

# ESD Protection Diode

## Ultra-Low Capacitance

### ESD9R3.3S, SZESD9R3.3S

The ESD9R is designed to provide ESD protection for ASSPs and ASICs used in ultra low current applications such as human body sensors. These devices have been designed for leakage under 1 nA from 0°C to 50°C when turned off. During an ESD event, these devices turn on to clamp the ESD to a safe voltage level for the IC. These devices have the added benefits of low capacitance for high speed data lines and small package size for space constrained designs.

#### Specification Features:

- Ultra-Low Leakage < 1 nA
- Ultra-Low Capacitance 0.5 pF
- Low Clamping Voltage
- Small Body Outline Dimensions:  
0.039" x 0.024" (1.00 mm x 0.60 mm)
- Low Body Height: 0.016" (0.4 mm)
- Stand-off Voltage: 3.3 V
- Response Time < 1.0 ns
- 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
- This is a Pb-Free and Halogen-Free Device

#### Mechanical Characteristics:

**CASE:** Void-free, transfer-molded, thermosetting plastic

Epoxy Meets UL 94 V-0

**LEAD FINISH:** 100% Matte Sn (Tin)

**MOUNTING POSITION:** Any

**QUALIFIED MAX REFLOW TEMPERATURE:** 260°C

Device Meets MSL 1 Requirements

#### MAXIMUM RATINGS

| Rating                                                                 | Symbol           | Value             | Unit |
|------------------------------------------------------------------------|------------------|-------------------|------|
| IEC 61000-4-2 (ESD) Contact Air HBM                                    |                  | ±10<br>±15<br>±16 | kV   |
| Total Power Dissipation on FR-5 Board (Note 1) @ T <sub>A</sub> = 25°C | P <sub>D</sub>   | 150               | mW   |
| Storage Temperature Range                                              | T <sub>stg</sub> | -55 to +150       | °C   |
| Junction Temperature Range                                             | T <sub>J</sub>   | -55 to +125       | °C   |
| Lead Solder Temperature – Maximum (10 Second Duration)                 | T <sub>L</sub>   | 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-5 = 1.0 x 0.75 x 0.62 in.

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



SOD-923  
CASE 514AB

#### MARKING DIAGRAM



J = Specific Device Code  
M = Date Code

\*Date Code orientation and/or position may vary depending upon manufacturing location.

#### ORDERING INFORMATION

| Device         | Package           | Shipping <sup>†</sup> |
|----------------|-------------------|-----------------------|
| ESD9R3.3ST5G   | SOD-923 (Pb-Free) | 8000 / Tape & Reel    |
| SZESD9R3.3ST5G | SOD-923 (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.

#### DEVICE MARKING INFORMATION

See specific marking information in the device marking column of the Electrical Characteristics tables starting on page 2 of this data sheet.

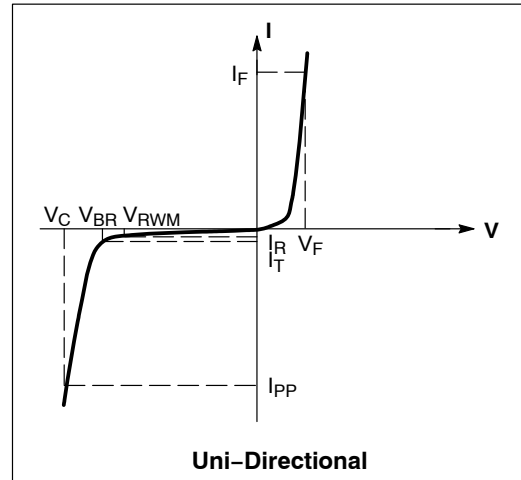
# ESD9R3.3S, SZESD9R3.3S

## ELECTRICAL CHARACTERISTICS

( $T_A = 25^\circ\text{C}$  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                                   |
| $I_F$     | Forward Current                                |
| $V_F$     | Forward Voltage @ $I_F$                        |
| $P_{pk}$  | Peak Power Dissipation                         |
| C         | Max. Capacitance @ $V_R = 0$ and $f = 1.0$ MHz |

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



## ELECTRICAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ unless otherwise noted, $V_F = 1.0$ V Max. @ $I_F = 10$ mA for all types)

| Device*      | Device Marking | $V_{RWM}$ (V) | $I_R$ (nA) @ 1 V<br>$T_A = 0^\circ\text{C}$<br>to $50^\circ\text{C}$<br>(Note 4) | $V_{BR}$ (V) @ $I_T$<br>(Note 2) | $I_T$ | C (pF) |     | $V_C$ (V)<br>@ $I_{PP} = 1$ A<br>(Note 5) | $V_C$                        |
|--------------|----------------|---------------|----------------------------------------------------------------------------------|----------------------------------|-------|--------|-----|-------------------------------------------|------------------------------|
|              |                | Max           | Max                                                                              | Min                              | mA    | Typ    | Max | Max                                       | Per IEC61000-4-2<br>(Note 3) |
| ESD9R3.3ST5G | J**            | 3.3           | 1.0                                                                              | 4.8                              | 1.0   | 0.5    | 0.9 | 7.8                                       | Figures 1 and 2<br>See Below |

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.

