## ESD Protection Diode

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

## ESD7361, SZESD7361

The ESD7361 Series ESD protection diodes are designed to protect high speed data lines from ESD. Ultra-low capacitance make this device an ideal solution for protecting voltage sensitive high speed data lines.

## Features

- Low Capacitance ( 0.55 pF Max, I/O to GND)
- Protection for the Following IEC Standards:
- IEC61000-4-2 (ESD): Level $4 \pm 15 \mathrm{kV}$ Contact
- IEC61000-4-4 (EFT): $40 \mathrm{~A}-5 / 50 \mathrm{~ns}$
- IEC61000-4-5 (Lightning): 1 A (8/20 $\mu \mathrm{s}$ )
- ISO 10605 (ESD) $330 \mathrm{pF} / 2 \mathrm{k} \Omega \pm 15 \mathrm{kV}$ Contact
- SZ Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q101 Qualified and PPAP Capable
- These Devices are $\mathrm{Pb}-$ Free, Halogen Free/BFR Free and are RoHS Compliant

Typical Applications

- Wireless Charger
- Near Field Communications

MAXIMUM RATINGS $\left(T_{J}=25^{\circ} \mathrm{C}\right.$ unless otherwise noted)

| Rating | Symbol | Value | Unit |
| :--- | :---: | :---: | :---: |
| Operating Junction Temperature Range | $\mathrm{T}_{\mathrm{J}}$ | -55 to +125 | ${ }^{\circ} \mathrm{C}$ |
| Storage Temperature Range | $\mathrm{T}_{\text {stg }}$ | -55 to +150 | ${ }^{\circ} \mathrm{C}$ |
| Lead Solder Temperature - | $\mathrm{T}_{\mathrm{L}}$ | 260 | ${ }^{\circ} \mathrm{C}$ |
| Maximum (10 Seconds) |  |  |  |
| IEC 61000-4-2 Contact (ESD) | ESD | $\pm 15$ | kV |
| IEC 61000-4-2 Air (ESD) | ESD | $\pm 15$ | kV |
| ISO 10605 330 pF/2 k $\Omega$ Contact (ESD) | ESD | $\pm 15$ | kV |

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.

MARKING


## ORDERING INFORMATION

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

## ELECTRICAL CHARACTERISTICS

( $\mathrm{T}_{\mathrm{A}}=25^{\circ} \mathrm{C}$ unless otherwise noted)

| Symbol | Parameter |
| :---: | :--- |
| $\mathrm{I}_{\mathrm{PP}}$ | Maximum Reverse Peak Pulse Current |
| $\mathrm{V}_{\mathrm{C}}$ | Clamping Voltage @ $\mathrm{I}_{\mathrm{PP}}$ |
| $\mathrm{V}_{\mathrm{RWM}}$ | Working Peak Reverse Voltage |
| $\mathrm{I}_{\mathrm{R}}$ | Maximum Reverse Leakage Current @ $\mathrm{V}_{\mathrm{RWM}}$ |
| $\mathrm{V}_{\mathrm{BR}}$ | Breakdown Voltage $@ \mathrm{I}_{\mathrm{T}}$ |
| $\mathrm{I}_{\mathrm{T}}$ | Test Current |

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


ELECTRICAL CHARACTERISTICS $\left(\mathrm{T}_{\mathrm{A}}=25^{\circ} \mathrm{C}\right.$ unless otherwise specified)

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Reverse Working Voltage | $\mathrm{V}_{\text {RWM }}$ |  |  | 5 | 16 | V |
| Breakdown Voltage | $V_{B R}$ | $\mathrm{I}_{\mathrm{T}}=1 \mathrm{~mA}$; pin 1 to pin 2 | 16.5 |  |  | V |
| Reverse Leakage Current | $\mathrm{I}_{\mathrm{R}}$ | $\begin{aligned} & \mathrm{V}_{\mathrm{RWM}}=5.0 \mathrm{~V} \\ & \mathrm{~V}_{\mathrm{RWM}}=15 \mathrm{~V} \end{aligned}$ |  | $\begin{aligned} & <1 \\ & 20 \end{aligned}$ | $\begin{aligned} & \hline 1000 \\ & 1000 \end{aligned}$ | $\begin{aligned} & \mathrm{nA} \\ & \mathrm{nA} \end{aligned}$ |
| Clamping Voltage (Note 2) | $\mathrm{V}_{\mathrm{C}}$ | $\mathrm{I}_{\mathrm{PP}}=8 \mathrm{~A}$ |  | 31 |  | V |
| Clamping Voltage (Note 2) | $\mathrm{V}_{\mathrm{C}}$ | $\mathrm{I}_{\mathrm{PP}}=16 \mathrm{~A}$ |  | 34 |  | V |
| Junction Capacitance | $\mathrm{C}_{J}$ | $\begin{aligned} & V_{\mathrm{R}}=0 \mathrm{~V}, \mathrm{f}=1 \mathrm{MHz} \\ & \mathrm{~V}_{\mathrm{R}}=0 \mathrm{~V}, \mathrm{f}<1 \mathrm{GHz} \end{aligned}$ |  |  | $\begin{aligned} & 0.55 \\ & 0.55 \end{aligned}$ | pF |
| Dynamic Resistance | $\mathrm{R}_{\text {DYN }}$ | TLP Pulse |  | 0.735 |  | $\Omega$ |
| Insertion Loss |  | $\begin{aligned} & \mathrm{f}=1 \mathrm{MHz} \\ & \mathrm{f}=5 \mathrm{GHz} \end{aligned}$ |  | $\begin{gathered} 0.01 \\ 2 \end{gathered}$ |  | 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.

