# TSDxxC Bidirectional TVS Diodes in SOD-323 Package

## 1 Features

- IEC 61000-4-2 ESD protection:
  - ±30kV contact discharge
  - ±30kV air gap discharge
- IEC 61000-4-5 surge protection:
  - 6.5-30A (8/20µs)
- Low IO capacitance < 7pF (typical)
- Ultra low leakage current: 10nA (maximum)
- Industrial temperature range: –55°C to +150°C
- Industry standard SOD-323 leaded package (2.65mm × 1.3mm)

## 2 Applications

- I/O Protection
- Power Line Protection
- USB VBUS
- Appliances
- Medical & Healthcare
- Retail Automation

## 3 Description

The TSDxxC are a family of bidirectional TVS protection diodes designed for clamping harmful transients such as ESD and surge. The TSDxxC devices are rated to dissipate ESD strikes up to ±30kV (contact and air gap discharge) which exceeds the maximum level specified in the IEC 61000-4-2 international standard (Level 4).

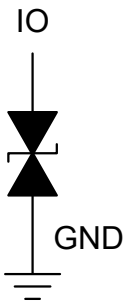
Combining the robust clamping performance and low capacitance of these devices, TSDxxC are excellent TVS diodes to protect both data lines and power lines in many different applications.

The TSDxxC family is offered in the industry standard, leaded SOD-323 package to enable easy solderability.

**Package Information**

| PART NUMBER | PACKAGE(1) | PACKAGE SIZE(2) |
|---|---|---|
| TSDxxC | DYF (SOD-323, 2) | 2.65mm × 1.3mm |

(1) For more information, see Section 9.
(2) The package size (length × width) is a nominal value and includes pins, where applicable.




**Functional Block Diagram**

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# 4 Pin Configuration and Functions

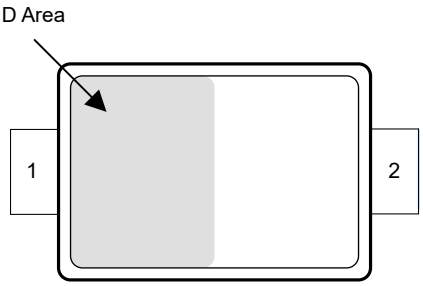


**Figure 4-1. DYF Package, 2-Pin SOD-323 (Top View)**

**Table 4-1. Pin Functions**

| PIN | | TYPE(1) | DESCRIPTION |
|---|---|---|---|
| NO. | NAME | | |
| 1 | IO | I/O | Protected Channel. If used as IO, connect pin 2 to ground |
| 2 | IO | I/O | Protected Channel. If used as IO, connect pin 1 to ground |

(1) I = input, O = output

# 5 Specifications

## 5.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted) (1)

| Parameter | | DEVICE | MIN | MAX | UNIT |
|---|---|---|---|---|---|
| $P_{PP}$ | IEC 61000-4-5 ($t_p$ 8/20µs) Peak Pulse Power at 25°C | TSD05C | | 400 | W |
| $P_{PP}$ | IEC 61000-4-5 ($t_p$ 8/20µs) Peak Pulse Power at 25°C | TSD12C | | 390 | W |
| | | TSD15C | | | |
| | | TSD18C | | | |
| | | TSD24C | | | |
| | | TSD36C | | 400 | W |
| $I_{PP}$ | IEC 61000-4-5 ($t_p$ 8/20µs) Peak Pulse Current at 25°C | TSD05C | | 30 | A |
| $I_{PP}$ | IEC 61000-4-5 ($t_p$ 8/20µs) Peak Pulse Current at 25°C | TSD12C | | 15 | A |
| | | TSD15C | | 12 | A |
| | | TSD18C | | | |
| | | TSD24C | | 9 | A |
| | | TSD36C | | 6.5 | A |
| $T_A$ | Ambient Operating Temperature | | -55 | 150 | °C |
| $T_{stg}$ | Storage Temperature | | -65 | 155 | °C |

(1) Operation outside the Absolute Maximum Ratings may cause permanent device damage. Absolute maximum ratings do not imply functional operation of the device at these or any other conditions beyond those listed under Recommended Operating Conditions. If briefly operating outside the Recommended Operating Conditions but within the Absolute Maximum Ratings, the device may not sustain damage, but it may not be fully functional. Operating the device in this manner may affect device reliability, functionality, performance, and shorten the device lifetime.

## 5.2 ESD Ratings—JEDEC Specification

| | | | VALUE | UNIT |
|---|---|---|---|---|
| $V_{(ESD)}$ | Electrostatic discharge | Human body model (HBM), per ANSI/ESDA/JEDEC JS-001 (1) | ±2500 | V |
| | | Charged device model (CDM), per JEDEC specification JS-002 (2) | ±1000 | V |

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

## 5.3 ESD Ratings—IEC Specification

| | | | VALUE | UNIT |
|---|---|---|---|---|
| $V_{(ESD)}$ | Electrostatic discharge | IEC 61000-4-2 contact discharge | ±30000 | V |
| | | IEC 61000-4-2 air-gap discharge | ±30000 | |

## 5.4 Recommended Operating Conditions

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

| | | MIN | NOM | MAX | UNIT |
|---|---|---|---|---|---|
| $T_A$ | Operating free-air temperature | -55 | | 150 | °C |

