ESD2IVN48-Q1 Automotive 2-Channel, 48V ESD Protection Diode for In-Vehicle Networks

1 Features

- 48V working voltage
- IEC 61000-4-2 ESD protection:
  - ±30kV contact discharge
- ISO 10605 (330pF, 330Ω) ESD Protection:
  - ±30kV contact and ±30kV air-gap discharge
- IEC 61000-4-5 surge protection (8/20µs):
  - 4A
- Bidirectional ESD protection
- I/O capacitance = 1.9pF typical
- Low clamping voltage protects downstream components
- AEC-Q101 qualified
- SOT-23 (DBZ) small, standard footprint
- Leaded packages to allow for automatic optical inspection (AOI)

2 Applications

- Automotive in-vehicle networks:
  - Controller area network (CAN)
  - Controlled area network flexible data-rate (CAN-FD)
  - Low, fault tolerant CAN
  - High-speed CAN

3 Description

The ESD2IVN48-Q1 is a bidirectional ESD protection diode for controller area network (CAN) interface protection. The ESD2IVN48-Q1 is rated to dissipate contact ESD strikes specified in the ISO 10605 automotive standard. The low dynamic resistance enables low clamping voltage to provide system level protection against transient events. This protection is key as automotive systems require a high level of robustness and reliability for safety applications.

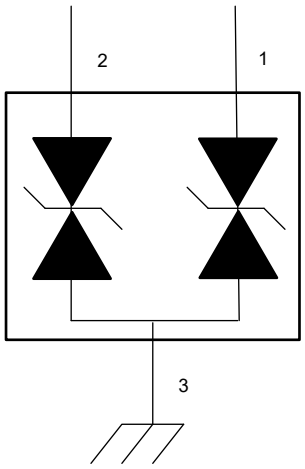
This device features a low IO capacitance per channel and a pin-out to suit two automotive CAN bus lines (CANH and CANL) from the damage caused by electrostatic discharge (ESD) and other transients. Additionally, the 1.9pF (typical) or less line capacitance of the ESD2IVN48-Q1 is an excellent choice for CAN, CAN-FD, and CAN SiC applications.

The ESD2IVN48-Q1 is offered in the 3-pin SOT-23 leaded package for easy flow through routing.

Package Information

PART NUMBER	PACKAGE(1)	PACKAGE SIZE
ESD2IVN48-Q1	DBZ (SOT-23, 3)	2.92mm × 2.37mm

(1) For more information, see Section 9



Functional Block Diagram

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An IMPORTANT NOTICE at the end of this data sheet addresses availability, warranty, changes, use in safety-critical applications, intellectual property matters and other important disclaimers. ADVANCE INFORMATION for preproduction products; subject to change without notice.

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4 Pin Configuration and Functions

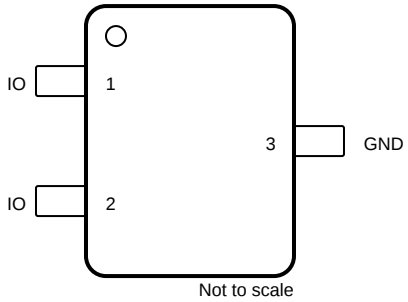


Figure 4-1. DBZ Package, 3-Pin SOT-23 (Top View)

Table 4-1. Pin Functions

PIN		TYPE[1]	DESCRIPTION
NAME	NO.		
IO	1, 2	I/O	ESD protected IO
GND	3	G	Connect to ground.

(1) I/O = Input or Output, G = Ground

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5 Specifications

5.1 Absolute Maximum Ratings

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

		MIN	MAX	UNIT
Peak pulse	IEC 61000-4-5 Power (t_p - 8/20 µs) at 25°C		320	W
	IEC 61000-4-5 current (t_p - 8/20 µs) at 25°C		4	A
T_A	Operating free-air temperature	-55	150	°C
TJ	Junction 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 used outside the Recommended Operating Conditions but within the Absolute Maximum Ratings, the device may not be fully functional, and this may affect device reliability, functionality, performance, and shorten the device lifetime.

5.2 ESD Ratings—AEC Specification

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human body model (HBM), per AEC Q101-001(1)	± 2500	V
		Charged device model (CDM), per AEC Q101-005	± 1000	

(1) AEC Q100-002 indicates that HBM stressing must be in accordance with the ANSI/ESDA/JEDEC JS-001 specification.

