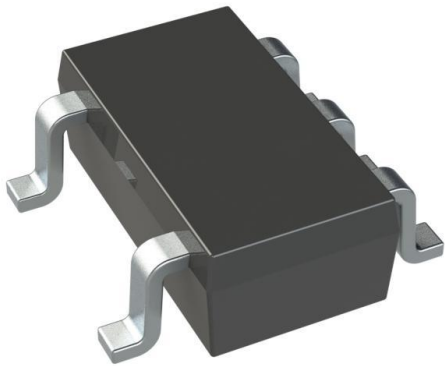


ESDS312DBVR Datasheet

www.digi-electronics.com



ESDS312DBVR

<https://www.DiGi-Electronics.com>

| | |
|------------------------------|--|
| DiGi Electronics Part Number | ESDS312DBVR-DG |
| Manufacturer | Texas Instruments |
| Manufacturer Product Number | ESDS312DBVR |
| Description | TVS DIODE 3.6VWM 6.5VC SOT23-5 |
| Detailed Description | 6.5V (Typ) Clamp 25A (8/20 μ s) Ipp Tvs Diode Surface Mount SOT-23-5 |



Tel: +00 852-30501935

RFQ Email: Info@DiGi-Electronics.com

DiGi is a global authorized distributor of electronic components.

Purchase and inquiry

Manufacturer Product Number:

ESDS312DBVR

Series:

-

Type:

Zener

Voltage - Reverse Standoff (Typ):

3.6V (Max)

Voltage - Clamping (Max) @ Ipp:

6.5V (Typ)

Power - Peak Pulse:

170W

Applications:

General Purpose

Operating Temperature:

-40°C ~ 125°C (TA)

Package / Case:

SC-74A, SOT-753

Base Product Number:

ESDS312

Manufacturer:

Texas Instruments

Product Status:

Active

Unidirectional Channels:

2

Voltage - Breakdown (Min):

4.5V

Current - Peak Pulse (10/1000µs):

25A (8/20µs)

Power Line Protection:

No

Capacitance @ Frequency:

4.5pF @ 1MHz

Mounting Type:

Surface Mount

Supplier Device Package:

SOT-23-5

Environmental & Export classification

RoHS Status:

ROHS3 Compliant

REACH Status:

REACH Unaffected

HTSUS:

8541.10.0080

Moisture Sensitivity Level (MSL):

1 (Unlimited)

ECCN:

EAR99

ESDS31x Data-Line Surge and ESD Protection Diode Array

1 Features

- IEC 61000-4-2 ESD protection:
 - ±30kV Contact Discharge
 - ±30kV Air Gap Discharge
- IEC 61000-4-4 EFT protection:
 - 80A (5/50ns)
- IEC 61000-4-5 surge protection:
 - 25A (8/20µs)
- IO capacitance:
 - 4.5pF (typical)
- DC breakdown voltage: 5.5V (minimum)
- Ultra low leakage current: 5nA (typical)
- Supports high speed interfaces up to 5Gbps
- Industrial temperature range: –40°C to +125°C
- Easy flow-through routing package (ESDS312)

2 Applications

- End equipment:
 - Ethernet switches
 - Access points
 - Gateways
 - Printers
 - DVR and NVR
- Interfaces:
 - Ethernet™ 10/100/1000Mbps
 - USB™ 2.0
 - GPIO

3 Description

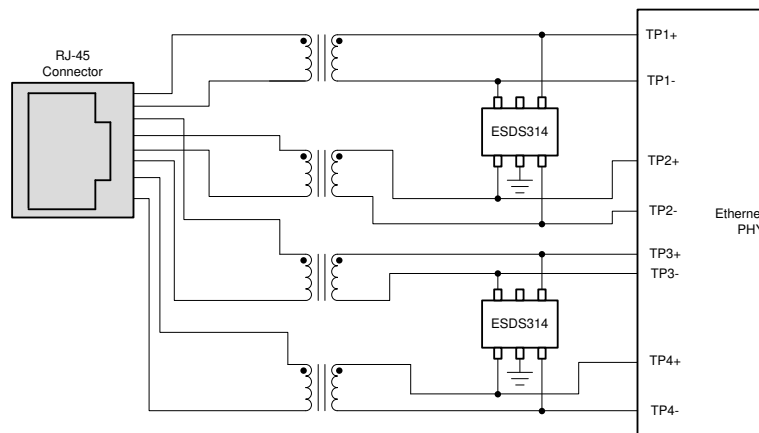
The ESDS31x devices are unidirectional TVS ESD protection diode array for Ethernet, USB and general purpose data line surge protection up to 25A (8/20µs). The ESDS31x devices are rated to dissipate ESD strikes above the maximum level specified in the IEC 61000-4-2 international standard (Level 4).

The devices feature a 4.5pF IO capacitance per channel making the device an excellent choice for protecting high-speed interfaces such as Ethernet 10/100/1000, USB 2.0 and GPIO. The low dynamic resistance and low clamping voltage provides system level protection against transient events.

Package Information

| PART NUMBER | CHANNEL COUNT | PACKAGE ⁽¹⁾ |
|-------------|---------------|------------------------|
| ESDS311 | 1 Channel | DYF (SOD323, 2) |
| ESDS312 | 2 Channels | DBV (SOT-23, 5) |
| ESDS314 | 4 Channels | DBV (SOT-23, 5) |

(1) For more information, [Section 10](#)



Typical Application Schematic

Table of Contents

| | | | |
|--|---|--|----|
| 1 Features | 1 | 6.4 Device Functional Modes..... | 8 |
| 2 Applications | 1 | 7 Application and Implementation | 9 |
| 3 Description | 1 | 7.1 Application Information..... | 9 |
| 4 Pin Configuration and Functions | 2 | 7.2 Typical Application..... | 9 |
| 5 Specifications | 4 | 7.3 Power Supply Recommendations..... | 10 |
| 5.1 Absolute Maximum Ratings..... | 4 | 7.4 Layout..... | 10 |
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| 5.4 Recommended Operating Conditions..... | 4 | 8.2 Receiving Notification of Documentation Updates.... | 12 |
| 5.5 Thermal Information..... | 4 | 8.3 Support Resources..... | 12 |
| 5.6 Electrical Characteristics..... | 5 | 8.4 Trademarks..... | 12 |
| 5.7 Typical Characteristics..... | 6 | 8.5 Electrostatic Discharge Caution..... | 12 |
| 6 Detailed Description | 8 | 8.6 Glossary..... | 12 |
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| 6.2 Functional Block Diagram..... | 8 | 10 Mechanical, Packaging, and Orderable Information | 13 |
| 6.3 Feature Description..... | 8 | | |

4 Pin Configuration and Functions

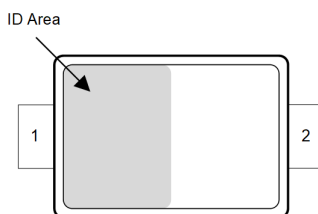


Figure 4-1. ESDS311 DYF, 2-Pin SOD323 (Top View)

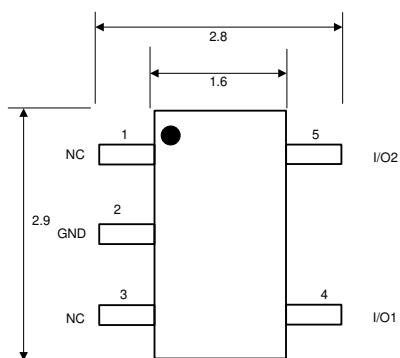


Figure 4-2. ESDS312 DBV Package, 5-Pin SOT23 (Top View)