## 5.5 Thermal Information

| THERMAL METRIC (1) | | TSD05C | TSD12C / TSD15C / TSD18C | TSD24C / TSD36C | UNIT |
|---|---|---|---|---|---|
| | | DYF (SOD-323) | DYF (SOD-323) | DYF (SOD-323) | |
| | | 2 PINS | 2 PINS | 2 PINS | |
| $R_{\theta JA}$ | Junction-to-ambient thermal resistance | 672.0 | 683.8 | 686.1 | °C/W |
| $R_{\theta JC(top)}$ | Junction-to-case (top) thermal resistance | 230.5 | 264.2 | 267.0 | °C/W |
| $R_{\theta JB}$ | Junction-to-board thermal resistance | 541.4 | 559.0 | 560.5 | °C/W |
| $\Psi_{JT}$ | Junction-to-top characterization parameter | 64.4 | 89.9 | 91.4 | °C/W |
| $\Psi_{JB}$ | Junction-to-board characterization parameter | 527.5 | 544.8 | 546.2 | °C/W |
| $R_{\theta JC(bot)}$ | 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 - TSD05C

At TA=25℃ (unless otherwise noted) (1)

| PARAMETER | | TEST CONDITION | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| $V_{RWM}$ | Reverse stand-off voltage | $I_{IO}$ <50 nA, across operating temperature range | -5.5 | | 5.5 | V |
| $V_{BR}$ | Break-down voltage | $I_{IO}$ = 1 mA, IO to GND and GND to IO | 7 | 8 | 9 | V |
| $I_{LEAK}$ | Reverse leakage current | $V_{IO}$ = 5.5 V, IO to GND or GND to IO | | 5 | 10 | nA |
| $V_{CLAMP}$ | Surge clamping voltage, $t_p$ = 8/20 µs (2) | $I_{PP}$ = 24 A, IO to GND or GND to IO | | 10.7 | 13.8 | V |
| | | $I_{PP}$ = 30 A, IO to GND or GND to IO | | 11.5 | 15 | V |
| | TLP clamping voltage, $t_p$ = 100 ns | $I_{PP}$ = 16 A, IO to GND or GND to IO | | 9.3 | | V |
| $R_{DYN}$ | Dynamic resistance (3) | IO to GND | | 0.15 | | Ω |
| | | GND to IO | | | | |
| $C_L$ | Line capacitance | $V_{IO}$ = 0 V; $f$ = 1 MHz, IO to GND | | 4 | 7 | pF |

(1) Typical parameters are measured at 25℃
(2) Nonrepetitive current pulse 8 to 20 µs exponentially decaying waveform according to IEC 61000-4-5
(3) Extraction of $R_{DYN}$ using least squares fit of TLP characteristics between I = 10 A and I = 20 A

## 5.7 Electrical Characteristics - TSD12C

At TA=25℃ (unless otherwise noted) (1)

| PARAMETER | | TEST CONDITION | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| $V_{RWM}$ | Reverse stand-off voltage | $I_{IO}$ <10 nA, across operating temperature range | | | 12 | V |
| $V_{BRR}$ | Breakdown voltage | $I_{IO}$ = 10 mA, IO to GND and GND to IO | 13.2 | 15.6 | 19 | V |
| $I_{LEAK}$ | Reverse leakage current | $V_{IO}$ = 12 V, IO to GND or GND to IO | | 5 | 10 | nA |
| $V_{CLAMP}$ | Surge clamping voltage, $t_p$ = 8/20 µs (2) | $I_{PP}$ = 1 A, IO to GND or GND to IO | | | 18.5 | V |
| | | $I_{PP}$ = 5 A, IO to GND or GND to IO | | | 21 | V |
| | | $I_{PP}$ = 15 A, IO to GND or GND to IO | | | 26 | V |
| | TLP clamping voltage, $t_p$ = 100 ns | $I_{PP}$ = 16 A, IO to GND or GND to IO | | 19.4 | | V |
| $R_{DYN}$ | Dynamic resistance(3) | IO to GND | | 0.15 | | Ω |
| | | GND to IO | | | | |
| $C_L$ | Line capacitance | $V_{IO}$ = 0 V; $f$ = 1 MHz, IO to GND | | 6.5 | 8 | pF |

(1) Typical parameters are measured at 25℃
(2) Nonrepetitive current pulse 8 to 20 µs exponentially decaying waveform according to IEC 61000-4-5
(3) Extraction of $R_{DYN}$ using least squares fit of TLP characteristics between I = 10 A and I = 20 A

## 5.8 Electrical Characteristics - TSD15C

At TA=25℃ (unless otherwise noted) (1)

| PARAMETER | | TEST CONDITION | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| $V_{RWM}$ | Reverse stand-off voltage | $I_{IO}$ <10 nA, across operating temperature range | | | 15 | V |
| $V_{BRR}$ | Breakdown voltage | $I_{IO}$ = 10 mA, IO to GND and GND to IO | 19 | 22 | 25 | V |
| $I_{LEAK}$ | Reverse leakage current | $V_{IO}$ = 15 V, IO to GND or GND to IO | | 5 | 10 | nA |
| $V_{CLAMP}$ | Surge clamping voltage, $t_p$ = 8/20 µs (2) | $I_{PP}$ = 1 A, IO to GND or GND to IO | | | 25.6 | V |
| | | $I_{PP}$ = 5 A, IO to GND or GND to IO | | | 28 | V |
| | | $I_{PP}$ = 12 A, IO to GND or GND to IO | | | 33 | V |
| | TLP clamping voltage, $t_p$ = 100 ns | $I_{PP}$ = 16 A, IO to GND or GND to IO | | 25 | | V |
| $R_{DYN}$ | Dynamic resistance(3) | IO to GND | | 0.2 | | Ω |
| | | GND to IO | | | | |
| $C_L$ | Line capacitance | $V_{IO}$ = 0 V; $f$ = 1 MHz, IO to GND | | 6.7 | 9 | pF |

(1) Typical parameters are measured at 25℃
(2) Nonrepetitive current pulse 8 to 20 µs exponentially decaying waveform according to IEC 61000-4-5
(3) Extraction of $R_{DYN}$ using least squares fit of TLP characteristics between I = 10 A and I = 20 A

