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_J = 25°C unless otherwise noted)

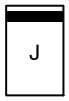
Rating	Symbol	Value	Unit
Operating Junction Temperature Range	T_J	−55 to +125	°C
Storage Temperature Range	T_{stg}	−55 to +150	°C
Lead Solder Temperature − Maximum (10 Seconds)	T_L	260	°C
IEC 61000−4−2 Contact (ESD) IEC 61000−4−2 Air (ESD)	ESD ESD	±30 ±30	kV kV
Maximum Peak Pulse Current 8/20 μs @ T_A = 25°C	I_{pp}	9.75	A
Maximum Peak Pulse Power 8/20 μs @ T_A = 25°C	P_{pk}	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.

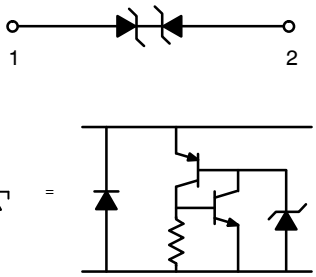
MARKING DIAGRAM

X4DFN2 (0201)
CASE 152AX



J = Specific Device Code
(Rotated 270 degrees)

PIN CONFIGURATION AND SCHEMATIC

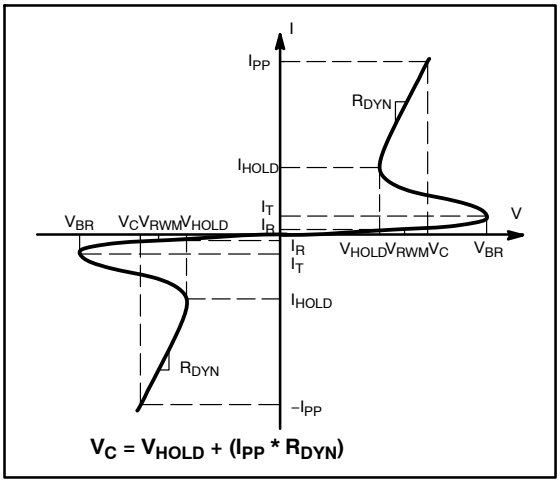


ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 6 of this data sheet.

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

Symbol	Parameter
V_{RWM}	Working Peak Voltage
I_R	Maximum Reverse Leakage Current @ V_{RWM}
V_{BR}	Breakdown Voltage @ I_T
I_T	Test Current
V_{HOLD}	Holding Reverse Voltage
I_{HOLD}	Holding Reverse Current
R_{DYN}	Dynamic Resistance
I_{PP}	Maximum Peak Pulse Current
V_C	Clamping Voltage @ I_{PP} $V_C = V_{HOLD} + (I_{PP} * R_{DYN})$



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			4.0	V
Breakdown Voltage	V_{BR}	I_T = 1 mA, I/O Pin to GND	5.1		8.5	V
Reverse Leakage Current	I_R	V_{RWM} = 4.0 V, I/O Pin to GND			0.05	μA
Reverse Holding Voltage	V_{HOLD}	I/O Pin to GND		2.5		V
Holding Reverse Current	I_{HOLD}	I/O Pin to GND		55		mA
Clamping Voltage TLP (Note 2)	V_C	I_{PP} = 8 A } IEC61000−4−2 Level 2 Equivalent (±4 kV Contact, ±8 kV Air)		5.25		V
		I_{PP} = 16 A } IEC61000−4−4 Level 2 Equivalent (±8 kV Contact, ±16 kV Air)		7.1		
Reverse Peak Pulse Current	I_{PP}	per IEC61000−4−5 (8x20 μs) Figure 11	9.75			A
Clamping Voltage 8/20 μs Waveform per Figure 11	V_C	I_{PP} = 9.75 A			8.0	V
Dynamic Resistance	R_{DYN}	Pin1 to Pin2 Pin2 to Pin1		0.22 0.22		Ω
Junction Capacitance	C_J	V_R = 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.

1. For test procedure see Figure 12 and application note AND8307/D.
2. 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 = 1 ns, averaging window: t_1 = 70 ns to t_2 = 90 ns.