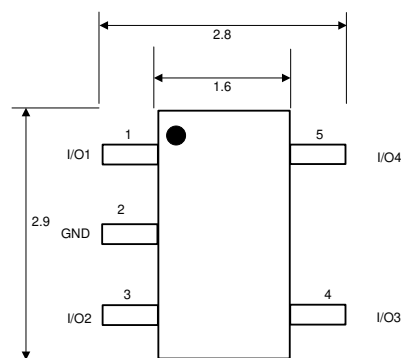


Figure 4-3. ESDS314 DBV Package, 5-Pin SOT23 (Top View)

Table 4-1. Pin Functions for ESDS311

| PIN | | TYPE ⁽¹⁾ | DESCRIPTION |
|------|-----|---------------------|---|
| NAME | NO. | | |
| I/O | 1 | I/O | Surge/ESD protected channels. Connect to the lines being protected. |
| GND | 2 | GND | Ground. Connect to ground. |

Table 4-2. Pin Functions for ESDS312

| PIN | | TYPE ⁽¹⁾ | DESCRIPTION |
|------|-----|---------------------|---|
| NAME | NO. | | |
| I/O1 | 4 | I/O | Surge/ESD protected channels. Connect to the lines being protected. |
| I/O2 | 5 | | |
| GND | 2 | GND | Ground. Connect to ground. |
| NC | 1 | NC | Not connected; Used for optional straight-through routing. Can be left floating or grounded |
| NC | 3 | | |

Table 4-3. Pin Functions for ESDS314

| PIN | | TYPE ⁽¹⁾ | DESCRIPTION |
|------|-----|---------------------|---|
| NAME | NO. | | |
| I/O1 | 1 | I/O | Surge/ESD protected channels. Connect to the lines being protected. |
| I/O2 | 3 | | |
| I/O3 | 4 | | |
| I/O4 | 5 | | |
| GND | 2 | GND | Ground. Connect to ground |

(1) I = input, O = output, NC = no connection, and GND = ground

ESDS311, ESDS312, ESDS314

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5 Specifications**5.1 Absolute Maximum Ratings**over operating free-air temperature range (unless otherwise noted)⁽¹⁾

| | | MIN | MAX | UNIT |
|---|--------------------------------|-----|-----|------|
| IEC 61000-4-4 Electrical Fast Transient | Peak Power at 25 °C | | 80 | A |
| IEC 61000-4-5 Surge (t _p 8/20µs) | Peak Power at 25 °C | | 170 | W |
| | Peak Current at 25 °C | | 25 | A |
| T _A | Operating free-air temperature | -40 | 125 | °C |
| T _{stg} | Storage temperature | -65 | 155 | °C |

- (1) Operation outside the *Absolute Maximum Rating* may cause permanent device damage. *Absolute Maximum Rating* do not imply functional operation of the device at these or any other conditions beyond those listed under *Recommended Operating Condition*. If used outside the *Recommended Operating Condition* but within the *Absolute Maximum Rating*, the device may not be fully functional, and this may affect device reliability, functionality, performance, and shorten the device lifetime.

5.2 ESD Ratings - JEDEC Specifications

| | | | VALUE | UNIT |
|--------------------|-------------------------|--|-------|------|
| V _(ESD) | Electrostatic discharge | Human body model (HBM), per ANSI/ESDA/ JEDEC JS-001, all-pins ⁽¹⁾ | ±2500 | V |
| | | Charged device model (CDM), per JEDEC specification JESD22-C101, all pins ⁽²⁾ | ±1000 | |

- (1) JEDEC document JEP155 states that 500V HBM allows safe manufacturing with a standard ESD control process.
(2) JEDEC document JEP157 states that 250V CDM allows safe manufacturing with a standard ESD control process.

5.3 ESD Ratings - IEC Specifications

| | | | VALUE | UNIT |
|--------------------|-------------------------|---|--------|------|
| V _(ESD) | Electrostatic discharge | IEC 61000-4-2 Contact Discharge, all pins | ±30000 | V |
| | | IEC 61000-4-2 Air Discharge, all pins | ±30000 | |

5.4 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)

| | | MIN | NOM | MAX | UNIT |
|-----------------|--------------------------------|-----|-----|-----|------|
| V _{IN} | Input voltage | 0 | | 3.6 | V |
| T _A | Operating Free Air Temperature | -40 | | 125 | °C |

5.5 Thermal Information

| THERMAL METRIC ⁽¹⁾ | | ESDS311 | ESDS312 | ESDS314 | UNIT |
|-------------------------------|--|--------------|--------------|--------------|------|
| | | DYF (SOD323) | DBV (SOT-23) | DBV (SOT-23) | |
| | | 2 PINS | 5 PINS | 5 PINS | |
| R _{θJA} | Junction-to-ambient thermal resistance | 739.2 | 163.9 | 127.6 | °C/W |
| R _{θJC(top)} | Junction-to-case (top) thermal resistance | 287.7 | 113.4 | 78.9 | °C/W |
| R _{θJB} | Junction-to-board thermal resistance | 605.5 | 76.9 | 43.9 | °C/W |
| Ψ _{JT} | Junction-to-top characterization parameter | 118.4 | 59.8 | 24.5 | °C/W |
| Ψ _{JB} | Junction-to-board characterization parameter | 591.1 | 76.8 | 43.7 | °C/W |

5.5 Thermal Information (continued)

| THERMAL METRIC ⁽¹⁾ | | ESDS311 | ESDS312 | ESDS314 | UNIT |
|-------------------------------|--|--------------|--------------|--------------|------|
| | | DYF (SOD323) | DBV (SOT-23) | DBV (SOT-23) | |
| | | 2 PINS | 5 PINS | 5 PINS | |
| R _{θJC(bot)} | Junction-to-case (bottom) thermal resistance | N/A | N/A | N/A | °C/W |

(1) For more information about traditional and new thermal metrics, see the [Semiconductor and IC Package Thermal Metrics](#) application report.

5.6 Electrical Characteristics

At T_A = 25°C unless otherwise noted

| PARAMETER | | TEST CONDITIONS | Device | MIN | TYP | MAX | UNIT | |
|----------------------|---|---|--|-------------|------|------|------|---|
| V _{RWM} | Reverse stand-off voltage | I _{IO} < 500nA, across operating temperature range | | | | 3.6 | V | |
| I _{LEAKAGE} | Leakage current at 3.6V | V _{IO} = 3.6V, Any IO pin to GND | | | 5 | 50 | nA | |
| V _{BRF} | Breakdown voltage, IO to GND ⁽¹⁾ | I _{IO} = 1mA | | 4.5 | | 7.5 | V | |
| V _{FWD} | Forward Voltage, GND to IO | I _{IO} = 1mA | | | 0.8 | | V | |
| V _{HOLD} | Holding Voltage, IO to GND ⁽²⁾ | I _{IO} = 1mA | | | 5 | | V | |
| V _{CLAMP} | Surge Clamping voltage, t _p = 8/20μs | I _{PP} = 1A, Any IO pin to GND | ESDS312/314 | | 5 | | V | |
| V _{CLAMP} | | I _{PP} = 12A, Any IO pin to GND | ESDS311 | | 6.3 | | V | |
| V _{CLAMP} | | | ESDS312/314 | | 5.6 | | | |
| V _{CLAMP} | | I _{PP} = 25A, Any IO pin to GND | ESDS311 | | 7.7 | | V | |
| V _{CLAMP} | | | ESDS312/314 | | 6.5 | | | |
| V _{CLAMP} | | I _{PP} = 1A, GND to any IO pin | ESDS312/314 | | 1 | | V | |
| V _{CLAMP} | | | I _{PP} = 12A, GND to any IO pin | ESDS311 | | 3 | | V |
| V _{CLAMP} | | | | ESDS312/314 | | 2.1 | | |
| V _{CLAMP} | | I _{PP} = 25A, GND to any IO pin | ESDS311 | | 4.9 | | V | |
| V _{CLAMP} | | | ESDS312/314 | | 3.6 | | | |
| V _{CLAMP} | I _{PP} = 16A, Any IO pin to GND | | ESDS311 | | 6.5 | V | | |
| V _{CLAMP} | | | ESDS312/314 | | 5.5 | | | |
| V _{CLAMP} | TLP Clamping Voltage, t _p = 100ns | ESDS311 | | 3.4 | V | | | |
| V _{CLAMP} | | ESDS312/314 | | 2.2 | | | | |
| C _{LINE} | Line capacitance, Any IO to GND | V _{IO} = 0V, V _{p-p} = 30mV, f = 1MHz | | | 4.5 | 5.5 | pF | |
| ΔC _{LINE} | Variation of line capacitance | C _{LINE1} - C _{LINE2} , V _{IO} = 0V, V _{p-p} = 30mV, f = 1MHz | ESDS312/314 | | 0.05 | 0.1 | pF | |
| C _{CROSS} | Line-to-line capacitance | V _{IO} = 0V, V _{rms} = 30mV, f = 1MHz | ESDS312/314 | | 2.25 | 2.75 | pF | |

