

# ESD Protection Diodes

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

### ESDL2031

The ESDL2031 ESD protection diodes are designed to protect high speed data lines from ESD. Ultra-low capacitance and low ESD clamping voltage make this device an ideal solution for protecting voltage sensitive high speed data lines.

#### Features

- Ultra Low Capacitance (0.40 pF Typ, I/O to GND)
- Protection for the Following IEC Standards:  
IEC 61000-4-2 (Level 4)
- Low ESD Clamping Voltage
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

#### Typical Applications

- USB 3.x
- MHL™ 2.0
- SATA/SAS
- PCI Express®
- HDMI®

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

Rating	Symbol	Value	Unit
Operating Junction Temperature Range	T <sub>J</sub>	-55 to +125	°C
Storage Temperature Range	T <sub>stg</sub>	-55 to +150	°C
Lead Solder Temperature – Maximum (10 Seconds)	T <sub>L</sub>	260	°C
IEC 61000-4-2 Contact (ESD)	ESD	±30	kV
IEC 61000-4-2 Air (ESD)	ESD	±30	kV
Maximum Peak Pulse Current 8/20 μs @ T <sub>A</sub> = 25°C	I <sub>pp</sub>	9.75	A
Maximum Peak Pulse Power 8/20 μs @ T <sub>A</sub> = 25°C	P <sub>pk</sub>	72	W

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.

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

#### MARKING DIAGRAM

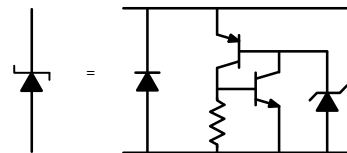
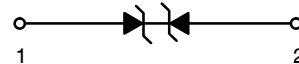


X4DFN2 (0201)  
CASE 152AX



X = Specific Device Code  
J (Rotated 270 degrees)  
P (Rotated 0 degrees)

#### PIN CONFIGURATION AND SCHEMATIC



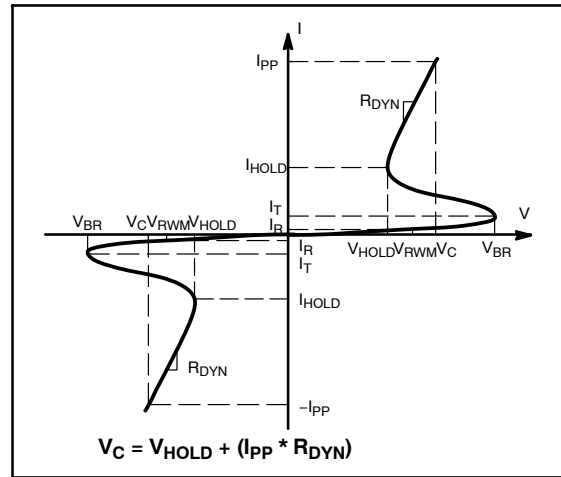
#### ORDERING INFORMATION

See detailed ordering and shipping information on page 6 of this data sheet.

**ELECTRICAL CHARACTERISTICS**

(T<sub>A</sub> = 25°C unless otherwise noted)

Symbol	Parameter
V <sub>RWM</sub>	Working Peak 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
V <sub>HOLD</sub>	Holding Reverse Voltage
I <sub>HOLD</sub>	Holding Reverse Current
R <sub>DYN</sub>	Dynamic Resistance
I <sub>PP</sub>	Maximum Peak Pulse Current
V <sub>C</sub>	Clamping Voltage @ I <sub>PP</sub> V <sub>C</sub> = V <sub>HOLD</sub> + (I <sub>PP</sub> * R <sub>DYN</sub> )