## 5.9 Electrical Characteristics - TSD18C

At TA=25℃ (unless otherwise noted) (1)

| PARAMETER | | TEST CONDITION | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| $V_{RWM}$ | Reverse stand-off voltage | $I_{IO}$ <10 nA, across operating temperature range | | | 18 | V |
| $V_{BRR}$ | Breakdown voltage | $I_{IO}$ = 10 mA, IO to GND and GND to IO | 19 | 22 | 25 | V |
| $I_{LEAK}$ | Reverse leakage current | $V_{IO}$ = 18 V, IO to GND or GND to IO | | 5 | 10 | nA |
| $V_{CLAMP}$ | Surge clamping voltage, $t_p$ = 8/20 µs (2) | $I_{PP}$ = 1 A, IO to GND or GND to IO | | | 25.6 | V |
| | | $I_{PP}$ = 5 A, IO to GND or GND to IO | | | 28 | V |
| | | $I_{PP}$ = 12 A, IO to GND or GND to IO | | | 33 | V |
| | TLP clamping voltage, $t_p$ = 100 ns | $I_{PP}$ = 16 A, IO to GND or GND to IO | | 25 | | V |
| $R_{DYN}$ | Dynamic resistance(3) | IO to GND | | 0.2 | | Ω |
| | | GND to IO | | | | |
| $C_L$ | Line capacitance | $V_{IO}$ = 0 V; $f$ = 1 MHz, IO to GND | | 6.7 | 9 | pF |

(1) Typical parameters are measured at 25℃
(2) Nonrepetitive current pulse 8 to 20 µs exponentially decaying waveform according to IEC 61000-4-5
(3) Extraction of $R_{DYN}$ using least squares fit of TLP characteristics between I = 10 A and I = 20 A

## 5.10 Electrical Characteristics - TSD24C

At TA=25℃ (unless otherwise noted) (1)

| PARAMETER | | TEST CONDITION | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| $V_{RWM}$ | Reverse stand-off voltage | $I_{IO}$ <10 nA, across operating temperature range | | | 24 | V |
| $V_{BR}$ | Breakdown voltage | $I_{IO}$ = 10 mA, IO to GND and GND to IO | 25.5 | 30.5 | 35.5 | V |
| $I_{LEAK}$ | Reverse leakage current | $V_{IO}$ = 24 V, IO to GND or GND to IO | | 5 | 10 | nA |
| $V_{CLAMP}$ | Surge clamping voltage, $t_p$ = 8/20 µs (2) | $I_{PP}$ = 1 A, IO to GND or GND to IO | | | 34 | V |
| | | $I_{PP}$ = 5 A, IO to GND or GND to IO | | | 43 | V |
| | | $I_{PP}$ = 9 A, IO to GND or GND to IO | | | 50 | V |
| | TLP clamping voltage, $t_p$ = 100 ns | $I_{PP}$ = 16 A, IO to GND or GND to IO | | 36 | | V |
| $R_{DYN}$ | Dynamic resistance(3) | IO to GND | | 0.35 | | Ω |
| | | GND to IO | | | | |
| $C_L$ | Line capacitance | $V_{IO}$ = 0 V; $f$ = 1 MHz, IO to GND | | 4.3 | 6 | pF |

(1) Typical parameters are measured at 25℃
(2) Nonrepetitive current pulse 8 to 20 µs exponentially decaying waveform according to IEC 61000-4-5
(3) Extraction of $R_{DYN}$ using least squares fit of TLP characteristics between I = 10 A and I = 20 A

## 5.11 Electrical Characteristics - TSD36C

At TA=25℃ (unless otherwise noted) (1)

| PARAMETER | | TEST CONDITION | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| $V_{RWM}$ | Reverse stand-off voltage | $I_{IO}$ <50 nA, across operating temperature range | | | 36 | V |
| $V_{BR}$ | Breakdown voltage | $I_{IO}$ = 10 mA, I/O to GND and GND to I/O | 37.8 | 41.2 | 44.2 | V |
| $I_{LEAK}$ | Reverse leakage current | $V_{IO}$ = 36 V, IO to GND or GND to IO | | 5 | 10 | nA |
| $V_{CLAMP}$ | Surge clamping voltage, $t_p$ = 8/20 µs (2) | $I_{PP}$ = 1 A, IO to GND or GND to IO | | | 47 | V |
| | | $I_{PP}$ = 5 A, IO to GND or GND to IO | | | 64 | V |
| | | $I_{PP}$ = 6.5 A, IO to GND or GND to IO | | | 71 | V |
| | TLP clamping voltage, $t_p$ = 100 ns | $I_{PP}$ = 16 A, IO to GND or GND to IO | | 56 | | V |
| $R_{DYN}$ | Dynamic resistance (3) | IO to GND | | 0.6 | | Ω |
| | | GND to IO | | | | |
| $C_L$ | Line capacitance | $V_{IO}$ = 0 V; $f$ = 1 MHz, IO to GND | | 4.3 | 6 | pF |

(1) Typical parameters are measured at 25℃
(2) Nonrepetitive current pulse 8 to 20 µs exponentially decaying waveform according to IEC 61000-4-5
(3) Extraction of RDYN using least squares fit of TLP characteristics between I = 10 A and I = 20 A

