ESD Protection Diode
Micro−Packaged Diodes for ESD Protection

ESDL2012

The ESDL2012 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 speed data line applications.

Features

- Low Capacitance
- Low Clamping Voltage
- Small Body Outline Dimensions: 0.60 mm x 0.30 mm
- Low Body Height: 0.2 mm
- Stand−off Voltage: 1.0 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
- SZESDL2012MX2WT5G − Wettable Flank Package for optimal Automated Optical Inspection (AOI)
- These Devices are Pb−Free, Halogen Free/BFR Free and are RoHS Compliant

Typical Applications

- USB 3.x
- USB 4.0
- Thunderbolt™ 3.0

MAXIMUM RATINGS

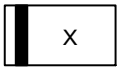
Rating		Symbol	Value	Unit
IEC 61000−4−2 (ESD)	Contact Air		±15 ±15	kV
Total Power Dissipation on FR−4 Board (Note 1) @ T_A = 25°C		P_D	313	mW
Thermal Resistance, Junction−to−Ambient		$R_{\theta JA}$	400	°C/W
Junction and Storage Temperature Range		T_J, T_{stg}	−55 to +150	°C
Lead Solder Temperature − 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−4 = 28 mm^2 1 oz. Cu JEDEC JESD51−3 two layer PCB.

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

X4DFN2
(0201)
CASE 152AX

MARKING DIAGRAM



X = Specific Device Code, K or R

X2DFNW2
CASE 717AB

AA = Specific Device Code
M = Date Code

ORDERING INFORMATION

Device	Package	Shipping†
ESDL2012MX4T5G	X4DFN2 (Pb−Free)	10000 / Tape & Reel
SZESDL2012MX2WT5G	X2DFNW2 (Pb−Free)	8000 / Tape & Reel

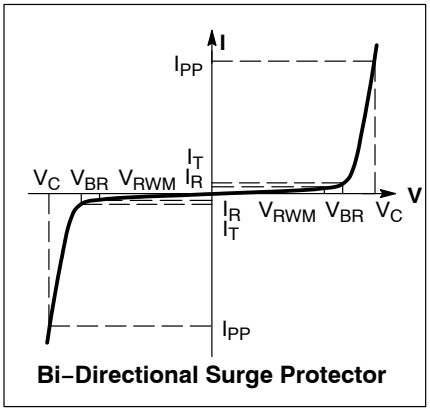
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

ELECTRICAL CHARACTERISTICS

(T_A = 25°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 Surge Protector

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 GND			1.0	V
Breakdown Voltage	V_{BR}	I_T = 1 mA, I/O Pin to GND	1.4	1.6	2.1	V
Reverse Leakage Current	I_R	V_{RWM} = 1.0 V		30	500	nA
Clamping Voltage (Note 2)	V_C	IEC61000−4−2, ±8 kV Contact	Figures 1 and 2			V
Clamping Voltage, 200 ns TLP, IEC61000−4−2 Level 1 Equivalent (±2 kV Contact, ±4 kV Air)	V_C	I_{PP} = 4 A I_{PP} = 4 A (SZESDL2012)		3.5	4.0 5.0	V
IEC61000−4−2 Level 2 Equivalent (±4 kV Contact, ±8 kV Air)		I_{PP} = 8 A I_{PP} = 8 A (SZESDL2012)		4.7	5.2 7.5	
Reverse Peak Pulse Current per Figure 13	I_{PP}	per IEC61000−4−5 (1.2/50 μs), R_{eq} = 12 Ω	3.5	4.7		A
Clamping Voltage, IEC61000−4−5 (1.2/50 μs) Waveform per Figure 13	V_C	I_{PP} = 2.1 A, R_{eq} = 12 Ω I_{PP} = 2.1 A, R_{eq} = 12 Ω (SZESDL2012) I_{PP} = 3.5 A, R_{eq} = 12 Ω I_{PP} = 3.5 A, R_{eq} = 12 Ω (SZESDL2012)		3.1 3.1 3.7 3.7	3.6 4.2 	V
Dynamic Resistance (200 ns TLP, 4 A to 8 A)	R_{DYN}	I/O Pin to GND I/O Pin to GND (SZESDL2012)		0.30 0.65		Ω
Junction Capacitance	C_J	V_R = 0 V, f = 1 MHz V_R = 0 V, f = 1 MHz (SZESDL2012)		0.18 0.25	0.23 0.35	pF
Insertion Loss	I_L	f = 10 GHz (ESDL2012MX4) f = 13 GHz (ESDL2012MX4) f = 15 GHz (ESDL2012MX4) f = 10 GHz (SZESDL2012) f = 13 GHz (SZESDL2012) f = 15 GHz (SZESDL2012)		0.26 0.27 0.28 0.9 1.5 2.3	0.33 0.36 0.37 0.93 1.6 2.4	dB dB dB dB dB dB
Return Loss	R_L	f = 10 GHz (ESDL2012MX4) f = 13 GHz (ESDL2012MX4) f = 15 GHz (ESDL2012MX4) f = 10 GHz (SZESDL2012) f = 13 GHz (SZESDL2012) f = 15 GHz (SZESDL2012)	14 12 11 12 9.8 8.4	16 14 13 13 10 9.0		dB dB dB dB dB 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. 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 = 200 ns, t_r = 1 ns, averaging window; t_1 = 170 ns to t_2 = 190 ns.