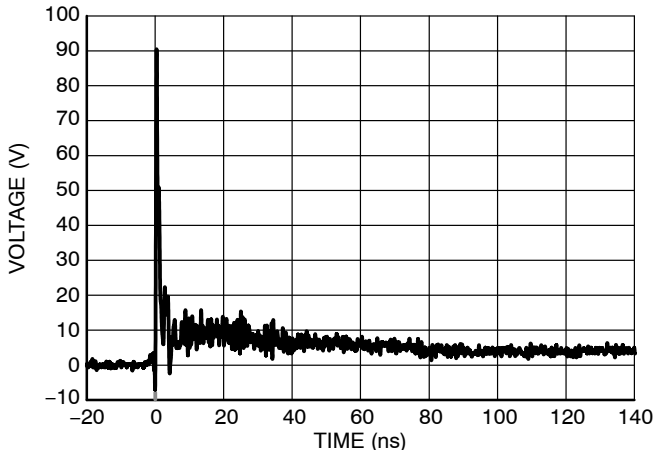


**ELECTRICAL CHARACTERISTICS** (T<sub>A</sub> = 25°C unless otherwise specified)

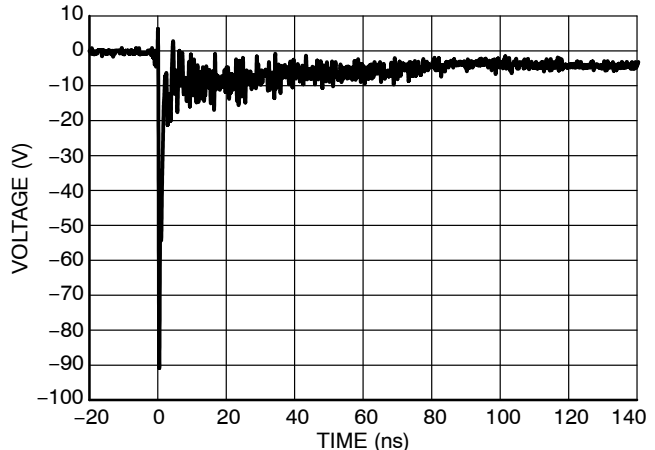
Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Reverse Working Voltage	V <sub>RWM</sub>	I/O Pin to GND			4.0	V
Breakdown Voltage	V <sub>BR</sub>	I <sub>T</sub> = 1 mA, I/O Pin to GND	5.1		8.5	V
Reverse Leakage Current	I <sub>R</sub>	V <sub>RWM</sub> = 4.0 V, I/O Pin to GND			0.05	μA
Reverse Holding Voltage	V <sub>HOLD</sub>	I/O Pin to GND		2.5		V
Holding Reverse Current	I <sub>HOLD</sub>	I/O Pin to GND		55		mA
Clamping Voltage TLP (Note 2)	V <sub>C</sub>	I <sub>PP</sub> = 8 A } IEC61000-4-2 Level 2 Equivalent (±4 kV Contact, ±8 kV Air)		5.25		V
		I <sub>PP</sub> = 16 A } IEC61000-4-4 Level 2 Equivalent (±8 kV Contact, ±16 kV Air)		7.1		
Reverse Peak Pulse Current	I <sub>PP</sub>	per IEC61000-4-5 (8x20 μs) Figure 11	9.75			A
Clamping Voltage 8/20 μs Waveform per Figure 11	V <sub>C</sub>	I <sub>PP</sub> = 9.75 A			8.0	V
Dynamic Resistance	R <sub>DYN</sub>	Pin1 to Pin2 Pin2 to Pin1		0.22 0.22		Ω
Junction Capacitance	C <sub>J</sub>	V <sub>R</sub> = 0 V, f = 1 MHz		0.40	0.55	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.

