5.5 V ESD Protection Diode

Micro−Packaged Diodes for ESD Protection

ESDM3551

The ESDM3551 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.

Features

- Low Clamping Voltage
- Small Body Outline Dimensions:
  - 0201: 0.62 mm x 0.32 mm
  - 0402: 1.00 mm x 0.60 mm
- Low Body Height: 0.3 mm
- Stand−off Voltage: 5.5 V
- IEC61000−4−2 Level 4 ESD Protection
- SZ Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC−Q101 Qualified and PPAP Capable
- These Devices are Pb−Free, Halogen Free/BFR Free and are RoHS Compliant

Typical Applications

- USB ID Line Protection
- μSD Card Protection
- Audio Line Protection
- GPIO

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
IEC 61000−4−2 Contact IEC 61000−4−2 Air ISO 10605 150 pF/2 kΩ ISO 10605 330 pF/2 kΩ ISO 10605 330 pF/330 Ω	ESD	±30 ±30 ±30 ±30 ±30	kV
Total Power Dissipation on FR−5 Board (Note 1) @ T_A = 25°C Thermal Resistance, Junction−to−Ambient	P_D $R_{\theta JA}$	250 400	mW °C/W
Junction and Storage Temperature Range	T_J, T_{stg}	−55 to +150	°C
Lead Solder Temperature − Maximum (10 Second Duration)	T_L	260	°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.

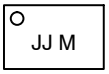
X3DFN2 (0201)
CASE 152AF

X2DFN2 (0402)
CASE 714AB

MARKING DIAGRAMS

PIN 1

5 = Specific Device Code
M = Date Code



JJ = Specific Device Code
M = Date Code

ORDERING INFORMATION

Device	Package	Shipping†
ESDM3551MXT5G	X3DFN2 (Pb−Free)	10000 / Tape & Reel
ESDM3551N2T5G	X2DFN2 (Pb−Free)	8000 / Tape & Reel
SZESDM3551N2T5G	X2DFN2 (Pb−Free)	8000 / Tape & Reel
SZESDM3551MXT5G	X3DFN2 (Pb−Free)	10000 / 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.

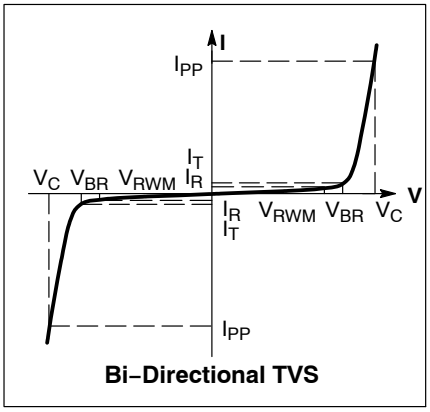
See Application Note AND8308/D for further description of survivability specs.

ELECTRICAL CHARACTERISTICS

(T_A = 25°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.



Bi−Directional TVS

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise specified)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Reverse Working Voltage	V_{RWM}				5.5	V
Breakdown Voltage (Note 2)	V_{BR}	I_T = 1 mA	5.6		7.0	V
Reverse Leakage Current	I_R	V_{RWM} = 5.5 V			0.1	μA
Clamping Voltage (Note 3)	V_C	I_{PP} = 1 A			6.0	V
Clamping Voltage (Note 3)	V_C	I_{PP} = 8 A			8.2	V
Peak Pulse Current (Note 3)	I_{PP}	t_P = 8/20 μs	9.9			A
Clamping Voltage TLP (Note 4)	V_C	I_{PP} = 16 A } IEC 61000−4−2 Level 4 equivalent (±8 kV Contact, ±15 kV Air)		7.5		V
Junction Capacitance	C_J	V_R = 0 V, f = 1 MHz			21	pF
Dynamic Resistance	R_{DYN}	TLP Pulse		0.11		Ω
Insertion Loss		f = 10 MHz		0.01		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.

