 0.270 BSC |       |
| L           | 0.112     | 0.128 |

**GENERIC MARKING DIAGRAM\***


X = Specific Device Code

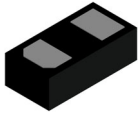
\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G", may or not be present.

**RECOMMENDED SOLDER FOOTPRINT\***


\*For additional information on our Pb-Free strategy and soldering details, please download the **onsemi** Soldering and Mounting Techniques Reference Manual, [SOLDERM/D](http://www.onsemi.com/SOLDERM/D).

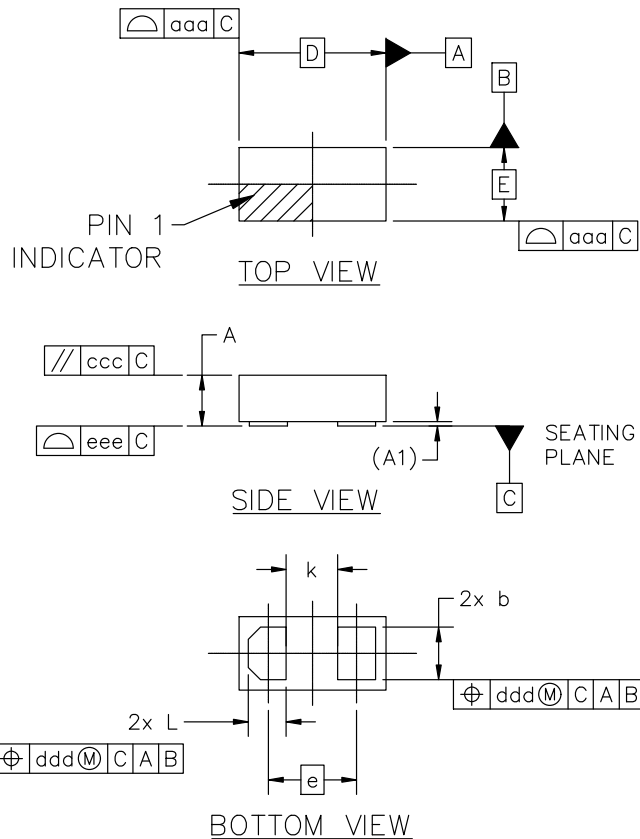
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**X4DFN2, 0.60x0.30x0.20, 0.36P**  
**CASE 152AX**  
**ISSUE K**

DATE 20 JUN 2025

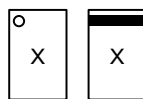


| MILLIMETERS                 |           |       |       |
|-----------------------------|-----------|-------|-------|
| DIM                         | MIN       | NOM   | MAX   |
| A                           | 0.175     | 0.200 | 0.225 |
| A1                          | 0.018 REF |       |       |
| b                           | 0.205     | 0.215 | 0.225 |
| D                           | 0.600 BSC |       |       |
| E                           | 0.300 BSC |       |       |
| e                           | 0.360 BSC |       |       |
| k                           | 0.180     | ---   | ---   |
| L                           | 0.145     | 0.155 | 0.165 |
| TOLERANCE FORM AND POSITION |           |       |       |
| aaa                         | 0.025     |       |       |
| ccc                         | 0.020     |       |       |
| ddd                         | 0.050     |       |       |
| eee                         | 0.010     |       |       |

#### NOTES:

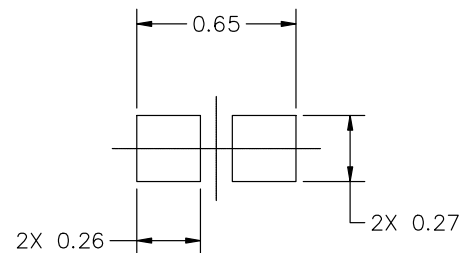
1. DIMENSIONING AND TOLERANCING AS PER ASME Y14.5M, 2018.
2. CONTROLLING DIMENSION: MILLIMETERS.

#### GENERIC MARKING DIAGRAM\*



X = Specific Device Code

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G", may or not be present. Some products may not follow the Generic Marking.



#### RECOMMENDED MOUNTING FOOTPRINT

\* For additional information on our Pb-Free strategy and soldering details, please download the onsemi Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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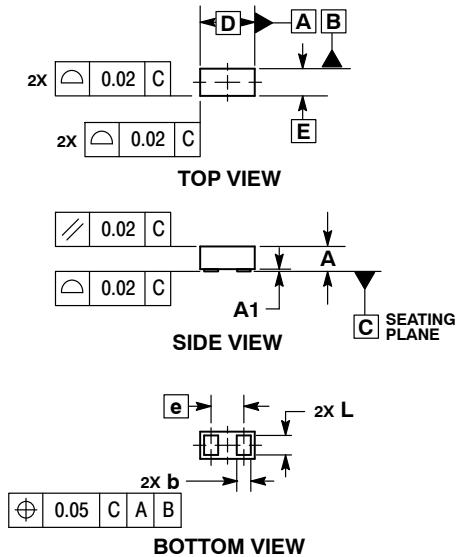
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SCALE 12:1

**WLCSP2, 0.6x0.3**  
CASE 567AV  
ISSUE C

DATE 22 SEP 2017



## NOTES:

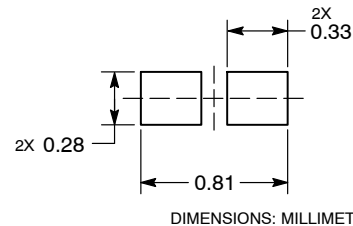
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.

| MILLIMETERS |          |       |       |
|-------------|----------|-------|-------|
| DIM         | MIN      | NOM   | MAX   |
| A           | 0.250    | 0.275 | 0.300 |
| A1          | 0.000    | 0.025 | 0.050 |
| b           | 0.140    | 0.155 | 0.170 |
| D           | 0.570    | 0.600 | 0.630 |
| E           | 0.270    | 0.300 | 0.330 |
| e           | 0.36 BSC |       |       |
| L           | 0.190    | 0.215 | 0.240 |

**GENERIC**  
**MARKING DIAGRAM\***


X = Specific Device Code

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

**RECOMMENDED**  
**SOLDER FOOTPRINT\***


\*For additional information on our Pb-Free strategy and soldering details, please download the **onsemi** Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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