



**THE DATASHEET OF  
ESD7501MUT5G**



# ESD7501

## ESD Protection Diode

### Micro-Packaged Diodes for ESD Protection

The ESD7501 is designed to protect voltage sensitive components that require low capacitance from ESD and transient voltage events. Excellent clamping capability, low capacitance, low leakage, and fast response time, make these parts ideal for ESD protection on designs where board space is at a premium. Because of its low capacitance, the part is well suited for use in high frequency designs such as USB 2.0 high speed applications.

#### Features

- Low Capacitance 0.45 pF (Typ)
- Low Clamping Voltage
- Small Body Outline Dimensions: 0.60 mm x 0.30 mm
- Low Body Height: 0.3 mm
- Stand-off Voltage: 5 V
- IEC61000-4-2 Level 4 ESD Protection
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

#### Typical Applications

- USB 2.0/3.0
- MHL 2.0
- eSATA

#### MAXIMUM RATINGS

Rating	Symbol	Value	Unit
IEC 61000-4-2 (ESD) Contact Air		$\pm 16$ $\pm 16$	kV
Total Power Dissipation on FR-5 Board (Note 1) @ $T_A = 25^\circ\text{C}$	$P_D$	250	mW
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$	400	$^\circ\text{C}/\text{W}$
Junction and Storage Temperature Range	$T_J, T_{stg}$	-55 to +150	$^\circ\text{C}$
Lead Solder Temperature - Maximum (10 Second Duration)	$T_L$	260	$^\circ\text{C}$

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.

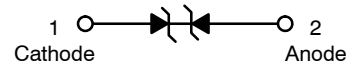
1. FR-5 = 1.0 x 0.75 x 0.62 in.

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



ON Semiconductor®

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X3DFN2  
CASE 152AF

#### MARKING DIAGRAM

PIN 1

> M

V = Specific Device Code  
M = Date Code

#### ORDERING INFORMATION

Device	Package	Shipping†
ESD7501MUT5G	X3DFN2 (Pb-Free)	15000 / Tape & Reel

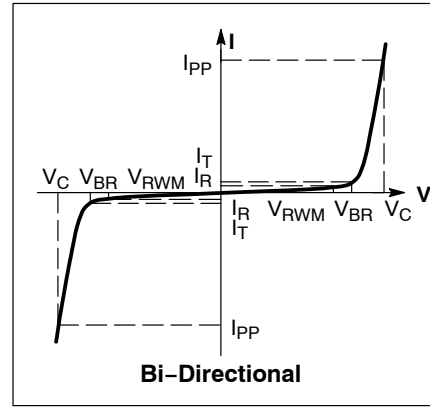
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

**ELECTRICAL CHARACTERISTICS**

( $T_A = 25^\circ\text{C}$  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