- For test procedure see Figure 12 and application note AND8307/D.
- ANSI/ESD STM5.5.1 – Electrostatic Discharge Sensitivity Testing using Transmission Line Pulse (TLP) Model.  
TLP conditions: Z<sub>0</sub> = 50 Ω, t<sub>p</sub> = 100 ns, t<sub>r</sub> = 1 ns, averaging window: t<sub>1</sub> = 70 ns to t<sub>2</sub> = 90 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**

TYPICAL CHARACTERISTICS

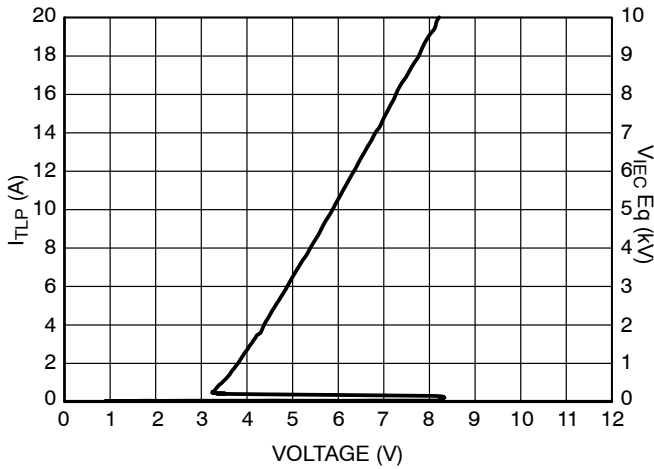


Figure 3. Positive TLP I-V Curve

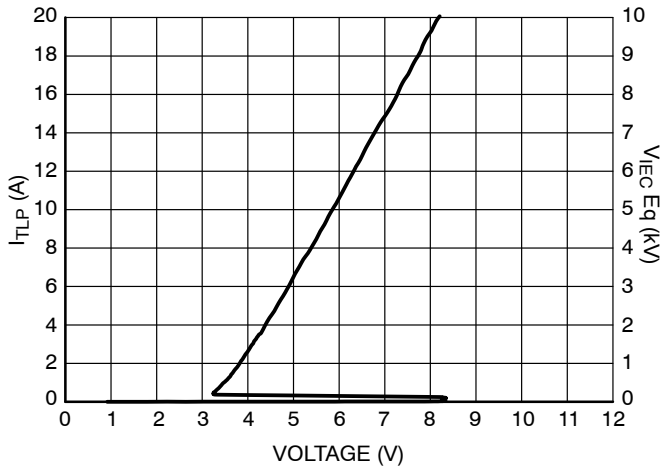


Figure 4. Negative TLP I-V Curve

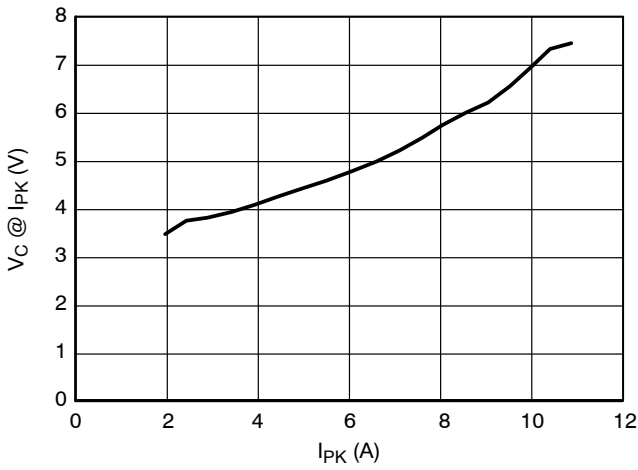


Figure 5. Positive Clamping Voltage vs. Peak Pulse Current ( $t_p = 8/20 \mu s$ )

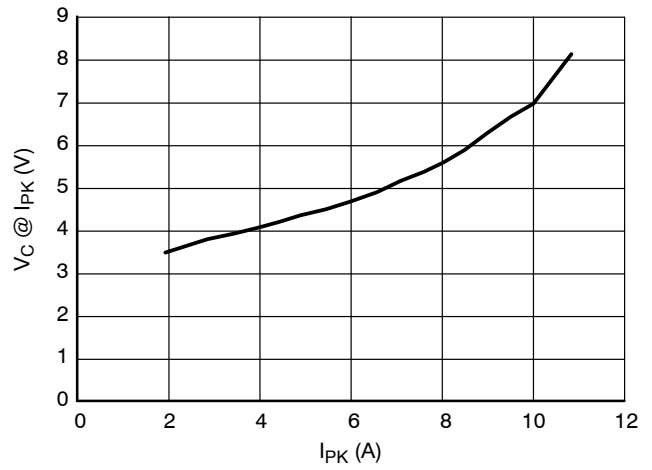


Figure 6. Negative Clamping Voltage vs. Peak Pulse Current ( $t_p = 8/20 \mu s$ )

