

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 _{θJA}	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 mm² 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

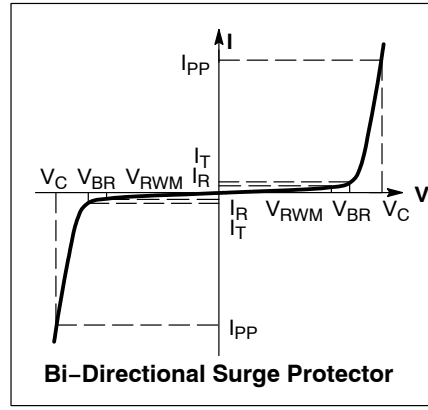
Device	Package	Shipping [†]
ESDL2012MX4T5G	X4DFN2 (Pb-Free)	10000 / Tape & Reel
SZESDL2012MX2WT5G	X2DFNW2 (Pb-Free)	8000 / Tape & Reel

[†]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.

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		3.5	4.0	V
		I _{PP} = 4 A (SZESDL2012)			5.0	
IEC61000-4-2 Level 2 Equivalent (±4 kV Contact, ±8 kV Air)	V _C	I _{PP} = 8 A		4.7	5.2	V
		I _{PP} = 8 A (SZESDL2012)			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		3.1	3.6	V
		I _{PP} = 2.1 A, R _{eq} = 12 Ω (SZESDL2012)		3.1		
		I _{PP} = 3.5 A, R _{eq} = 12 Ω		3.7	4.2	
		I _{PP} = 3.5 A, R _{eq} = 12 Ω (SZESDL2012)		3.7		
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)		0.26	0.33	dB
		f = 13 GHz (ESDL2012MX4)		0.27	0.36	dB
		f = 15 GHz (ESDL2012MX4)		0.28	0.37	dB
		f = 10 GHz (SZESDL2012)		0.9	0.93	dB
		f = 13 GHz (SZESDL2012)		1.5	1.6	dB
		f = 15 GHz (SZESDL2012)		2.3	2.4	dB
Return Loss	R _L	f = 10 GHz (ESDL2012MX4)	14	16		dB
		f = 13 GHz (ESDL2012MX4)	12	14		dB
		f = 15 GHz (ESDL2012MX4)	11	13		dB
		f = 10 GHz (SZESDL2012)	12	13		dB
		f = 13 GHz (SZESDL2012)	9.8	10		dB
		f = 15 GHz (SZESDL2012)	8.4	9.0		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.

- For test procedure see application note AND8307/D.
- ANSI/ESD STM5.5.1 – Electrostatic Discharge Sensitivity Testing using Transmission Line Pulse (TLP) Model.
TLP conditions: Z₀ = 50 Ω, t_p = 200 ns, t_r = 1 ns, averaging window; t₁ = 170 ns to t₂ = 190 ns.