TYPICAL CHARACTERISTICS

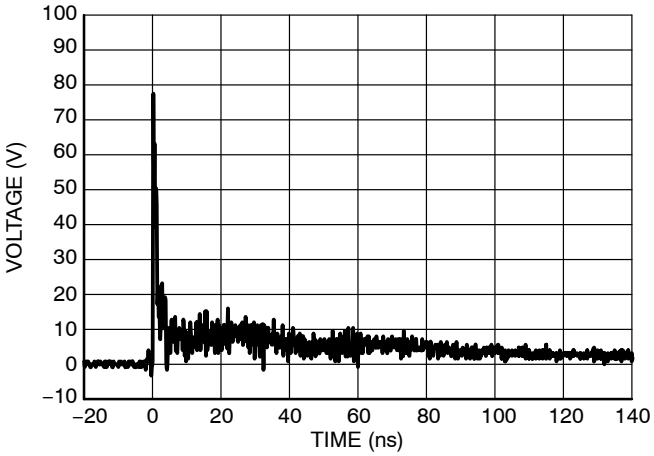


Figure 1. ESD Clamping Voltage Positive 8 kV Contact per IEC61000−4−2

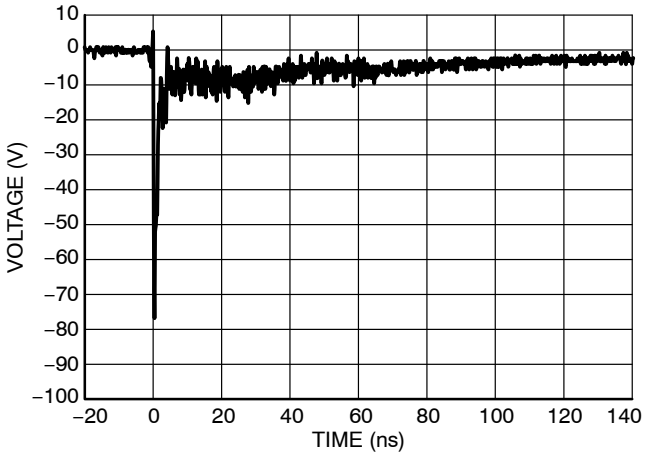


Figure 2. ESD Clamping Voltage Negative 8 kV Contact per IEC61000−4−2

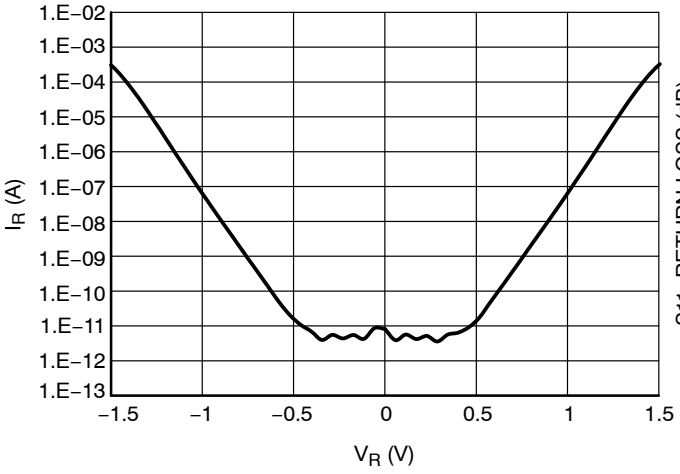


Figure 3. IV Characteristics

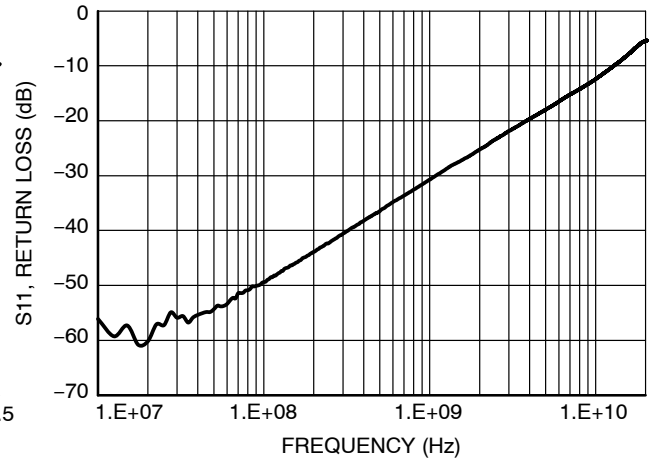