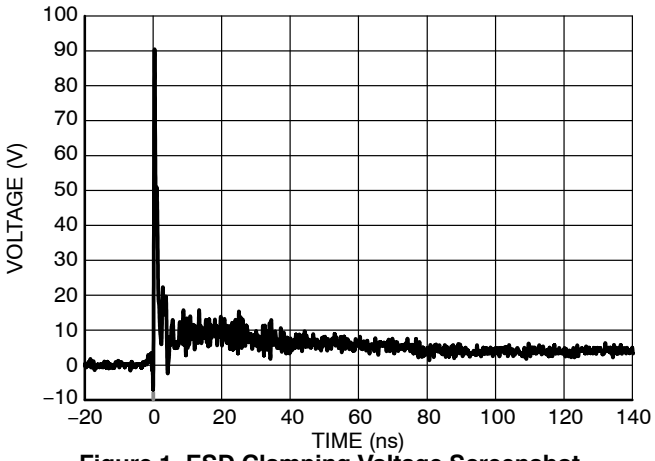


Figure 1. ESD Clamping Voltage Screenshot Positive 8 kV Contact per IEC61000−4−2

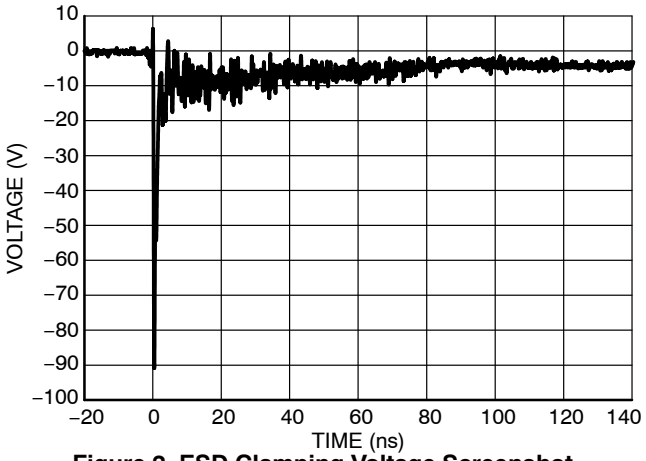


Figure 2. ESD Clamping Voltage Screenshot Negative 8 kV Contact per IEC61000−4−2

TYPICAL CHARACTERISTICS

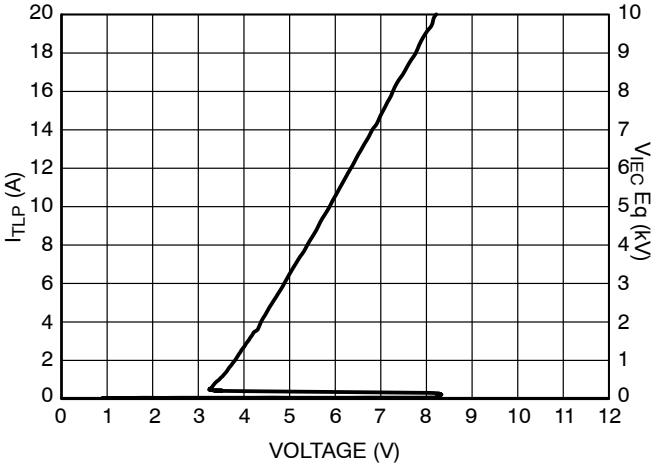