## 5.12 Typical Characteristics

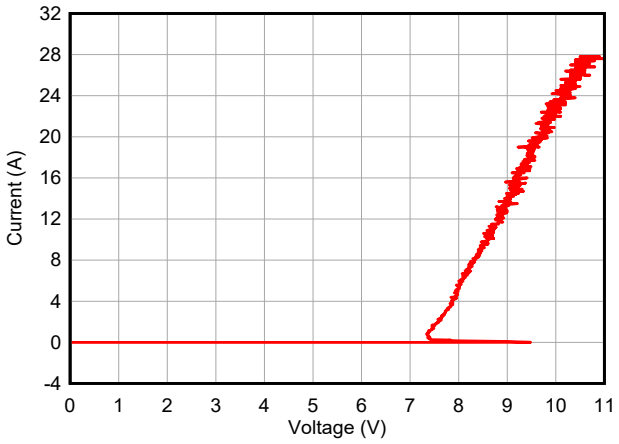


**Figure 5-1. Positive TLP Curve - TSD05C**

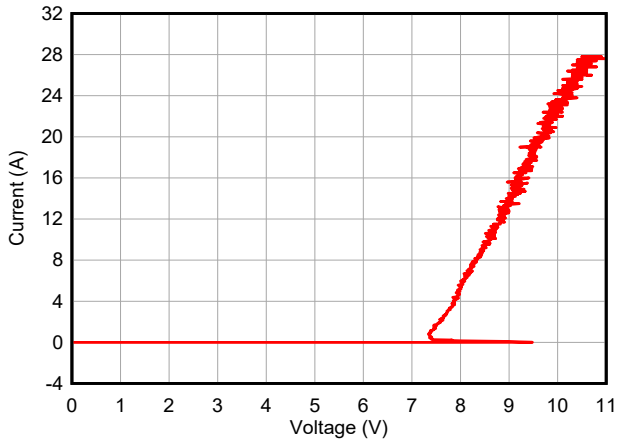


**Figure 5-2. Negative TLP Curve - TSD05C**

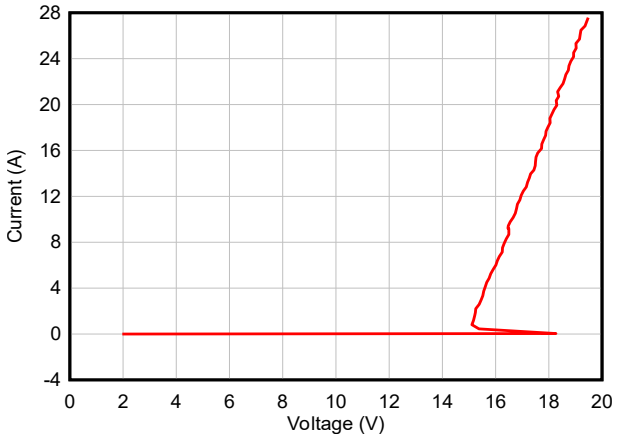


**Figure 5-3. Positive TLP Curve - TSD12C**

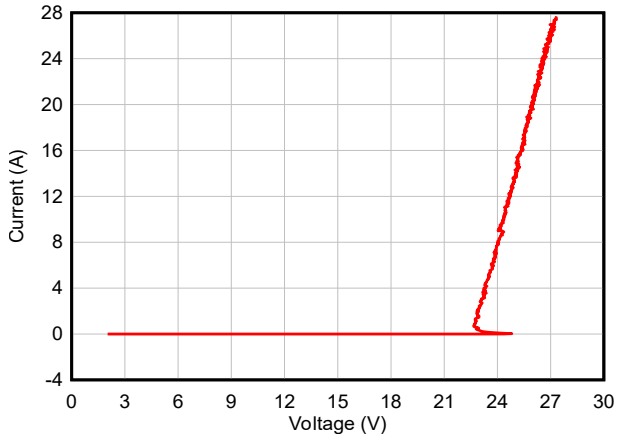


**Figure 5-4. Positive TLP Curve - TSD15C**

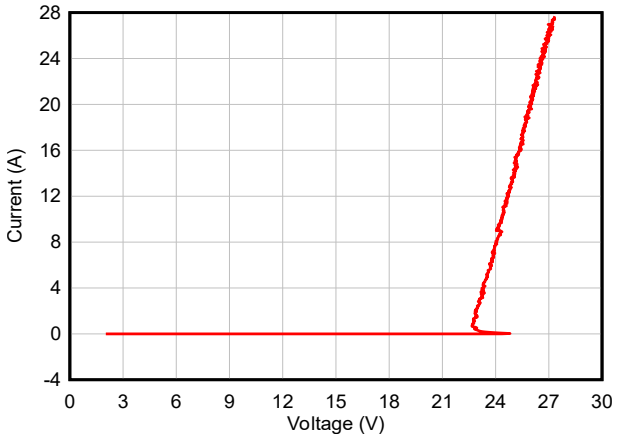


**Figure 5-5. Positive TLP Curve - TSD18C**

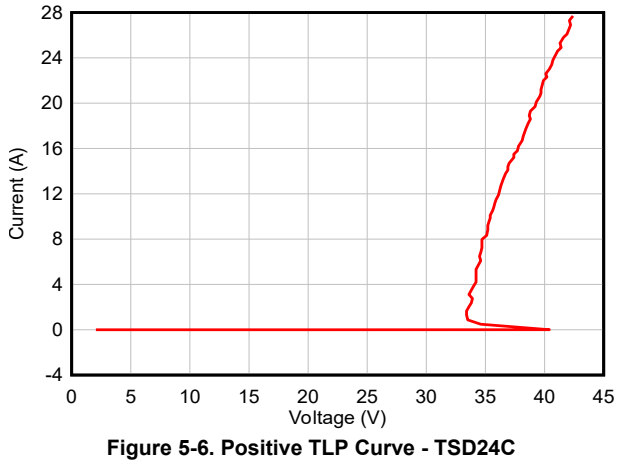


**Figure 5-6. Positive TLP Curve - TSD24C**

## 5.12 Typical Characteristics (continued)

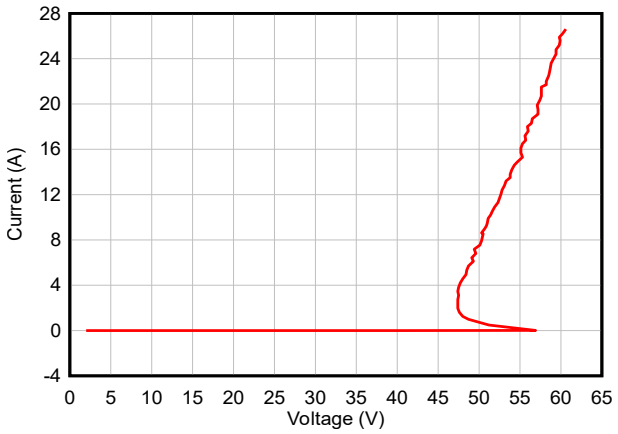


**Figure 5-7. Positive TLP Curve - TSD36C**

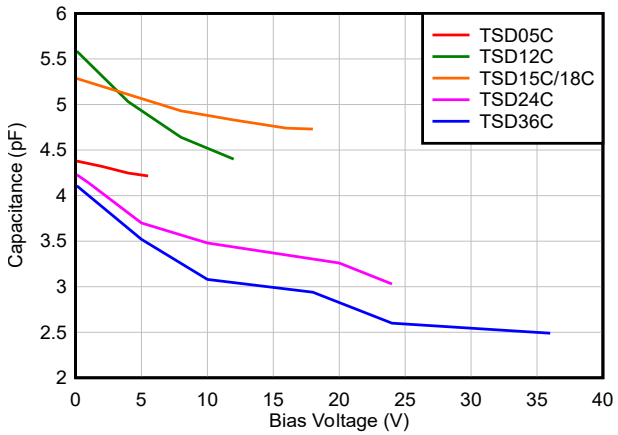


**Figure 5-8. Capacitance vs Bias Voltage**

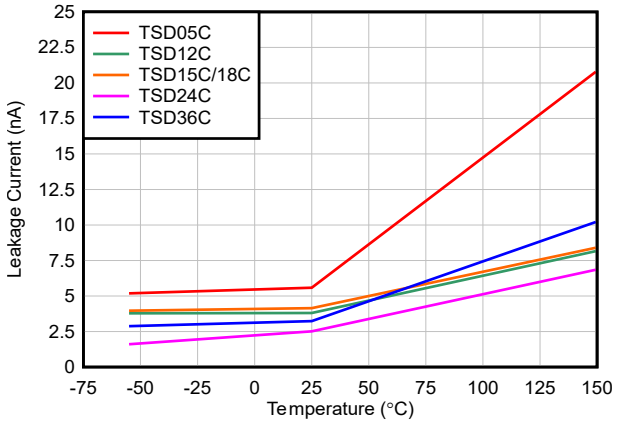


**Figure 5-9. Leakage Current vs Temperature**

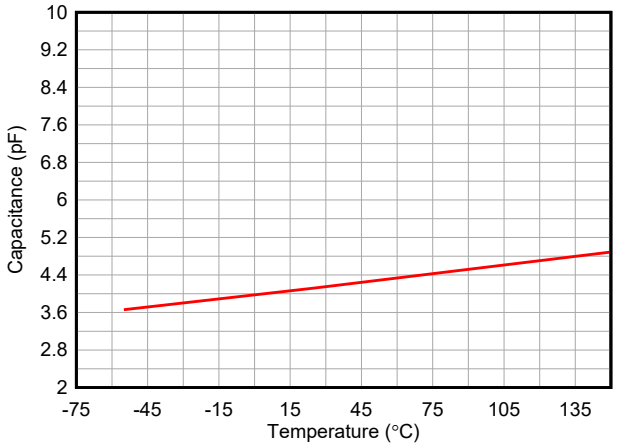