5.3 ESD Ratings—IEC Specification

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	IEC 61000-4-2 Contact Discharge, all pins	±30000	V
		IEC 61000-4-2 Air-gap Discharge, all pins	±30000	

5.4 ESD Ratings - ISO Specification

				VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	ISO 10605, C=150pF, R=330Ω(1)	Contact discharge	± 30000	V
			Air-gap discharge	± 30000	
		ISO 10605, C=330pF, R=330Ω	Contact discharge	± 30000	
			Air-gap discharge	± 30000	

(1) 1) ISO 7637 is a system level transient test. Results given here are specific to the IBEE CAN EMC Test specification conditions. Different system level configurations will lead to different results.

5.5 Recommended Operating Conditions

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

		MIN	NOM	MAX	UNIT
V_{IN}	Input voltage	-48		48	V
T_A	Operating free-air temperature	-55		150	°C

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5.6 Electrical Characteristics

over T_A = 25°C (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_{RWM}	Reverse stand-off voltage	Both Positive and Negative			48	V
V_{BR}	Breakdown voltage	I_{IO} = ±10mA, IO to GND, Both Positive and Negative	54	64		V
V_{CLAMP}	Clamping voltage(1)	I_{PP} = 1A, t_p = 8/20µs, from IO to GND		62		V
V_{CLAMP}	Clamping voltage(1)	I_{PP} = 4A, t_p = 8/20µs, from IO to GND		72		V
V_{CLAMP}	Clamping voltage(2)	I_{PP} = 16A, TLP, from IO to GND		73		V
I_{LEAK}	Leakage current, any IO pin to GND	V_{IO} = ±48V, Both Positive and Negative			50	nA
R_{DYN}	Dynamic resistance(2)	IO to GND and GND to IO		0.5		Ω
C_L	Line capacitance, any IO to GND	V_{IO} = 0V, f = 1MHz, V_{p-p} = 30mV		1.9		pF

(1) Device stressed with 8/20µs exponential decay waveform according to IEC 61000-4-5.
(2) Non-repetitive current pulse, Transmission Line Pulse (TLP); square pulse; ANSI / ESD STM5.5.1-2008

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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 ESD2IVN48-Q1 is a dual channel TVS diode that provides a path to ground for dissipating ESD events on differential CAN signal lines. The CAN signal lines are typically routed throughout the automobile to connect between the different ECUs. As the current from 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.

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7 Device and Documentation Support

TI offers an extensive line of development tools. Tools and software to evaluate the performance of the device, generate code, and develop solutions are listed below.

7.1 Documentation Support

7.1.1 Related Documentation

For related documentation, see the following:

- 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

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.

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7.4 Trademarks

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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.

DATE	REVISION	NOTES
September 2026	*	Initial Release

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.

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PACKAGE OPTION ADDENDUM

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)
ESD2IVN48DBZRQ1	Preview	Preproduction	SOT-23 (DBZ) | 3	3000 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-55 to 150	4DEU

(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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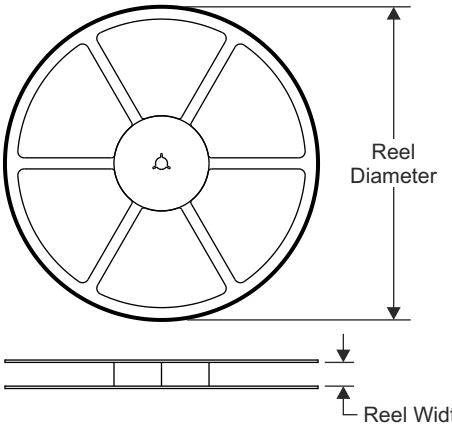
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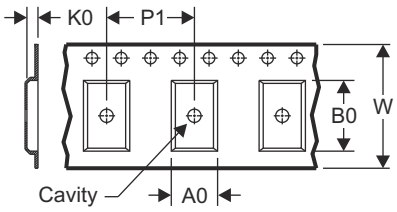
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9.1 Tape and Reel Information