\*Includes SZ-prefix device where applicable.

\*\*Rotated  $270^\circ$ .

2.  $V_{BR}$  is measured with a pulse test current  $I_T$  at an ambient temperature of  $25^\circ\text{C}$ .

3. For test procedure see Figures 3 and 4 and Application Note AND8307/D.

4. Limits over temperature are guaranteed by design, not production tested.

5.  $V_C$  measured using pulse waveform in Figure 5.

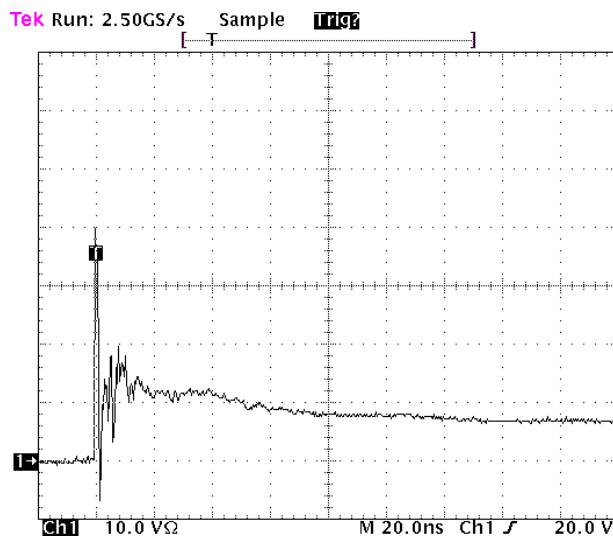


Figure 1. ESD Clamping Voltage Screenshot  
Positive 8 kV Contact per IEC61000-4-2

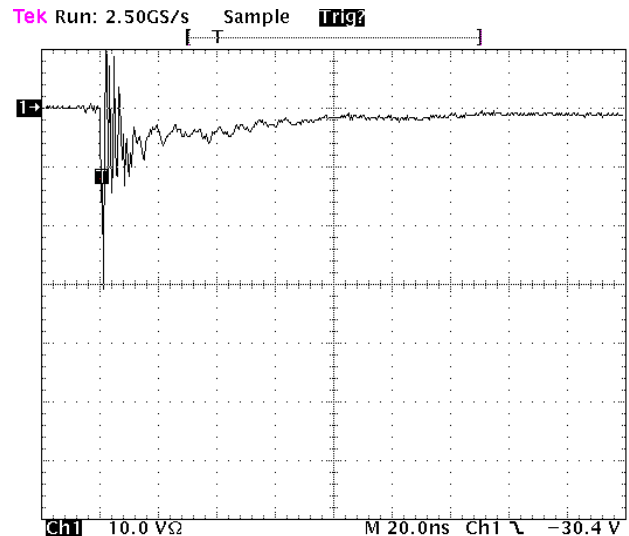


Figure 2. ESD Clamping Voltage Screenshot  
Negative 8 kV Contact per IEC61000-4-2