**Figure 5-10. Capacitance vs Temperature - TSD05C**

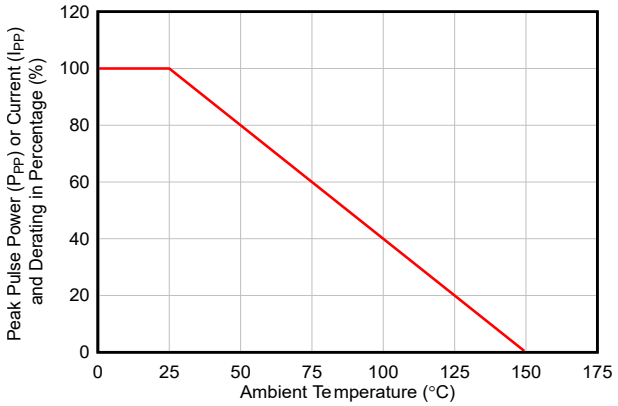


**Figure 5-11. Peak Pulse Power Derating Curve**

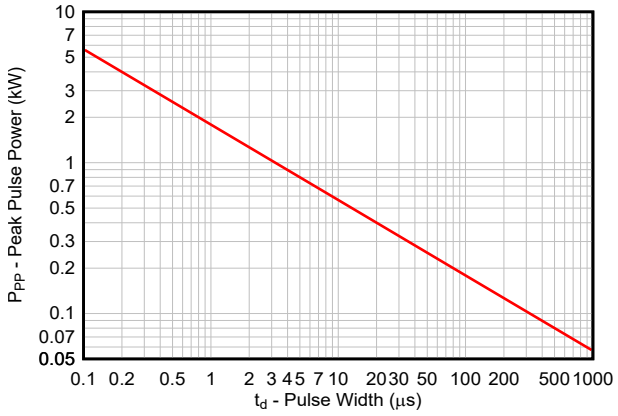


**Figure 5-12. Pulse Power Rating Curve**

# 6 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.

## 6.1 Application Information

The TSDxxC are TVS diodes that provide a path to ground for dissipating transient voltage spikes (such as ESD or surge) on signal lines and power lines. Connect the device in parallel to the down stream circuitry for protection. As the current from the transient passes through the TVS, only a small voltage drop is present across the diode. The small voltage drop is 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. For more information on how to properly use this device, refer to the *ESD Packaging and Layout Guide*.

