ESD Protection Diode



Micro−Packaged Diodes for ESD Protection

ESD5481

The ESD5481 is designed to protect voltage sensitive components from ESD. Excellent clamping capability, low leakage, and fast response time provide best in class protection on designs that are exposed to ESD. Because of its small size, it is suited for use in cellular phones, MP3 players, digital cameras and many other portable applications where board space comes at a premium.

Specification Features

- Low Capacitance 15 pF
- Low Clamping Voltage
- Small Body Outline Dimensions: 0.60 mm x 0.30 mm
- Low Body Height: 0.3 mm
- Stand−off Voltage: 5.0 V
- Low Leakage
- Response Time is < 1 ns
- IEC61000−4−2 Level 4 ESD Protection
- IEC61000−4−4 Level 4 EFT Protection
- These Devices are Pb−Free, Halogen Free/BFR Free and are RoHS Compliant

Mechanical Characteristics

MOUNTING POSITION: Any
QUALIFIED MAX REFLOW TEMPERATURE: 260°C
Device Meets MSL 1 Requirements

MAXIMUM RATINGS

Rating		Symbol	Value	Unit
IEC 61000−4−2 (ESD)	Contact Air		±20 ±20	kV
IEC 61000−4−4 (EFT)	5/50 ns		40	A
Total Power Dissipation on FR−5 Board (Note 1) @ T_A = 25°C Thermal Resistance, Junction−to−Ambient		P_D $R_{\theta JA}$	300 400	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

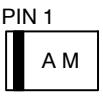
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.
1. FR−5 = 1.0 x 0.75 x 0.62 in.

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



X3DFN2
CASE 152AF

MARKING DIAGRAM



A = Specific Device Code
M = Date Code

ORDERING INFORMATION

Device	Package	Shipping†
ESD5481MUT5G	X3DFN2 (Pb−Free)	10,000 / Tape & Reel

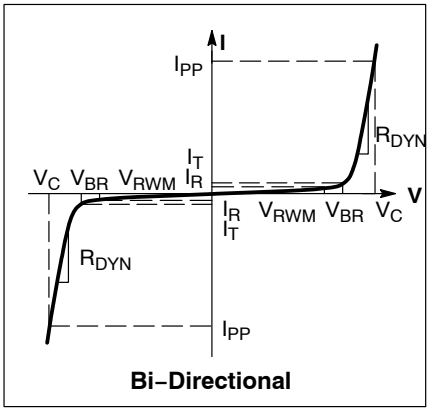
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

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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
R_{DYN}	Dynamic Resistance

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



Bi−Directional

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

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Reverse Working Voltage	V_{RWM}	I/O Pin to I/O Pin			5.0	V
Breakdown Voltage	V_{BR}	I_T = 5 μA	4.5		10	V
Breakdown Voltage	V_{BR}	I_T = 1 mA	5.7		8.0	V
Reverse Leakage Current	I_R	V_{RWM} = 5.0 V			1.0	μA
Clamping Voltage (Note 2)	V_C	IEC61000−4−2, ±8 kV Contact	See Figures 1 and 2			V
Clamping Voltage TLP (Note 3)	V_C	I_{PP} = 16 A I_{PP} = −16 A } IEC 61000−4−2 Level 2 equivalent (±8 kV Contact, ±15 kV Air)		19.7 −11	23 −13	V
Clamping Voltage 8/20 μs Waveform per Figure 10	V_C	I_{PP} = 1 A I_{PP} = 2 A		9.8 12.4	12 15	V
Dynamic Resistance	R_{DYN}	Pin 1 to Pin 2 Pin 2 to Pin 1		0.49 0.28		Ω
Reverse Peak Pulse Current	I_{PP}	per IEC 61000−4−5 (8/20 μs) Figure 10		2.0		A
Junction Capacitance	C_J	V_R = 0 V, f = 1 MHz		12	15	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.