2. Breakdown voltage is tested from pin 1 to 2 and pin 2 to 1.
3. Non−repetitive current pulse at T_A = 25°C, per IEC61000−4−5 waveform.
4. ANSI/ESD STM5.5.1 − Electrostatic Discharge Sensitivity Testing using Transmission Line Pulse (TLP) Model. TLP conditions: Z_0 = 50 Ω, t_p = 100 ns, t_r = 4 ns, averaging window; t_1 = 30 ns to t_2 = 60 ns.

TYPICAL CHARACTERISTICS

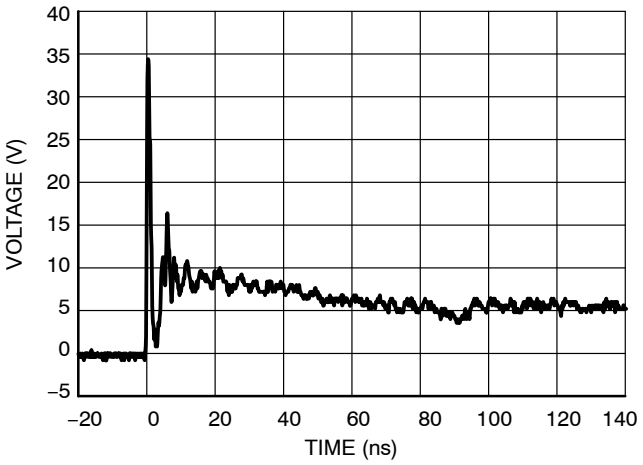


Figure 1. ESD Clamping Voltage Screenshot Positive 8 kV Contact per IEC61000−4−2

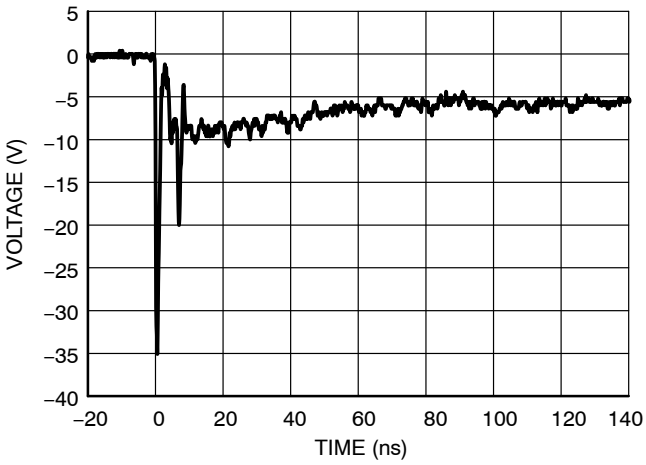


Figure 2. ESD Clamping Voltage Screenshot Negative 8 kV Contact per IEC61000−4−2

TYPICAL CHARACTERISTICS (continued)

