

# ESD and Surge Protection Device, Bidirectional, 15 V Micro-Packaged Diodes for ESD Protection

## ESDL4151

The ESDL4151 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 frequency designs such as USB 2.0/3.0 high speed applications.

### Features

- Low Capacitance 0.8 pF (Typ)
- Low Clamping Voltage
- Small Body Outline Dimensions: 1.00 mm x 0.60 mm
- Low Body Height: 0.23 mm
- Stand-off Voltage: 15 V
- Protection for the following IEC Standards:  
IEC61000-4-2 Level 4:  $\pm 30$  kV Contact Discharge  
IEC61000-4-5 (Lightning): 53 V Input (8/20  $\mu$ s)
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

### Typical Applications

- USB 2.0/3.0
- MHL 2.0
- eSATA

### MAXIMUM RATINGS

Rating	Symbol	Value	Unit
IEC 61000-4-2 (ESD) Contact Air		$\pm 30$ $\pm 30$	kV
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.

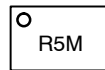
See Application Note AND8308/D for further description of survivability specs.



**X3DFN2**  
**1.0 X 0.6**  
**CASE 514AG**

### MARKING DIAGRAM

PIN 1



R5 = Specific Device Code  
M = Date Code

### ORDERING INFORMATION

Device	Package	Shipping <sup>†</sup>
ESDL4151MX4T5G	X3DFN2 (Pb-Free)	8000 / Tape & Reel

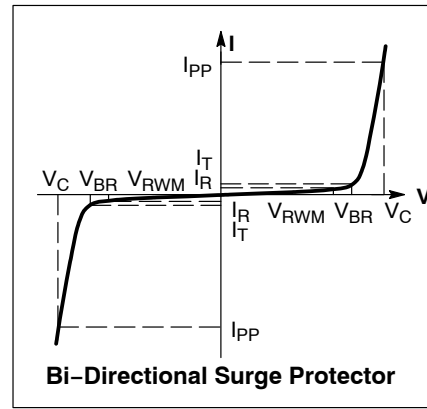
<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

# ELECTRICAL CHARACTERISTICS

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

Symbol	Parameter
I <sub>PP</sub>	Maximum Reverse Peak Pulse Current
V <sub>C</sub>	Clamping Voltage @ I <sub>PP</sub>
V <sub>RWM</sub>	Working Peak Reverse 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

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



## 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			15	V
Breakdown Voltage	V <sub>BR</sub>	I <sub>T</sub> = 1 mA, I/O Pin to GND	15.5	16.6	19.5	V
Reverse Leakage Current	I <sub>R</sub>	@ 3.3 V, I/O Pin to GND @ 15 V, I/O Pin to GND			0.1 1.0	μA
Clamping Voltage	V <sub>C</sub>	Per IEC61000-4-2, ±8 kV Contact	See Figures 1 & 2			V
Clamping Voltage TLP (Note 1)	V <sub>C</sub>	I <sub>PP</sub> = 8 A IEC61000-4-2 Level 2 Equivalent (±4 kV Contact, ±8 kV Air)		21.3		V
		I <sub>PP</sub> = 16 A IEC61000-4-2 Level 4 Equivalent (±8 kV Contact, ±16 kV Air)		22.9		V
Reverse Peak Pulse Current	I <sub>PP</sub>	IEC61000-4-5 (8x20 μs) Input Voltage	53			V
		IEC61000-4-5 (8x20 μs) per Figure 11	11			A
Clamping Voltage 8x20 μs Waveform per Figure A (Note 2)	V <sub>C</sub>	IEC61000-4-5 (8x20 μs) Input Voltage = 53 V		23	26	V
Dynamic Resistance	R <sub>DYN</sub>	I/O Pin to GND (8x20 μs)		0.43		Ω
Junction Capacitance	C <sub>J</sub>	V <sub>R</sub> = 0 V, f = 1 MHz		0.80	1.0	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.

- ANSI/ESD STM5.5.1 – Electrostatic Discharge Sensitivity Testing using Transmission Line Pulse (TLP) Model.  
TLP conditions: Z<sub>0</sub> = 50, 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.
- Non-repetitive current pulse at T<sub>A</sub> = 25°C, per IEC61000-4-5 waveform.