# 7 Device and Documentation Support

## 7.1 Documentation Support

### *7.1.1 Related Documentation*

For related documentation, see the following:

- Texas Instruments, *ESD Packaging and Layout Guide* application reports
- Texas Instruments, *ESD Layout Guide* application reports
- Texas Instruments, *Generic ESD Evaluation Module* user's guide
- Texas Instruments, *Reading and Understanding an ESD Protection* data sheet

## 7.2 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.

## 7.3 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.

## 7.4 Trademarks

TI E2E™ is a trademark of Texas Instruments.
All trademarks are the property of their respective owners.

## 7.5 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.

## 7.6 Glossary

| | |
|---|---|
| TI Glossary | This glossary lists and explains terms, acronyms, and definitions. |

## 8 Revision History

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

| Changes from Revision B (July 2024) to Revision C (October 2024) | Page |
|---|---|
| • Added TSD12C, TSD15C, TSD18C, and TSD24C to the data sheet | 1 |

| Changes from Revision A (July 2023) to Revision B (July 2024) | Page |
|---|---|
| • Added TSD36C to the data sheet | 1 |
| • Changed the status of the data sheet from: *Advanced Information* to: *Production Data* | 1 |

## 9 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) |
|---|---|---|---|---|---|---|---|---|---|
| TSD05CDYFR | Active | Production | SOT (DYF) \| 2 | 3000 \| LARGE T&R | Yes | SN | Level-3-260C-168 HR | -40 to 125 | 33KF |
| TSD05CDYFR.B | Active | Production | SOT (DYF) \| 2 | 3000 \| LARGE T&R | Yes | SN | Level-3-260C-168 HR | -55 to 150 | 33KF |
| TSD12CDYFR | Active | Production | SOT (DYF) \| 2 | 3000 \| LARGE T&R | Yes | SN | Level-3-260C-168 HR | -55 to 150 | 3JMF |
| TSD12CDYFR.B | Active | Production | SOT (DYF) \| 2 | 3000 \| LARGE T&R | Yes | SN | Level-3-260C-168 HR | -55 to 150 | 3JMF |
| TSD15CDYFR | Active | Production | SOT (DYF) \| 2 | 3000 \| LARGE T&R | Yes | SN | Level-3-260C-168 HR | -55 to 150 | 3MLF |
| TSD15CDYFR.B | Active | Production | SOT (DYF) \| 2 | 3000 \| LARGE T&R | Yes | SN | Level-3-260C-168 HR | -55 to 150 | 3MLF |
| TSD18CDYFR | Active | Production | SOT (DYF) \| 2 | 3000 \| LARGE T&R | Yes | SN | Level-3-260C-168 HR | -55 to 150 | 3JQF |
| TSD18CDYFR.B | Active | Production | SOT (DYF) \| 2 | 3000 \| LARGE T&R | Yes | SN | Level-3-260C-168 HR | -55 to 150 | 3JQF |
| TSD24CDYFR | Active | Production | SOT (DYF) \| 2 | 3000 \| LARGE T&R | Yes | SN | Level-3-260C-168 HR | -55 to 150 | 3GWF |
| TSD24CDYFR.B | Active | Production | SOT (DYF) \| 2 | 3000 \| LARGE T&R | Yes | SN | Level-3-260C-168 HR | -55 to 150 | 3GWF |
| TSD36CDYFR | Active | Production | SOT (DYF) \| 2 | 3000 \| LARGE T&R | Yes | SN | Level-3-260C-168 HR | -55 to 150 | 3GNF |
| TSD36CDYFR.B | Active | Production | SOT (DYF) \| 2 | 3000 \| LARGE T&R | Yes | SN | Level-3-260C-168 HR | -55 to 150 | 3GNF |

(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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In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

**OTHER QUALIFIED VERSIONS OF TSD12C, TSD15C, TSD18C, TSD24C, TSD36C :**

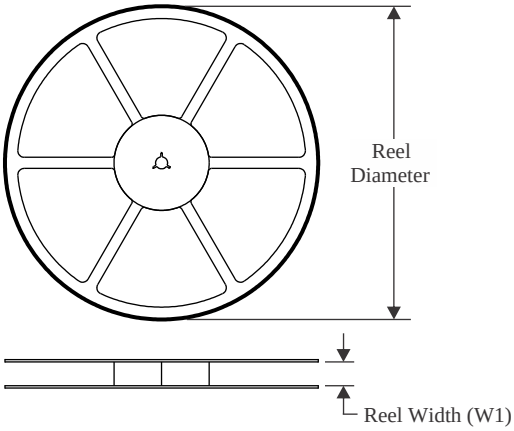
- Automotive : TSD12C-Q1, TSD15C-Q1, TSD18C-Q1, TSD24C-Q1, TSD36C-Q1

NOTE: Qualified Version Definitions:

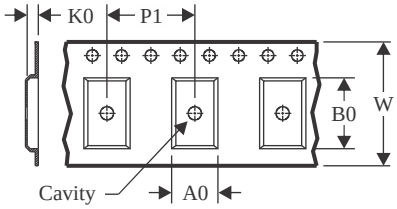
- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects

## TAPE AND REEL INFORMATION

**REEL DIMENSIONS**

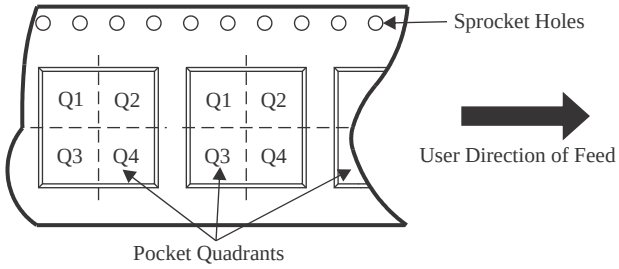



**TAPE DIMENSIONS**




| | |
|---|---|
| A0 | Dimension designed to accommodate the component width |
| B0 | Dimension designed to accommodate the component length |
| K0 | Dimension designed to accommodate the component thickness |
| W | Overall width of the carrier tape |
| P1 | Pitch between successive cavity centers |