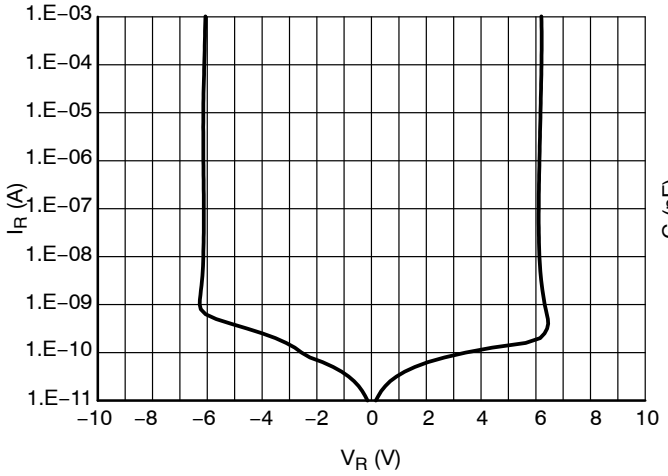


Figure 3. IV Characteristics

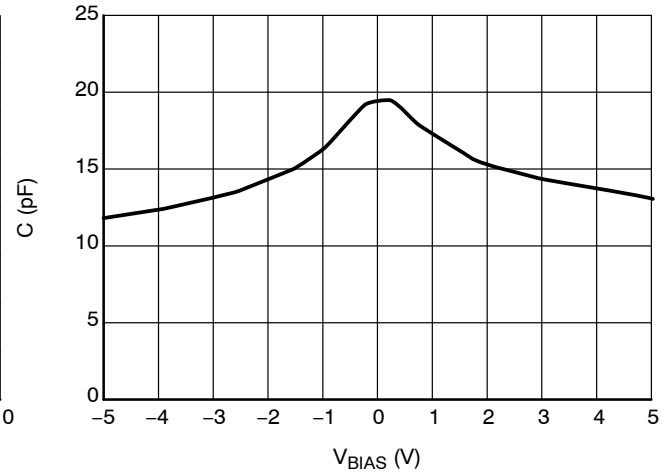


Figure 4. CV Characteristics

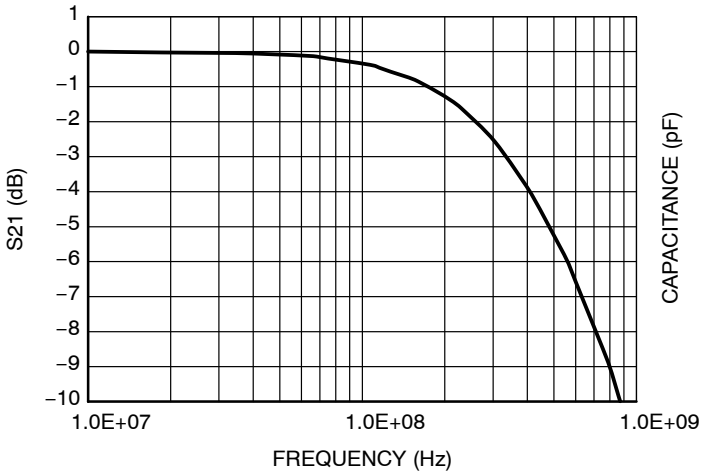


Figure 5. RF Insertion Loss

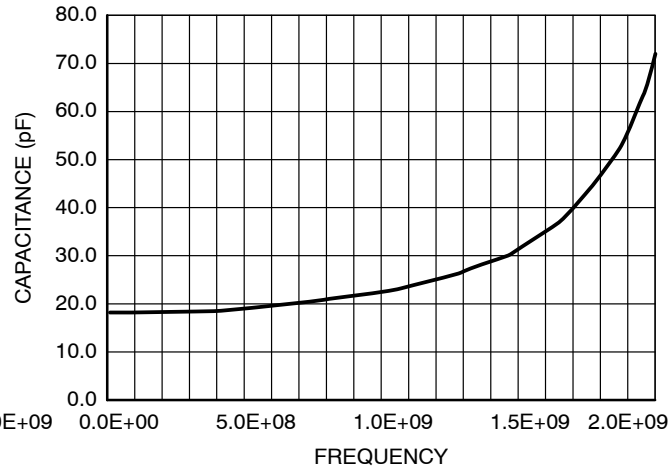


Figure 6. Capacitance over Frequency

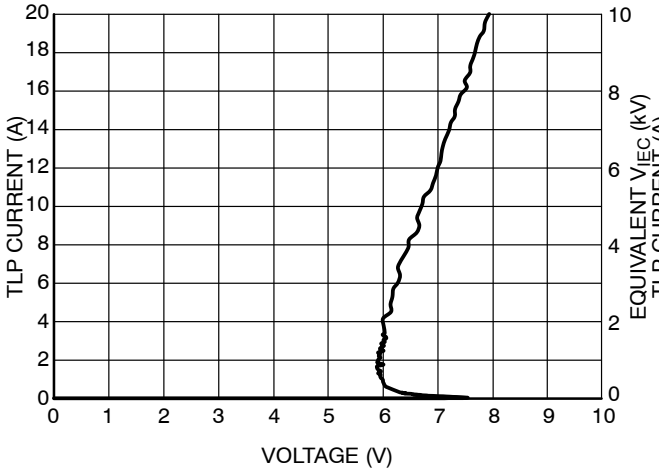


Figure 7. Positive TLP I−V Curve