REEL DIMENSIONS

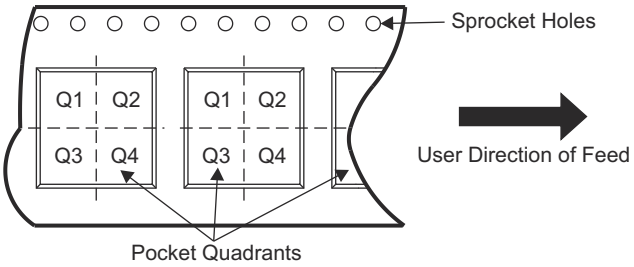


TAPE DIMENSIONS



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



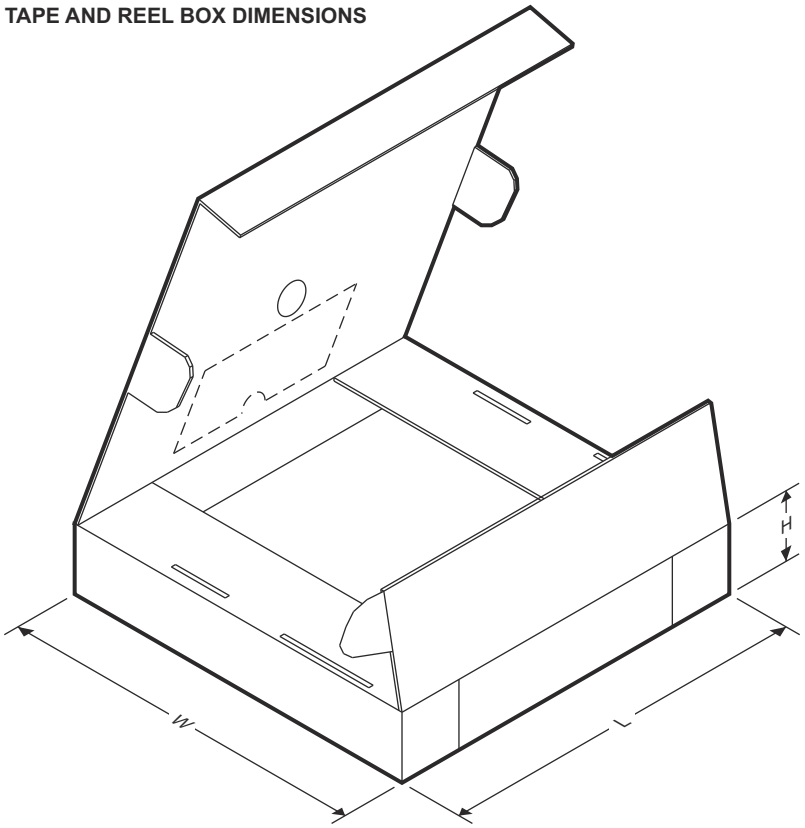
Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
ESD2IVN48DBZRQ1	SOT-23	DBZ	3	3000	180.0	8.4	3.2	2.85	1.3	4.0	8.0	Q3

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TAPE AND REEL BOX DIMENSIONS



Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
ESD2IVN48DBZRQ1	SOT-23	DBZ	3	3000	210.0	185.0	35.0