2. For test procedure see application note AND8307/D.
3. 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.

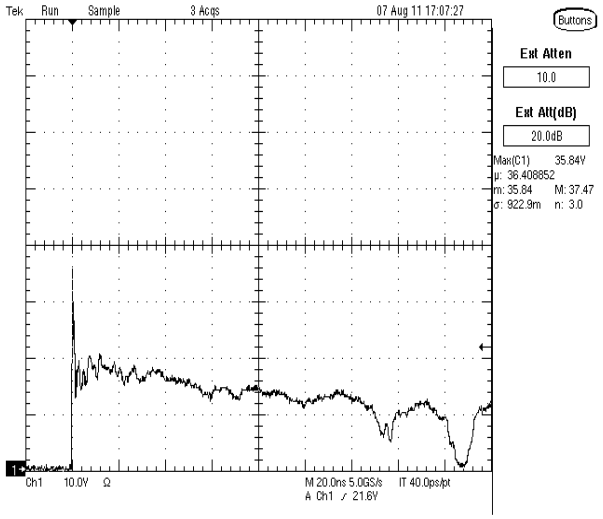


Figure 1. ESD Clamping Voltage Screenshot Positive 8 kV Contact per IEC61000−4−2

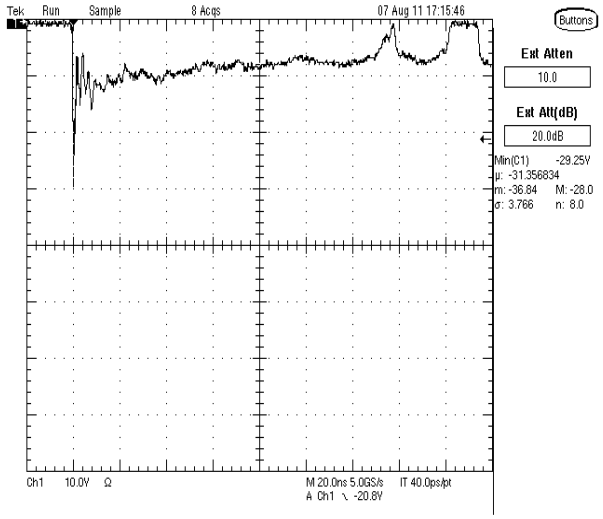


Figure 2. ESD Clamping Voltage Screenshot Negative 8 kV Contact per IEC61000−4−2

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

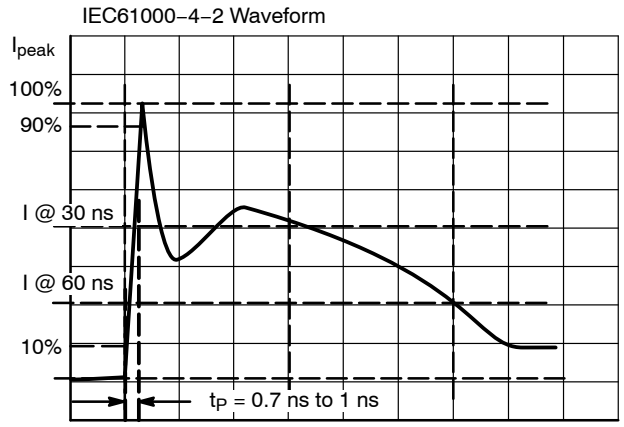


Figure 3. IEC61000−4−2 Spec

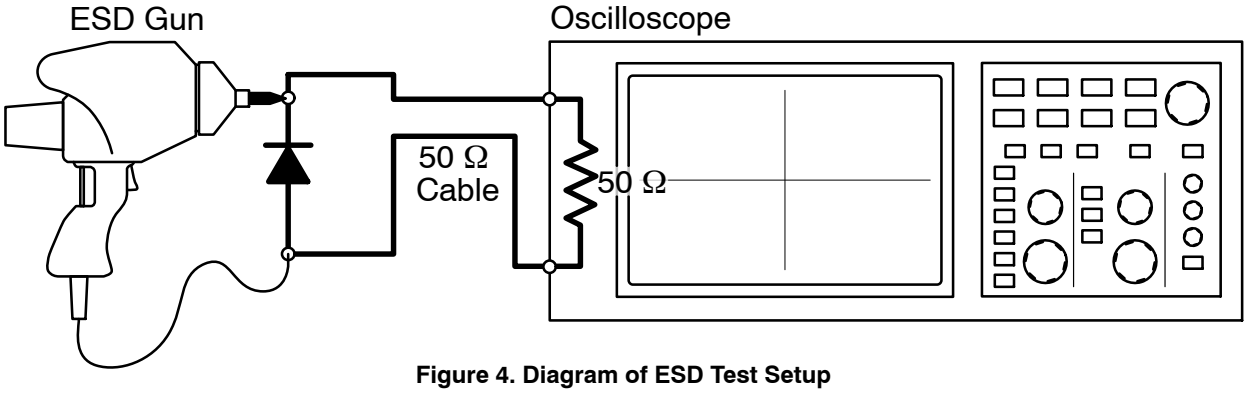