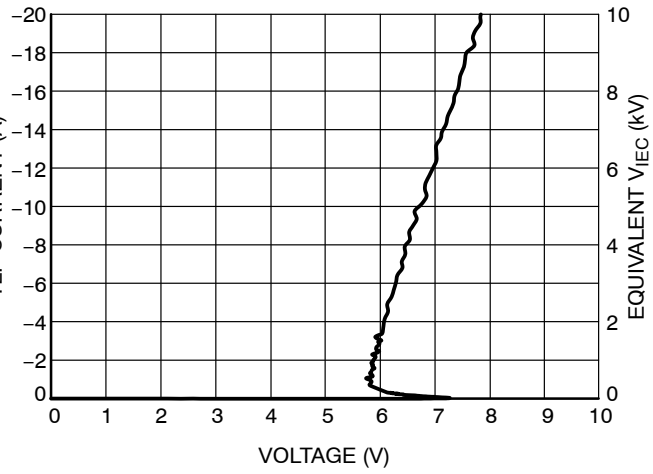


Figure 8. Negative TLP I−V Curve

TYPICAL CHARACTERISTICS (continued)

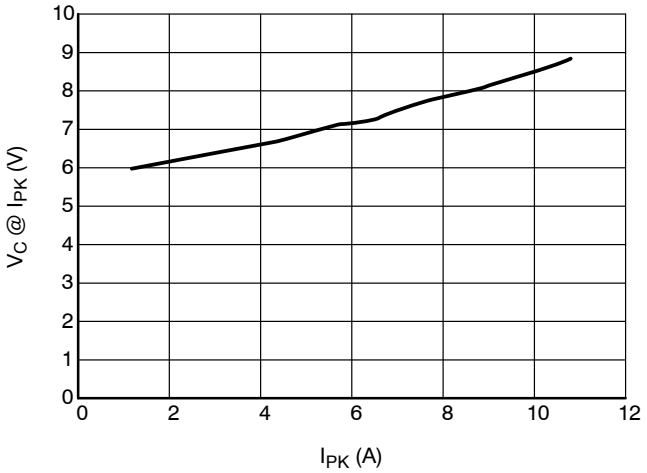


Figure 9. Positive Clamping Voltage vs. Peak Pulse Current (tp = 8/20 μs)

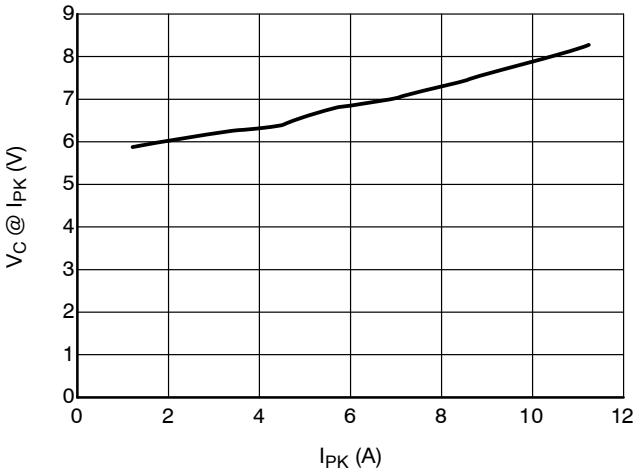


Figure 10. Negative Clamping Voltage vs. Peak Pulse Current (tp = 8/20 μs)