TYPICAL CHARACTERISTICS

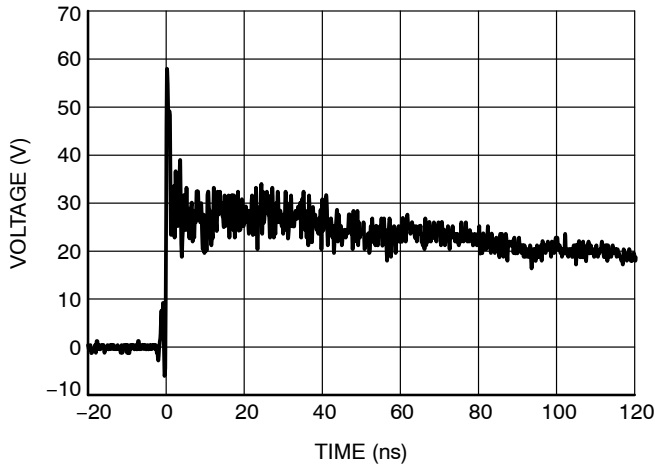


Figure 1. ESD Clamping Voltage Pin 1 to Pin 2  
8 kV Contact per IEC61000-4-2

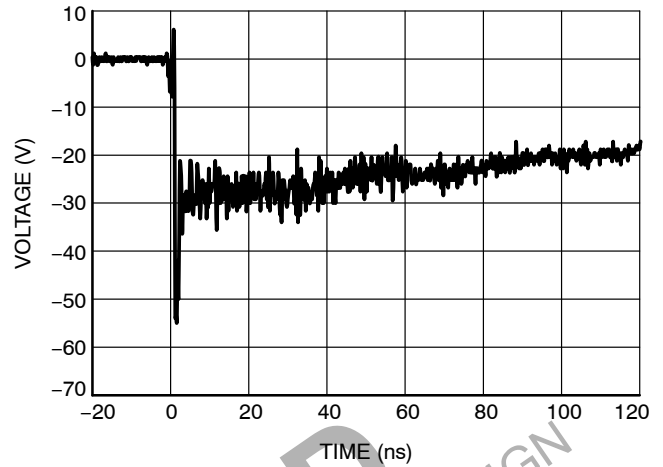


Figure 2. ESD Clamping Voltage Pin 2 to Pin 1  
8 kV Contact per IEC61000-4-2

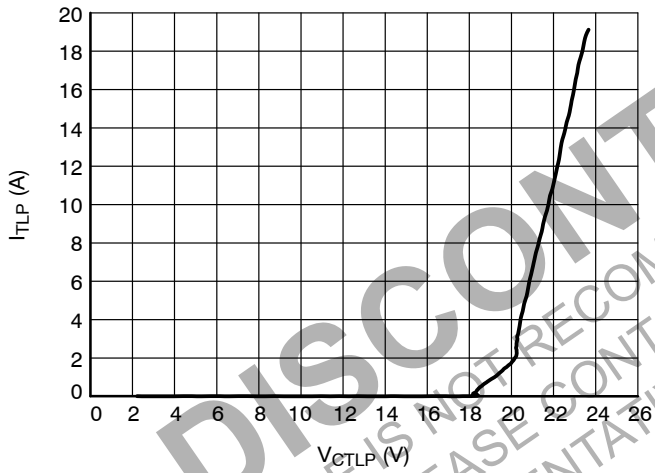


Figure 3. Pin 1 to Pin 2 100 ns TLP I-V Curve

