

# ESD Protection Diode Array

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

### ESDR0502N

The ESDR0502N ultra low capacitance surge protection 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

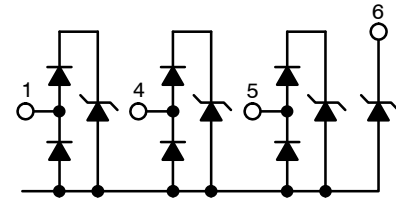
- High Speed Communication Line Protection
- USB 2.0 High Speed Data Line and Power Line Protection
- Monitors and Flat Panel Displays
- MP3
- Gigabit Ethernet

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

Rating	Symbol	Value	Unit
Operating Junction Temperature Range	$T_J$	-40 to +125	$^\circ\text{C}$
Peak Power Dissipation 8x20 $\mu\text{s}$ @ $T_A = 25^\circ\text{C}$ (Note 1)	$P_{pk}$	100	W
Peak Power Current 8x20 $\mu\text{s}$ @ $T_A = 25^\circ\text{C}$ (Note 1)	$I_{pp}$	3.0	A
Storage Temperature Range	$T_{stg}$	-55 to +150	$^\circ\text{C}$
Lead Solder Temperature – Maximum (10 Seconds)	$T_L$	260	$^\circ\text{C}$
IEC 61000-4-2 Contact (ESD)	ESD	8.0	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.

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



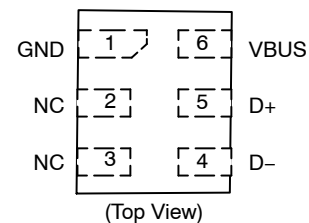
UDFN6  
MU SUFFIX  
CASE 517AA

#### MARKING DIAGRAM



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

#### PINOUT



#### ORDERING INFORMATION

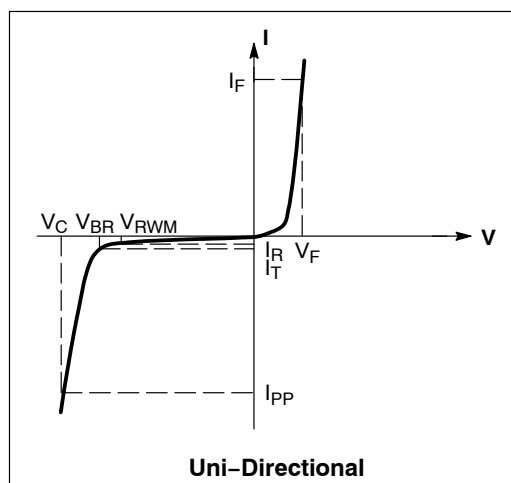
Device	Package	Shipping <sup>†</sup>
ESDR0502NMUTAG	UDFN6 (Pb-Free)	3000 / Tape & Reel
ESDR0502NMUTBG	UDFN6 (Pb-Free)	3000 / Tape & Reel

<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specification 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
I <sub>F</sub>	Forward Current
V <sub>F</sub>	Forward Voltage @ I <sub>F</sub>
P <sub>pk</sub>	Peak Power Dissipation
C	Capacitance @ V <sub>R</sub> = 0 and f = 1.0 MHz

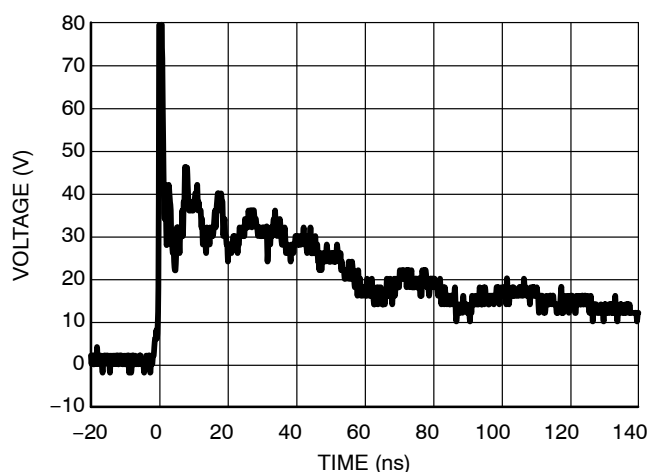
\*See Application Note AND8308/D for detailed explanations of datasheet parameters.