Figure 3. Positive TLP I–V Curve

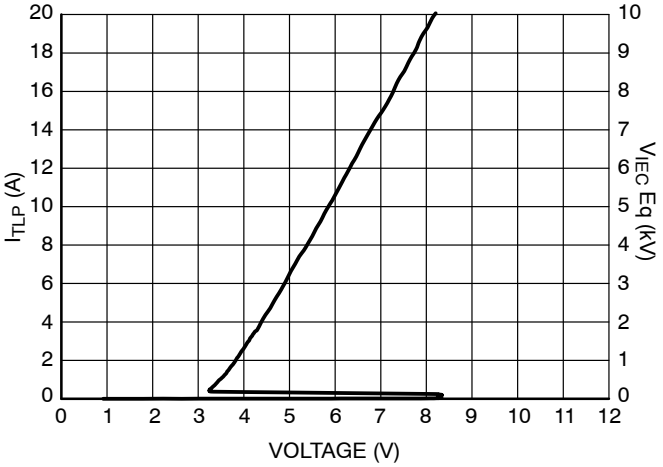


Figure 4. Negative TLP I–V Curve

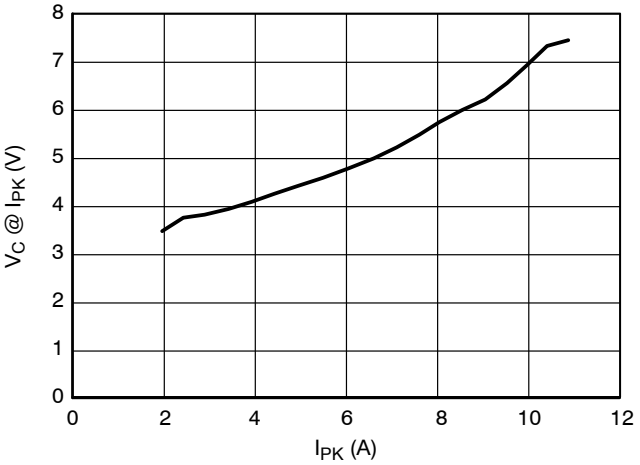


Figure 5. Positive Clamping Voltage vs. Peak Pulse Current (t_p = 8/20 μs)

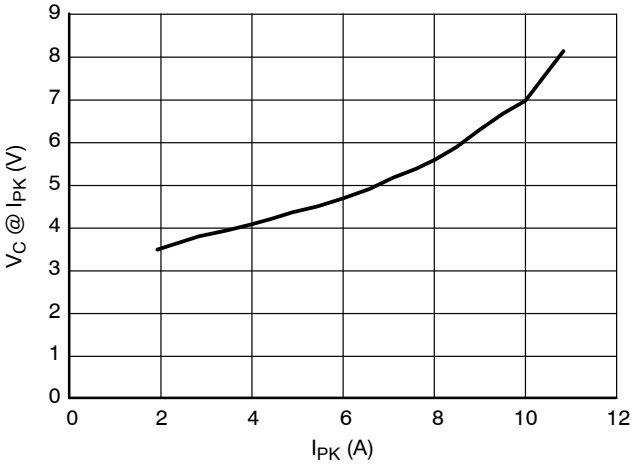


Figure 6. Negative Clamping Voltage vs. Peak Pulse Current (t_p = 8/20 μs)

