

# ESD Protection Diodes

## Low Capacitance ESD Protection Diode for High Speed Data Lines

### ESD7321

The ESD7321 ESD protection diodes are designed to protect high speed data lines from ESD. Low capacitance and low ESD clamping voltage make this device an ideal solution for protecting voltage sensitive high speed data lines.

#### Features

- Low Capacitance (0.5 pF Max, I/O to GND)
- 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

#### Typical Applications

- USB 3.x
- MHL 2.0
- SATA/SAS
- PCI Express

#### MAXIMUM RATINGS ( $T_J = 25^\circ\text{C}$ unless otherwise noted)

| Rating                                                 | Symbol    | Value       | Unit             |
|--------------------------------------------------------|-----------|-------------|------------------|
| Operating Junction Temperature Range                   | $T_J$     | -55 to +125 | $^\circ\text{C}$ |
| Storage Temperature Range                              | $T_{stg}$ | -55 to +150 | $^\circ\text{C}$ |
| Lead Solder Temperature – Maximum (10 Second Duration) | $T_L$     | 260         | $^\circ\text{C}$ |
| IEC 61000-4-2 Contact (ESD)                            | ESD       | $\pm 15$    | kV               |
| IEC 61000-4-2 Air (ESD)                                | ESD       | $\pm 15$    | kV               |

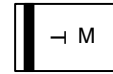
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

#### MARKING DIAGRAM



X3DFN2  
CASE 152AF

PIN 1



T = Specific Device Code  
(Rotated 90° clockwise)  
M = Date Code

#### PIN CONFIGURATION AND SCHEMATIC



#### ORDERING INFORMATION

| Device       | Package          | Shipping <sup>†</sup> |
|--------------|------------------|-----------------------|
| ESD7321MUT5G | X3DFN2 (Pb-Free) | 10000 / Tape & Reel   |

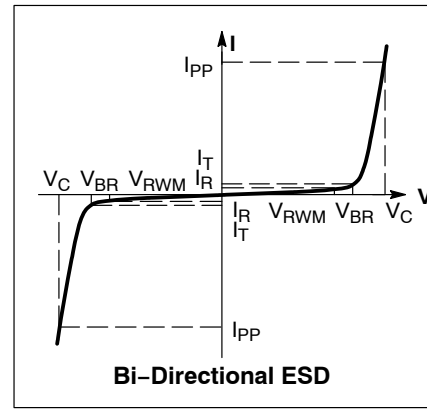
<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

# ELECTRICAL CHARACTERISTICS

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

| Symbol           | Parameter                                          |
|------------------|----------------------------------------------------|
| I <sub>PP</sub>  | Maximum Reverse Peak Pulse Current                 |
| V <sub>C</sub>   | Clamping Voltage @ I <sub>PP</sub>                 |
| V <sub>RWM</sub> | Working Peak Reverse Voltage                       |
| I <sub>R</sub>   | Maximum Reverse Leakage Current @ V <sub>RWM</sub> |
| V <sub>BR</sub>  | Breakdown Voltage @ I <sub>T</sub>                 |
| I <sub>T</sub>   | Test Current                                       |

\*See Application Note AND8308/D for detailed explanations of datasheet parameters.