TYPICAL CHARACTERISTICS

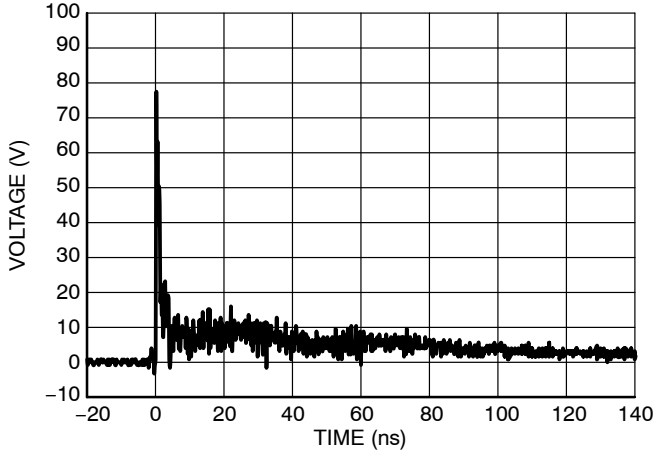


Figure 1. ESD Clamping Voltage
Positive 8 kV Contact per IEC61000-4-2

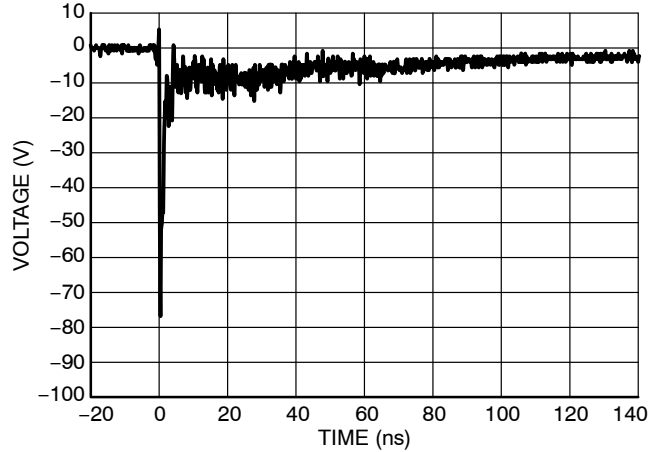


Figure 2. ESD Clamping Voltage
Negative 8 kV Contact per IEC61000-4-2

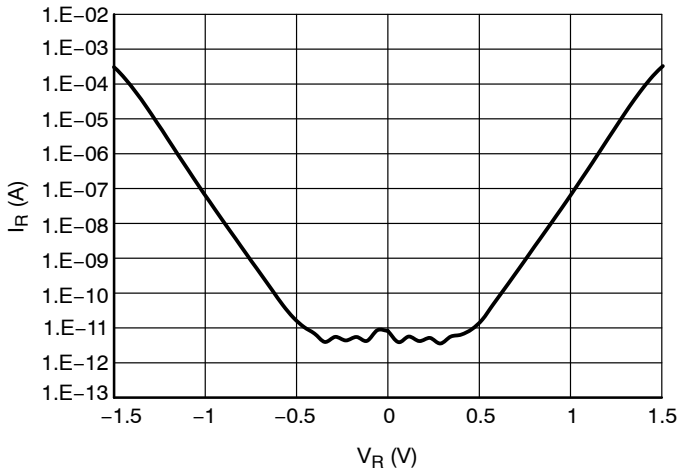


Figure 3. IV Characteristics

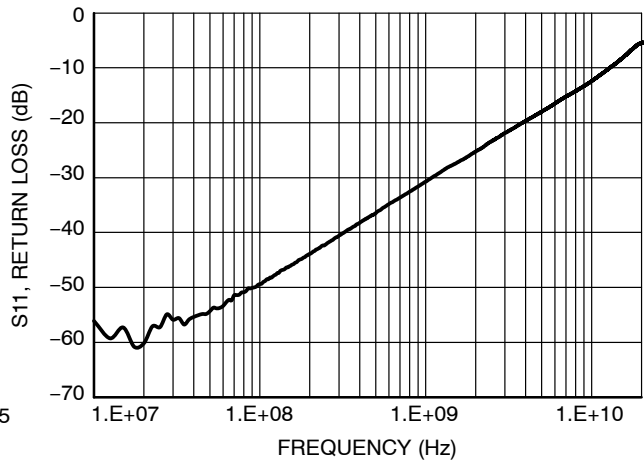


Figure 6. Return Loss for SZESDL2012