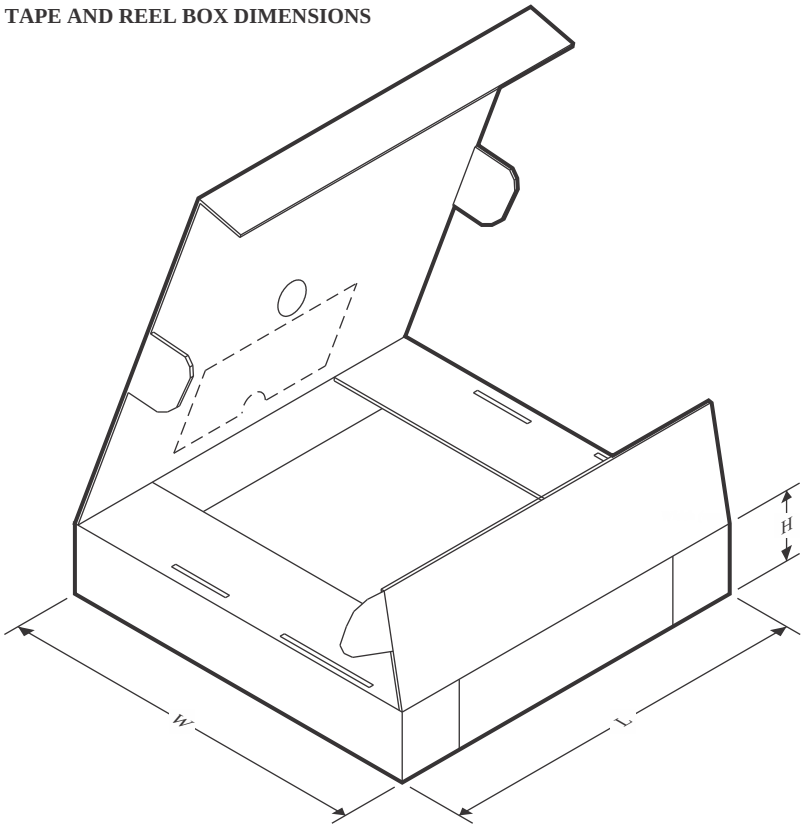
**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**




*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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TSD05CDYFR | SOT | DYF | 2 | 3000 | 178.0 | 9.5 | 1.48 | 3.3 | 1.25 | 4.0 | 8.0 | Q1 |
| TSD12CDYFR | SOT | DYF | 2 | 3000 | 178.0 | 9.5 | 1.48 | 3.3 | 1.25 | 4.0 | 8.0 | Q1 |
| TSD15CDYFR | SOT | DYF | 2 | 3000 | 178.0 | 9.5 | 1.48 | 3.3 | 1.25 | 4.0 | 8.0 | Q1 |
| TSD18CDYFR | SOT | DYF | 2 | 3000 | 178.0 | 9.5 | 1.48 | 3.3 | 1.25 | 4.0 | 8.0 | Q1 |
| TSD24CDYFR | SOT | DYF | 2 | 3000 | 178.0 | 9.5 | 1.48 | 3.3 | 1.25 | 4.0 | 8.0 | Q1 |
| TSD36CDYFR | SOT | DYF | 2 | 3000 | 178.0 | 9.5 | 1.48 | 3.3 | 1.25 | 4.0 | 8.0 | Q1 |