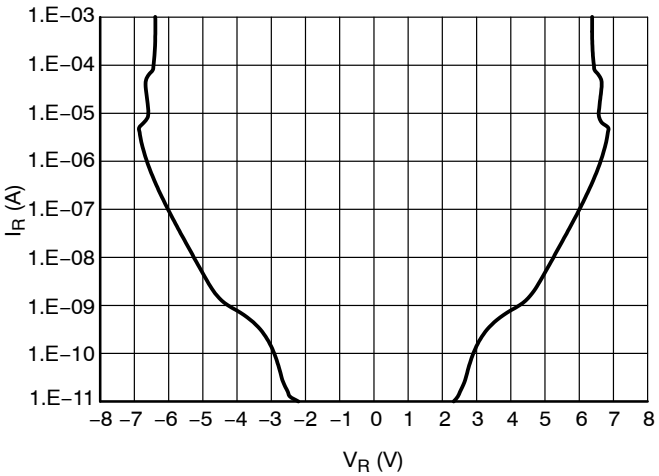


Figure 7. Breakdown Voltage

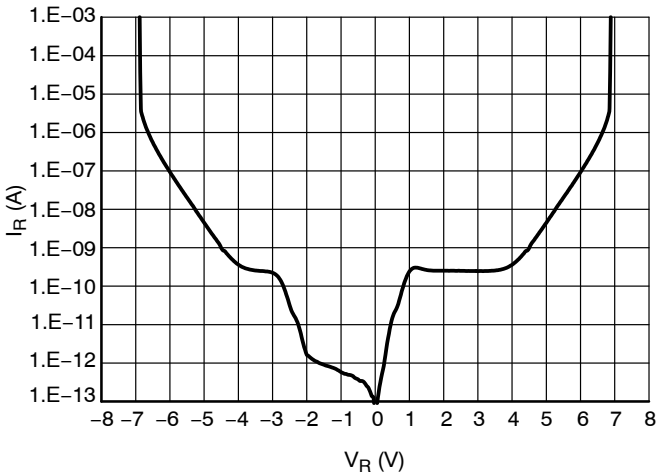


Figure 8. Reverse Leakage Current

TYPICAL CHARACTERISTICS

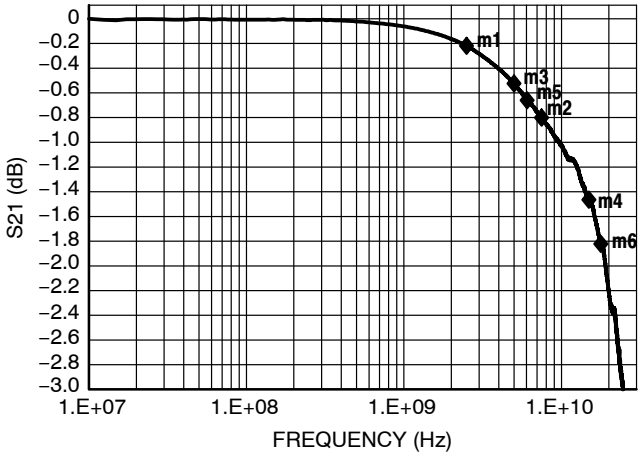


Figure 9. Insertion Loss

Interface	Data Rate (Gb/s)	Fundamental Frequency (GHz)	3rd 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

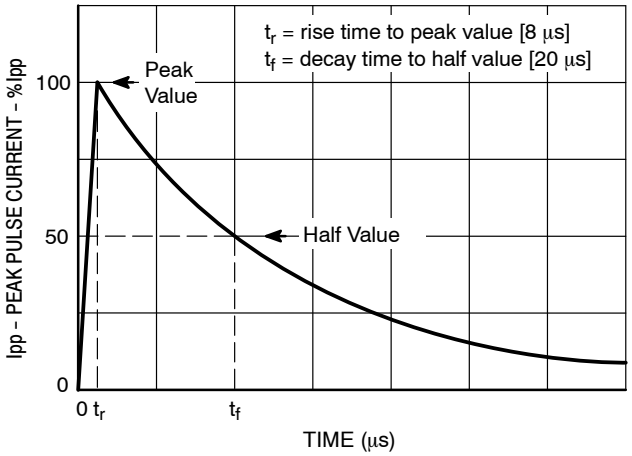


Figure 11. 8 X 20 μs Pulse Waveform

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

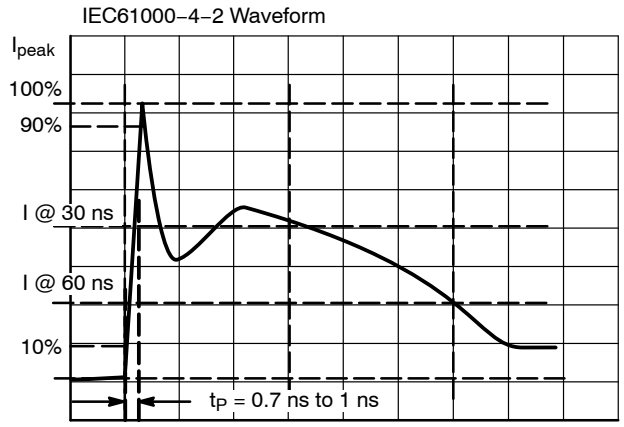


Figure 12. IEC61000−4−2 Spec

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.