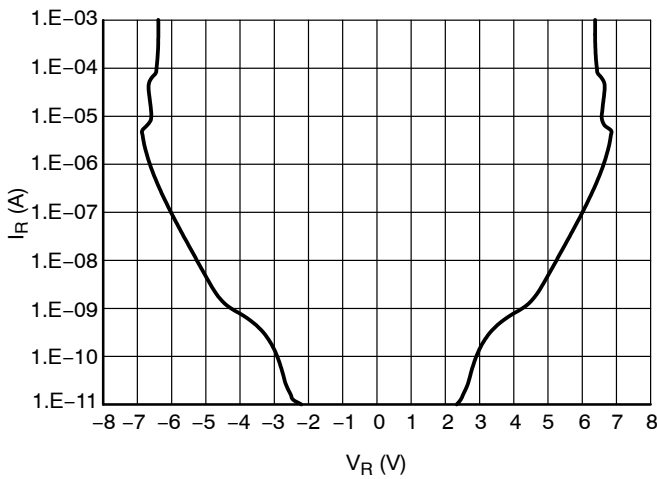


Figure 7. Breakdown Voltage

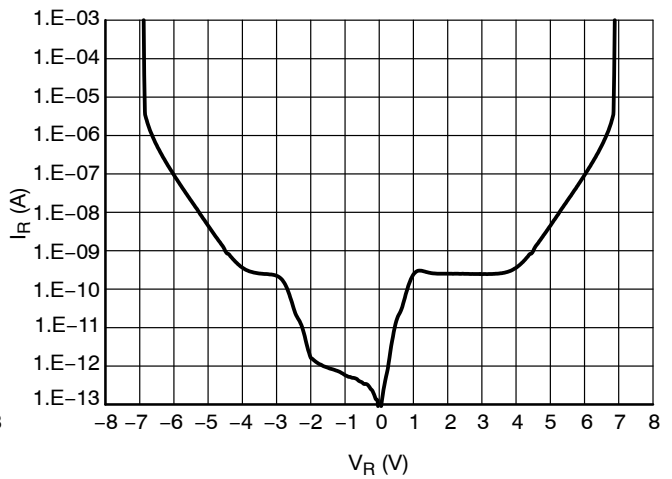


Figure 8. Reverse Leakage Current

# ESDL2031

## TYPICAL CHARACTERISTICS

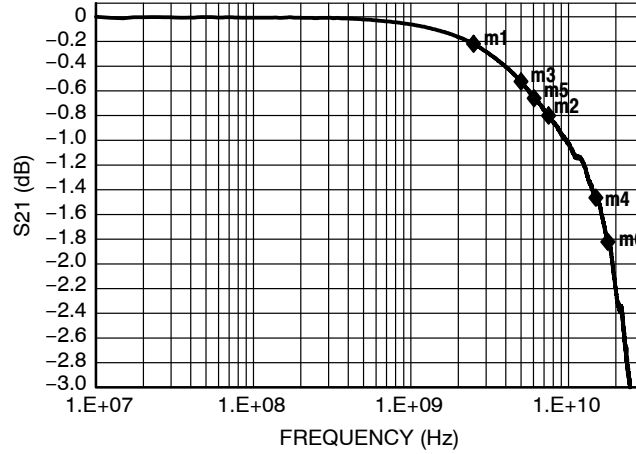


Figure 9. Insertion Loss

Interface	Data Rate (Gb/s)	Fundamental Frequency (GHz)	3 <sup>rd</sup> Harmonic Frequency (GHz)	ESDL2031 Insertion Loss (dB)
USB 3.0	5	2.5 (m1)	7.5 (m2)	m1 = -0.23 m2 = -0.81
USB 3.1	10	5.0 (m3)	15 (m4)	m3 = -0.53 m4 = -1.47
HDMI 2.1	12	6.0 (m5)	18 (m6)	m5 = -0.65 m6 = -1.82