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

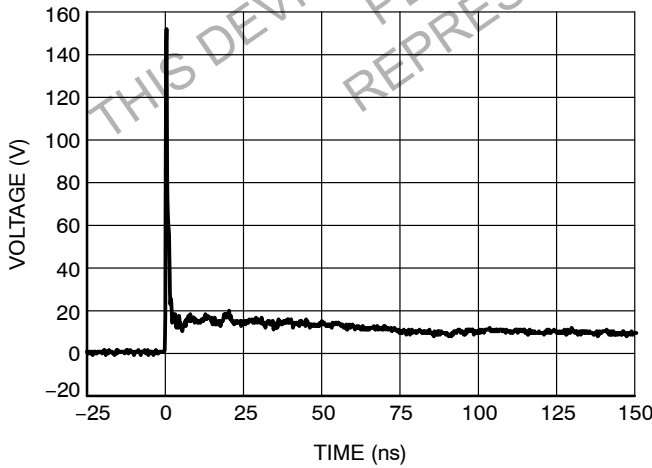


**ELECTRICAL CHARACTERISTICS** ( $T_A = 25^\circ\text{C}$  unless otherwise specified)

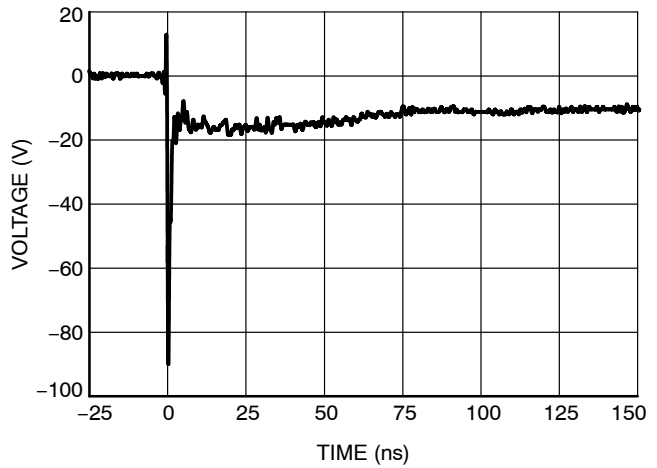
Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Reverse Working Voltage	$V_{RWM}$				5.0	V
Breakdown Voltage (Note 2)	$V_{BR}$	$I_T = 1\text{ mA}$	5.5			V
Reverse Leakage Current	$I_R$	$V_{RWM} = 5\text{ V}$			1.0	$\mu\text{A}$
Clamping Voltage 8x20 $\mu\text{s}$	$V_C$	$I_{PP} = 0.5\text{ A}$		8.4	8.9	V
Clamping Voltage 8x20 $\mu\text{s}$	$V_C$	$I_{PP} = 1.0\text{ A}$		9	9.5	V
Clamping Voltage (Note 3)	$V_C$	$I_{PP} = 2\text{ A}$			11.5	V
ESD Clamping Voltage	$V_C$	Per IEC61000-4-2	See Figures 1 and 2			
Junction Capacitance	$C_J$	$V_R = 0\text{ V}$ , $f = 1\text{ MHz}$		0.45	0.75	pF
Dynamic Resistance	$R_{DYN}$	TLP Pulse Pin 1 to Pin 2 Pin 2 to Pin 1		0.28 0.42		$\Omega$
Insertion Loss		$f = 1\text{ GHz}$ $f = 5\text{ GHz}$ $f = 10\text{ GHz}$		0.08 0.55 1.77		dB

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.

- Breakdown voltage is tested from pin 1 to 2 and pin 2 to 1.
- Non-repetitive current pulse at  $T_A = 25^\circ\text{C}$ , per IEC61000-4-5 waveform.