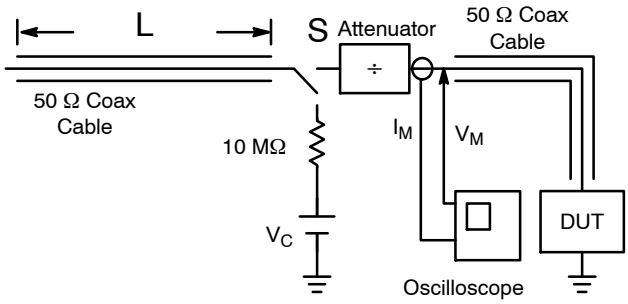


Figure 13. Simplified Schematic of a Typical TLP System

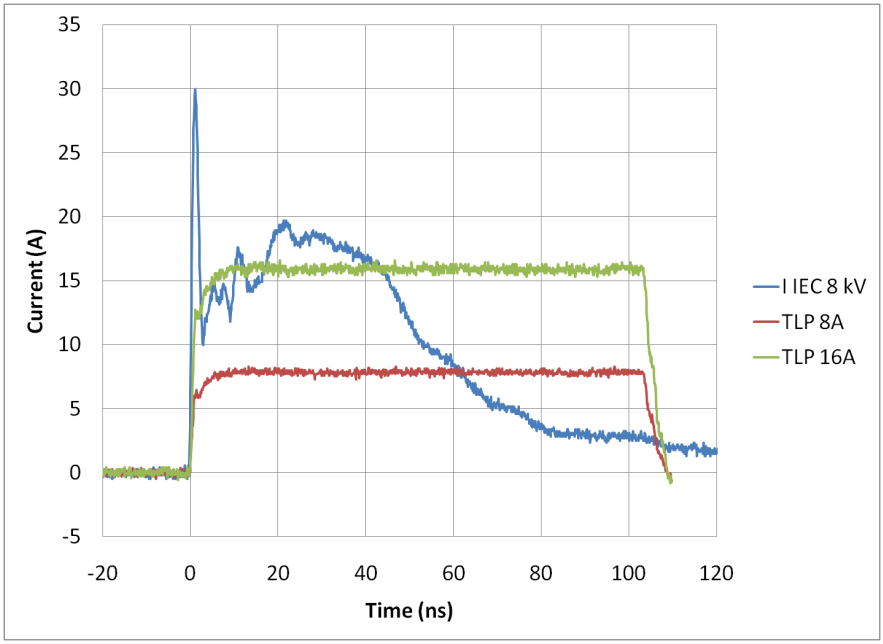
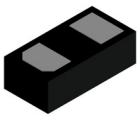


Figure 14. Comparison Between 8 kV IEC 61000−4−2 and 8 A and 16 A TLP Waveforms

ORDERING INFORMATION

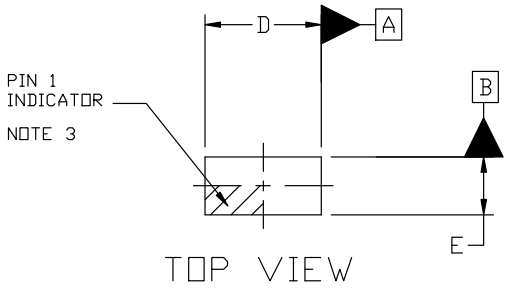
Device	Package	Shipping†
ESDL2031MX4T5G	X4DFN2 (0201) (Pb−Free)	10,000 / Tape & Reel

†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.

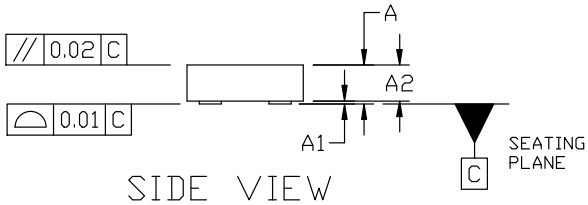


X4DFN2, 0.60x0.30x0.19, 0.36P
CASE 152AX
ISSUE H

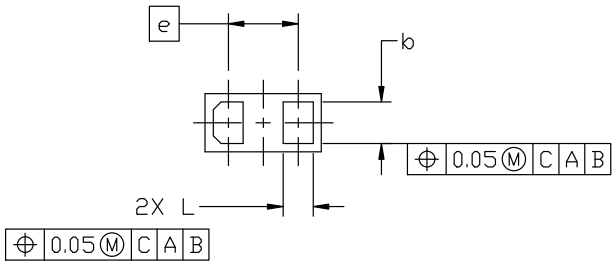
DATE 01 AUG 2023



TOP VIEW



SIDE VIEW

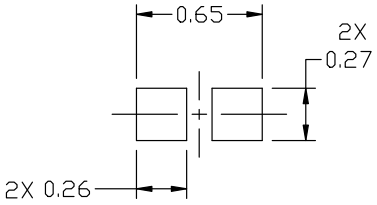


BOTTOM VIEW

NOTES:

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

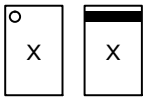
DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	0.175	0.200	0.225
A1	0.018 REF		
A2	0.180	0.190	0.200
b	0.205	0.215	0.225
D	0.575	0.600	0.625
E	0.275	0.300	0.325
e	0.36 BSC		
L	0.145	0.155	0.165



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

*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.

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:	**X4DFN2, 0.60x0.30x0.19, 0.36P**		**PAGE 1 OF 1**

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