

# ESDR0502N

## Ultra Low Capacitance ESD Protection Array for High Speed Data Line Protection

The ESDR0502N ultra low capacitance TVS array is designed to protect high speed data lines from ESD. Ultra-low capacitance and high level of ESD protection makes this device well suited for use in USB 2.0 applications.

### Features

- Low Capacitance (0.3 pF Typical Between I/O Lines and Ground)
- IEC 61000-4-2 Level 4
- UL Flammability Rating of 94 V-0
- These Devices are Pb-Free and are RoHS Compliant

### Typical Applications

- High Speed Communication Line Protection
- USB 2.0 High Speed Data Line and Power Line Protection
- Monitors and Flat Panel Displays
- MP3
- Gigabit Ethernet

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

| Rating                                                             | Symbol           | Value       | Unit |
|--------------------------------------------------------------------|------------------|-------------|------|
| Operating Junction Temperature Range                               | T <sub>J</sub>   | -40 to +125 | °C   |
| Peak Power Dissipation<br>8x20 μs @ T <sub>A</sub> = 25°C (Note 1) | P <sub>pk</sub>  | 100         | W    |
| Peak Power Current<br>8x20 μs @ T <sub>A</sub> = 25°C (Note 1)     | I <sub>pp</sub>  | 3.0         | A    |
| Storage Temperature Range                                          | T <sub>stg</sub> | -55 to +150 | °C   |
| Lead Solder Temperature –<br>Maximum (10 Seconds)                  | T <sub>L</sub>   | 260         | °C   |
| IEC 61000-4-2 Contact (ESD)                                        | ESD              | 8.0         | kV   |

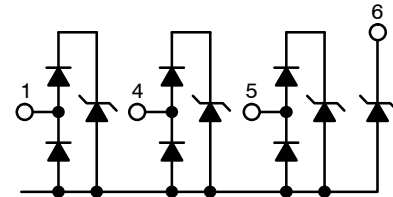
Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

1. Nonrepetitive current pulse (pin 6 to pin 1).



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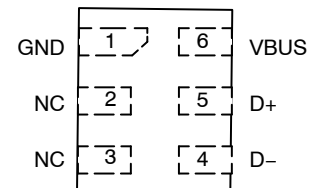
UDFN6  
MU SUFFIX  
CASE 517AA

### MARKING DIAGRAM



D = Specific Device Code\*  
(Rotated 90° clockwise)  
M = Date Code & Assembly Location

### PINOUT



(Top View)

### ORDERING INFORMATION

| Device         | Package            | Shipping†             |
|----------------|--------------------|-----------------------|
| ESDR0502NMUTBG | UDFN6<br>(Pb-Free) | 3000 /<br>Tape & Reel |

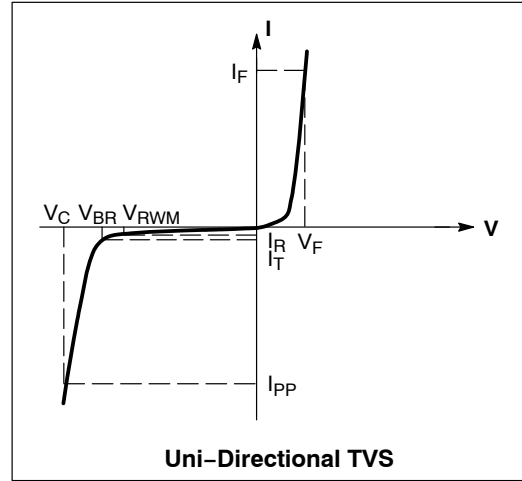
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specification Brochure, BRD8011/D.

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## ELECTRICAL CHARACTERISTICS

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

| Symbol    | Parameter                                   |
|-----------|---------------------------------------------|
| $I_{PP}$  | Maximum Reverse Peak Pulse Current          |
| $V_C$     | Clamping Voltage @ $I_{PP}$                 |
| $V_{RWM}$ | Working Peak Reverse Voltage                |
| $I_R$     | Maximum Reverse Leakage Current @ $V_{RWM}$ |
| $V_{BR}$  | Breakdown Voltage @ $I_T$                   |
| $I_T$     | Test Current                                |
| $I_F$     | Forward Current                             |
| $V_F$     | Forward Voltage @ $I_F$                     |
| $P_{pk}$  | Peak Power Dissipation                      |
| $C$       | Capacitance @ $V_R = 0$ and $f = 1.0$ MHz   |



