TEXAS INSTRUMENTS
ESD2CAN24-Q1, ESD2CANFD24-Q1, ESD2CANXL24-Q1
JAJSK18C – APRIL 2022 – REVISED NOVEMBER 2022

ESD2CANxx24-Q1 車載用 24V、2 チャネル ESD 保護ダイオード 車載ネットワーク向け

1 特長

- IEC 61000-4-2 レベル 4 ESD 保護
  - ±30kV、±25kV、または ±20kV の接触放電
  - ±30kV、±25kV、または ±20kV のエアギャップ放電
- ISO 10605 (330pF、330Ω) ESD 保護
  - ±30kV、±25kV、または ±20kV の接触放電
  - ±30kV、±25kV、または ±20kV のエアギャップ放電
- IEC 61000-4-5 に従ってテスト済み
- 24V の動作電圧
- 双方向 ESD 保護
- 1 つの部品で完全な ESD 保護機能を実現できる 2 チャネル・デバイス
- 下流の部品を保護する低いクランピング電圧
- AEC-Q101 準拠
- I/O 容量= 3pF、2.5pF、1.7pF (標準値)
- SOT-23 (DBZ): 小型、標準、共通フットプリント
- SOT-323、SC-70 (DCK): 超小型、標準、省スペース、共通フットプリント
- 自動光学検査 (AOI) に適したリード付きパッケージ

2 アプリケーション

- 車載ネットワーク:
  - CAN (Controller Area Network)
  - CAN-FD (CAN with Flexible Data Rate)
  - 低速、フォルト・トレラント CAN
  - 高速 CAN
- 産業用制御ネットワーク
  - DeviceNet IEC 62026-3
  - CANopen – CiA 301/302-2、EN 50325-4

3 概要

ESD2CANxx24-Q1 は、CAN (Controller Area Network) インターフェイス保護用の双方向 ESD 保護ダイオードです。ESD2CANxx24-Q1 は、ISO 10605 車載規格 (接触 ±30kV、気中 ±30kV) に規定された最大レベルを超える接触 ESD 衝撃を吸収できるように定格が規定されています。低い動的抵抗および低いクランピング電圧により、過渡現象に対してシステム・レベルの保護を実現します。車載用システムでは、安全アプリケーションに対して高レベルの堅牢性と信頼性が求められるので、この保護機能は重要です。

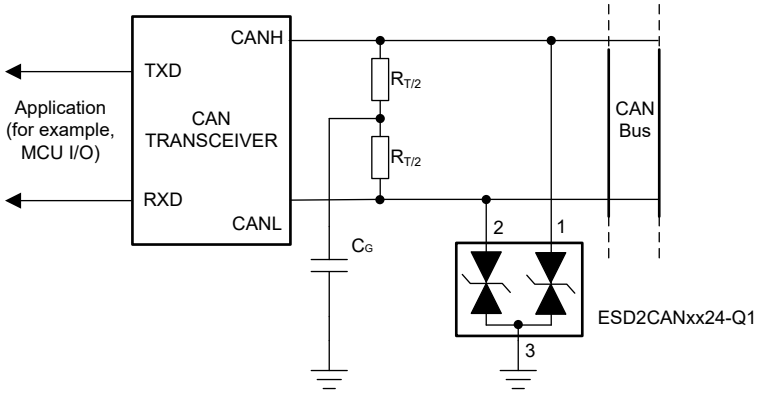
このデバイスはチャネルごとの IO 容量が低く、静電放電 (ESD) とその他の過渡現象に起因する損傷から保護されるように 2 つの車載用 CAN バス・ライン (CANH、CANL) に適合したピン配置を備えています。また、ESD2CANxx24-Q1 の 3pF (標準値) 以下のライン容量は、最大 10Mbps のデータ・レートをサポートできる CAN、CANFD、CAN SiC、CAN-XL アプリケーションに適しています。

ESD2CANxx24-Q1 は、2 種類のリード付きパッケージで供給され、フロースルー配線が容易になっています。

パッケージ情報 (1)

部品番号	パッケージ	本体サイズ (公称)
ESD2CAN24-Q1	DBZ (SOT-23、3)	2.92mm × 1.30mm
	DCK (SC-70、3)	2.00mm × 1.25mm
ESD2CANFD24-Q1	DBZ (SOT-23、3)	2.92mm × 1.30mm
ESD2CANXL24-Q1	DBZ (SOT-23、3)	2.92mm × 1.30mm