Figure 6. Return Loss for SZESDL2012

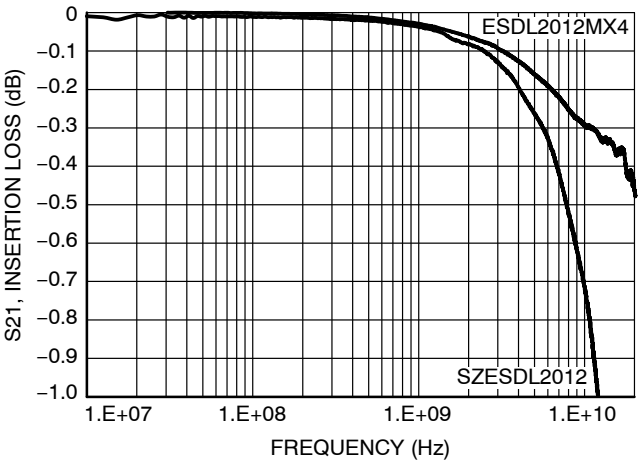


Figure 4. Insertion Loss

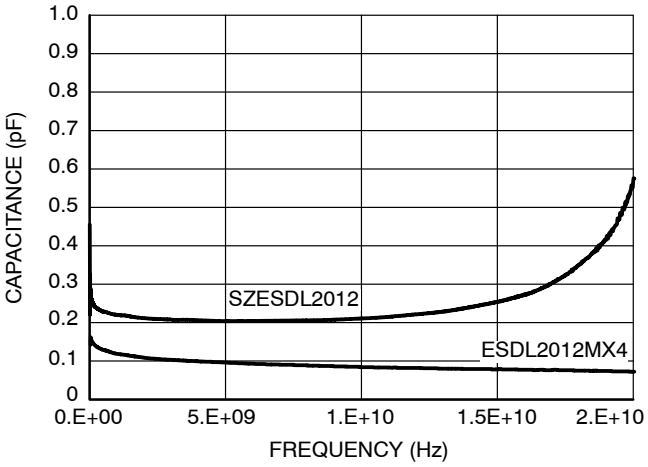


Figure 5. Capacitance Over Frequency

TYPICAL CHARACTERISTICS

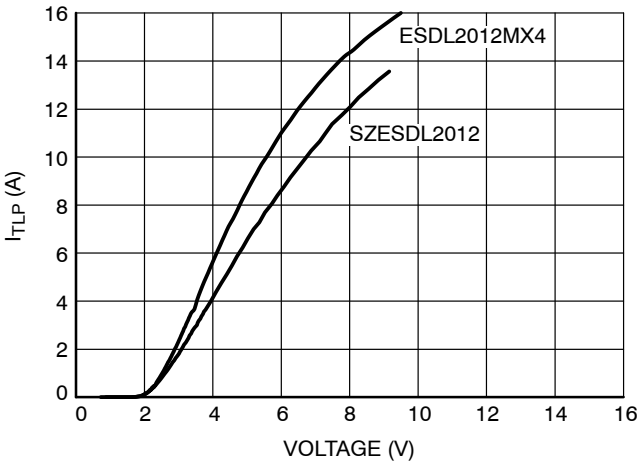


Figure 7. Positive 200 ns TLP IV Curve

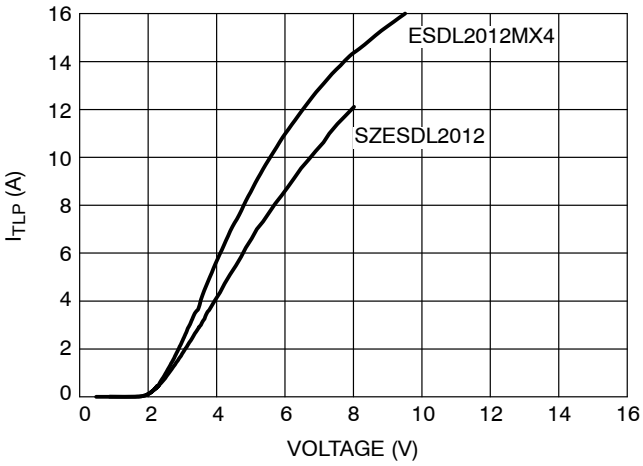