1. For test procedure see Figures 9 and 10 and application note AND8307/D.
2. ANSI/ESD STM5.5.1 - Electrostatic Discharge Sensitivity Testing using Transmission Line Pulse (TLP) Model.

TLP conditions: $\mathrm{Z}_{0}=50 \Omega, \mathrm{t}_{\mathrm{p}}=100 \mathrm{~ns}, \mathrm{t}_{\mathrm{r}}=4 \mathrm{~ns}$, averaging window; $\mathrm{t}_{1}=30 \mathrm{~ns}$ to $\mathrm{t}_{2}=60 \mathrm{~ns}$.


Figure 1. Typical IV Characteristics


Figure 2. Typical CV Characteristics


Figure 3. Typical Insertion Loss
ESD7361HT1G (SOD323)


Figure 5. Typical Insertion Loss ESD7361XV2T1G (SOD523)


Figure 7. Typical Insertion Loss ESD7361P2T5G (SOD923)


Figure 4. Typical Capacitance Over Frequency ESD7361HT1G (SOD323)


Figure 6. Typical Capacitance Over Frequency ESD7361XV2T1G (SOD523)


Figure 8. Typical Capacitance Over Frequency ESD7361P2T5G (SOD923)

IEC 61000-4-2 Spec.

| Level | Test Volt- <br> age (kV) | First Peak <br> Current <br> $(A)$ | Current at <br> 30 ns (A) | Current at <br> $\mathbf{6 0}$ 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 9. IEC61000-4-2 Spec


Figure 10. Diagram of ESD Clamping Voltage Test Setup

The following is taken from Application Note AND8308/D - Interpretation of Datasheet Parameters for ESD Devices.

## 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.


NOTE: TLP parameter: $Z_{0}=50 \Omega, t_{p}=100 \mathrm{~ns}, \mathrm{t}_{\mathrm{r}}=300 \mathrm{ps}$, averaging window: $\mathrm{t}_{1}=30 \mathrm{~ns}$ to $\mathrm{t}_{2}=60 \mathrm{~ns}$. $V_{\text {IEC }}$ is the equivalent voltage stress level calculated at the secondary peak of the IEC 61000-4-2 waveform at $t=30 \mathrm{~ns}$ with $2 \mathrm{~A} / \mathrm{kV}$. See TLP description below for more information.

## 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 10 s 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 ${ }^{\dagger}$ |
| :---: | :---: | :---: |
| ESD7361HT1G | $\begin{aligned} & \text { SOD-323 } \\ & \text { (Pb-Free) } \end{aligned}$ | 3000 / Tape \& Reel |
| SZESD7361HT1G* |  |  |
| ESD7361XV2T1G | $\begin{aligned} & \text { SOD-523 } \\ & \text { (Pb-Free) } \end{aligned}$ | 3000 / Tape \& Reel |
| SZESD7361XV2T1G* |  |  |
| ESD7361XV2T5G |  | 8000 / Tape \& Reel |
| SZESD7361XV2T5G* |  |  |
| ESD7361P2T5G | $\begin{aligned} & \text { SOD-923 } \\ & \text { (Pb-Free) } \end{aligned}$ | 8000 / Tape \& Reel |
| SZESD7361P2T5G* |  |  |

$\dagger$ 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.
*SZ Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q101 Qualified and PPAP Capable.