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

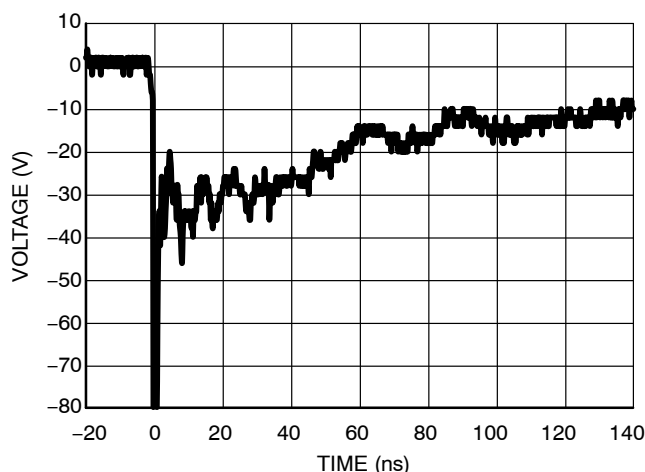
Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Reverse Working Voltage	V <sub>RWM</sub>	(Note 2)			5.5	V
Breakdown Voltage	V <sub>BR</sub>	I <sub>T</sub> = 1 mA, (Note 3)	6.0			V
Reverse Leakage Current	I <sub>R</sub>	V <sub>RWM</sub> = 5.5 V			1.0	μA
ESD Clamping Voltage	V <sub>C</sub>	Per IEC61000-4-2 (Note 4)	See Figures 1 & 2			
Junction Capacitance	C <sub>J</sub>	V <sub>R</sub> = 0 V, f = 1 MHz between I/O Pins and GND		0.3	0.6	pF
Junction Capacitance	C <sub>J</sub>	V <sub>R</sub> = 0 V, f = 1 MHz between I/O Pins		0.3	0.6	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.

- Surge protection devices are normally selected according to the working peak reverse voltage (V<sub>RWM</sub>), which should be equal or greater than the DC or continuous peak operating voltage level.
- V<sub>BR</sub> is measured at pulse test current I<sub>T</sub>.
- 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

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

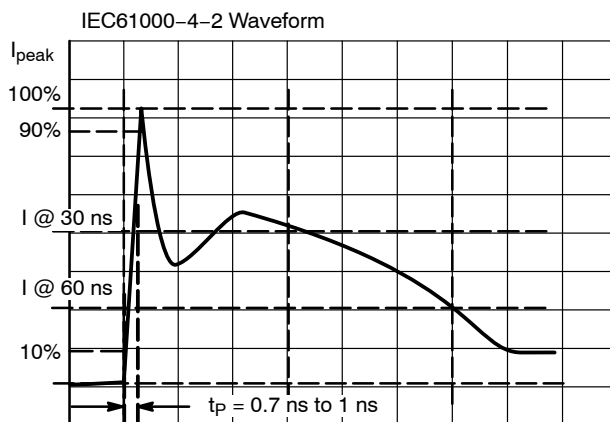


Figure 3. IEC61000-4-2 Spec

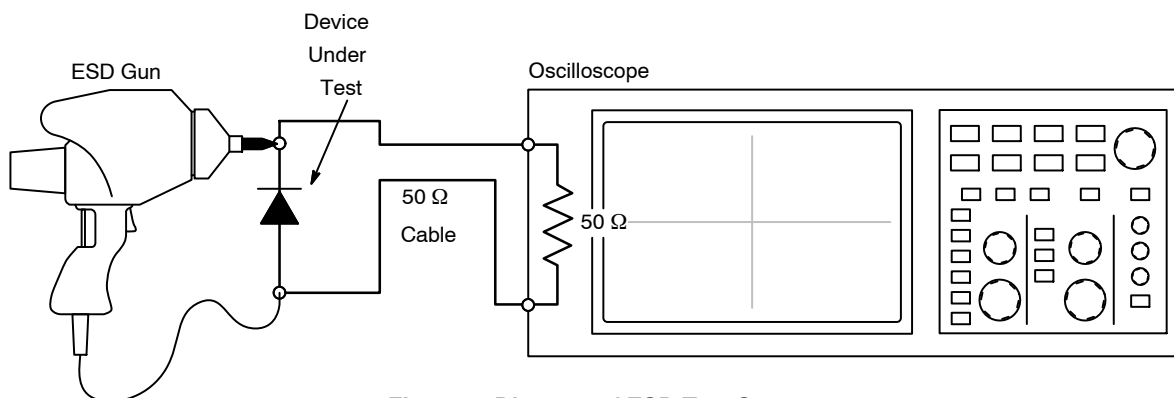


Figure 4. Diagram of ESD Test Setup

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. **onsemi** 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 **onsemi** creates these screenshots and how to interpret them please refer to AND8307/D.

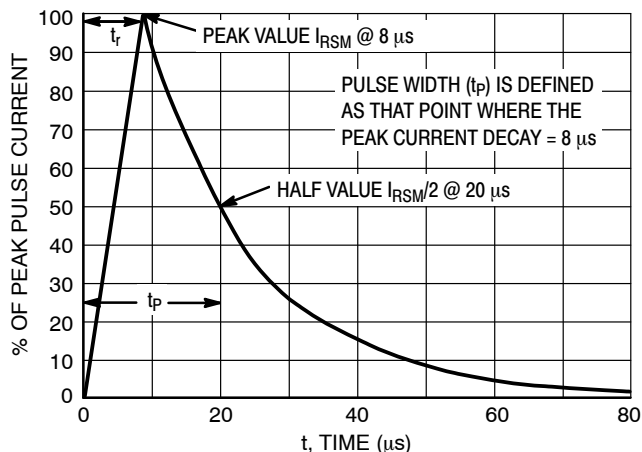


Figure 5. 8 x 20 μs Pulse Waveform

## 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

breakdown voltage of the protection device, the internal rectifiers are forward biased conducting the transient current away from the protected controller chip. The surge protection diode suppresses ESD strikes directly on the voltage bus and directs the surge to ground, protecting both the power and data pins.