(1) 利用可能なパッケージについては、このデータシートの末尾にある注文情報を参照してください。



ESD2CANxx24-Q1 の代表的なアプリケーション

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4 Revision History

資料番号末尾の英字は改訂を表しています。その改訂履歴は英語版に準じています。

Changes from Revision B (September 2022) to Revision C (November 2022)	Page
• ESD2CANFD24-Q1 および ESD2CANXL24-Q1 のステータスをプレビューからアクティブに変更	1
• Added the *Application Curves* section	14

Changes from Revision A (June 2022) to Revision B (September 2022)	Page
• データシートのステータスを「事前情報」から *「量産データ」に変更*	1

5 Pin Configuration and Functions

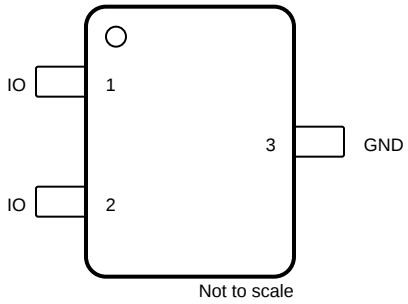


図 5-1. DCK or DBZ Package, 3-Pin SC-70 or SOT-23 (Top View)

表 5-1. Pin Functions

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

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

6 Specifications

6.1 Absolute Maximum Ratings

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

Parameter		DEVICE	MIN	MAX	UNIT
P_{PP}	IEC 61000-4-5 Power (t_p – 8/20 µs) at 25°C	ESD2CAN24-Q1		210	W
		ESD2CANFD24-Q1		133	
		ESD2CANXL24-Q1		90	
I_{PP}	IEC 61000-4-5 current (t_p – 8/20 µs) at 25°C	ESD2CAN24-Q1		5.7	A
		ESD2CANFD24-Q1		3.5	
		ESD2CANXL24-Q1		2.5	
T_A	Operating free-air temperature		-55	150	°C
T_J	Junction temperature		-55	150	
T_{stg}	Storage temperature		-65	155	

(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.

6.2 ESD Ratings—AEC Specification

Parameter		Test Conditions	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 (2)	± 1000	

(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.

6.3 ESD Ratings—IEC Specification

over TA = 25°C (unless otherwise noted)

Parameter		Test Conditions	DEVICE	VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	IEC 61000-4-2 Contact Discharge, all pins	ESD2CAN24-Q1	±30000	V
			ESD2CANFD24-Q1	±25000	
			ESD2CANXL24-Q1	±20000	
		IEC 61000-4-2 Air-gap Discharge, all pins	ESD2CAN24-Q1	±30000	
			ESD2CANFD24-Q1	±25000	
			ESD2CANXL24-Q1	±20000	

6.4 ESD Ratings - ISO Specification

over TA = 25°C (unless otherwise noted)

Parameter			Test Conditions	DEVICE	VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Contact discharge	ISO 10605, 150-pF, 330-Ω, IO	ESD2CAN24-Q1	±30000	V
				ESD2CANFD24-Q1	±25000	
				ESD2CANXL24-Q1	±20000	
			ISO 10605, 330-pF, 330-Ω, IO	ESD2CAN24-Q1	±30000	
				ESD2CANFD24-Q1	±25000	
				ESD2CANXL24-Q1	±20000	
		Air-gap discharge	ISO 10605, 150-pF, 330-Ω, IO	ESD2CAN24-Q1	±30000	
				ESD2CANFD24-Q1	±25000	
				ESD2CANXL24-Q1	±20000	
			ISO 10605, 330-pF, 330-Ω, IO	ESD2CAN24-Q1	±30000	
				ESD2CANFD24-Q1	±25000	
				ESD2CANXL24-Q1	±20000	

6.5 Recommended Operating Conditions

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

Parameter		MIN	NOM	MAX	UNIT
V_{IN}	Input voltage	-24		24	V
T_A	Operating free-air temperature	-55		150	°C

6.6 Thermal Information

THERMAL METRIC(1)		ESD2CAN24-Q1		ESD2CANFD24-Q1	ESD2CANXL24-Q1	UNIT
		DBZ (SOT-23)	DCK (SOT-323 / SC-70)	DBZ (SOT-23)	DBZ (SOT-23)	
		3 PINS	3 PINS	3 PINS	3 PINS	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	291.5	283.0	316.3	325.3	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	147.1	164.1	170.7	178.8	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	131.1	105.1	156.2	165.5	°C/W
Ψ_{JT}	Junction-to-top characterization parameter	32.0	67.1	45.9	52.4	°C/W
Ψ_{JB}	Junction-to-board characterization parameter	130.2	104.4	155.1	164.4	°C/W
$R_{\theta JC(bot)}$	Junction-to-case (bottom) thermal resistance	N/A	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.