Figure 4. Diagram of ESD Test Setup

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.

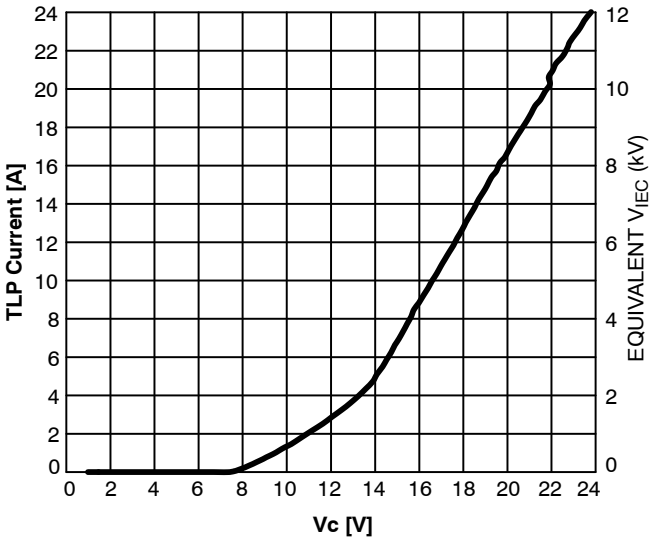


Figure 5. Positive TLP I–V Curve

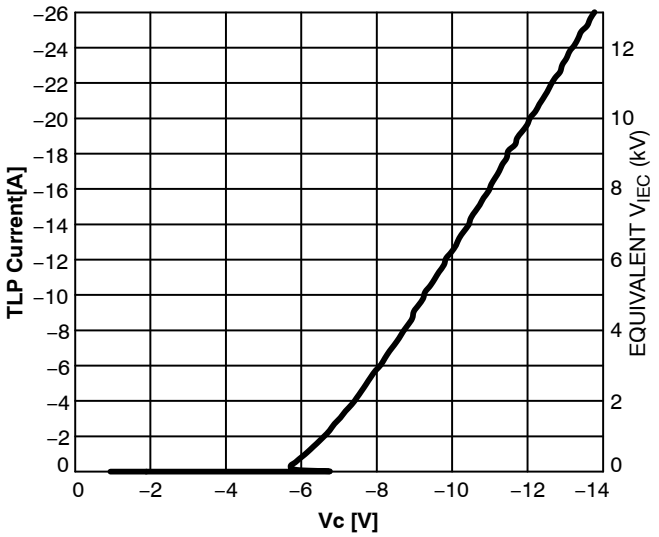


Figure 6. Negative TLP I–V Curve

NOTE: TLP parameter: Z_0 = 50 Ω, t_p = 100 ns, t_r = 300 ps, averaging window: t_1 = 30 ns to t_2 = 60 ns. V_{IEC} is the equivalent voltage stress level calculated at the secondary peak of the IEC 61000−4−2 waveform at t = 30 ns with 2 A/kV. See TLP description below for more information.