TAPE AND REEL BOX DIMENSIONS




*All dimensions are nominal

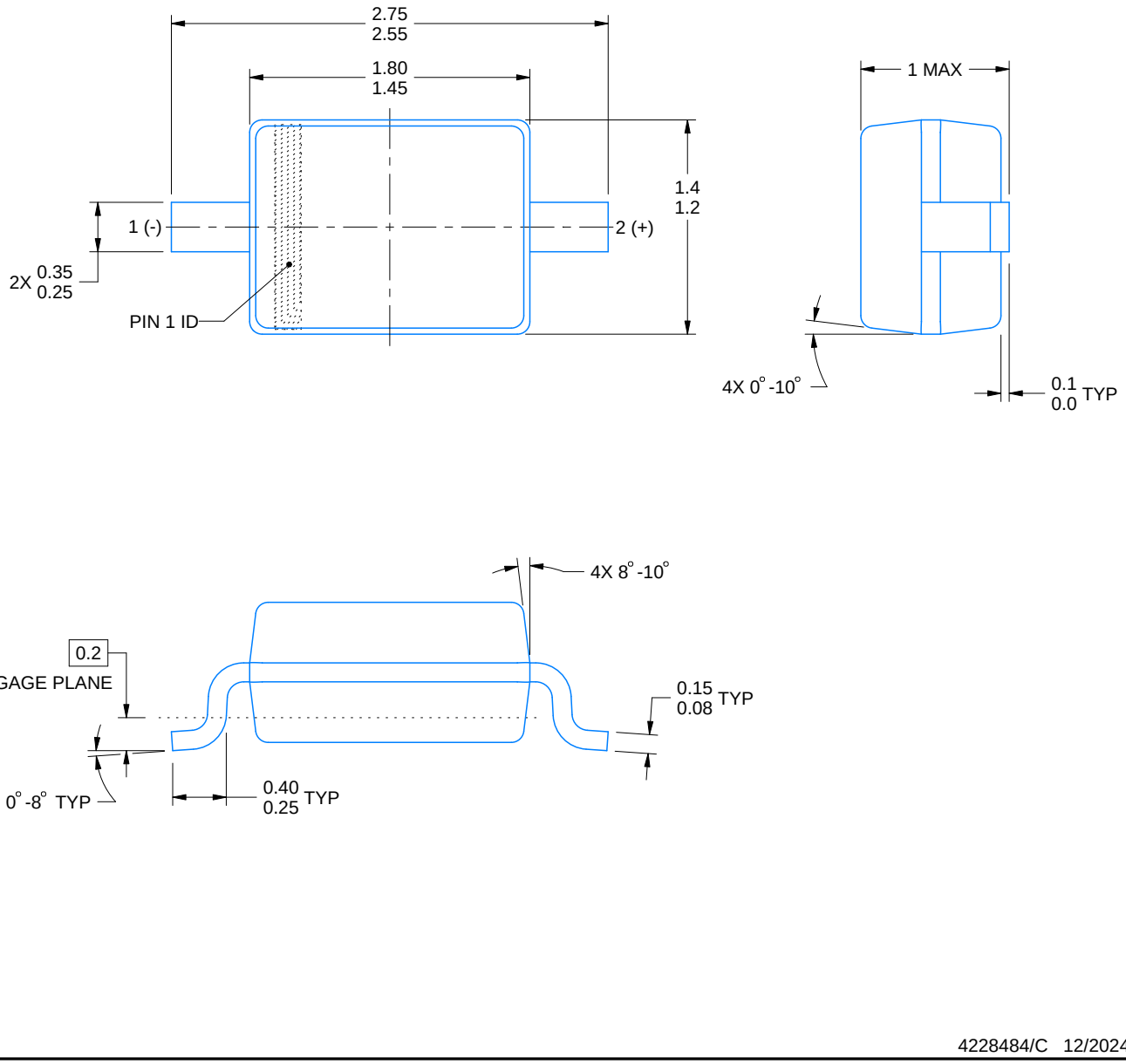
| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|---|---|---|---|---|---|---|---|
| TSD05CDYFR | SOT | DYF | 2 | 3000 | 210.0 | 200.0 | 42.0 |
| TSD12CDYFR | SOT | DYF | 2 | 3000 | 210.0 | 200.0 | 42.0 |
| TSD15CDYFR | SOT | DYF | 2 | 3000 | 210.0 | 200.0 | 42.0 |
| TSD18CDYFR | SOT | DYF | 2 | 3000 | 210.0 | 200.0 | 42.0 |
| TSD24CDYFR | SOT | DYF | 2 | 3000 | 210.0 | 200.0 | 42.0 |
| TSD36CDYFR | SOT | DYF | 2 | 3000 | 210.0 | 200.0 | 42.0 |

# PACKAGE OUTLINE

## DYF0002A

## SOT(SOD-323) - 1 mm max height

SMALL OUTLINE TRANSISTOR

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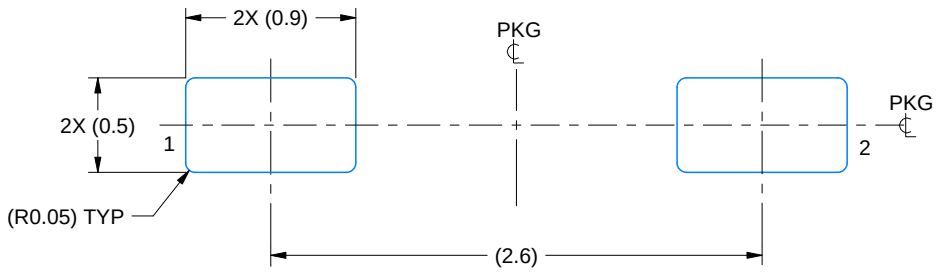
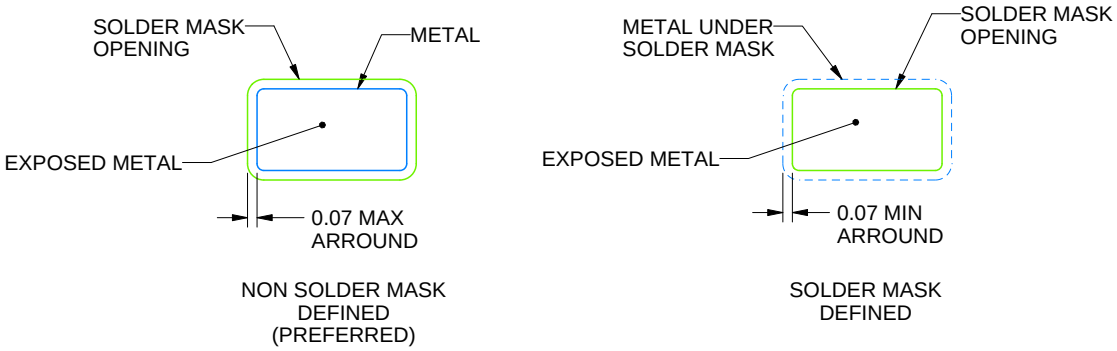
NOTES:

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.




LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:25X




SOLDER MASK DETAILS

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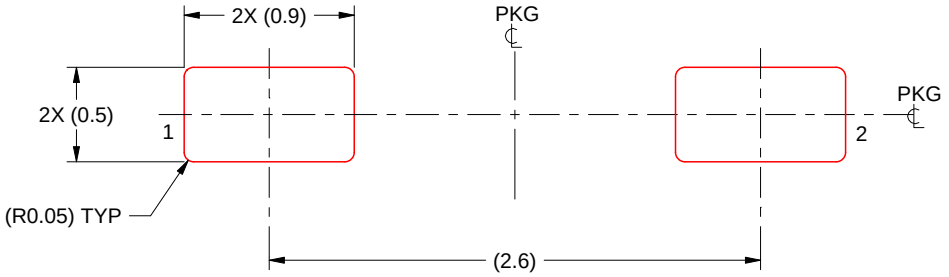
NOTES: (continued)

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




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

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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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