Figure 10. ESDL2031 Insertion Loss

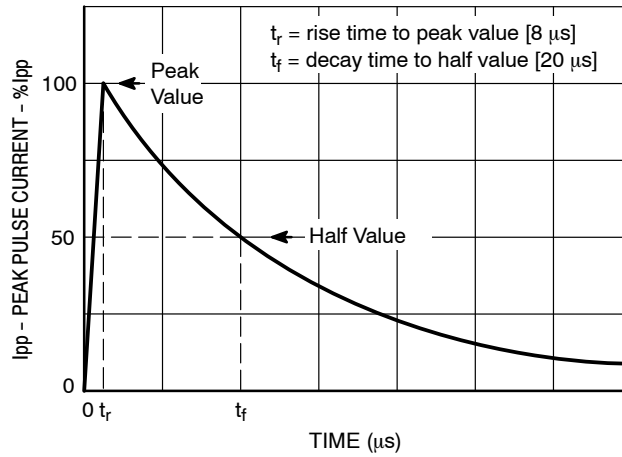


Figure 11. 8 X 20 μs Pulse Waveform

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

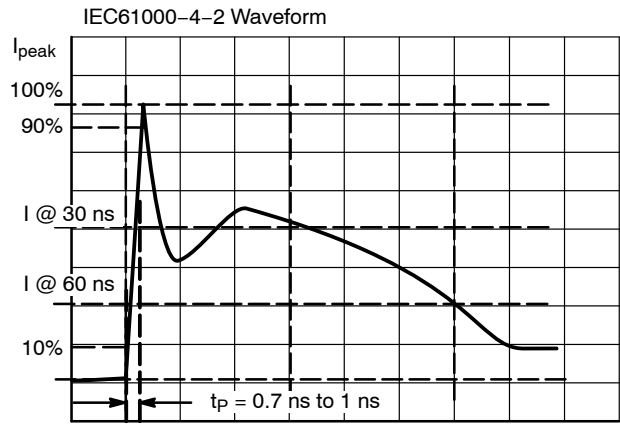


Figure 12. IEC61000-4-2 Spec

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 13. 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 14 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.