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

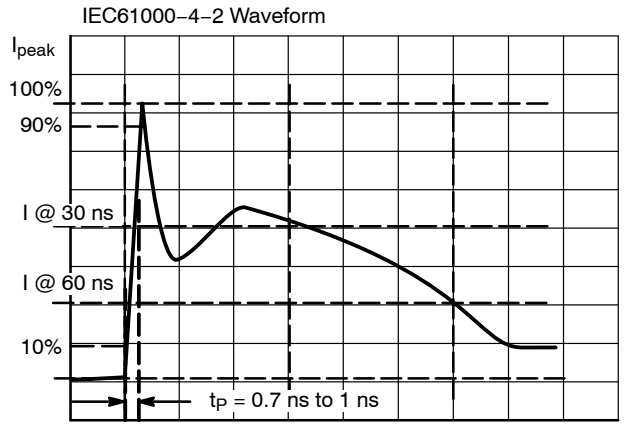


Figure 11. IEC61000−4−2 Spec

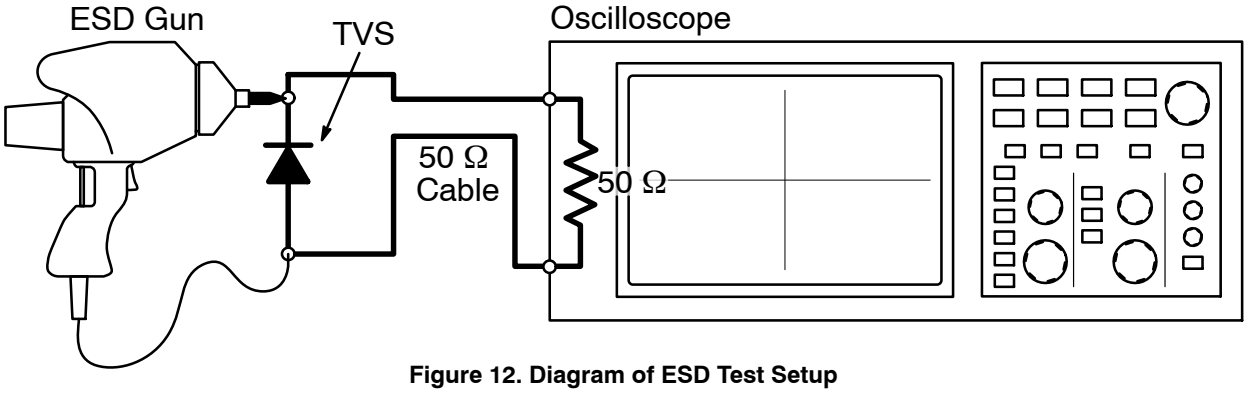


Figure 12. Diagram of ESD Test Setup

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. **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.

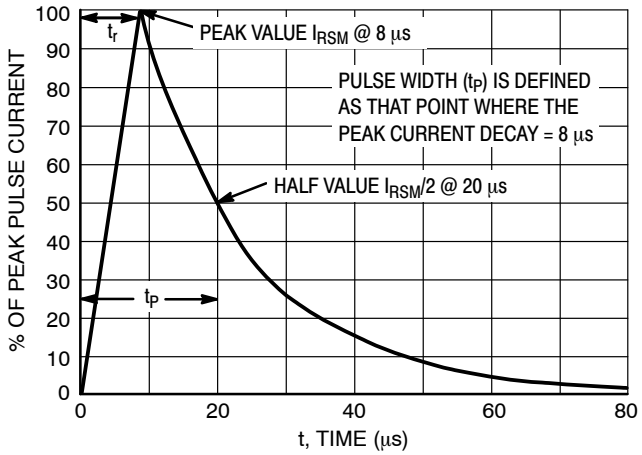


Figure 13. 8 X 20 μs Pulse Waveform

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.