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9.2 Mechanical Data

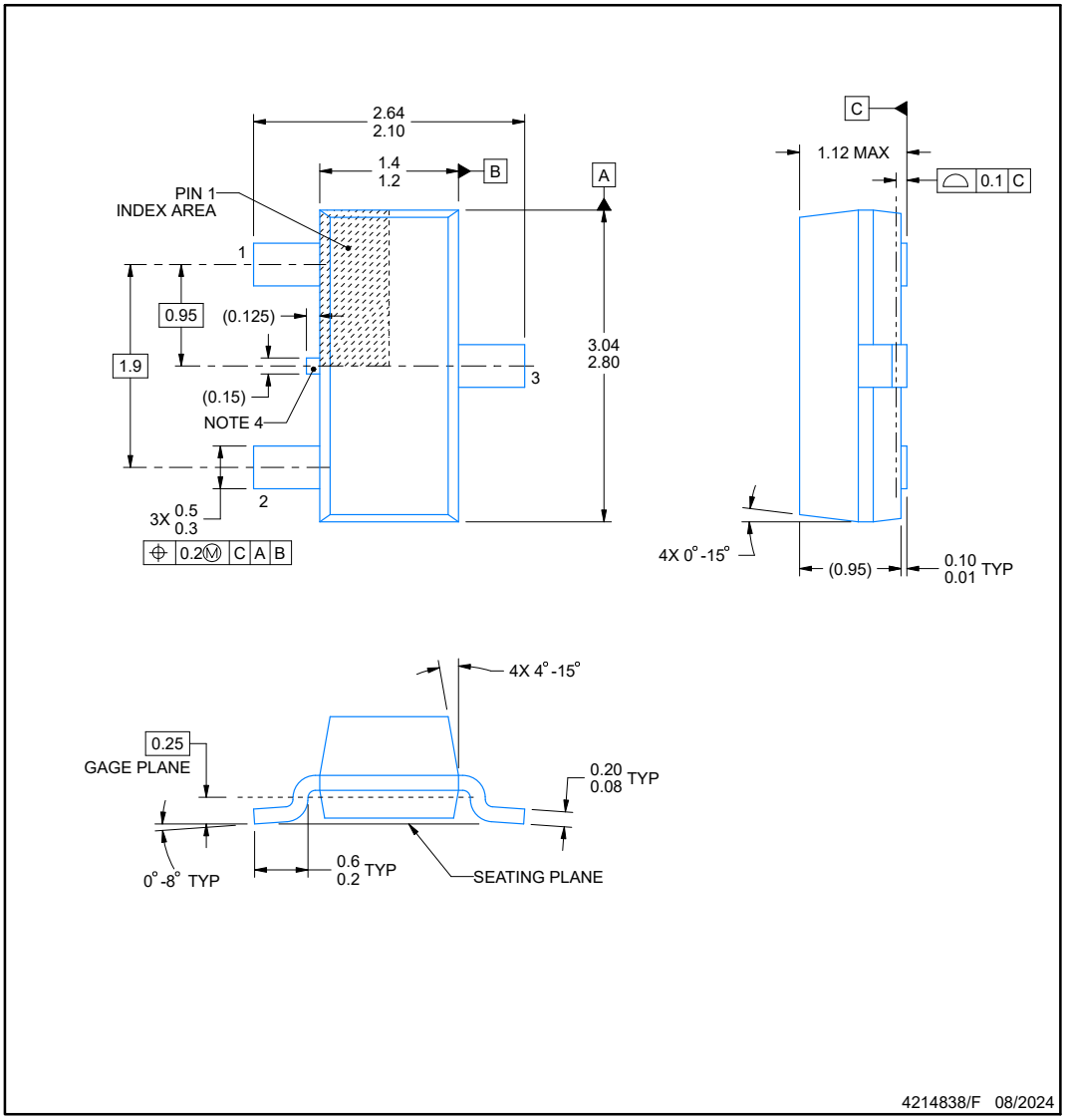
DBZ0003A



PACKAGE OUTLINE

SOT-23 - 1.12 mm max height

SMALL OUTLINE TRANSISTOR



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.
3. Reference JEDEC registration TO-236, except minimum foot length.
4. Support pin may differ or may not be present.
5. Body dimensions do not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.25mm per side

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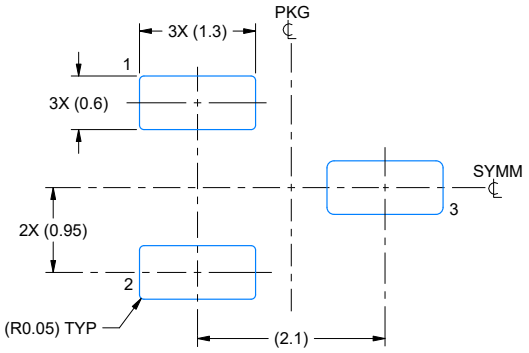
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EXAMPLE BOARD LAYOUT

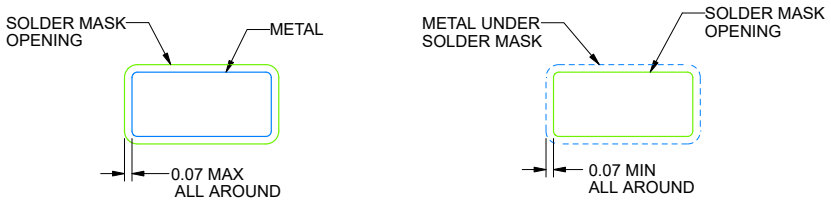
DBZ0003A

SOT-23 - 1.12 mm max height

SMALL OUTLINE TRANSISTOR



LAND PATTERN EXAMPLE
SCALE:15X



SOLDER MASK DETAILS

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NOTES: (continued)