6.7 Electrical Characteristics

over T_A = 25°C (unless otherwise noted)(1)

PARAMETER		TEST CONDITIONS	DEVICE	MIN	TYP	MAX	UNIT
V_{RWM}	Reverse stand-off voltage			–24		24	V
V_{BRF}	Breakdown voltage(2)	I_{IO} = 10 mA, IO to GND		25.5		35.5	V
V_{BRR}	Breakdown voltage(2)	I_{IO} = –10 mA, IO to GND		–35.5		–25.5	V

over T_A = 25°C (unless otherwise noted)(1)

PARAMETER		TEST CONDITIONS	DEVICE	MIN	TYP	MAX	UNIT
V_{CLAMP}	Clamping voltage(3)	I_{PP} = 5.7 A, t_p = 8/20 µs, IO to GND	ESD2CAN24-Q1		37		V
		I_{PP} = 3.5 A, t_p = 8/20 µs, IO to GND	ESD2CANFD24-Q1		37		
		I_{PP} = 2.5 A, t_p = 8/20 µs, IO to GND	ESD2CANXL24-Q1		36		
V_{CLAMP}	Clamping voltage(4)	I_{PP} = 16 A, TLP, IO to GND or GND to IO	ESD2CAN24-Q1		35		V
			ESD2CANFD24-Q1		36		
			ESD2CANXL24-Q1		38		
V_{Hold}	Holding voltage after snapback	TLP	ESD2CAN24-Q1		30		V
			ESD2CANFD24-Q1		30		
			ESD2CANXL24-Q1		30		
I_{LEAK}	Leakage current	V_{IO} = ±24 V, IO to GND		-50	5	50	nA
R_{DYN}	Dynamic resistance(4)	IO to GND and GND to IO	ESD2CAN24-Q1		0.35		Ω
			ESD2CANFD24-Q1		0.45		Ω
			ESD2CANXL24-Q1		0.57		Ω
C_L	Line capacitance(5)	V_{IO} = 0 V, f = 1 MHz, V_{pp} = 30 mV	ESD2CAN24-Q1		3	5	pF
			ESD2CANFD24-Q1		2.5	4.2	
			ESD2CANXL24-Q1		1.7	2.8	

(1) Measurements made on each IO channel
(2) V_{BRF} and V_{BRR} are defined as the voltage when ±10 mA is applied in the positive and negative going direction respectively, before the device latches into the snapback state
(3) Device stressed with 8/20 µs exponential decay waveform according to IEC 61000-4-5
(4) Non-repetitive current pulse, Transmission Line Pulse (TLP); square pulse; ANSI / ESD STM5.5.1-2008
(5) Measured from IO to GND on each channel