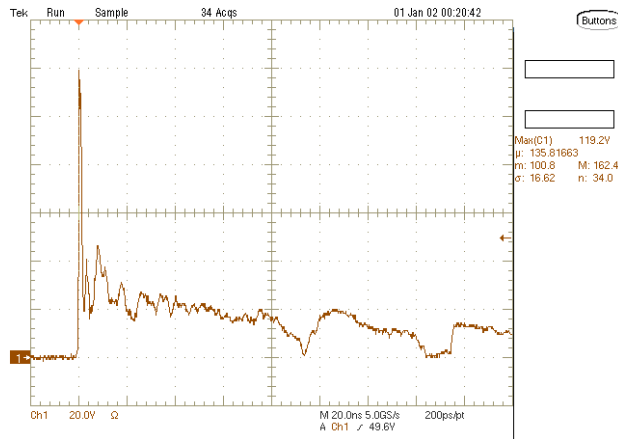


# ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25°C unless otherwise noted)

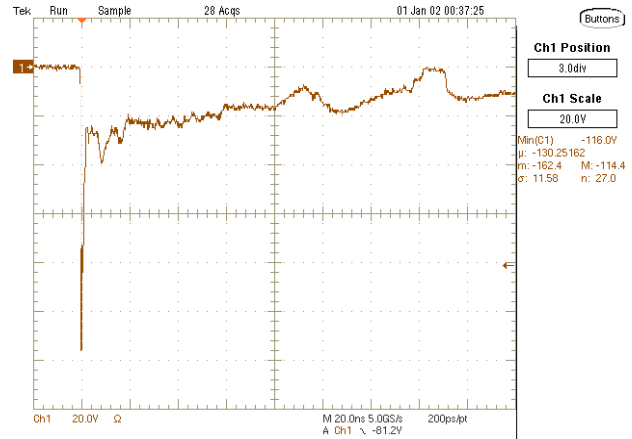
| Parameter               | Symbol           | Condition                                                                               | Min                 | Typ | Max | Unit |
|-------------------------|------------------|-----------------------------------------------------------------------------------------|---------------------|-----|-----|------|
| Reverse Working Voltage | V <sub>RWM</sub> |                                                                                         |                     |     | 7.0 | V    |
| Breakdown Voltage       | V <sub>BR</sub>  | I <sub>T</sub> = 1 mA (Note 1)                                                          | 8.0                 |     |     | V    |
| Reverse Leakage Current | I <sub>R</sub>   | V <sub>RWM</sub> = 7.0 V, I/O to GND                                                    |                     |     | 200 | nA   |
| Clamping Voltage        | V <sub>C</sub>   | I <sub>PP</sub> = 8 A – (IEC61000–4–2 Level 2 Equivalent<br>(±4 kV Contact, ±8 kV Air)) |                     | 18  |     | V    |
| ESD Clamping Voltage    | V <sub>C</sub>   | Per IEC 61000–4–2                                                                       | See Figures 1 and 2 |     |     |      |
| Junction Capacitance    | C <sub>J</sub>   | V <sub>R</sub> = 0 V, f = 1 MHz                                                         |                     |     | 0.5 | pF   |
| Dynamic Resistance      | R <sub>DYN</sub> | TLP Pulse                                                                               |                     | 0.7 |     | Ω    |

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. Breakdown voltage is tested from pin 1 to 2 and pin 2 to 1.