(1) V_{BRF} and V_{BRR} are defined as the voltage obtained at 1mA when sweeping the voltage up, before the device latches into the snapback state

(2) V_{HOLD} is defined as the voltage when 1mA is applied, after the device has successfully latched into the snapback state.

5.7 Typical Characteristics

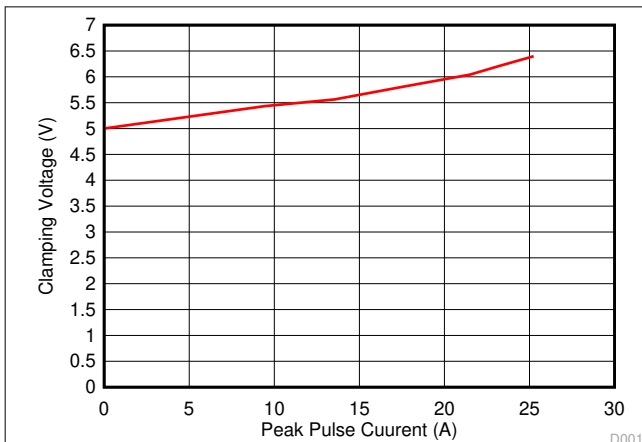


Figure 5-1. Clamping Voltage vs. Peak Pulse Current ($t_p = 8/20\mu s$), Any IO Pin to GND

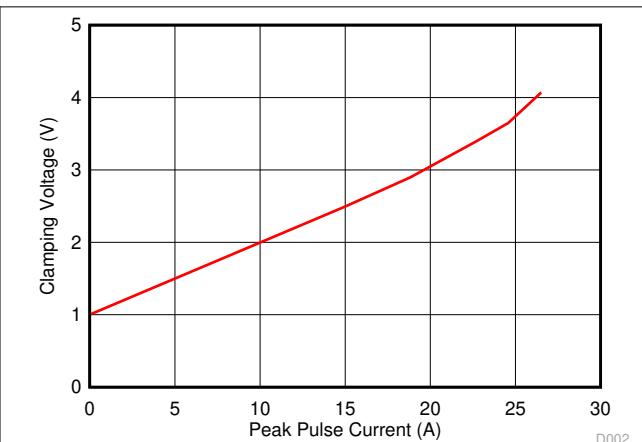


Figure 5-2. Clamping Voltage vs. Peak Pulse Current ($t_p = 8/20\mu s$), GND to Any IO Pin

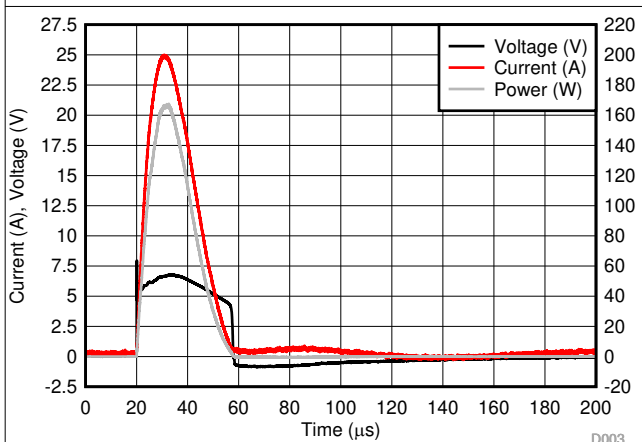


Figure 5-3. Surge Current, Clamping Voltage and Power Curve ($t_p = 8/20\mu s$), Any IO Pin to GND