6.8 Typical Characteristics – ESD2CAN24-Q1

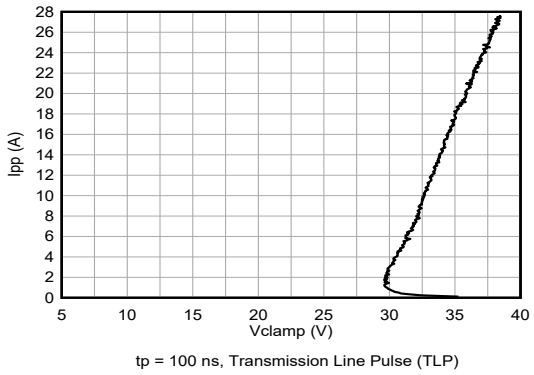


図 6-1. Positive TLP Curve

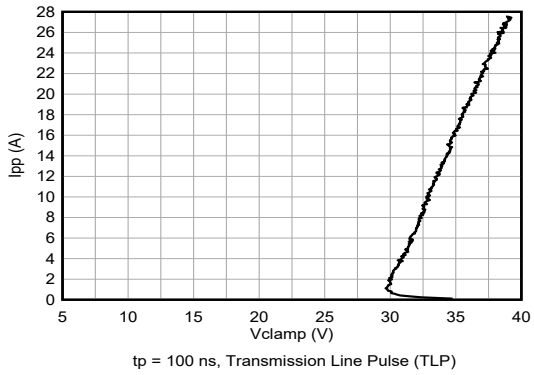


図 6-2. Negative TLP Curve

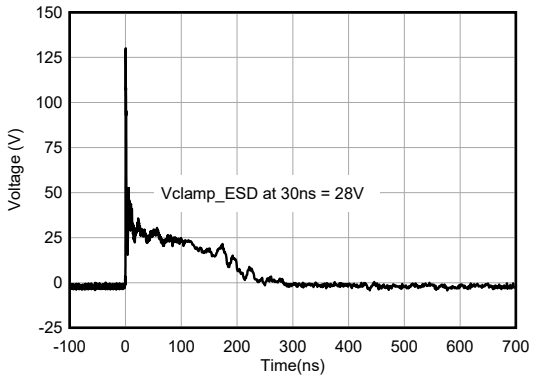


図 6-3. +8-kV Clamped IEC Waveform

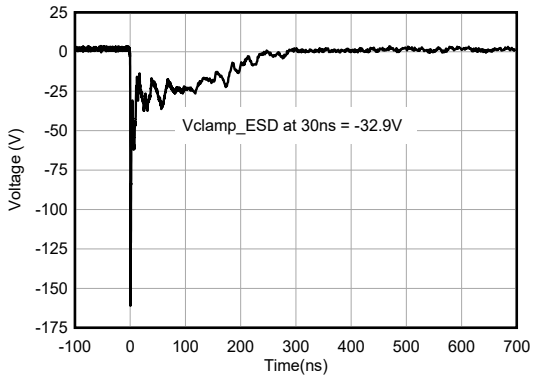


図 6-4. −8-kV Clamped IEC Waveform

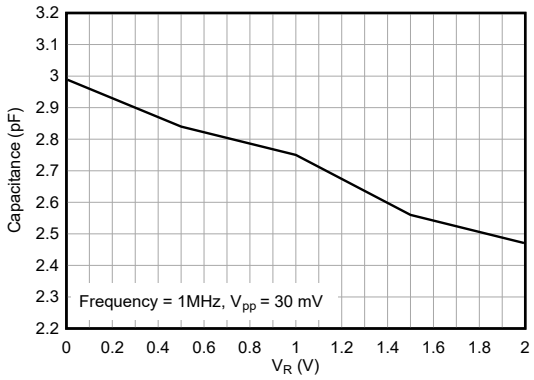


図 6-5. Capacitance vs. Bias Voltage

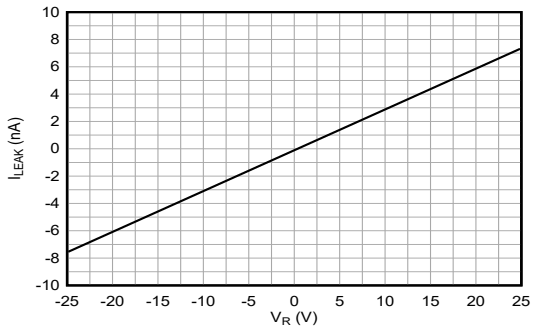


図 6-6. Leakage Current vs. Bias Voltage Across Temperature

6.8 Typical Characteristics – ESD2CAN24-Q1 (continued)

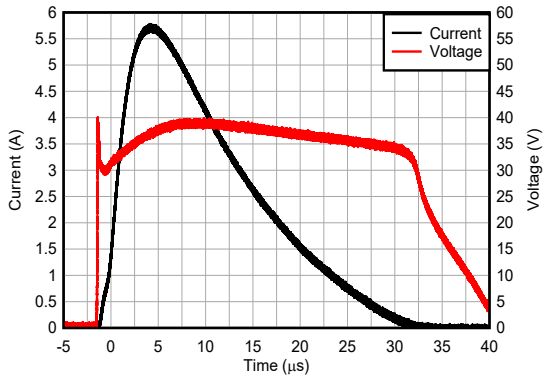


図 6-7. 8/20 µs Surge Response at 5.7 A

6.9 Typical Characteristics – ESD2CANFD24-Q1

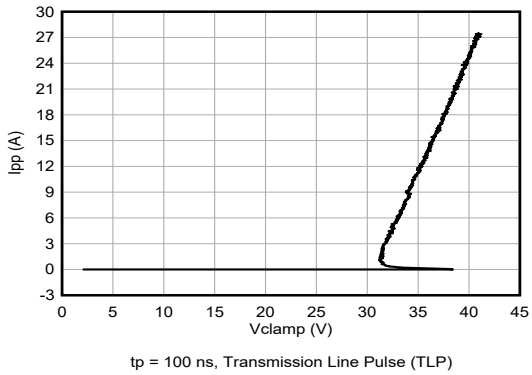


図 6-8. Positive TLP Curve

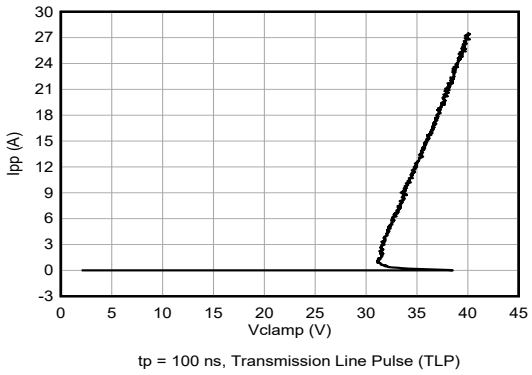


図 6-9. Negative TLP Curve

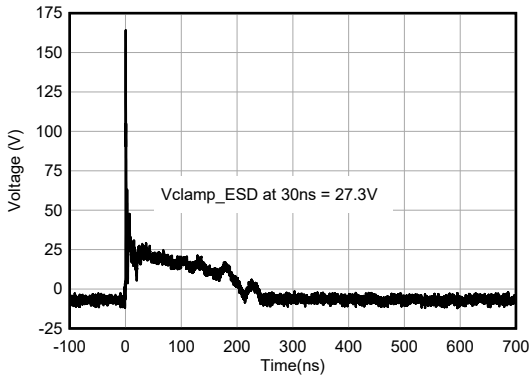


図 6-10. +8-kV Clamped IEC Waveform

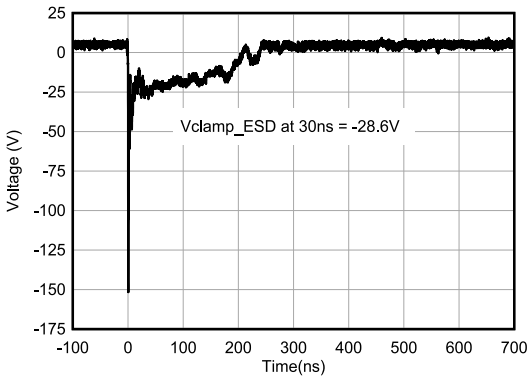