## ESD9R3.3S, SZESD9R3.3S

### 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                    |

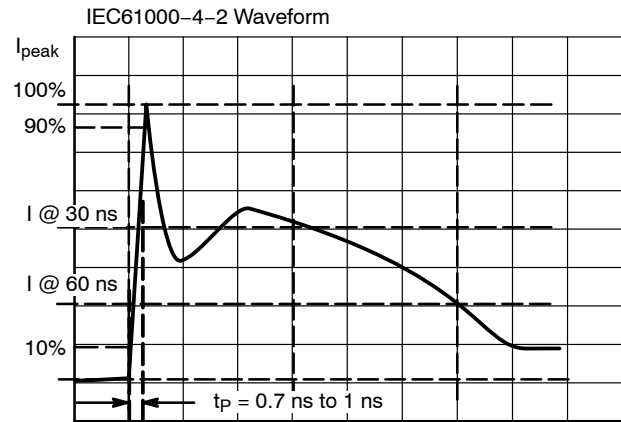


Figure 3. IEC61000-4-2 Spec

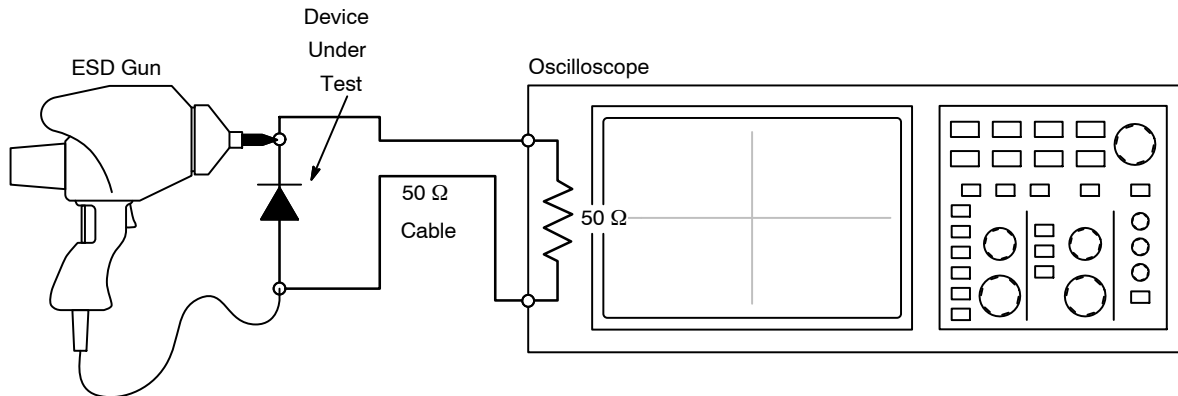


Figure 4. Diagram of ESD Test Setup

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.

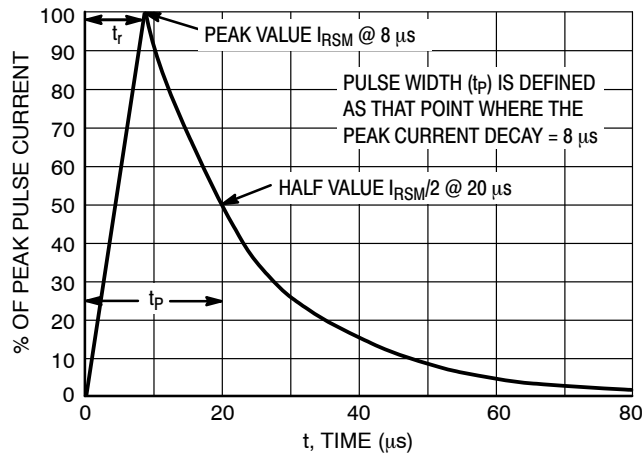
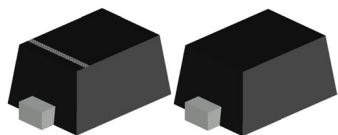


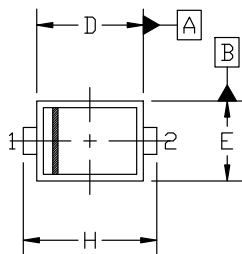
Figure 5. 8 x 20  $\mu$ s Pulse Waveform

# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS

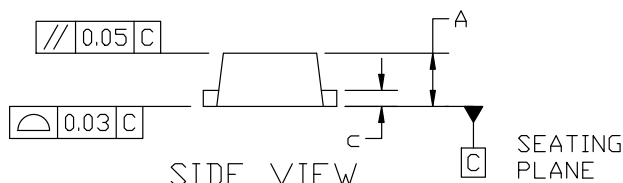


**SOD-923 0.80x0.60x0.37**  
**CASE 514AB**  
**ISSUE E**

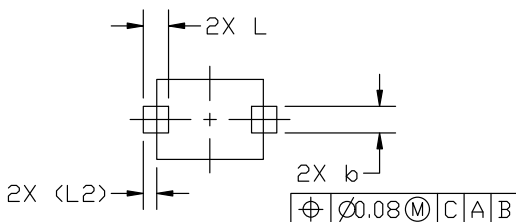
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TOP VIEW

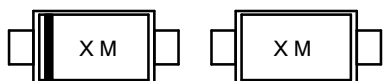


SIDE VIEW



BOTTOM VIEW

## GENERIC MARKING DIAGRAM\*



STYLE 1

STYLE 2

X = 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.

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

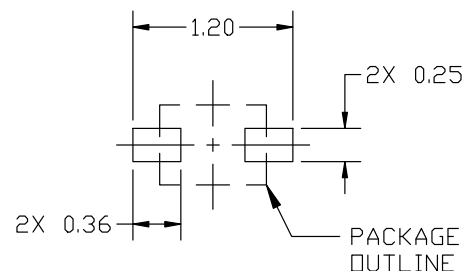
STYLE 2: NO POLARITY

## NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2018.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.
5. DIMENSION L WILL NOT EXCEED 0.30mm.

## MILLIMETERS

| DIM | MIN.     | NOM. | 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 |



## 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.

|                         |                               |                                                                                                                                                                                  |
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