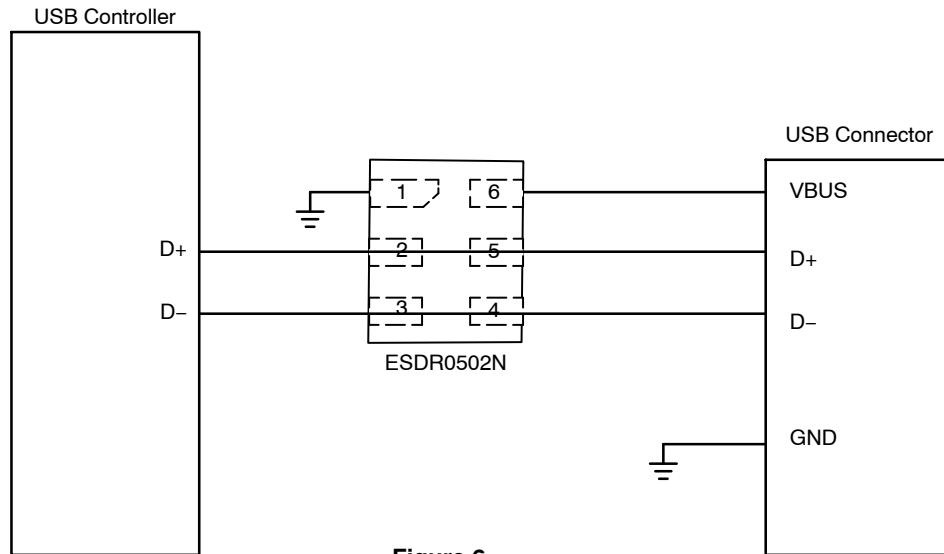
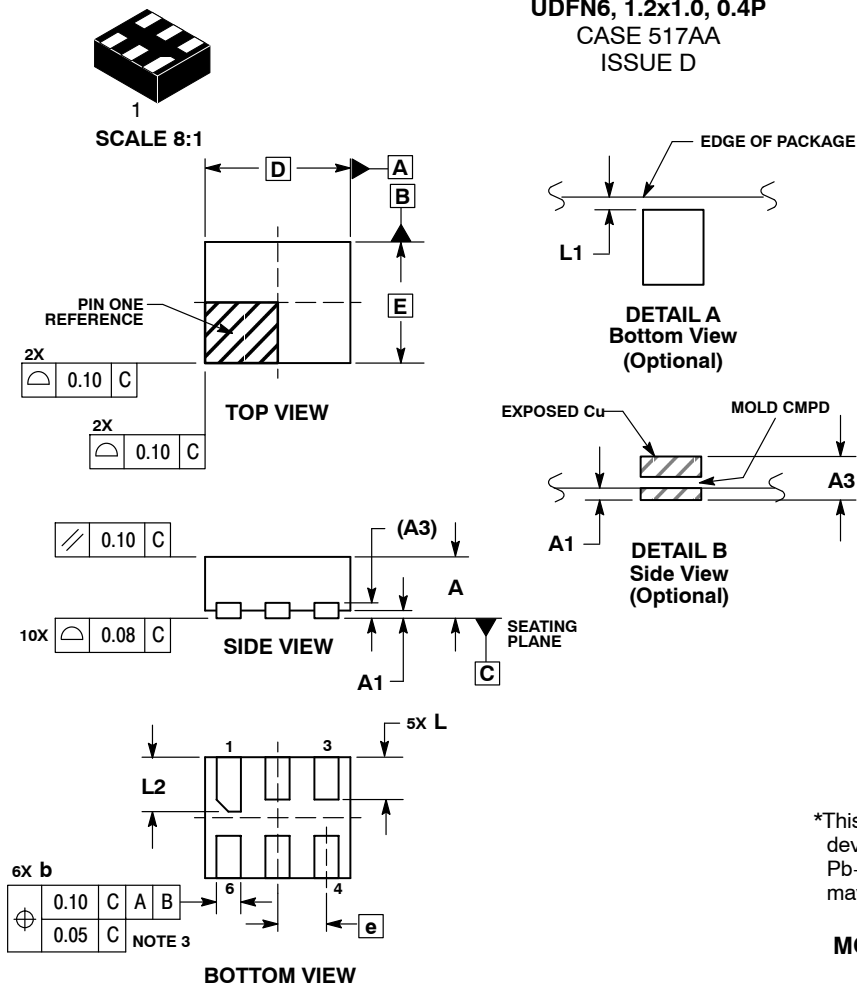
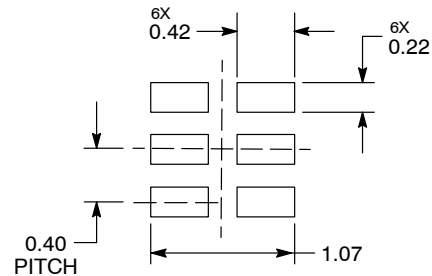


Figure 6.

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

DATE 03 SEP 2010


**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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