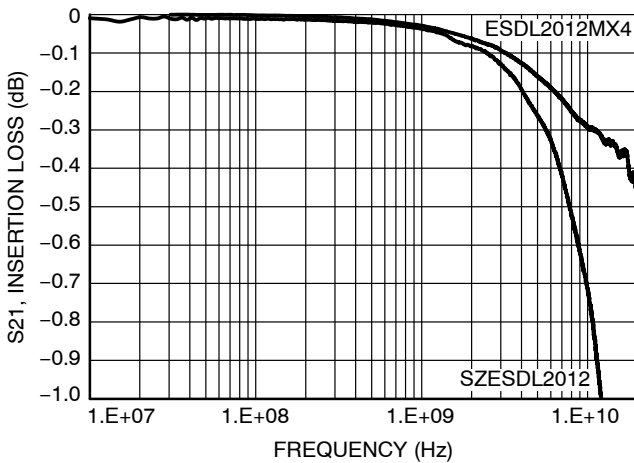


Figure 4. Insertion Loss

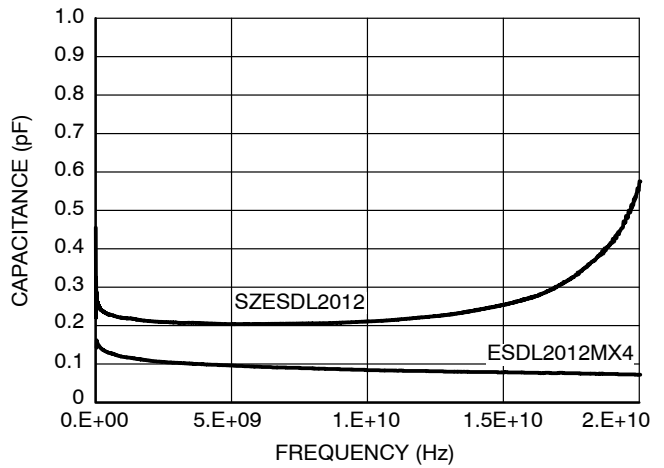


Figure 5. Capacitance Over Frequency

TYPICAL CHARACTERISTICS

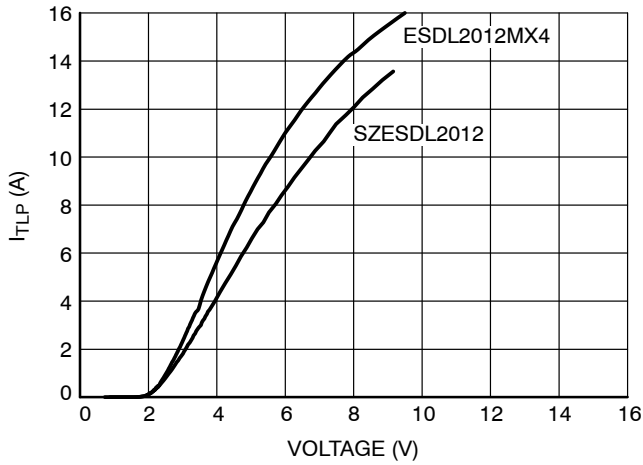


Figure 7. Positive 200 ns TLP IV Curve

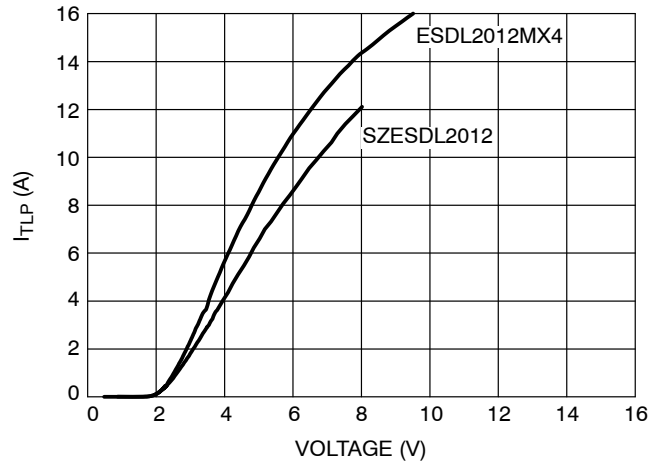


Figure 8. Negative 200 ns TLP IV Curve

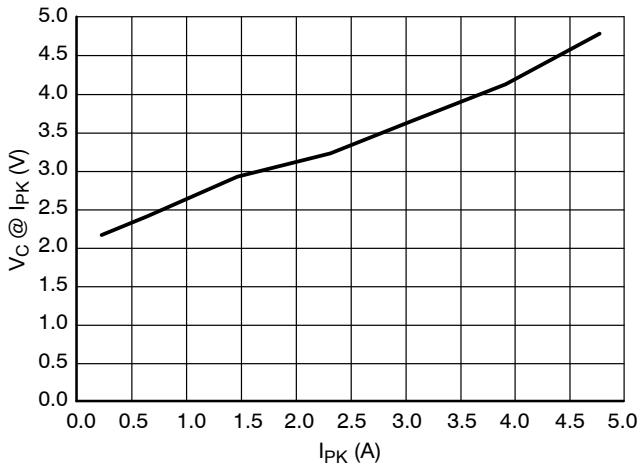