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

## ELECTRICAL CHARACTERISTICS ( $T_J=25^\circ\text{C}$ unless otherwise specified)

| Parameter               | Symbol    | Conditions                                        | Min               | Typ | Max | Unit          |
|-------------------------|-----------|---------------------------------------------------|-------------------|-----|-----|---------------|
| Reverse Working Voltage | $V_{RWM}$ | (Note 2)                                          |                   |     | 5.5 | V             |
| Breakdown Voltage       | $V_{BR}$  | $I_T = 1$ mA, (Note 3)                            | 6.0               |     |     | V             |
| Reverse Leakage Current | $I_R$     | $V_{RWM} = 5.5$ V                                 |                   |     | 1.0 | $\mu\text{A}$ |
| ESD Clamping Voltage    | $V_C$     | Per IEC61000-4-2 (Note 4)                         | See Figures 1 & 2 |     |     |               |
| Junction Capacitance    | $C_J$     | $V_R = 0$ V, $f = 1$ MHz between I/O Pins and GND |                   | 0.3 | 0.6 | pF            |
| Junction Capacitance    | $C_J$     | $V_R = 0$ V, $f = 1$ MHz between I/O Pins         |                   | 0.3 | 0.6 | pF            |

- TVS devices are normally selected according to the working peak reverse voltage ( $V_{RWM}$ ), which should be equal or greater than the DC or continuous peak operating voltage level.
- $V_{BR}$  is measured at pulse test current  $I_T$ .
- For test procedure see Figures 3 and 4 and Application Note AND8307/D.

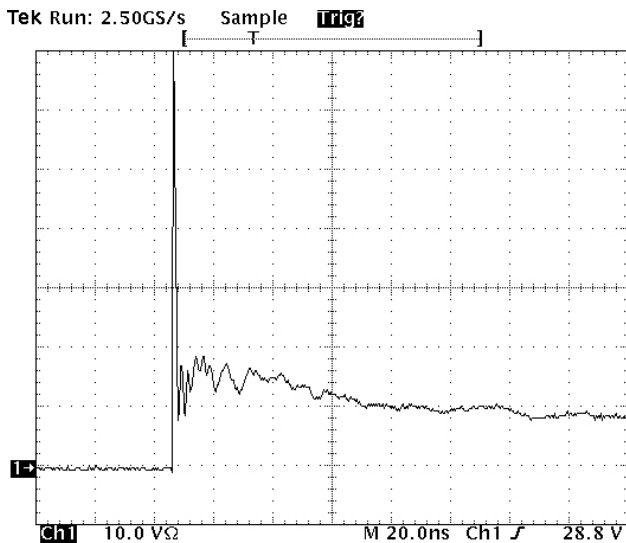


Figure 1. ESD Clamping Voltage Screenshot Positive 8 kV Contact per IEC61000-4-2

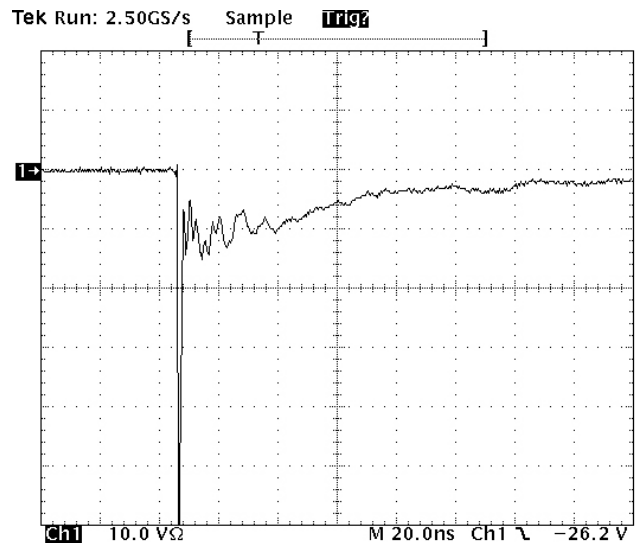


Figure 2. ESD Clamping Voltage Screenshot Negative 8 kV Contact per IEC61000-4-2

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## 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                    |