図 6-11. −8-kV Clamped IEC Waveform

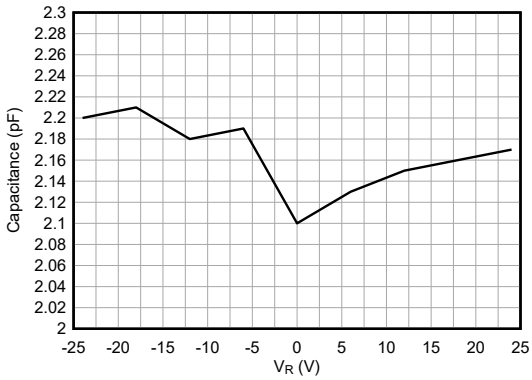


図 6-12. Capacitance vs. Bias Voltage

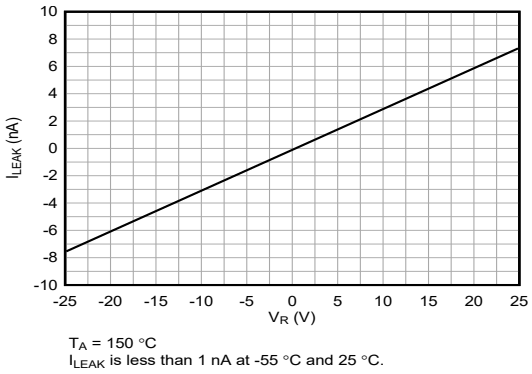


図 6-13. Leakage Current vs. Bias Voltage Across Temperature

6.9 Typical Characteristics – ESD2CANFD24-Q1 (continued)

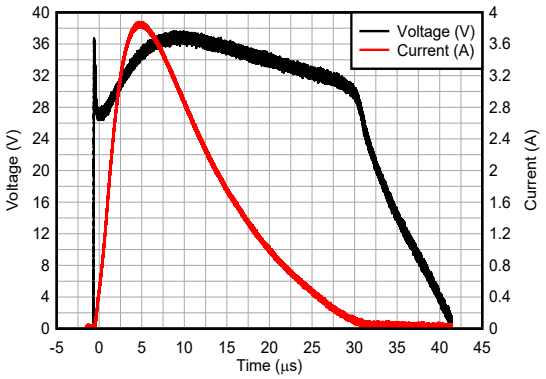


図 6-14. 8/20 µs Surge Response at 5.7 A

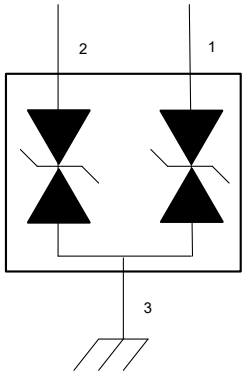
7 Detailed Description

7.1 Overview

The ESD2CANxx24-Q1 is a dual-channel ESD TVS diode in SOT-23 and SC-70 leaded packages which are convenient for automatic optical inspection. This product offers ISO 10605 ±30-kV or ±25-kV or ±20-kV air-gap, ±30-kV or ±25-kV or ±20-kV contact ESD protection, and has a clamp circuit with a back-to-back TVS diode for bidirectional signal support. The 3 pF (typical) or less line capacitance of this ESD protection diode is suitable for CAN, CANFD, CAN SiC, and CAN-XL applications that can support data rates up to 10 Mbps.