**Figure 1. ESD Clamping Voltage Screenshot  
Positive 8 kV Contact per IEC61000–4–2**



**Figure 2. ESD Clamping Voltage Screenshot  
Negative 8 kV Contact per IEC61000–4–2**

TYPICAL CHARACTERISTICS

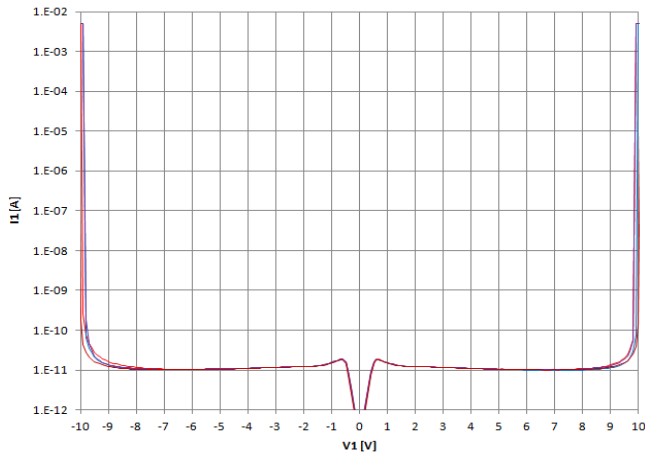


Figure 3. IV Characteristics

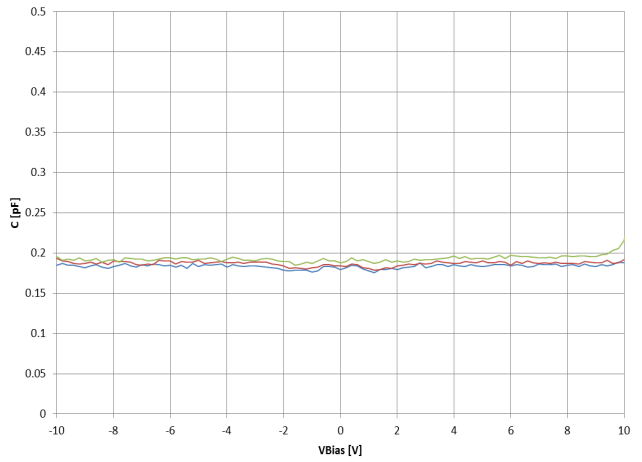


Figure 4. CV Characteristics

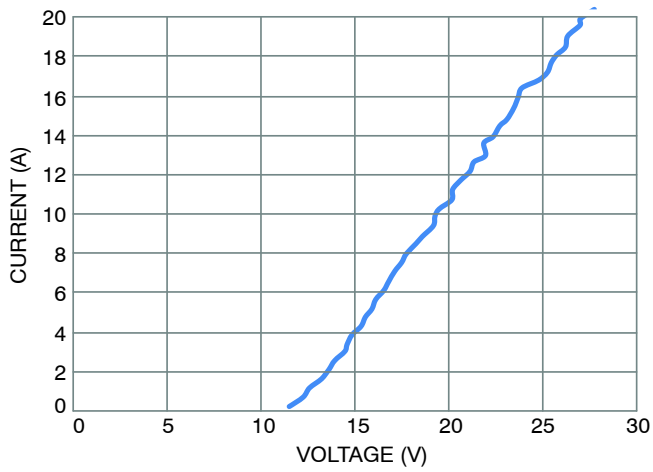


Figure 5. Positive TLP I-V Curve

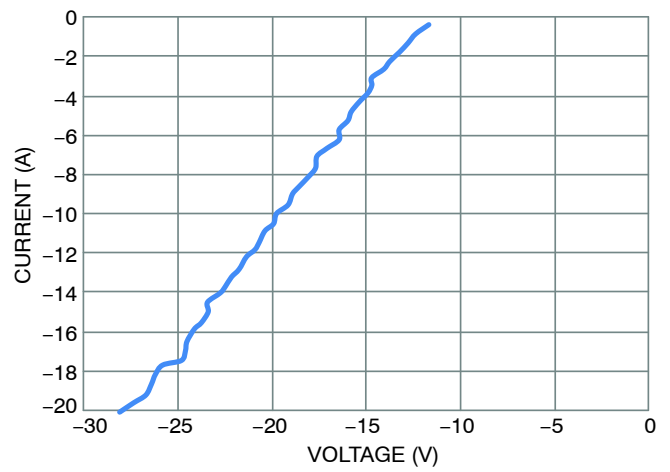


Figure 6. Negative TLP I-V Curve

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                    |

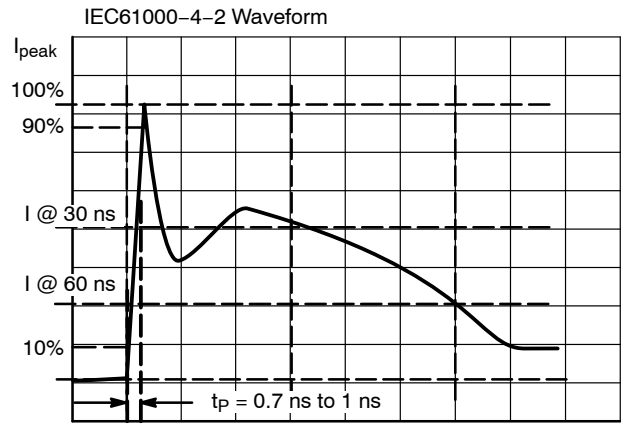


Figure 7. IEC61000-4-2 Spec

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 8. 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 9 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.