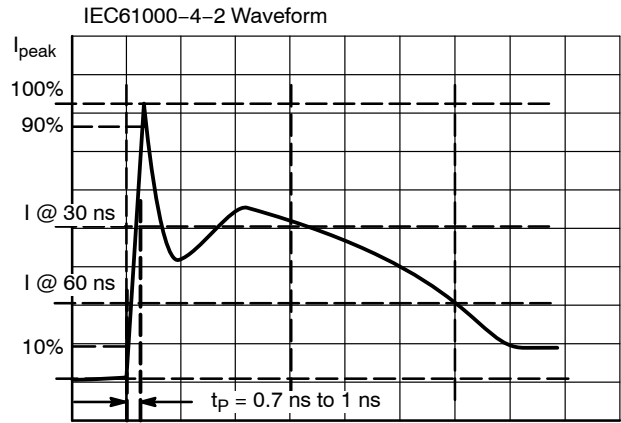


Figure 3. IEC61000-4-2 Spec

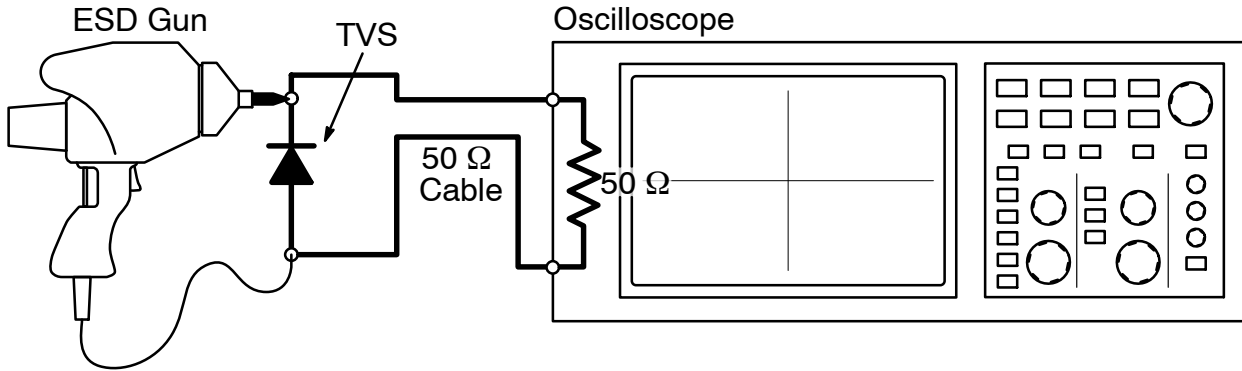


Figure 4. Diagram of ESD Test Setup

The following is taken from Application Note AND8308/D – Interpretation of Datasheet Parameters for ESD Devices.

### ESD Voltage Clamping

For sensitive circuit elements it is important to limit the voltage that an IC will be exposed to during an ESD event to as low a voltage as possible. The ESD clamping voltage is the voltage drop across the ESD protection diode during an ESD event per the IEC61000-4-2 waveform. Since the IEC61000-4-2 was written as a pass/fail spec for larger

systems such as cell phones or laptop computers it is not clearly defined in the spec how to specify a clamping voltage at the device level. ON Semiconductor has developed a way to examine the entire voltage waveform across the ESD protection diode over the time domain of an ESD pulse in the form of an oscilloscope screenshot, which can be found on the datasheets for all ESD protection diodes. For more information on how ON Semiconductor creates these screenshots and how to interpret them please refer to AND8307/D.

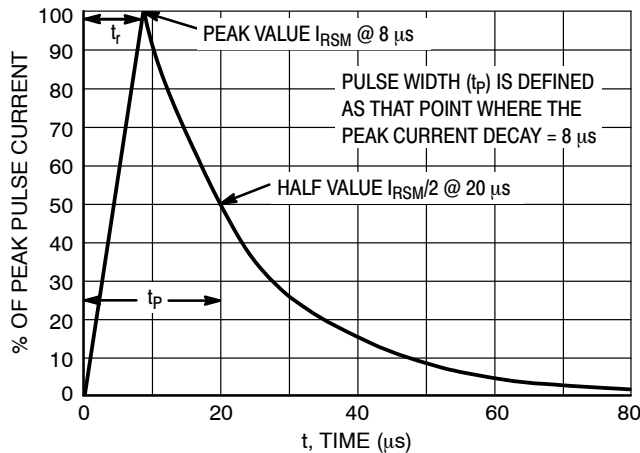


Figure 5. 8 X 20 μs Pulse Waveform

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## APPLICATION INFORMATION

### Protecting USB 2.0 Interfaces

The USB interface consists of Data (D- and D+) lines and a 5.5 V bus, which are all vulnerable to ESD and cable discharge events. Each ESDR0502N device will protect the four USB connections ( $V_{CC}$ , D+, D-, and GND) of one USB port. When the voltage on the data lines exceed the bus

voltage (plus one diode drop), the internal rectifiers are forward biased conducting the transient current away from the protected controller chip. The TVS diode suppresses ESD strikes directly on the voltage bus and directs the surge to ground, protecting both the power and data pins.