Figure 9. Positive Clamping Voltage vs. Peak Pulse Current (per IEC61000-4-5 ($t_p = 1.2/50 \mu s$, $R_{eq} = 12 \Omega$))

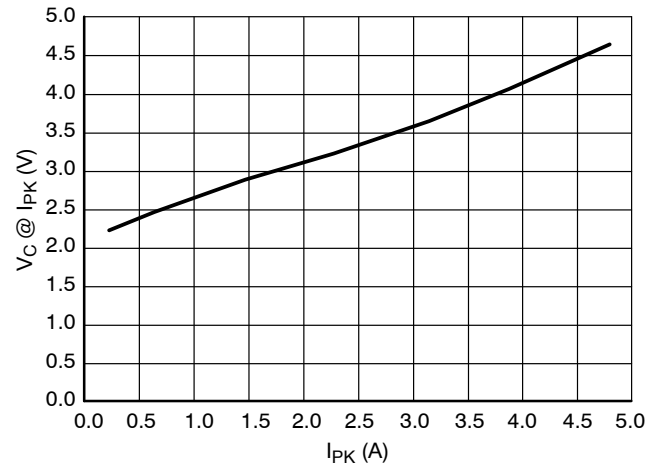


Figure 10. Negative Clamping Voltage vs. Peak Pulse Current (per IEC61000-4-5 ($t_p = 1.2/50 \mu s$, $R_{eq} = 12 \Omega$))

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

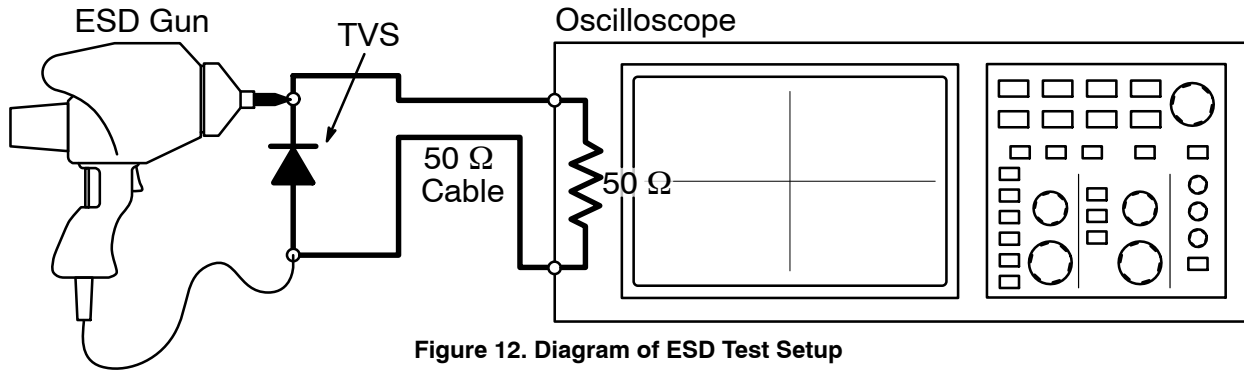


Figure 12. Diagram of ESD Test Setup

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.