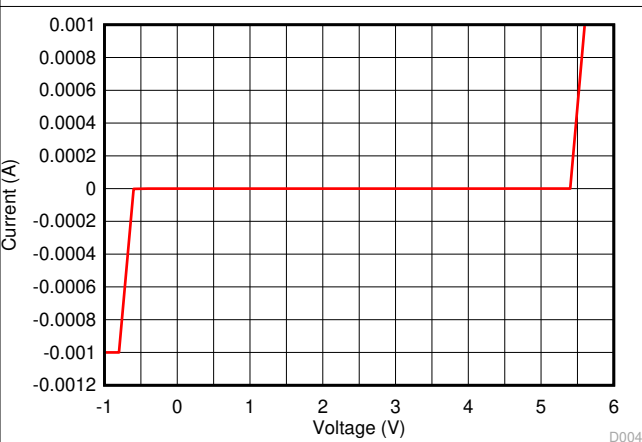


Figure 5-4. DC I-V Curve

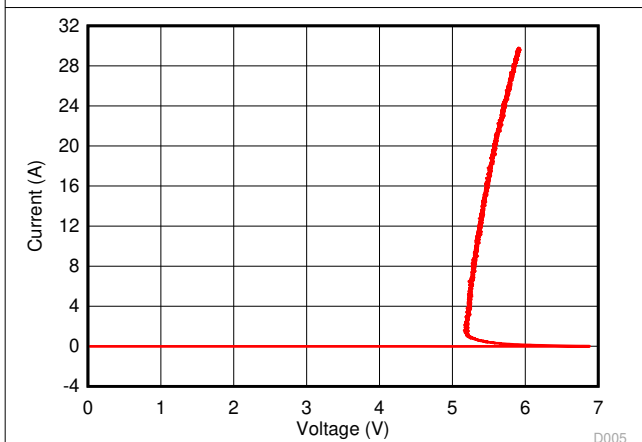


Figure 5-5. TLP I-V Curve, IO to GND, $t_p = 100ns$

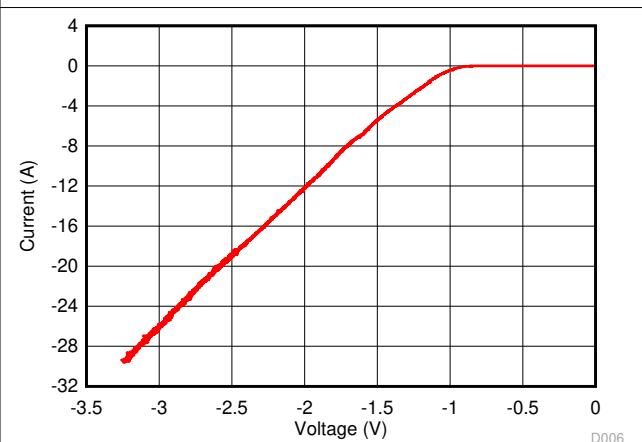
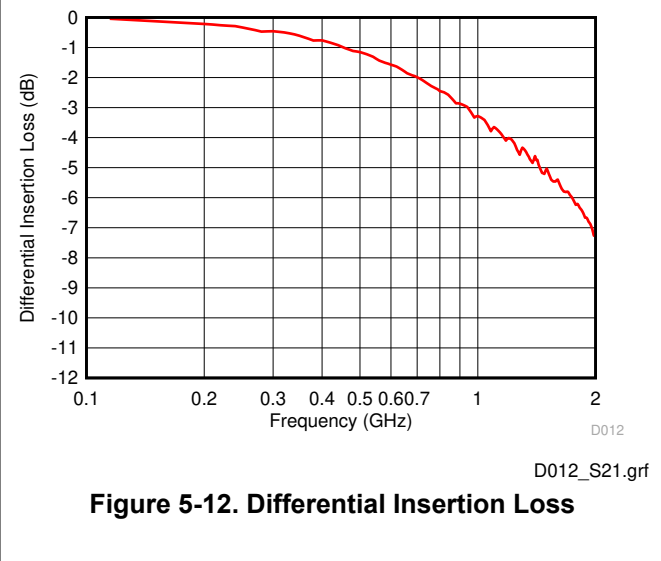
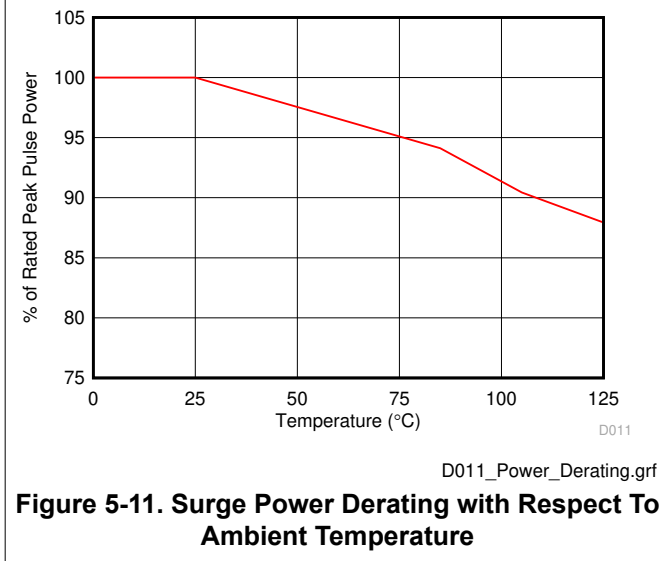
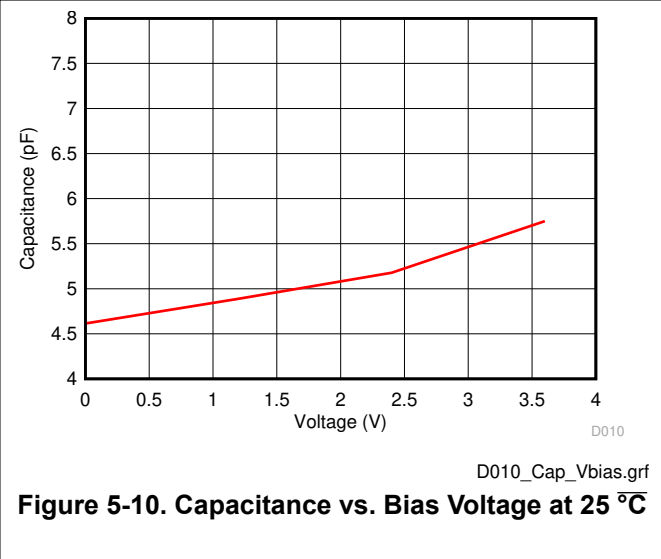
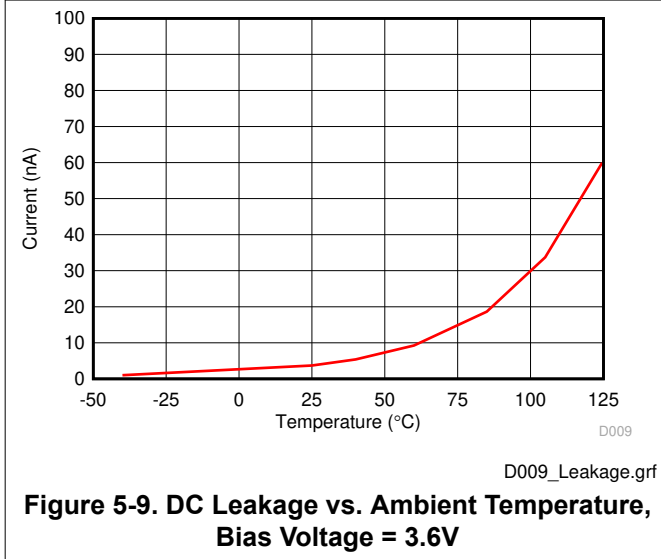
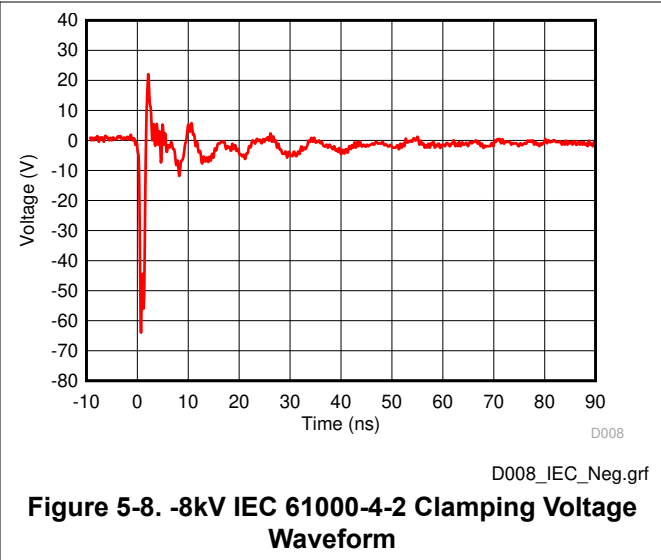
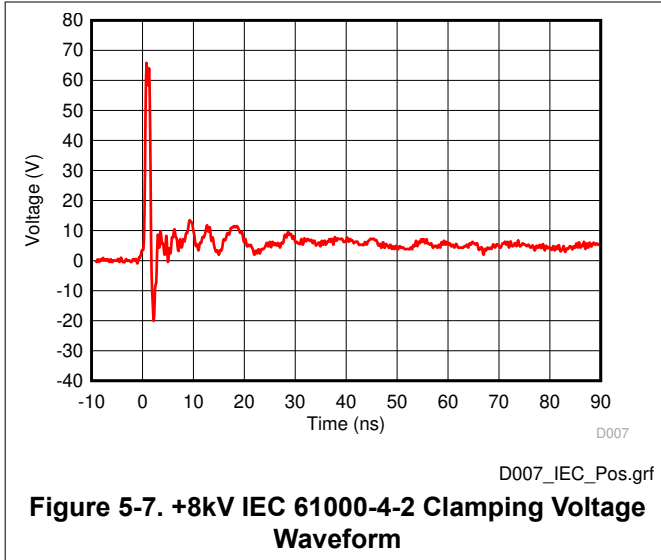


Figure 5-6. TLP I-V Curve, IO to GND Negative, $t_p = 100ns$



ESDS311, ESDS312, ESDS314

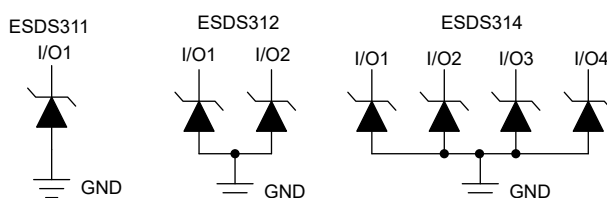
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6 Detailed Description

6.1 Overview

The ESDS31x devices are unidirectional ESD Protection Diodes with a low capacitance. These devices can dissipate high surge currents up to 25A (8/20 μ s) and ESD strikes above the maximum level specified by the IEC 61000-4-2 International Standard. The low capacitance makes this device an excellent choice for protecting high-speed signal interfaces such as Ethernet 10/100/1000Mbps and general purpose high speed data lines.