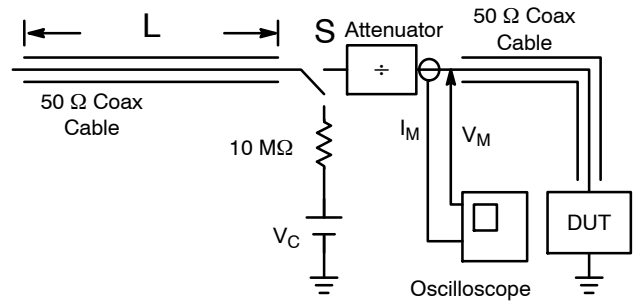


Figure 8. Simplified Schematic of a Typical TLP System

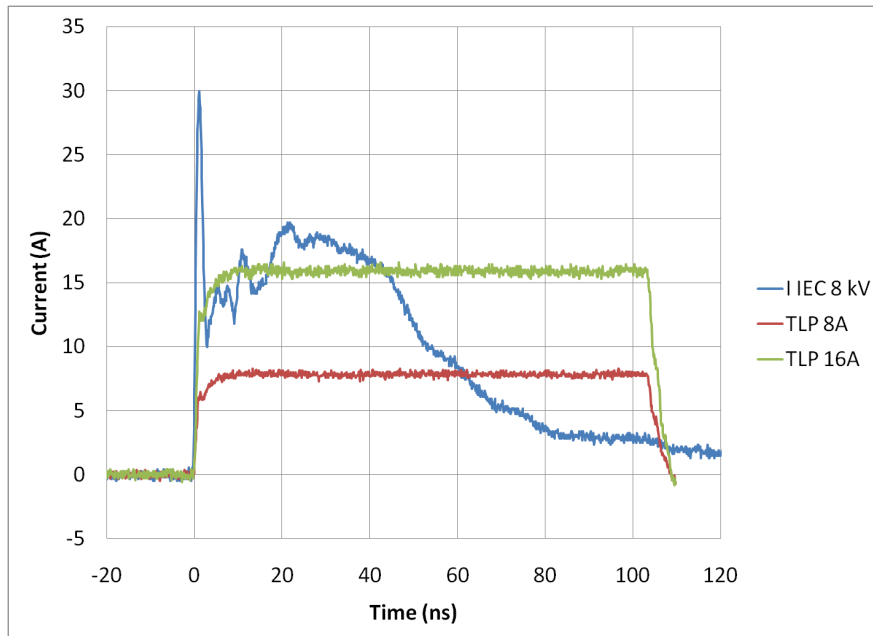
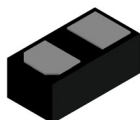


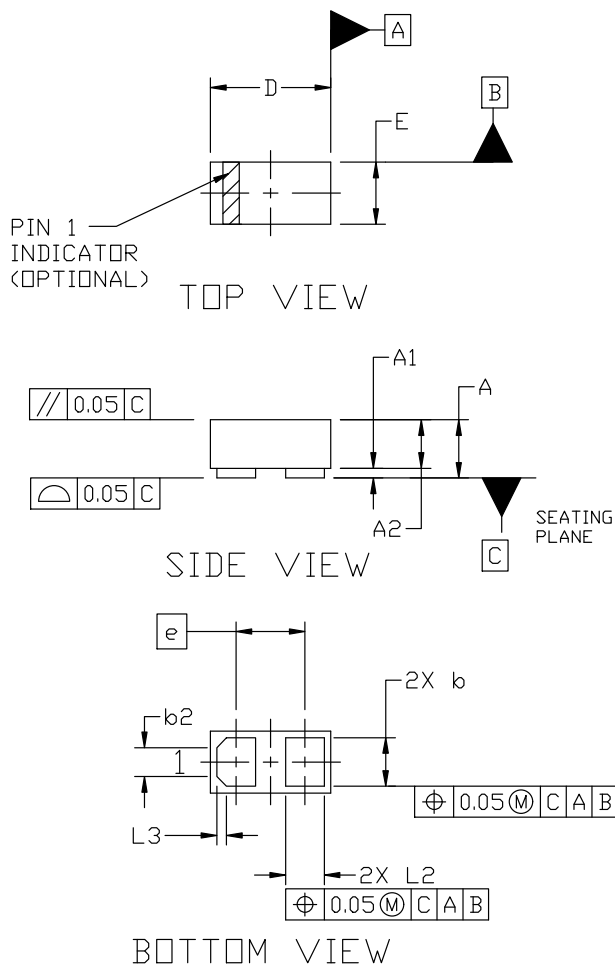
Figure 9. Comparison Between 8 kV IEC 61000-4-2 and 8 A and 16 A TLP Waveforms



**X3DFN2 0.62x0.32x0.24, 0.35P**

CASE 152AF  
ISSUE C

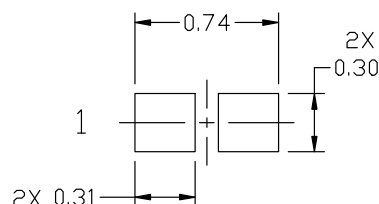
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### NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS
3. 0201

| MILLIMETERS |           |      |      |
|-------------|-----------|------|------|
| DIM         | MIN.      | NOM. | MAX. |
| A           | 0.25      | 0.29 | 0.33 |
| A1          | 0.00      | ---  | 0.05 |
| A2          | 0.14      | 0.24 | 0.34 |
| b           | 0.22      | 0.25 | 0.28 |
| b2          | 0.150 REF |      |      |
| D           | 0.58      | 0.62 | 0.66 |
| E           | 0.28      | 0.32 | 0.36 |
| e           | 0.355 BSC |      |      |
| L2          | 0.17      | 0.20 | 0.23 |
| L3          | 0.050 REF |      |      |



### RECOMMENDED MOUNTING FOOTPRINT\*

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

### GENERIC MARKING DIAGRAM\*



X = Specific Device Code  
M = Date 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.

|                         |                                     |                                                                                                                                                                                  |
|-------------------------|-------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
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| <b>DESCRIPTION:</b>     | <b>X3DFN2 0.62x0.32x0.24, 0.35P</b> | <b>PAGE 1 OF 1</b>                                                                                                                                                               |

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