Figure 8. Negative 200 ns TLP IV Curve

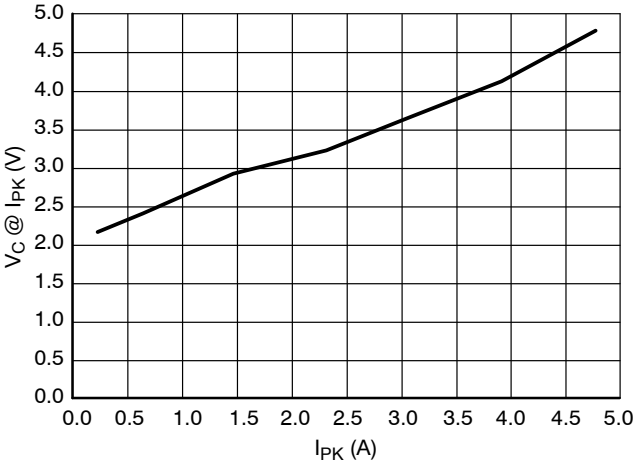


Figure 9. Positive Clamping Voltage vs. Peak Pulse Current (per IEC61000−4−5 (t_p = 1.2/50 μs, R_{eq} = 12 Ω))

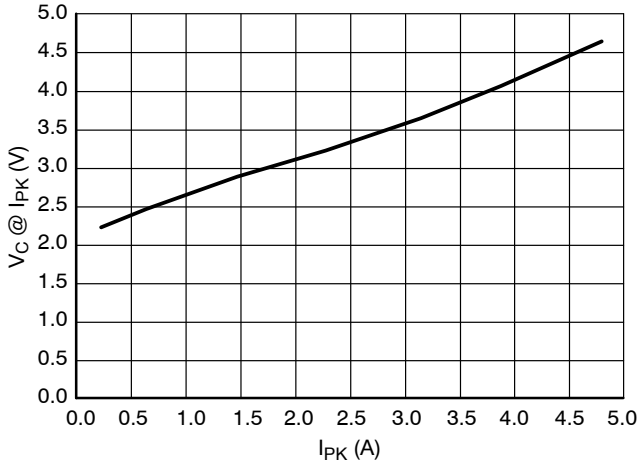


Figure 10. Negative Clamping Voltage vs. Peak Pulse Current (per IEC61000−4−5 (t_p = 1.2/50 μs, R_{eq} = 12 Ω))