A typical application for this product is ESD circuit protection for CAN transceivers used in automotive applications. The ESD2CANxx24-Q1 is a good fit for the ESD protection inside automotive electronic control units (ECUs) for head lights, door modules, climate control, roof control, wipers, cluster, audio, and many other automotive applications.

7.2 Functional Block Diagram



7.3 Feature Description

The ESD2CANxx24-Q1 is a bidirectional TVS with a high ESD protection level. This device protects the circuit from ESD strikes up to ±30-kV or ±25-kV or ±20-kV contact and ±30-kV or ±25-kV or ±20-kV air-gap specified in the ISO 10605 automotive standard. The device can also handle up to 5.7 A surge current (IEC 61000-4-5 8/20 µs). The I/O capacitance of 3-pF (typical) supports a data rate up to 10 Mbps. This clamping device has a small dynamic resistance, which makes the clamping voltage low when the device is actively protecting other circuits. For example, the clamping voltage is only 37 V when the device is taking 5.7 A transient surge current. The breakdown is bidirectional so this protection device is a good fit for CAN which is a differential signal. Low leakage allows the diode to conserve power when working below the V_{RWM}. The temperature range of −55°C to +150°C makes this ESD device work at extensive temperatures in most environments. The leaded SOT-23 and SC-70 packages are good for applications requiring automatic optical inspection (AOI).

7.3.1 AEC-Q101 Qualified and Temperature Range

This device is qualified to AEC-Q101 standards and is qualified to operate from –55°C to +150°C.

7.3.2 ISO 10605 ESD Protection

The I/O pins can withstand ESD events of at least ±30-kV contact and ±30-kV air-gap in the leaded SOT-23 and SC-70 packages according to the ISO 10605 (330 pF and 330 Ω loading condition) standard. An ESD-surge clamp diverts the current to ground.

7.3.3 IEC 61000-4-5 Surge Protection

The IO pins can withstand surge events up to 5.7 A (8/20 µs waveform). An ESD-surge clamp diverts this current to ground.

7.3.4 IO Capacitance

The capacitance between the I/O pins is 3 pF (typical) or less. This capacitance supports data rates for CAN, CANFD, CAN SiC, and CAN-XL up to 10 Mbps.

7.3.5 Dynamic Resistance

The IO pins feature an ESD clamp that has a low R_{DYN} of 0.57 Ω (Pin 1 or Pin 2 to Pin 3) and 0.57 Ω (Pin 3 to Pin 1 or Pin 2) or less which prevents system damage during ESD events.

7.3.6 DC Breakdown Voltage

The DC breakdown voltage between the IO pins is a minimum of ± 25.5 V. This protects sensitive equipment from surges above the reverse standoff voltage of ± 24 V.

7.3.7 Ultra Low Leakage Current

The IO pins feature an ultra-low leakage current of ± 50 nA (maximum) with a bias of ± 24 V.

7.3.8 Clamping Voltage

The IO pins feature an ESD clamp that is capable of clamping the voltage to 37 V (I_{PP} = 5.7 A) and 35 V (I_{PP} = 16 A for TLP) for ESD2CAN24-Q1, and 38 V (I_{PP} = 3.5 A) and 34 V (I_{PP} = 16 A for TLP) for ESD2CANFD24-Q1, and 36 V (I_{PP} = 1.5 A) and 38 V (I_{PP} = 16 A for TLP) for ESD2CANXL24-Q1.

7.3.9 Industry Standard Leaded Packages

This device features industry standard SOT-23 (DBZ) and SC-70 (DCK) leaded packages for automatic optical inspection (AOI).

7.4 Device Functional Modes

The ESD2CANxx24-Q1 is a dual channel passive clamp that has low leakage during normal operation when the voltage between pin 1 or pin 2 and pin 3 is below V_{RWM}, and activates when the voltage between pin 1 or pin 2 and pin 3 goes above V_{BR}. During ISO 10605 ESD events, transient voltages as high as ±30 kV can be clamped on either channel. When the voltages on the protected lines fall below the V_{HOLD}, the device reverts back to the low leakage passive state.