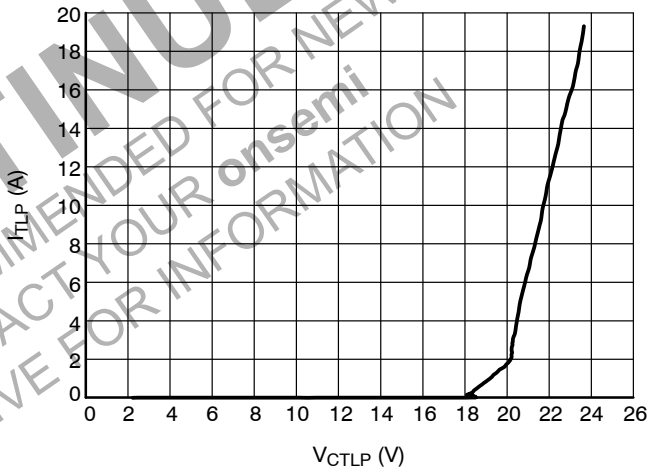


Figure 4. Pin 2 to Pin 1 TLP I-V Curve

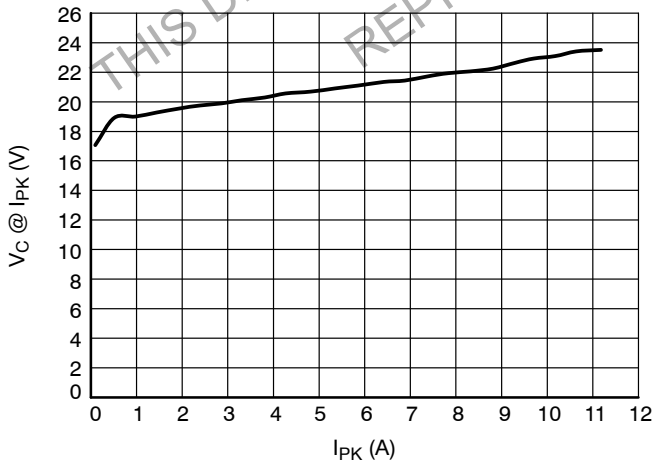


Figure 5. Pin 1 to Pin 2 Clamping Voltage vs.  
Peak Pulse Current ( $t_p = 8/20 \mu s$ )

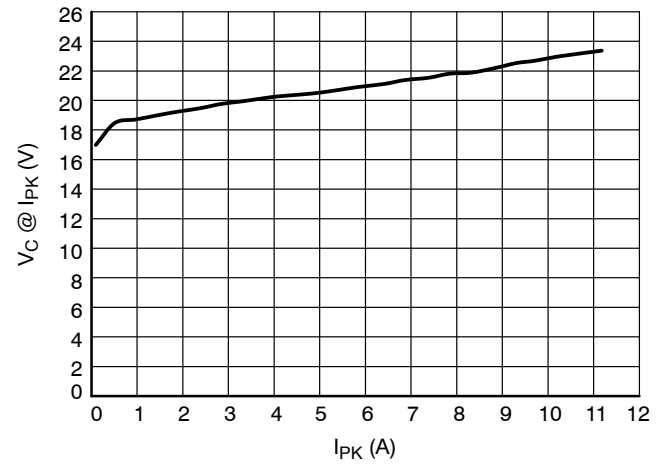


Figure 6. Pin 2 to Pin 1 Clamping Voltage vs.  
Peak Pulse Current ( $t_p = 8/20 \mu s$ )