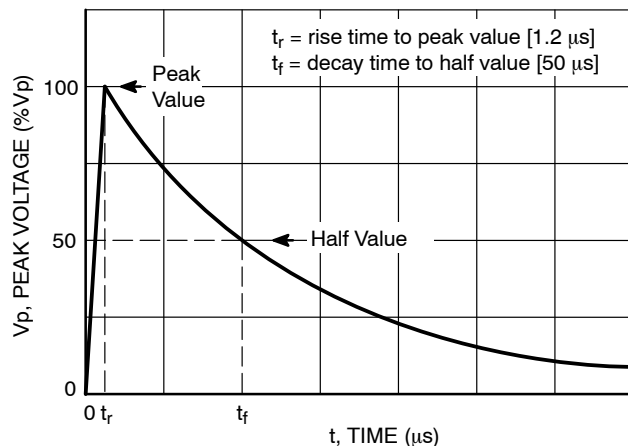
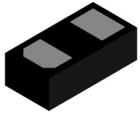


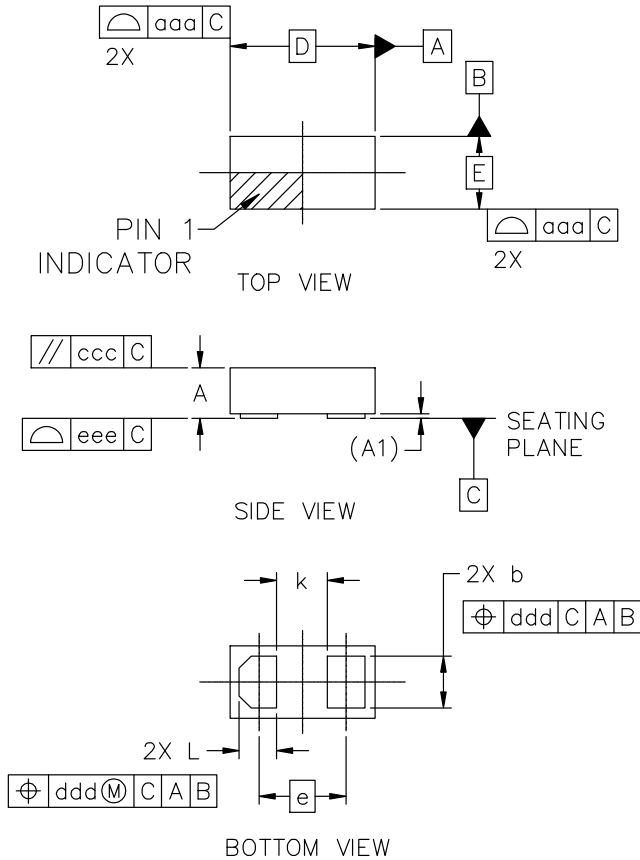
Figure 13. IEC61000-4-5 1.2/50 μs Pulse Waveform

Thunderbolt and the Thunderbolt logo are trademarks of Intel Corporation or its subsidiaries in the U.S. and/or other countries. USB4 is a registered trademarks of USB Implementers Forum.

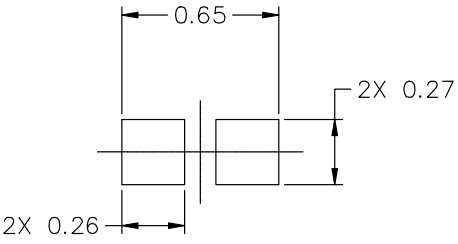


X4DFN-2, 0.60x0.30x0.20, 0.36P
CASE 152AX
ISSUE L

DATE 02 JUN 2026

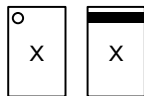


MILLIMETERS			
DIM	MIN	NOM	MAX
A	0.175	0.200	0.225
A1	0.018 REF		
b	0.205	0.215	0.225
D	0.600 BSC		
E	0.300 BSC		
e	0.360 BSC		
k	0.180	---	---
L	0.145	0.155	0.165
TOLERANCE FORM AND POSITION			
aaa	0.025		
ccc	0.020		
ddd	0.050		
eee	0.010		



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

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.