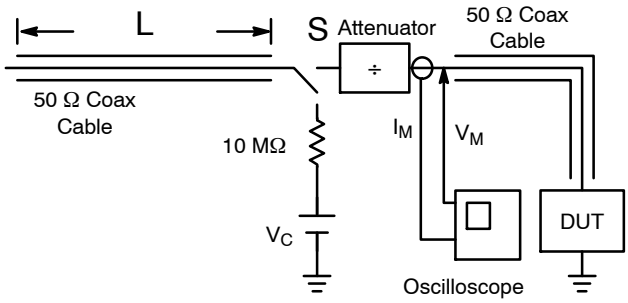


Figure 14. Simplified Schematic of a Typical TLP System

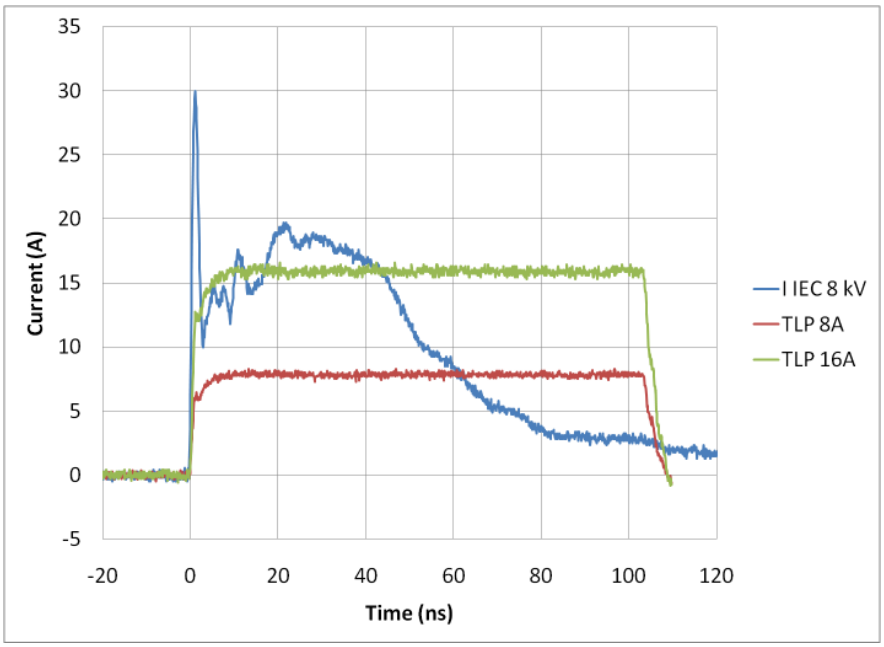
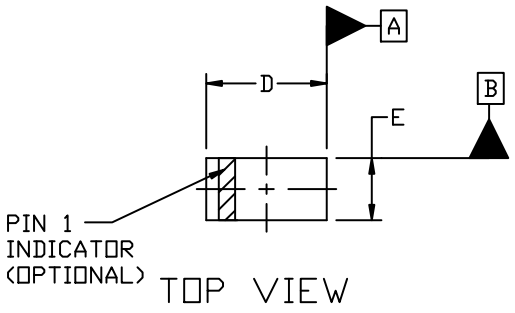


Figure 15. Comparison Between 8 kV IEC 61000−4−2 and 8 A and 16 A TLP Waveforms

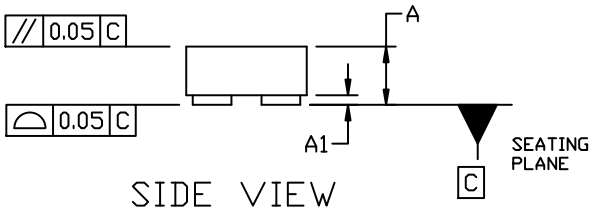
X3DFN2, 0.62x0.32, 0.355P, (0201)
CASE 152AF
ISSUE B