**Figure 1. IEC61000-4-2 + 8 kV Contact ESD Clamping Voltage**



**Figure 2. IEC61000-4-2 - 8 kV Contact ESD Clamping Voltage**

TYPICAL CHARACTERISTICS

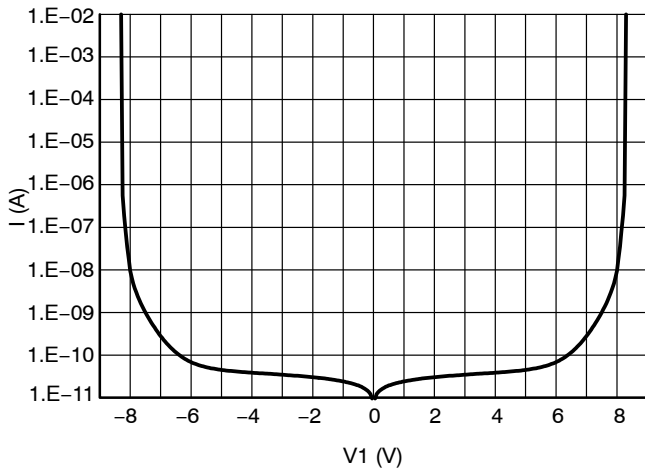


Figure 3. IV Characteristics

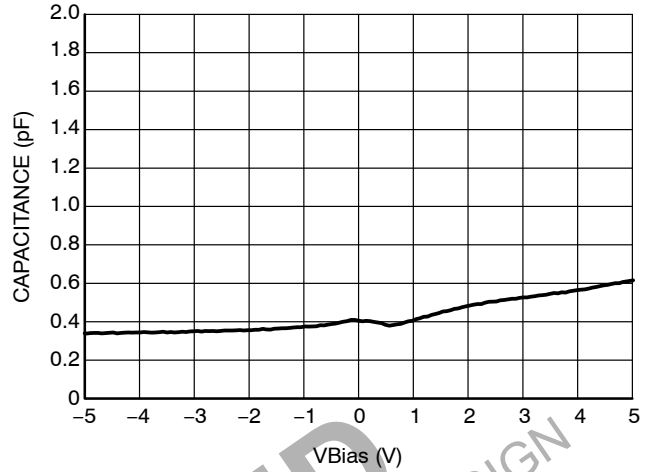


Figure 4. CV Characteristics

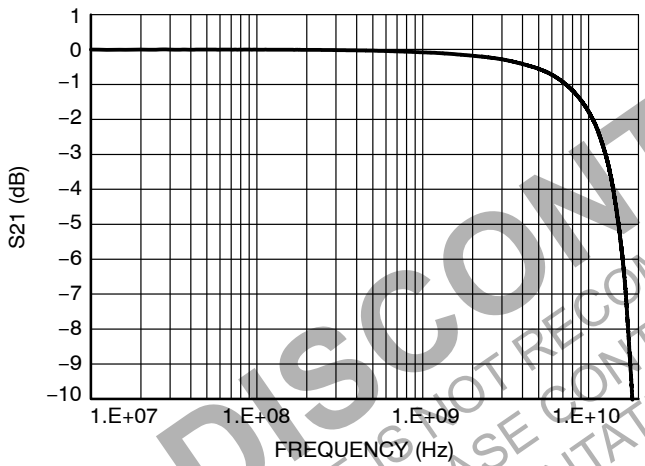


Figure 5. Insertion Loss

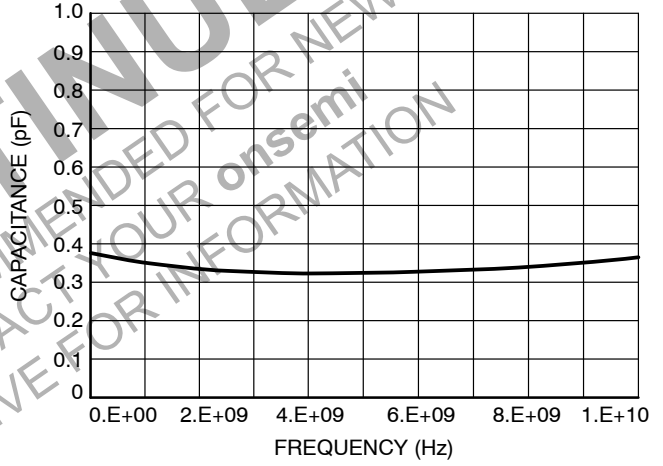


Figure 6. Typical Capacitance over Frequency

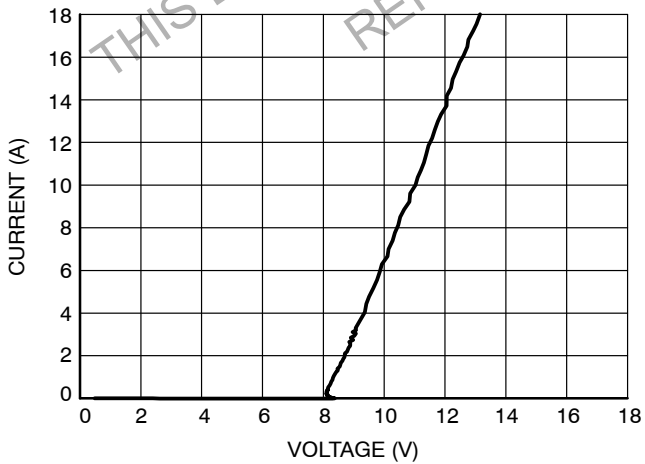


Figure 7. Pin 1 to Pin 2 TLP IV Curve

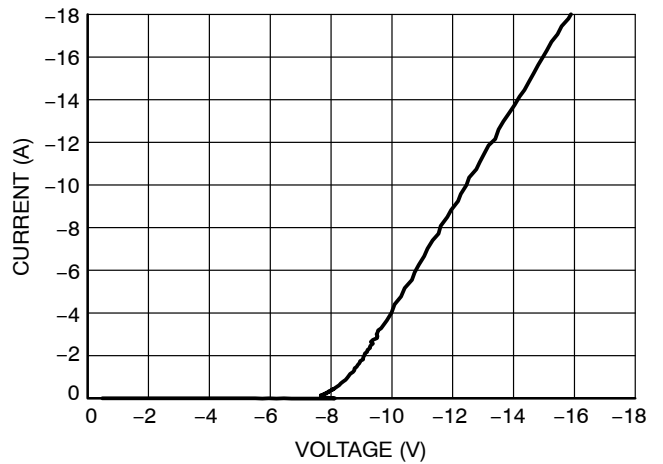


Figure 8. Pin 2 to Pin 1 TLP IV Curve