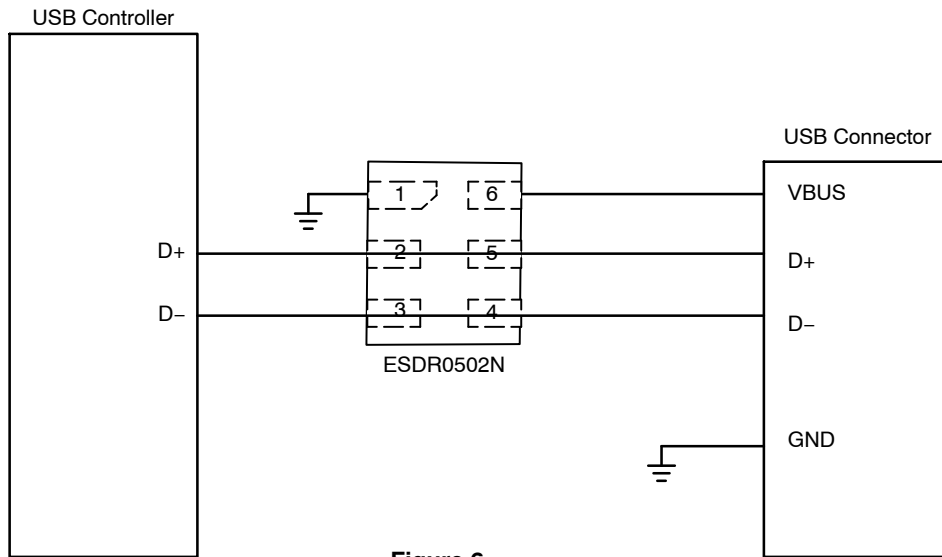
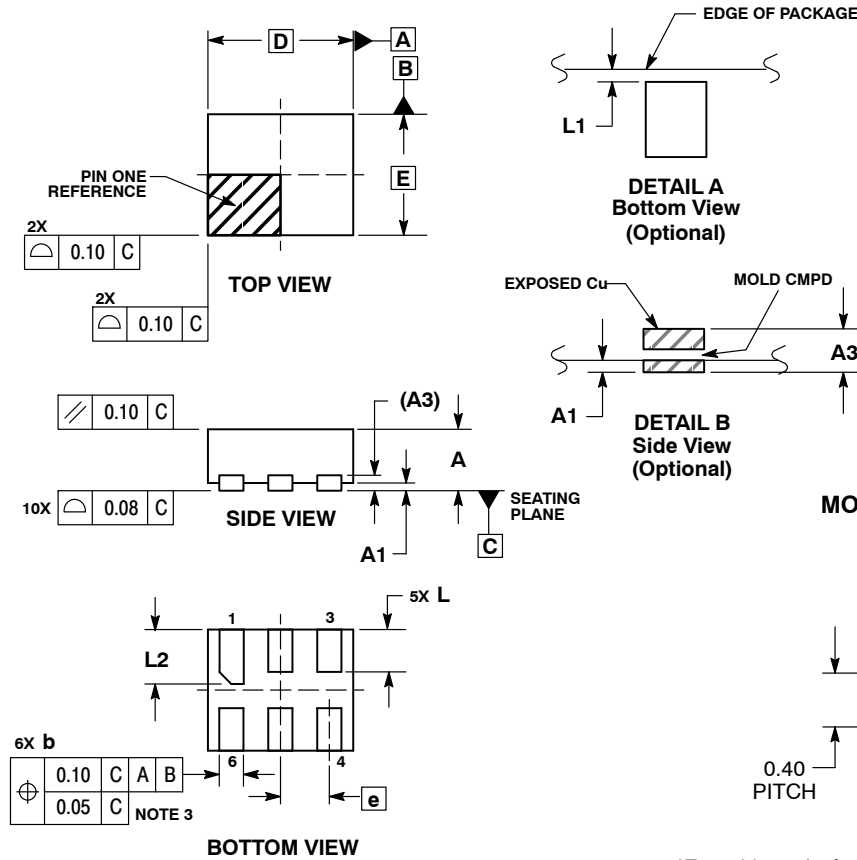


Figure 6.

# ESDR0502N

## PACKAGE DIMENSIONS

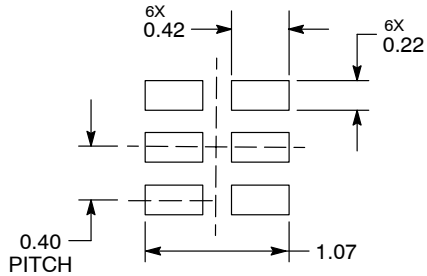
UDFN6, 1.2x1.0, 0.4P  
CASE 517AA-01  
ISSUE D



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
  2. CONTROLLING DIMENSION: MILLIMETERS.
  3. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.25 AND 0.30 mm FROM TERMINAL.
  4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.

| MILLIMETERS |       |      |
|-------------|-------|------|
| DIM         | MIN   | MAX  |
| A           | 0.45  | 0.55 |
| A1          | 0.00  | 0.05 |
| A3          | 0.127 | REF  |
| b           | 0.15  | 0.25 |
| D           | 1.20  | BSC  |
| E           | 1.00  | BSC  |
| e           | 0.40  | BSC  |
| L           | 0.30  | 0.40 |
| L1          | 0.00  | 0.15 |
| L2          | 0.40  | 0.50 |

### MOUNTING FOOTPRINT\*



DIMENSIONS: MILLIMETERS

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

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