6.2 Functional Block Diagram



6.3 Feature Description

6.3.1 IEC 61000-4-4 EFT Protection

The I/O pins of ESDS311, ESDS312, and ESDS314 can withstand surge events (IEC 61000-4-5, 8/20 μ s waveform) up to 25A and 170W. These devices also provide ESD protection up to ± 30 kV contact and ± 30 kV air gap per IEC 61000-4-2 standard. The I/O pins can withstand an electrical fast transient (EFT) burst of up to 80A (IEC 61000-4-4 5/50ns waveform, 4kV with 50 Ω impedance). The capacitance between each I/O pin to ground is 4.5pF (typical) and 5.5pF (maximum). This device supports data rates up to 1Gbps.

The reverse DC breakdown voltage of each I/O pin is a minimum of 4.5V. This ensures that sensitive equipment is protected from surges above the reverse standoff voltage of 3.6V. The I/O pins feature an ultra-low leakage current of 100nA (maximum) with a bias of 3.6V. This device features an industrial operating range of -40°C to $+125^{\circ}\text{C}$.

6.4 Device Functional Modes

The ESDS31x devices are a passive integrated circuit that triggers when voltages are above V_{BRF} or below 0.7V. During ESD events, voltages as high as ± 30 kV (air) can be directed to ground via the internal diode network. When the voltages on the protected line fall below the trigger levels of ESDS31x (usually within a few nano-seconds) the devices reverts to passive.

7 Application and Implementation

Note

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes, as well as validating and testing their design implementation to confirm system functionality.

7.1 Application Information

The ESDS31x devices are a diode type TVS which is used to provide a path to ground for dissipating surge and ESD events on high-speed signal lines between a human interface connector and a system. As the current from surge or ESD passes through the TVS, only a small voltage drop is present across the diode. This is the voltage presented to the protected IC. The low R_{DYN} of the triggered TVS holds this voltage, V_{CLAMP} , to a safe level for the protected IC.

7.2 Typical Application

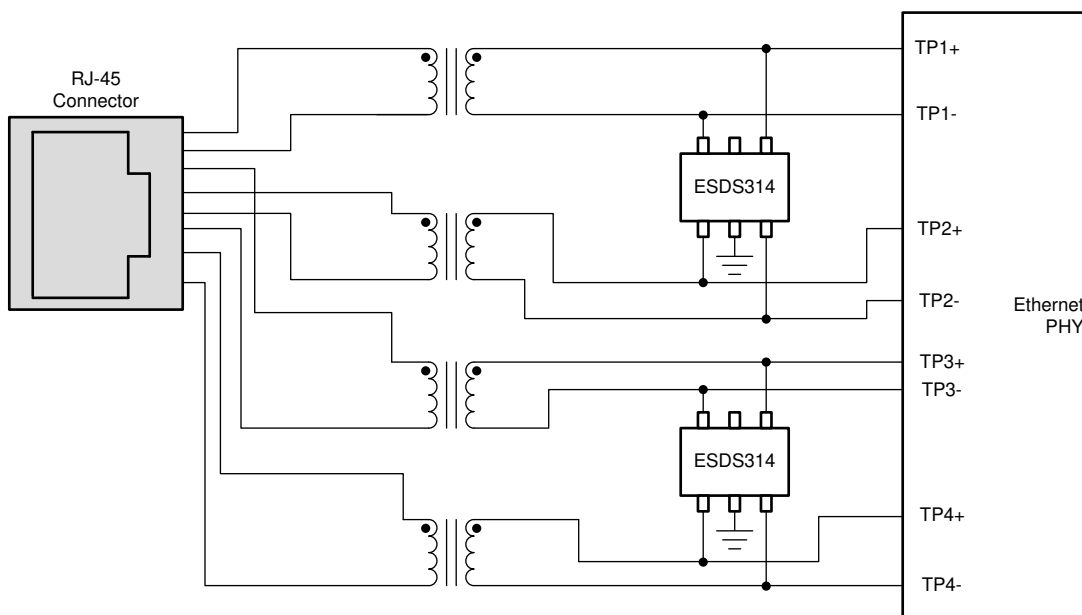


Figure 7-1. ESDS314 Protecting the Ethernet 1Gbps Interface

7.2.1 Design Requirements

A typical operation for the ESDS314 would be protecting a high speed dataline similar to one shown in [Figure 7-1](#). In this example, the ESDS314 is protecting an Ethernet PHY's data lines that has a nominal operating voltage of 3.6V. Many of the Ethernet interfaces that connect to long cables require protection against $\pm 1\text{kV}$ surge test through a 42Ω coupling resistor and a $0.5\mu\text{F}$ capacitor, equaling roughly 24A of surge current. Without any input protection, if a surge event is caused by lightning, coupling, ringing, or any other fault condition, this input voltage will rise to hundreds of volts for multiple microseconds, harming the device.

For Ethernet 1000Base-T (1Gbps), application design parameters listed in [Table 7-1](#) are known.

Table 7-1. Design Parameters

| DESIGN PARAMETER | VALUE |
|--|-----------|
| Signal range on differential data line pairs | 0 to 3.6V |
| Operating frequency | 125MHz |

ESDS311, ESDS312, ESDS314

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7.2.2 Detailed Design Procedure

7.2.2.1 Signal Range

The ESDS314 has 4 identical surge protection channels with each channel supporting a signal range of 0 to 3.6V. The device will work well with any Ethernet PHY that drives the single ended voltage on the data line up to a 3.6V.

7.2.2.2 Operating Frequency

The ESDS314 has a capacitance of 4.5pF (typical) and can support the 125MHz operation of Ethernet 1000Base-T application

7.2.3 Application Curves

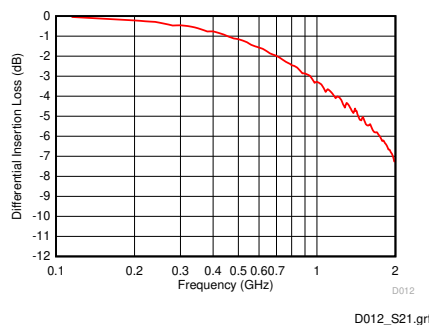


Figure 7-2. Differential Insertion Loss vs. Frequency

7.3 Power Supply Recommendations

The ESDS314, ESDS312 devices are passive ESD devices and there is no need to power it. Take care not to violate the recommended I/O specification (0 V to 3.6 V) to ensure the device functions properly.