# ESD7501

## 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 9. IEC61000-4-2 Spec

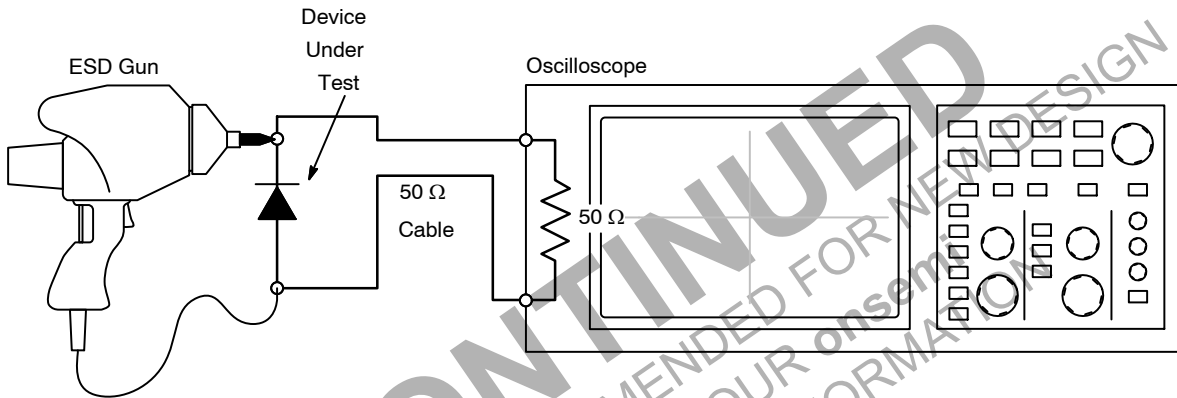


Figure 10. Diagram of ESD Test Setup

### 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.

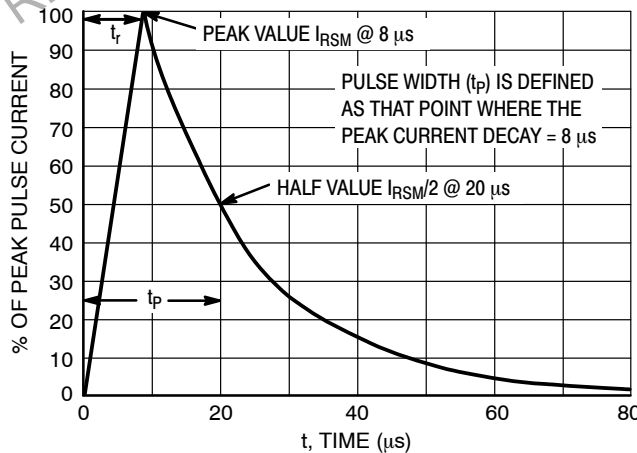
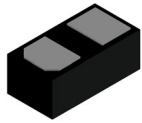


Figure 11. 8 x 20 μs Pulse Waveform

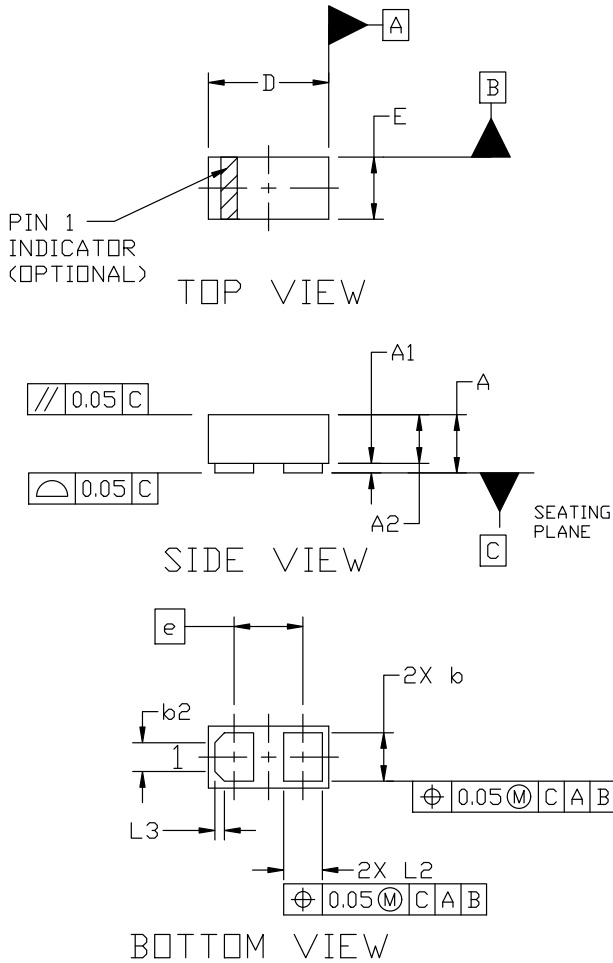
# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS



**X3DFN2 0.62x0.32x0.24, 0.35P**  
**CASE 152AF**  
**ISSUE C**

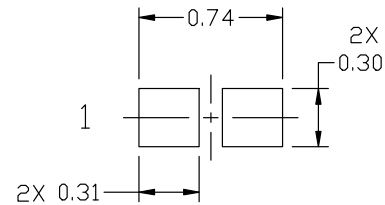
DATE 08 AUG 2023



**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, SOLDERM/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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