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

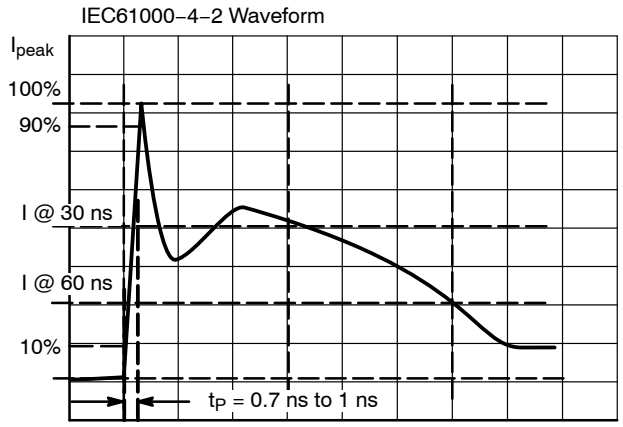


Figure 11. IEC61000−4−2 Spec

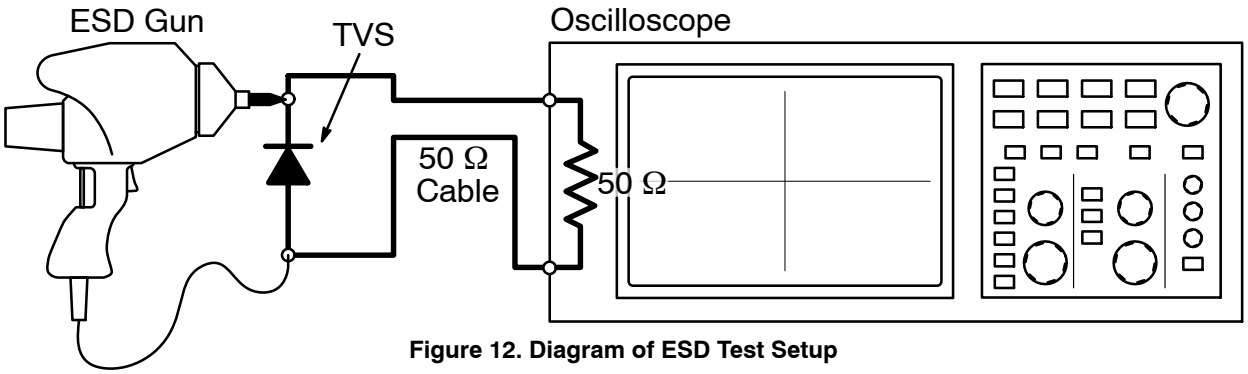


Figure 12. Diagram of ESD Test Setup

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.

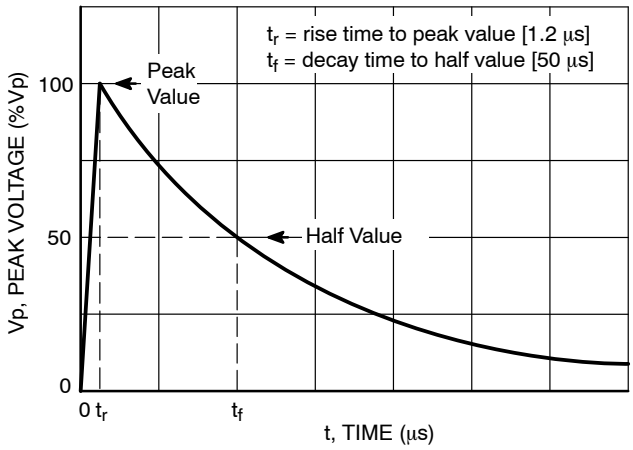
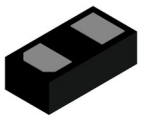
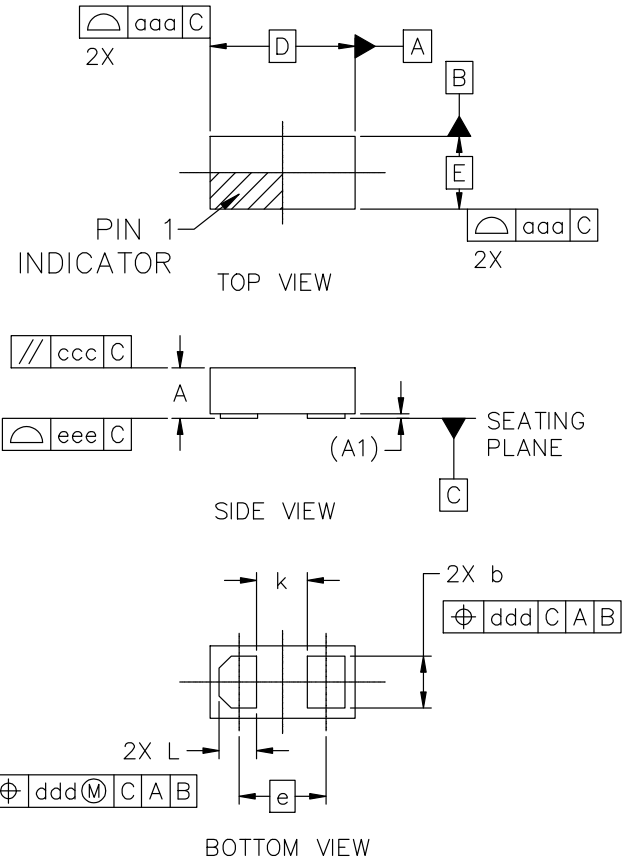