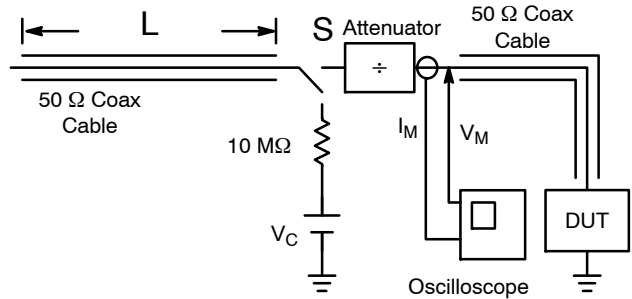


Figure 13. Simplified Schematic of a Typical TLP System

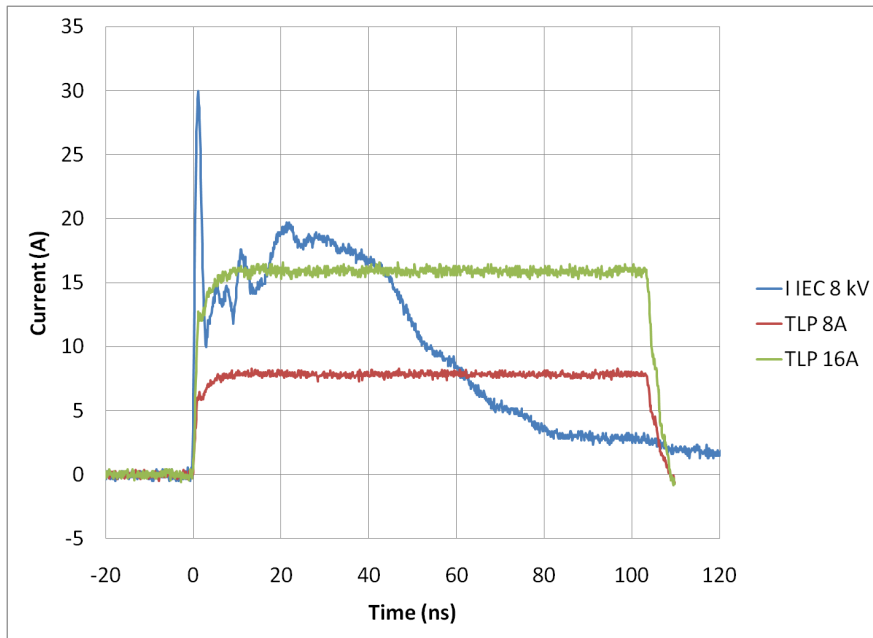


Figure 14. Comparison Between 8 kV IEC 61000-4-2 and 8 A and 16 A TLP Waveforms

# ESDL2031

## ORDERING INFORMATION

Device	Package	Shipping†
ESDL2031MX4T5G	X4DFN2 (0201) (Pb-Free)	10,000 / Tape & Reel

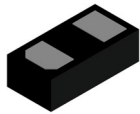
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

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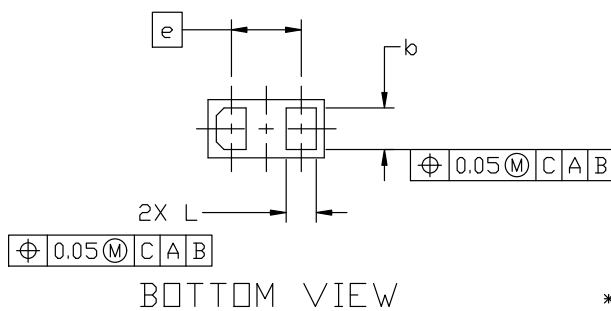
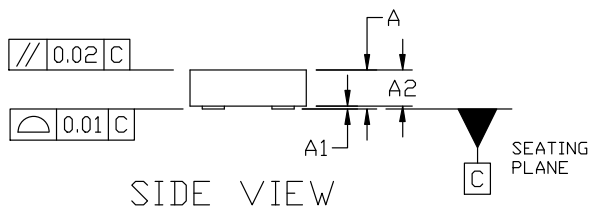
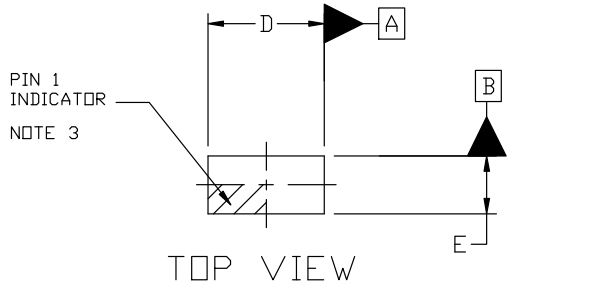
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# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS



**X4DFN2, 0.60x0.30x0.19, 0.36P**  
CASE 152AX  
ISSUE H

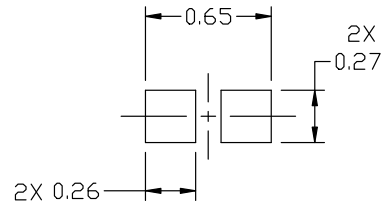
DATE 01 AUG 2023



NOTES:

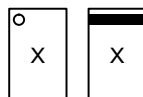
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS

DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	0.175	0.200	0.225
A1	0.018 REF		
A2	0.180	0.190	0.200
b	0.205	0.215	0.225
D	0.575	0.600	0.625
E	0.275	0.300	0.325
e	0.36 BSC		
L	0.145	0.155	0.165



\* 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

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G", may or not be present. Some products may not follow the Generic Marking.

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