TYPICAL CHARACTERISTICS

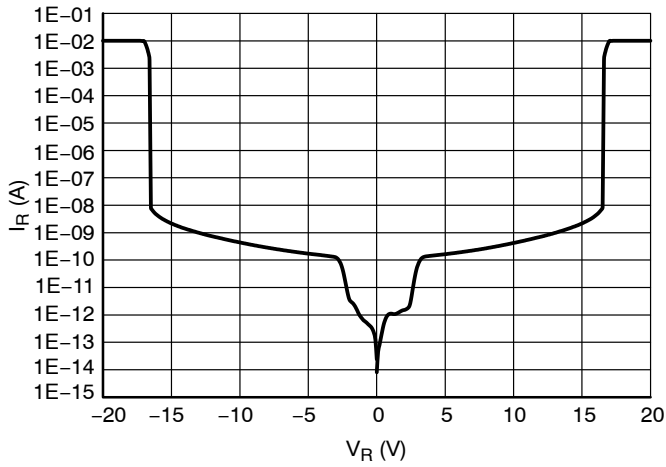


Figure 7. Reverse Leakage Current

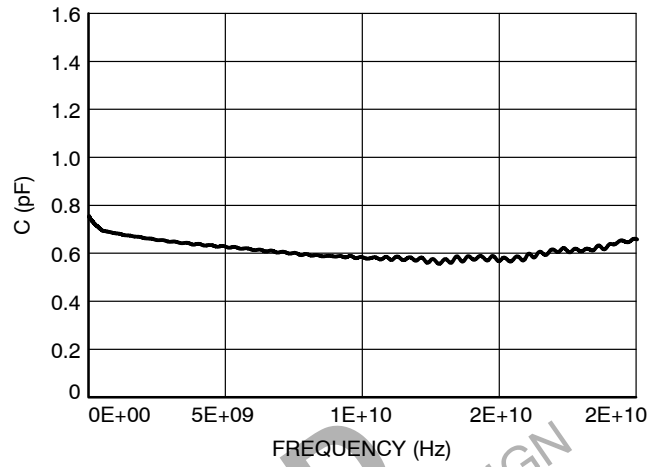


Figure 8. Capacitance Over Frequency

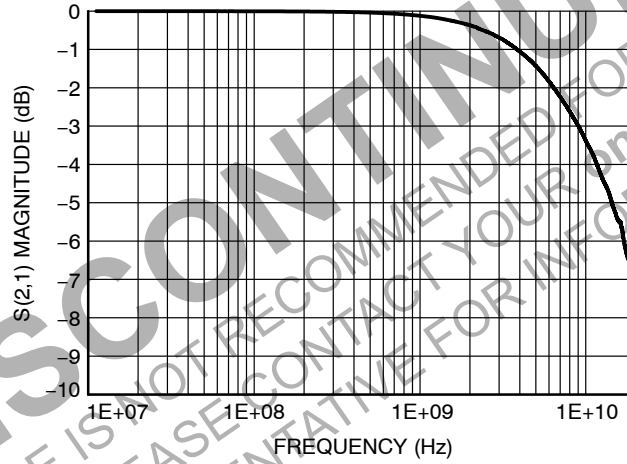


Figure 9. Insertion Loss

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 10. IEC61000-4-2 Spec

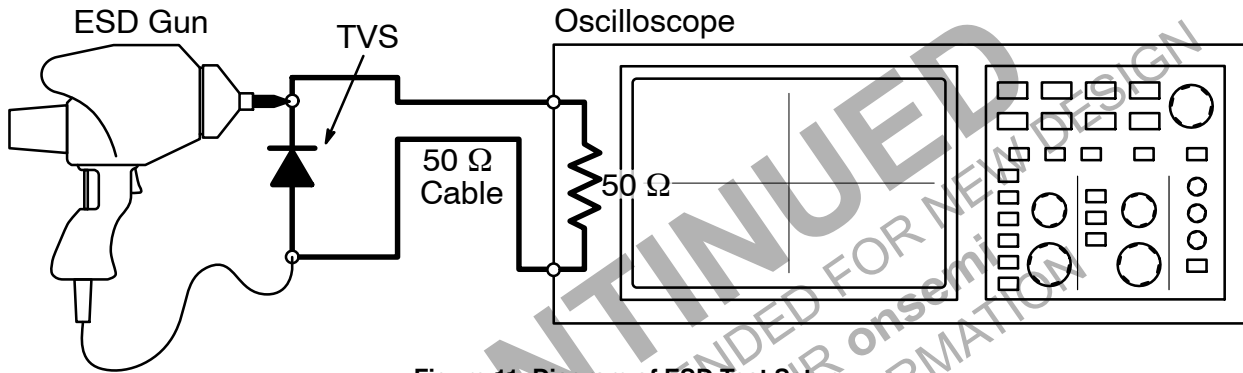


Figure 11. Diagram of ESD Test Setup

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. ON Semiconductor 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.