Figure 13. IEC61000−4−5 1.2/50 μs Pulse Waveform



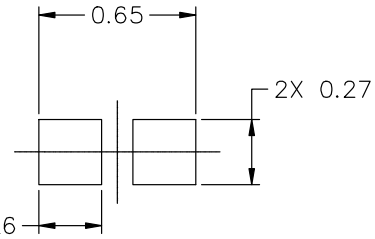
X4DFN−2, 0.60x0.30x0.20, 0.36P
CASE 152AX
ISSUE L

DATE 02 JUN 2026



MILLIMETERS			
DIM	MIN	NOM	MAX
A	0.175	0.200	0.225
A1		0.018 REF	
b	0.205	0.215	0.225
D		0.600 BSC	
E		0.300 BSC	
e		0.360 BSC	
k	0.180	−−−	−−−
L	0.145	0.155	0.165
TOLERANCE FORM AND POSITION			
aaa		0.025	
ccc		0.020	
ddd		0.050	
eee		0.010	

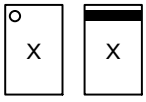
NOTES:
1. DIMENSIONING AND TOLERANCING AS PER ASME Y14.5M, 2018.
2. CONTROLLING DIMENSION: MILLIMETERS.



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

*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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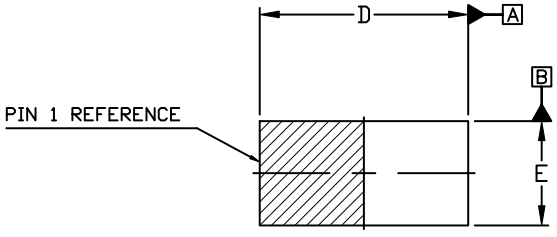
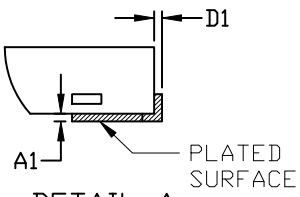
DESCRIPTION:	**X4DFN−2, 0.60x0.30x0.20, 0.36P**		**PAGE 1 OF 1**

X2DFNW2 1.60x0.80
CASE 717AB
ISSUE B

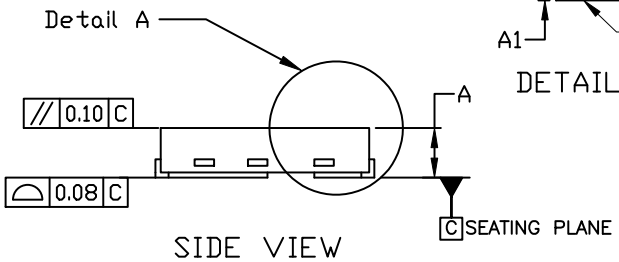
DATE 30 OCT 2019



TOP VIEW



DETAIL A

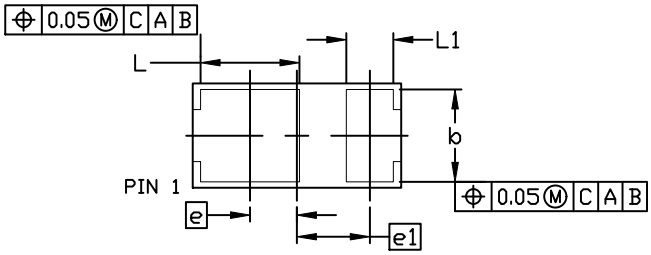


SIDE VIEW

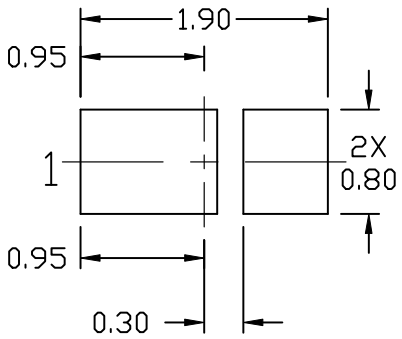
NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
2. CONTROLLING DIMENSION: MILLIMETERS

DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	0.34	0.37	0.40
A1	---	---	0.04
b	0.67	0.71	0.75
D	1.55	1.60	1.65
D1	---	---	0.04
E	0.75	0.80	0.85
e	0.36 BSC		
e1	0.56 BSC		
L	0.72	0.76	0.80
L1	0.32	0.36	0.40



BOTTOM VIEW



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*

XX = Specific Device Code
M = Date 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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DESCRIPTION:	**X2DFNW2 1.60x0.80**		**PAGE 1 OF 1**

ADDITIONAL INFORMATION

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