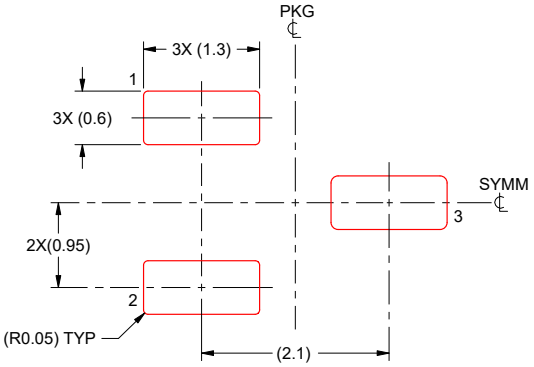
5. Publication IPC-7351 may have alternate designs.
6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

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EXAMPLE STENCIL DESIGN

DBZ0003A — **SOT-23 - 1.12 mm max height**

SMALL OUTLINE TRANSISTOR



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

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NOTES: (continued)

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

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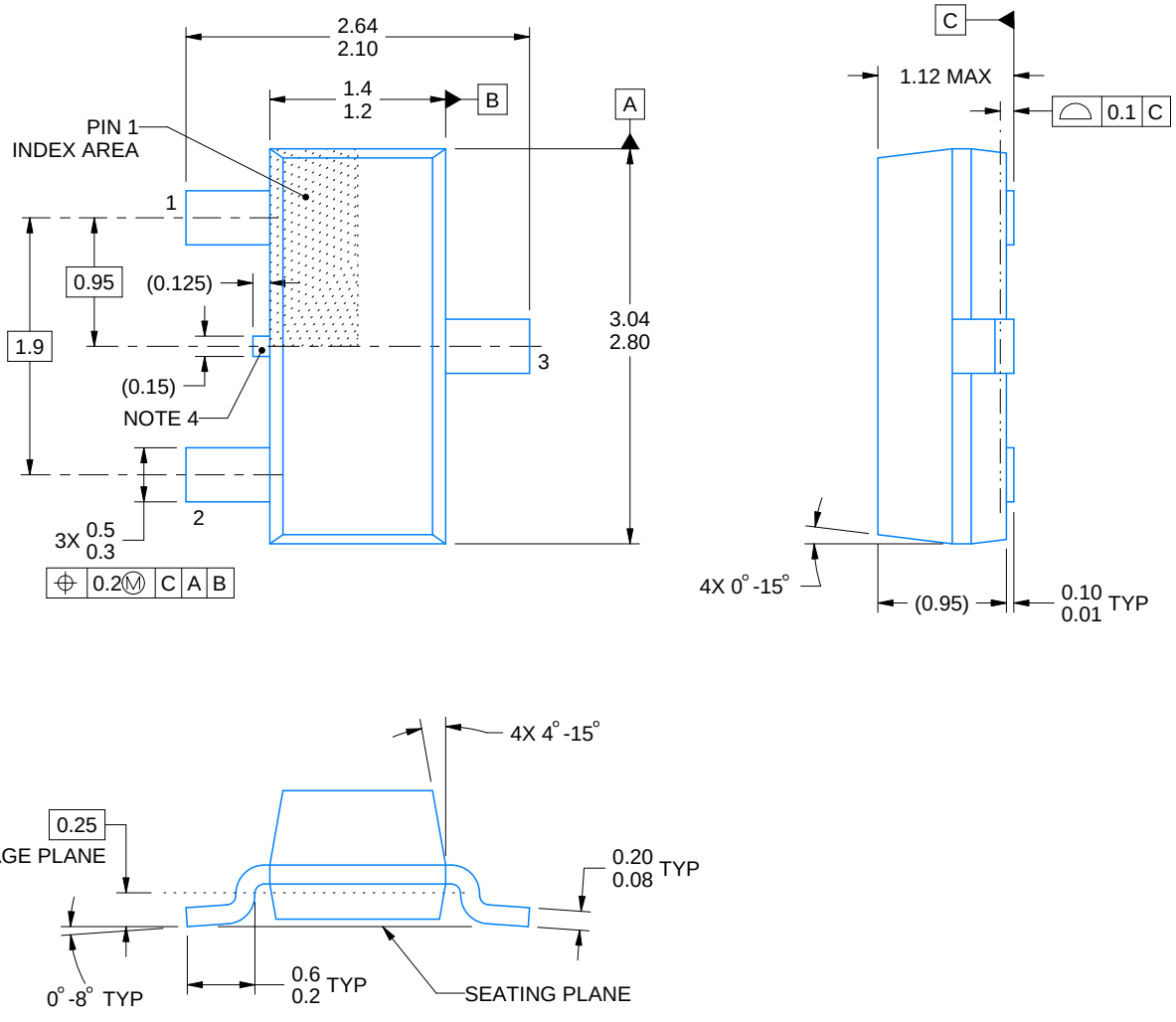
PACKAGE OUTLINE