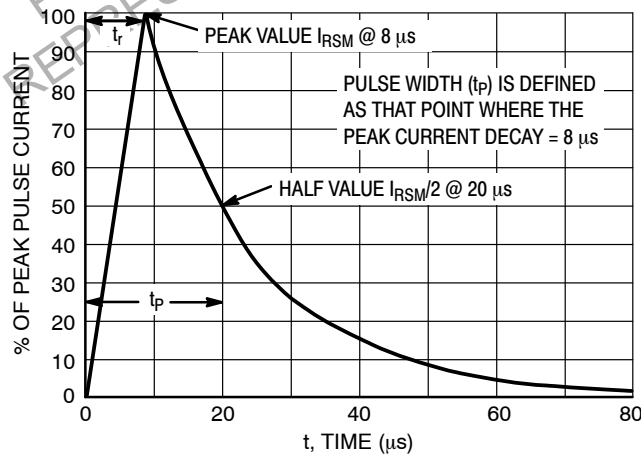
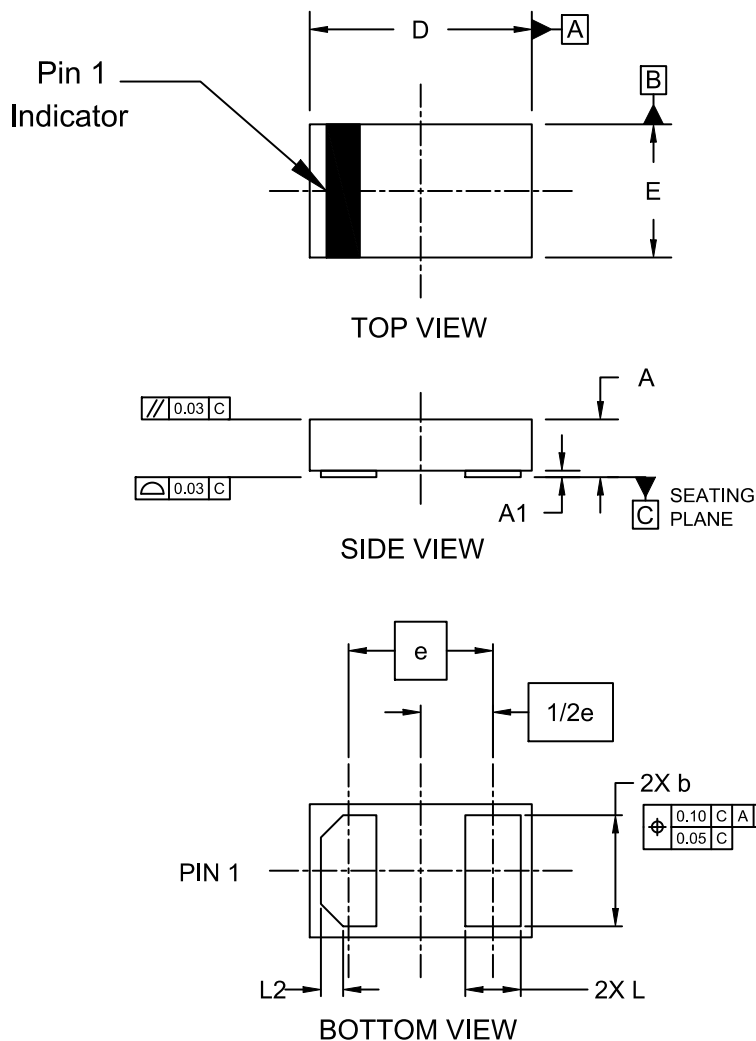


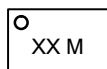
Figure 12. 8 X 20  $\mu$ s Pulse Waveform

**X3DFN2 1.0x0.6, 0.65P**  
CASE 514AG  
ISSUE 0

DATE 05 DEC 2018



### GENERIC MARKING DIAGRAM\*



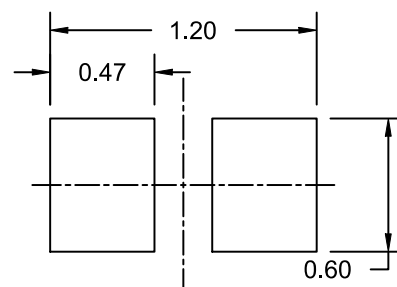
XX = Specific Device Code  
M = Date Code

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

NOTES:

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

DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	0.20	0.23	0.26
A1	0.00	---	0.03
b	0.45	0.50	0.55
D	0.95	1.00	1.05
E	0.55	0.60	0.65
e	0.65 BSC		
L	0.20	0.25	0.30
L2	0.10 REF		



## 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.

<b>DOCUMENT NUMBER:</b>	<b>98AON01136H</b>	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
<b>DESCRIPTION:</b>	<b>X3DFN2 1.0x0.6, 0.65P</b>	<b>PAGE 1 OF 1</b>

**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](http://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](http://www.onsemi.com/design/resources/technical-documentation)  
onsemi Website: [www.onsemi.com](http://www.onsemi.com)

### ONLINE SUPPORT: [www.onsemi.com/support](http://www.onsemi.com/support)

For additional information, please contact your local Sales Representative at  
[www.onsemi.com/support/sales](http://www.onsemi.com/support/sales)

# Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

[onsemi:](#)

[ESDL4151MX4T5G](#)