SCALE 8:1

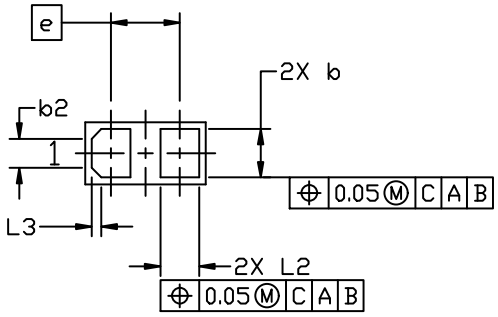
DATE 13 JAN 2023



TOP VIEW



SIDE VIEW

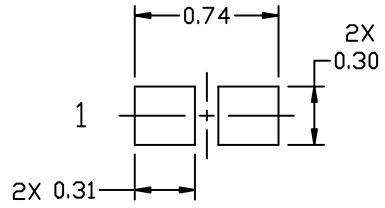


BOTTOM VIEW

NOTES:

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

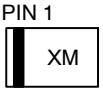
	MILLIMETERS		
DIM	MIN.	NOM.	MAX.
A	0.25	0.29	0.33
A1	0.00	---	0.05
b	0.22	0.25	0.28
b2	0.150 REF		
D	0.58	0.62	0.66
E	0.28	0.32	0.36
e	0.355 BSC		
L2	0.17	0.20	0.23
L3	0.050 REF		



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.

DOCUMENT NUMBER:	**98AON56472E**	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped “CONTROLLED COPY” in red.
DESCRIPTION:	**X3DFN2, 0.62X0.32, 0.355P, (0201)**	**PAGE 1 OF 1**

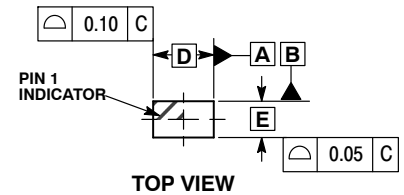
MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS

ON Semiconductor®

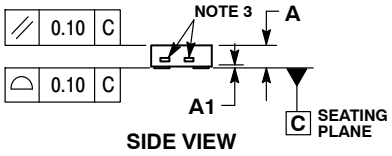
X2DFN2 1.0x0.6, 0.65P
CASE 714AB
ISSUE B

DATE 21 NOV 2017

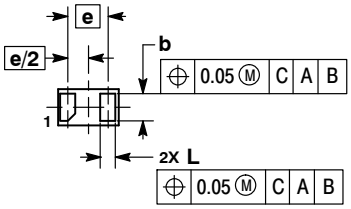
SCALE 8:1



TOP VIEW



SIDE VIEW

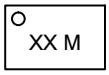


BOTTOM VIEW

NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. EXPOSED COPPER ALLOWED AS SHOWN.

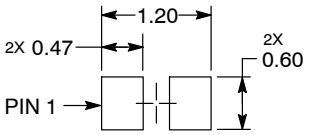
	MILLIMETERS		
DIM	MIN	NOM	MAX
A	0.34	0.37	0.40
A1	---	0.03	0.05
b	0.45	0.50	0.55
D	0.95	1.00	1.05
E	0.55	0.60	0.65
e	0.65 BSC		
L	0.20	0.25	0.30

GENERIC MARKING DIAGRAM*



XX = Specific Device Code
M = Date Code

RECOMMENDED SOLDER FOOTPRINT*



DIMENSIONS: MILLIMETERS

*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.

DOCUMENT NUMBER:	**98AON98172F**	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped “CONTROLLED COPY” in red.
DESCRIPTION:	**X2DFN2 1.0X0.6, 0.65P**	**PAGE 1 OF 1**

ADDITIONAL INFORMATION

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Technical Library: www.onsemi.com/design/resources/technical−documentation
onsemi Website: www.onsemi.com

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