8 Application and Implementation

注

以下のアプリケーション情報は、TI の製品仕様に含まれるものではなく、TI ではその正確性または完全性を保証いたしません。個々の目的に対する製品の適合性については、お客様の責任で判断していただくことになります。お客様は自身の設計実装を検証しテストすることで、システムの機能を確認する必要があります。

8.1 Application Information

The ESD2CANxx24-Q1 is a dual channel TVS diode which is used to provide 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.

8.2 Typical Application

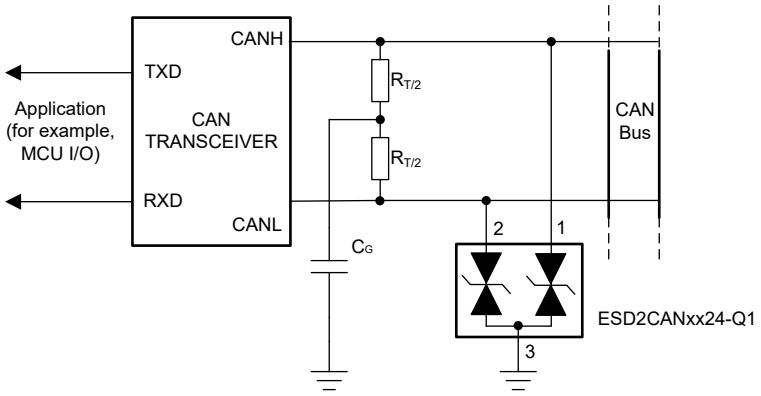


図 8-1. ESD2CANxx24-Q1 Typical Application

8.2.1 Design Requirements

For this design example, the ESD2CANxx24-Q1 is used to provide ESD protection for a CAN transceiver. 表 8-1 lists the known design parameters for this application.

表 8-1. Design Parameters for the ESD2CAN24-Q1 Typical Application

Design Parameter	Value
Diode configuration	Bidirectional
V_{IO} differential signal range	> ±1.5 V
V_{RWM}	±24 V
Jumpstart short to battery event on V_{IO}	±24 V
Data rate	Up to 10 Mbps
RT/2	60 Ω

8.2.2 Detailed Design Procedure

The ESD2CANxx24-Q1 has a V_{RWM} of ±24 V to protect the diode from being damaged during a short to battery event that can occur by reversing the terminal connections during jumpstart. The bidirectional characteristic enables the signal integrity of the differential CAN lines to not be impacted by the diode. The low capacitance of 3 pF (typical) or less enables data rates up to 10 Mbps, which allows the designer to meet the requirements for CAN, CANFD, CAN SiC, and CAN-XL. The 60 Ω split termination improves the electromagnetic emissions behavior of the network by filtering higher-frequency common-mode noise that may be present on the differential signal lines.