7.4 Layout

7.4.1 Layout Guidelines

- The optimum placement is as close to the connector as possible.
 - EMI during an ESD event can couple from the trace being struck to other nearby unprotected traces, resulting in early system failures.
 - The PCB designer must minimize the possibility of EMI coupling by keeping any unprotected traces away from the protected traces which are between the TVS and the connector.
- Route the protected traces as straight as possible.
- Eliminate any sharp corners on the protected traces between the TVS and the connector by using rounded corners with the largest radii possible.
 - Electric fields tend to build up on corners, increasing EMI coupling.

7.4.2 Layout Example

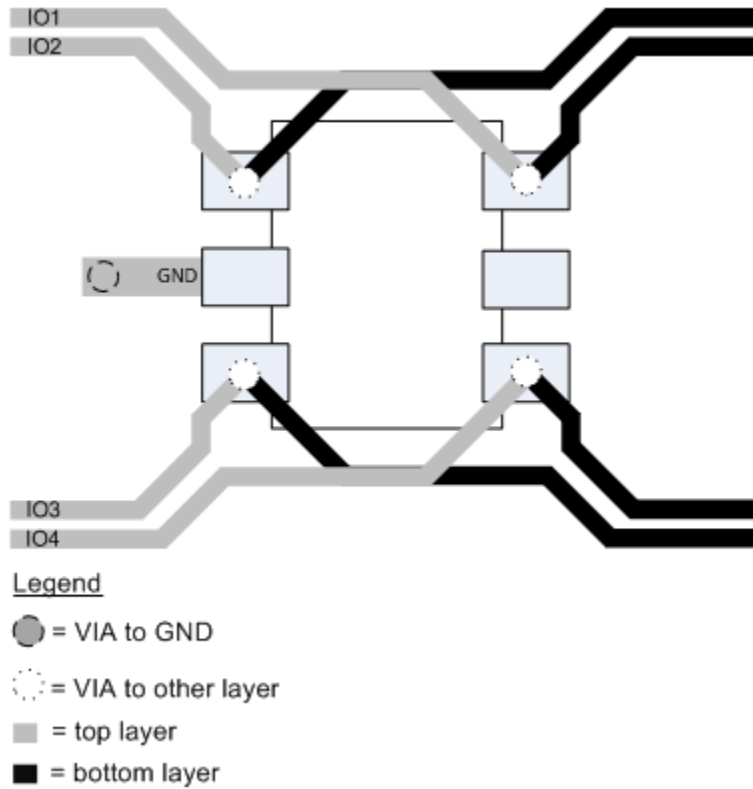


Figure 7-3. Layout Example for 4-channel Device

8 Device and Documentation Support

8.1 Documentation Support

8.1.1 Related Documentation

For related documentation, see the following:

- Texas Instruments, [TI's IEC 61000-4-x Testing application note](#)
- Texas Instruments, [ESD Layout Guide user's guide](#)
- Texas Instruments, [ESD Protection Diodes EVM user's guide](#)
- Texas Instruments, [Generic ESD Evaluation Module user's guide](#)
- Texas Instruments, [Reading and Understanding an ESD Protection Data Sheet user's guide](#)

8.2 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on [ti.com](#). Click on *Notifications* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

8.3 Support Resources

[TI E2E™ support forums](#) are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

Linked content is provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's [Terms of Use](#).

8.4 Trademarks

Ethernet™ is a trademark of Xerox Corporation.

USB™ is a trademark of USB Implementers Forum.

TI E2E™ is a trademark of Texas Instruments.

All trademarks are the property of their respective owners.

8.5 Electrostatic Discharge Caution



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

8.6 Glossary

[TI Glossary](#) This glossary lists and explains terms, acronyms, and definitions.

9 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Revision B (September 2018) to Revision C (February 2024) Page

- | | |
|--|---|
| • Updated the numbering format for tables, figures, and cross-references throughout the document | 1 |
| • Added the ESDS311 device to the data sheet..... | 1 |
-

Changes from Revision A (July 2018) to Revision B (September 2018) Page

- | | |
|--|---|
| • Changed from Advanced Information to Production Data | 1 |
|--|---|
-

Changes from Revision * (May 2018) to Revision A (July 2018)
Page

- Changed from Product Preview to Advance Information..... **1**
-

10 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

PACKAGING INFORMATION

| Orderable part number | Status (1) | Material type (2) | Package Pins | Package qty Carrier | RoHS (3) | Lead finish/ Ball material (4) | MSL rating/ Peak reflow (5) | Op temp (°C) | Part marking (6) |
|-----------------------------|---------------|----------------------|------------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| ESDS311DYFR | Active | Production | SOT (DYF) 2 | 3000 LARGE T&R | Yes | SN | Level-3-260C-168 HR | -40 to 125 | 37OF |
| ESDS311DYFR.B | Active | Production | SOT (DYF) 2 | 3000 LARGE T&R | Yes | SN | Level-3-260C-168 HR | -40 to 125 | 37OF |
| ESDS312DBVR | Active | Production | SOT-23 (DBV) 5 | 3000 LARGE T&R | Yes | SN | Level-1-260C-UNLIM | -40 to 125 | 1R4B |
| ESDS314DBVR | Active | Production | SOT-23 (DBV) 5 | 3000 LARGE T&R | Yes | SN | Level-1-260C-UNLIM | -40 to 125 | 1R2B |

⁽¹⁾ **Status:** For more details on status, see our [product life cycle](#).

⁽²⁾ **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

⁽³⁾ **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

⁽⁴⁾ **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

⁽⁵⁾ **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

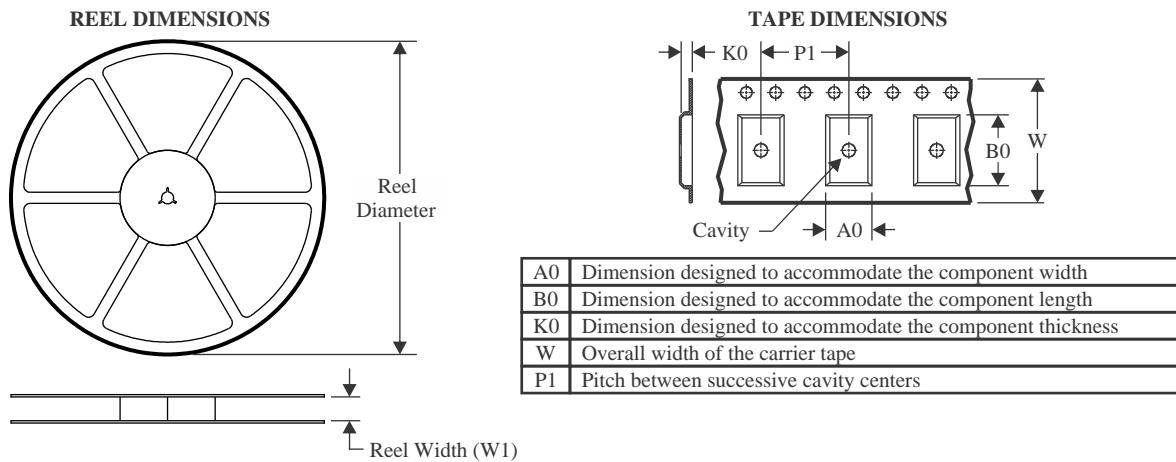
⁽⁶⁾ **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

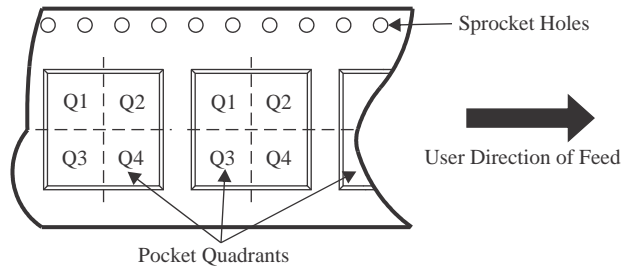
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TAPE AND REEL INFORMATION