SIDE VIEW


NDTES:

1. DIMENSIDNING AND TILERANCING AS PER ASME Y14.5M, 2018
2. CONTRaLLING DIMENSIDN: MILLIMETERS
3. LEAD THICKNESS SPECIFIED PER L/F DRAWING WITH SULDER PLATING.
4. DIMENSIIDNS A AND B DD NDT INCLUDE MDLD FLASH, pRITRUSIDNS aR GATE BURRS
5. DIMENSIIN L IS MEASURE FRDM END DF RADIUS



## RECDMMENDED MDUNTING FIDTPRINT

*For additional information on our $\mathrm{Pb}-$ Free strategy and soldering details, please download the ZN Semiconductor Soldering and Mounting Techniques Reference manual, SOLDERRM/D.


$$
\begin{aligned}
& X X=\text { Specific Device Code } \\
& M \text { = Date Code }
\end{aligned}
$$

*This information is generic. Please refer to device data sheet for actual part marking. $\mathrm{Pb}-\mathrm{Free}$ indicator, " G " or microdot " "", may or may not be present. Some products may not follow the Generic Marking.
STYLE 1:
PIN 1. CATHODE (POLARITY BAND) $\quad$ STYLE 2:
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| DESCRIPTION: | SOD-323 1.70x1.25x0.85 | PAGE 1 OF 1 |

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TロP VIEW


GENERIC
MARKING DIAGRAM*


XX = Specific Device Code M Date Code
*This information is generic. Please refer to device data sheet for actual part marking. $\mathrm{Pb}-\mathrm{Free}$ indicator, " G " or microdot " r ", may or may not be present. Some products may not follow the Generic Marking.

STYLE 1 :
PIN 1. CATHODE (POLARITY BAND) 2. ANODE

SOD-523 1.20×0.80x0.60
CASE 502
ISSUE F
DATE 08 FEB 2024
NDTES:

1. DIMENSIDNING AND TDLERANCING PER ASME Y14.5M, 2018.
2. CZNTROLLING DIMENSIDN: MILLIMETERS.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH, MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS DF BASE MATERIAL.
4. DIMENSIDNS D AND E DD NDT INCLUDE MLLD FLASH, PRDTRUSIDNS, $\square R$ GATE BURRS,

| DIM | MILLIMETERS |  |  |
| :--- | :--- | :--- | :--- |
|  | MIN. | NDM. | MAX. |
| A | 0.50 | 0.60 | 0.70 |
| $b$ | 0.25 | 0.30 | 0.35 |
| $C$ | 0.07 | 0.14 | 0.20 |
| $D$ | 1.10 | 1.20 | 1.30 |
| $E$ | 0.70 | 0.80 | 0.90 |
| $H$ | 1.50 | 1.60 | 1.70 |
| $L$ | 0.30 REF |  |  |
| $L 2$ | 0.15 | 0.20 | 0.25 |



## RECDMMENDED MDUNTING F $\square \square$ TPRINT

*For additional information on our
Pb-Free strategy and soldering details, please download the $\square N$ Semiconductor Soldering and Mounting Techniques Reference manual, SDLDERRM/D.

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| ---: | :--- | :--- | :--- |
| DESCRIPTION: | SOD-523 1.20x0.80x0.60 | PAGE 1 OF 1 |  |



SOD-923 $0.80 \times 0.60 \times 0.37$
CASE 514AB
ISSUE E
DATE 08 FEB 2024


NDTES:

1. DIMENSIDNING AND TULERANCING PER ASME Y14.5M, 2018.
2. CDNTRDLLING DIMENSIDN: MILLIMETERS.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS DF BASE MATERIAL
4. DIMENSIUNS D AND E DZ NDT INCLUDE MILD FLASH, PRITRUSIINS, GR GATE BURRS
5. DIMENSIUN L WILL NDT EXCEED 0.30 mm .

TロP VIEW


SEATING
PLANE

| MILLIMETERS |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
| DIM | MIN. | NDM. | MAX |  |
| A | 0.34 | 0.37 | 0.40 |  |
| b | 0.15 | 0.20 | 0.25 |  |
| $C$ | 0.07 | 0.12 | 0.17 |  |
| D | 0.75 | 0.80 | 0.85 |  |
| E | 0.55 | 0.60 | 0.65 |  |
| $H$ | 0.95 | 1.00 | 1.05 |  |
| $L$ | 0.19 REF |  |  |  |
| L2 | 0.05 | 0.10 | 0.15 |  |


*For additional information on our Pb-Free strategy and soldering details, please download the $\square N$
Semiconductor Soldering and Mounting Techniques Reference Manual,

SLLDERRM/D
*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.

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| DESCRIPTION: | SOD-923 0.80x0.60x0.37 | PAGE 1 OF 1 |  |

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