DBZ0003A



SOT-23 - 1.12 mm max height

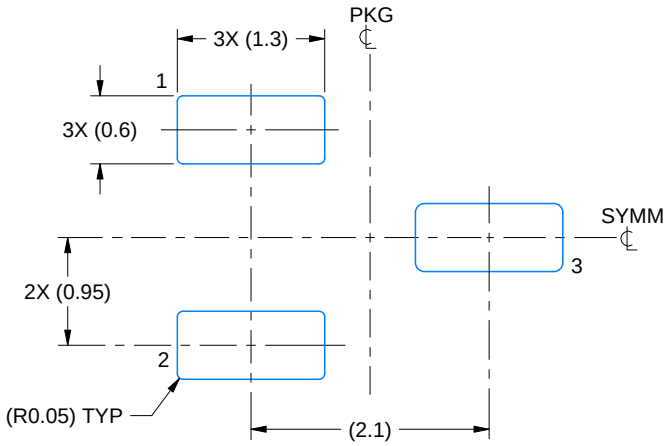
SMALL OUTLINE TRANSISTOR



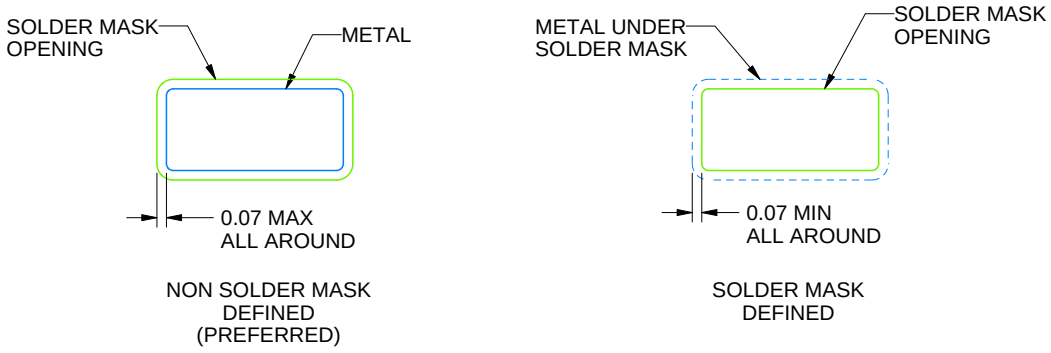
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LAND PATTERN EXAMPLE
SCALE:15X

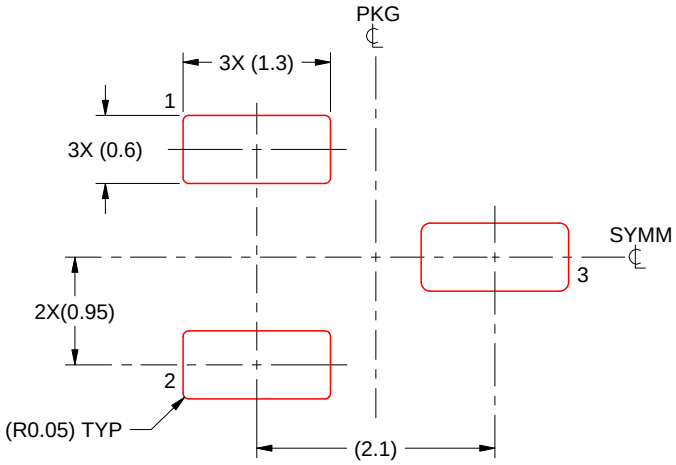


SOLDER MASK DETAILS

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NOTES: (continued)

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6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.



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

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NOTES: (continued)

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8. Board assembly site may have different recommendations for stencil design.

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