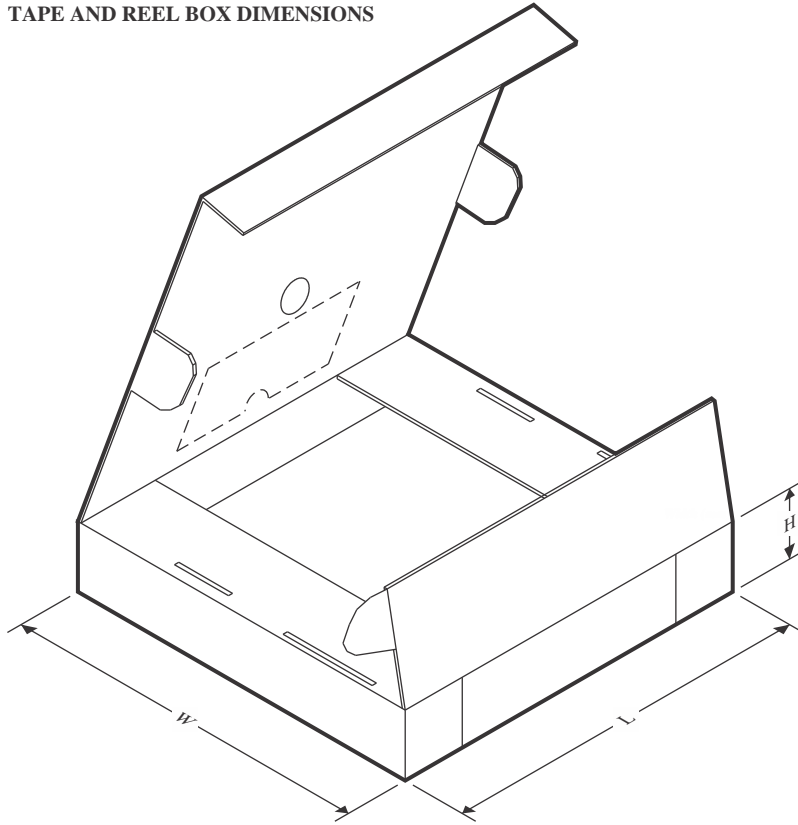
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|-------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| ESDS311DYFR | SOT | DYF | 2 | 3000 | 178.0 | 9.5 | 1.48 | 3.3 | 1.25 | 4.0 | 8.0 | Q1 |
| ESDS312DBVR | SOT-23 | DBV | 5 | 3000 | 178.0 | 9.0 | 3.3 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| ESDS314DBVR | SOT-23 | DBV | 5 | 3000 | 178.0 | 9.0 | 3.3 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |

TAPE AND REEL BOX DIMENSIONS

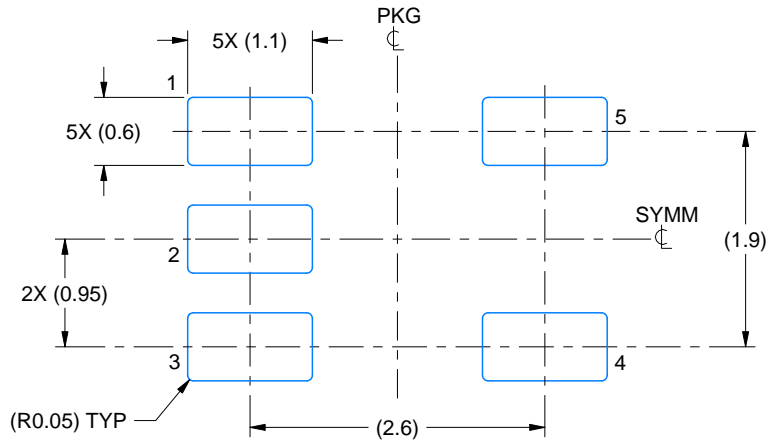


*All dimensions are nominal

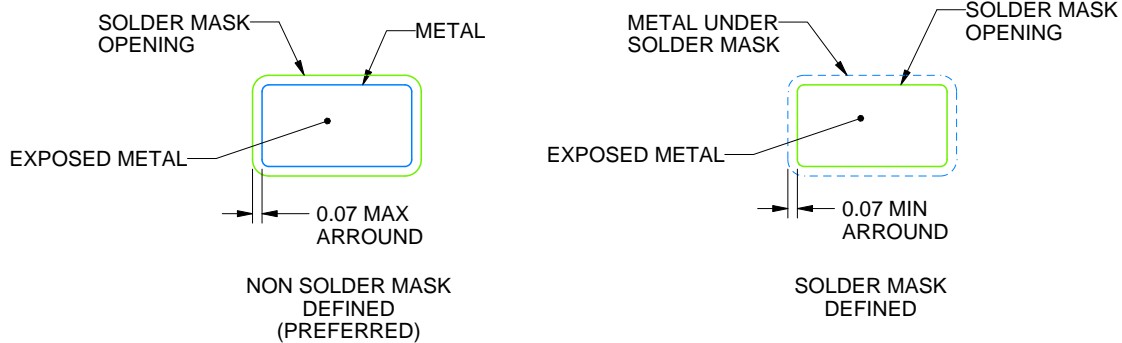
| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|-------------|--------------|-----------------|------|------|-------------|------------|-------------|
| ESDS311DYFR | SOT | DYF | 2 | 3000 | 210.0 | 200.0 | 42.0 |
| ESDS312DBVR | SOT-23 | DBV | 5 | 3000 | 180.0 | 180.0 | 18.0 |
| ESDS314DBVR | SOT-23 | DBV | 5 | 3000 | 180.0 | 180.0 | 18.0 |

EXAMPLE BOARD LAYOUT**DBV0005A****SOT-23 - 1.45 mm max height**

SMALL OUTLINE TRANSISTOR



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:15X



SOLDER MASK DETAILS

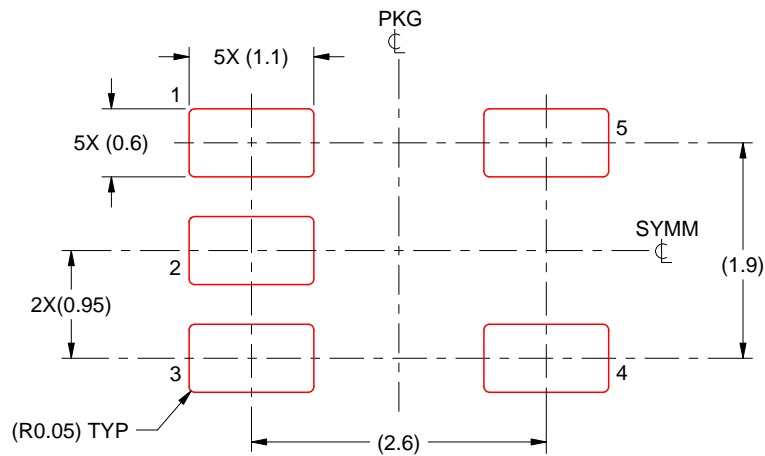
4214839/K 08/2024

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN**DBV0005A****SOT-23 - 1.45 mm max height**

SMALL OUTLINE TRANSISTOR



SOLDER PASTE EXAMPLE
 BASED ON 0.125 mm THICK STENCIL
 SCALE:15X

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NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