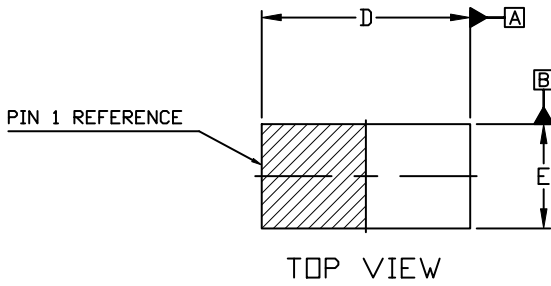
* For additional information on our Pb-Free strategy and soldering details, please download the onsemi Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

DOCUMENT NUMBER:	98AON06808G	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
DESCRIPTION:	X4DFN-2, 0.60x0.30x0.20, 0.36P	PAGE 1 OF 1

onsemi and ONSEMI are trademarks of Semiconductor Components Industries, LLC dba onsemi or its subsidiaries in the United States and/or other countries. onsemi reserves the right to make changes without further notice to any products herein. onsemi makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does onsemi assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. onsemi does not convey any license under its patent rights nor the rights of others.

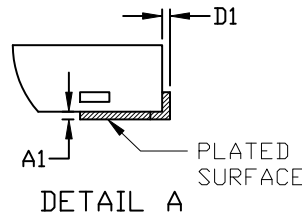
X2DFNW2 1.60x0.80
CASE 717AB
ISSUE B

DATE 30 OCT 2019

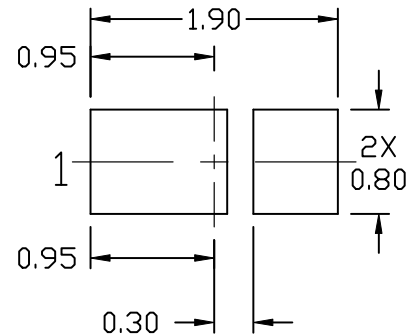
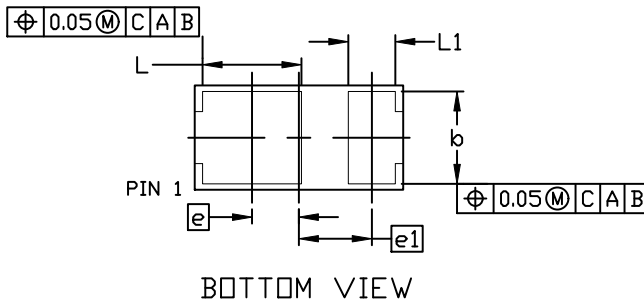
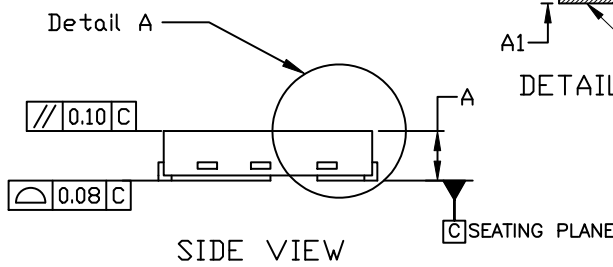


NOTES:

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



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.

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.

DOCUMENT NUMBER:	98AON84164G	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
DESCRIPTION:	X2DFNW2 1.60x0.80	PAGE 1 OF 1

onsemi and ONSEMI are trademarks of Semiconductor Components Industries, LLC dba onsemi or its subsidiaries in the United States and/or other countries. onsemi reserves the right to make changes without further notice to any products herein. onsemi makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does onsemi assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. onsemi does not convey any license under its patent rights nor the rights of others.

onsemi, **Onsemi**, and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "**onsemi**" or its affiliates and/or subsidiaries in the United States and/or other countries. **onsemi** owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of **onsemi**'s product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. **onsemi** reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided "as-is" and **onsemi** makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does **onsemi** assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using **onsemi** products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by **onsemi**. "Typical" parameters which may be provided in **onsemi** data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. **onsemi** does not convey any license under any of its intellectual property rights nor the rights of others. **onsemi** products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use **onsemi** products for any such unintended or unauthorized application, Buyer shall indemnify and hold **onsemi** and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that **onsemi** was negligent regarding the design or manufacture of the part. **onsemi** is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

ADDITIONAL INFORMATION

TECHNICAL PUBLICATIONS:

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

ONLINE SUPPORT: www.onsemi.com/support

For additional information, please contact your local Sales Representative at www.onsemi.com/support/sales