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 7. 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 8 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. For more information on TLP measurements and how to interpret them please refer to AND9007/D.

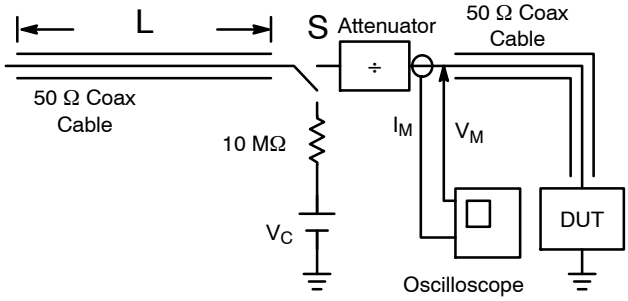


Figure 7. Simplified Schematic of a Typical TLP System

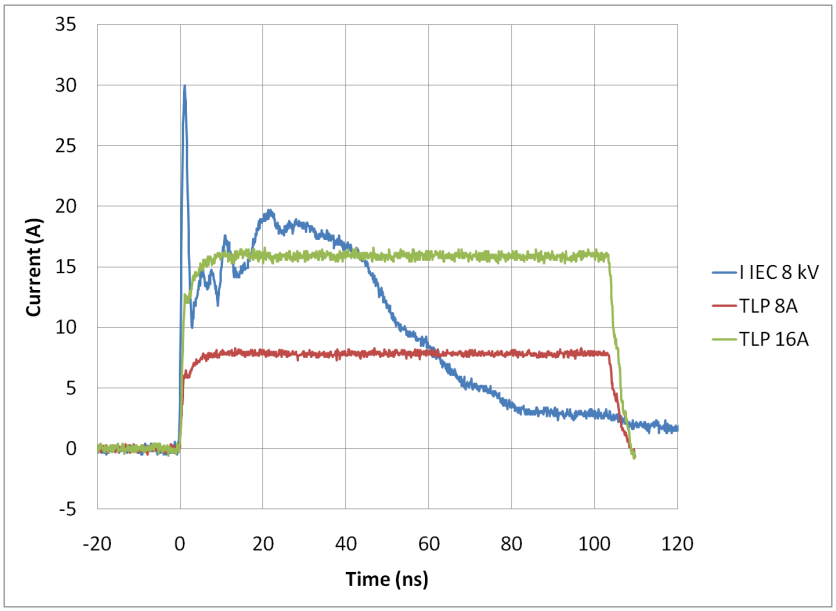


Figure 8. Comparison Between 8 kV IEC 61000−4−2 and 8 A and 16 A TLP Waveforms

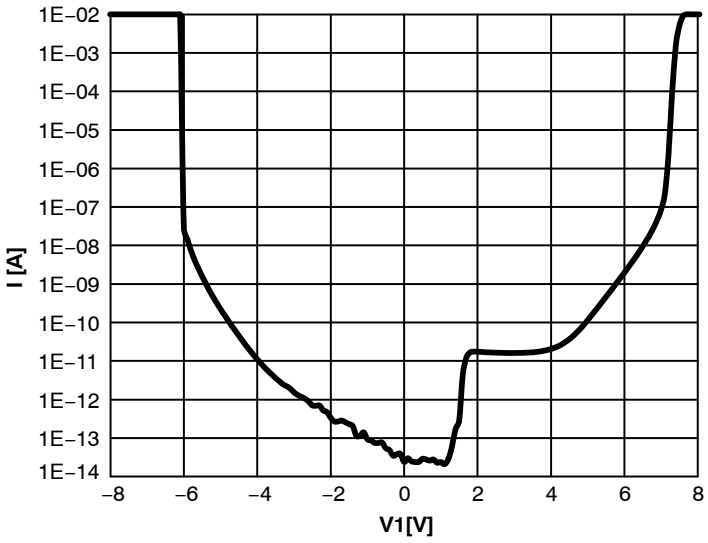


Figure 9. IV Characteristics

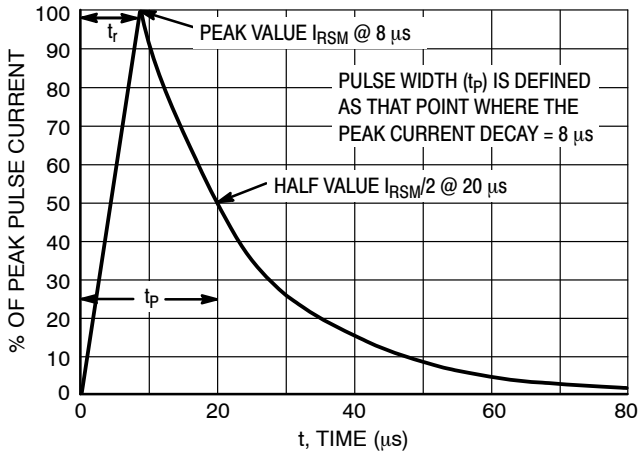
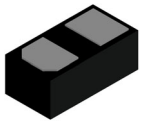
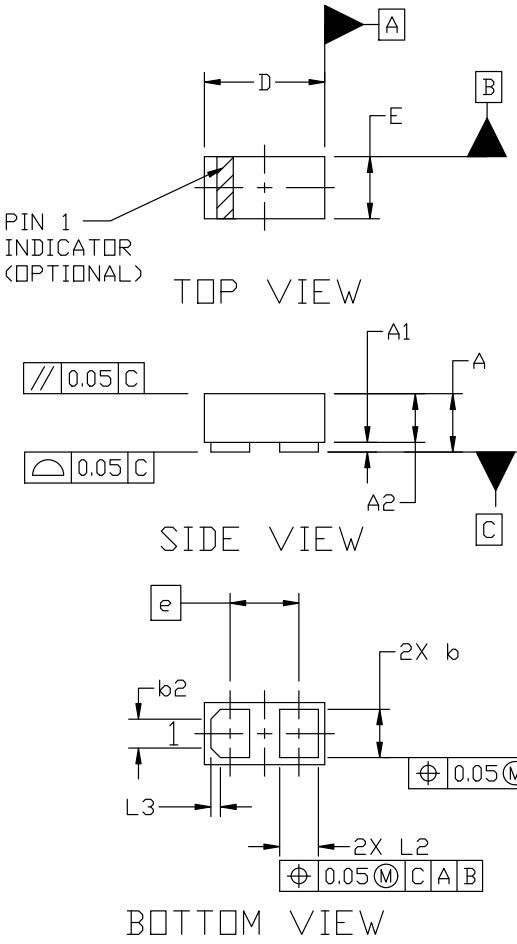


Figure 10. 8 X 20 μs Pulse Waveform



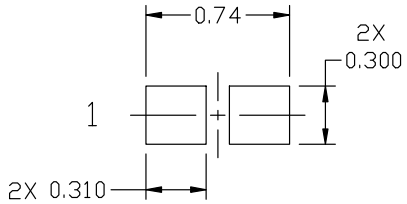
X3DFN−2 0.62x0.32x0.24, 0.35P
CASE 152AF
ISSUE D

DATE 08 OCT 2025



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

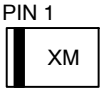
	MILLIMETERS		
DIM	MIN.	NOM.	MAX.
A	0.25	0.29	0.33
A1	0.00	---	0.05
A2	0.14	0.24	0.34
b	0.22	0.25	0.28
b2	0.150 REF		
D	0.58	0.62	0.66
E	0.28	0.32	0.36
e	0.355 BSC		
L2	0.17	0.20	0.23
L3	0.050 REF		



RECOMMENDED
MOUNTING FOOTPRINT*

* For additional information on our Pb−Free strategy and soldering details, please download the onsemi 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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