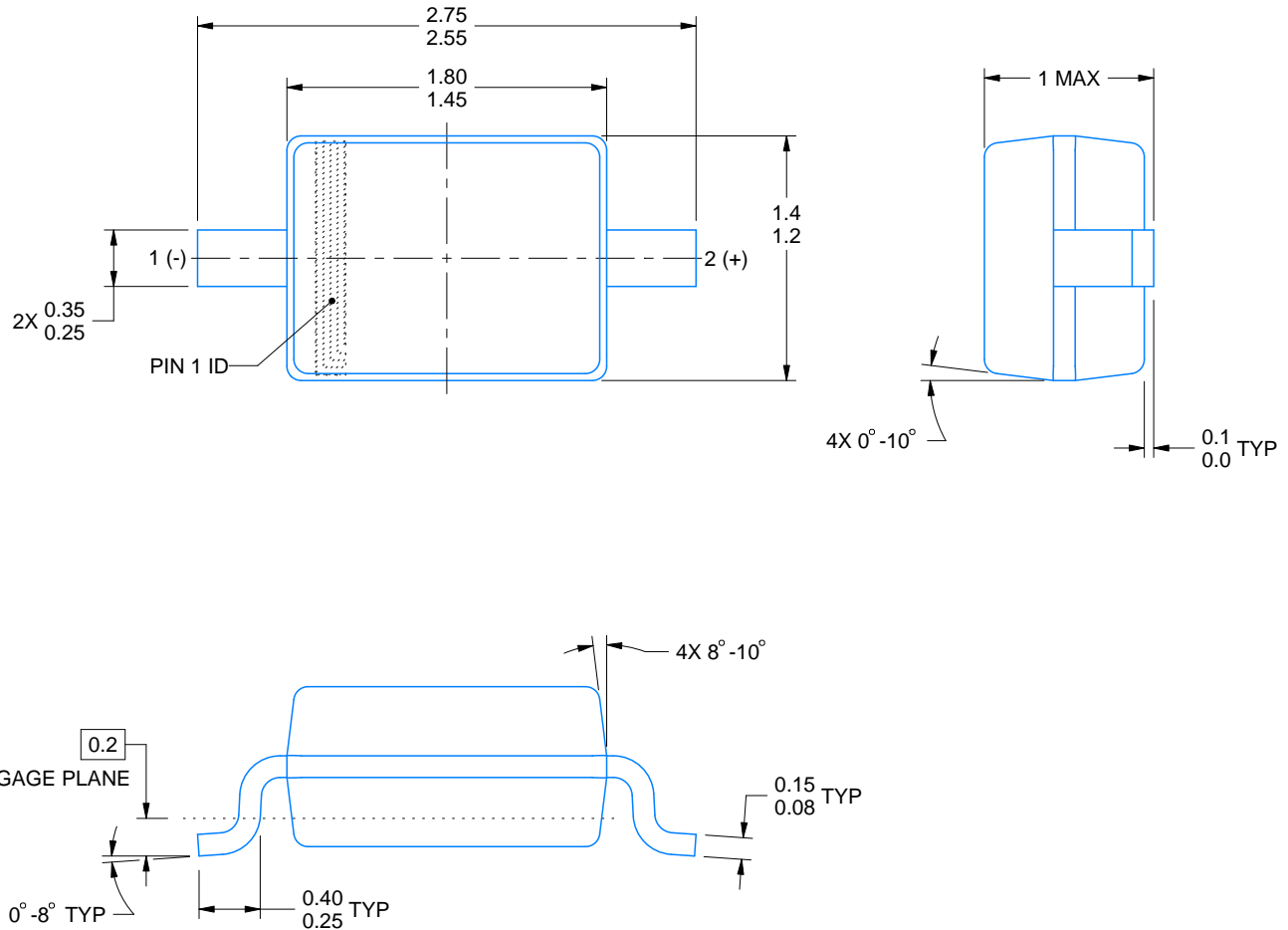


PACKAGE OUTLINE

DYF0002A

SOT(SOD-323) - 1 mm max height

SMALL OUTLINE TRANSISTOR



4228484/C 12/2024

NOTES:

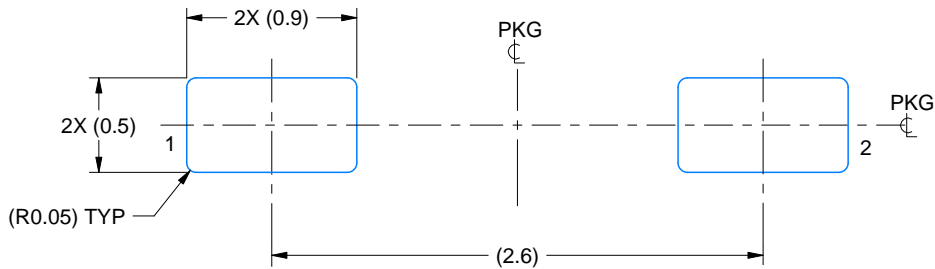
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.

EXAMPLE BOARD LAYOUT

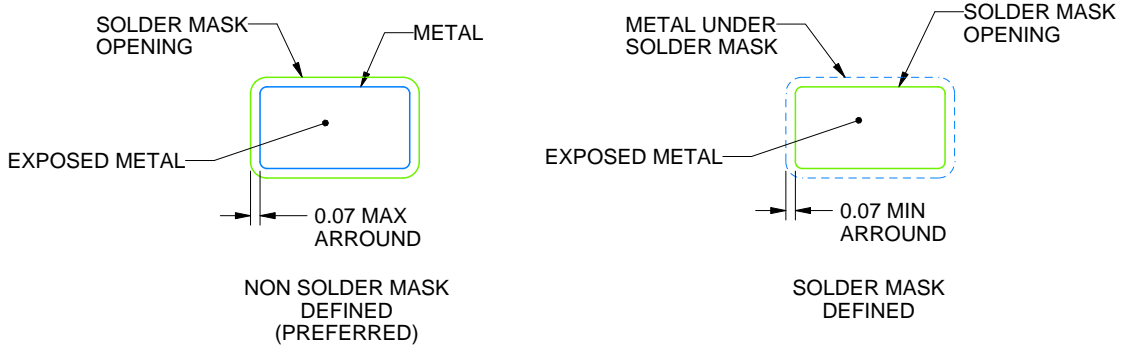
DYF0002A

SOT(SOD-323) - 1 mm max height

SMALL OUTLINE TRANSISTOR



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:25X



SOLDER MASK DETAILS

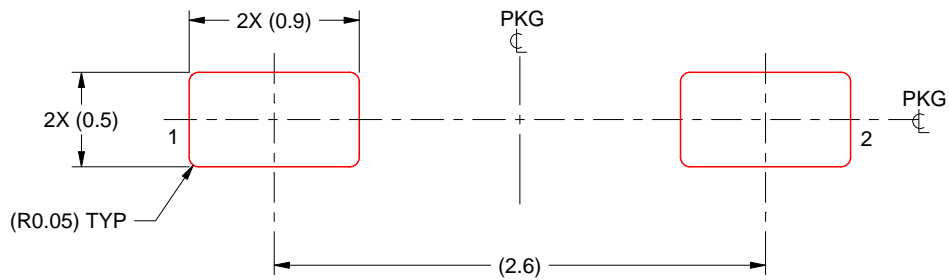
4228484/C 12/2024

NOTES: (continued)

- 3. Publication IPC-7351 may have alternate designs.
- 4. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN**DYF0002A****SOT(SOD-323) - 1 mm max height**

SMALL OUTLINE TRANSISTOR



SOLDER PASTE EXAMPLE
 BASED ON 0.125 mm THICK STENCIL
 SCALE:25X

4228484/C 12/2024

NOTES: (continued)

5. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
6. Board assembly site may have different recommendations for stencil design.

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