8.2.3 Application Curves

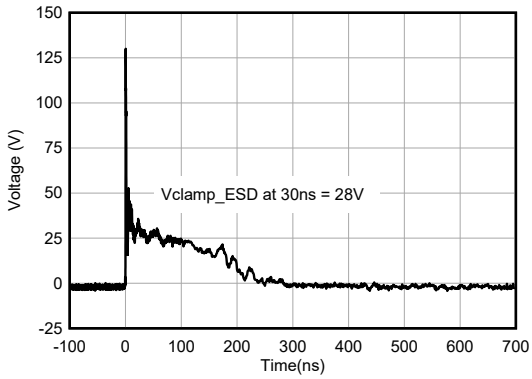


図 8-2. +8-kV Clamped IEC Waveform

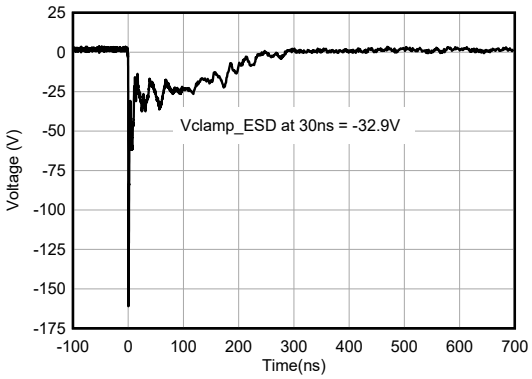


図 8-3. −8-kV Clamped IEC Waveform

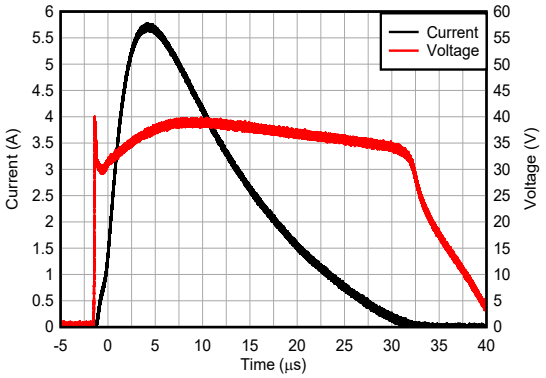


図 8-4. 8/20 µs Surge Response at 5.7 A

9 Power Supply Recommendations

This device is a passive TVS diode-based ESD protection device, therefore there is no requirement to power it. Ensure that the maximum voltage specifications for each pin are not violated.

10 Layout

10.1 Layout Guidelines

- The optimum placement of the device 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.
- If pin 3 is connected to ground, use a thick and short trace for this return path.

10.2 Layout Example

This example is typical of a dual channel differential data pair application, such as CAN.

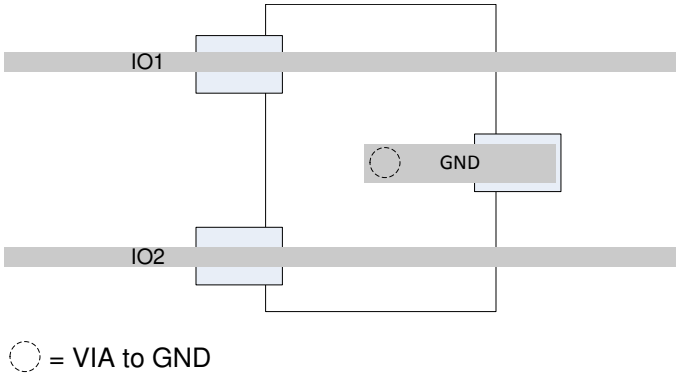


図 10-1. Routing with DBZ and DCK Package

11 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.

11.1 Documentation Support

11.1.1 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

11.2 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. Click on *Subscribe to updates* 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.

11.3 サポート・リソース

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11.4 Trademarks

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11.5 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.

11.6 Glossary

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

12 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 Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
ESD2CAN24DBZRQ1	ACTIVE	SOT-23	DBZ	3	3000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 150	1L3	Samples
ESD2CAN24DCKRQ1	ACTIVE	SC70	DCK	3	3000	RoHS & Green	NIPDAU	Level-3-260C-168 HR	-55 to 150	1L6	Samples
ESD2CANFD24DBZRQ1	ACTIVE	SOT-23	DBZ	3	3000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 150	2QP8	Samples
ESD2CANXL24DBZRQ1	ACTIVE	SOT-23	DBZ	3	3000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 150	2RI8	Samples

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".
RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.
Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices 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.

continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals.
TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

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 ESD2CANFD24-Q1 :

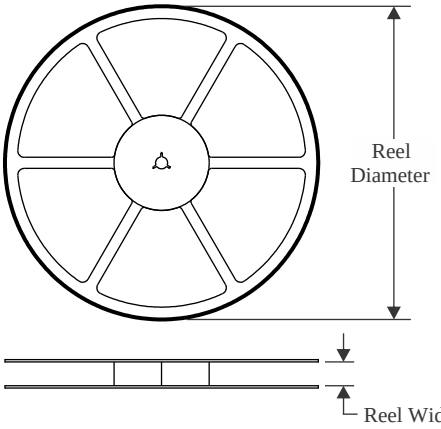
- Catalog : ESD2CANFD24

NOTE: Qualified Version Definitions:

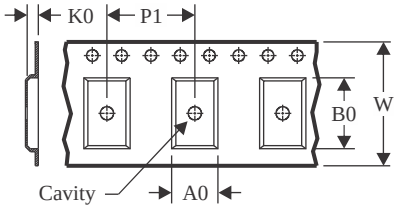
- Catalog - TI's standard catalog product

TAPE AND REEL INFORMATION

REEL DIMENSIONS

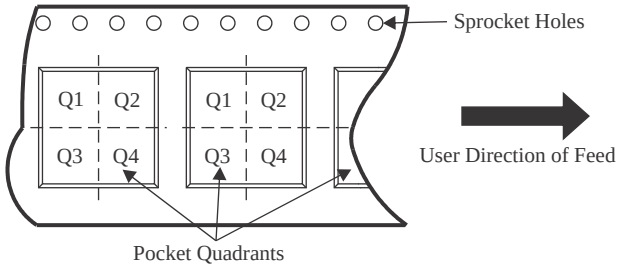


TAPE DIMENSIONS



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

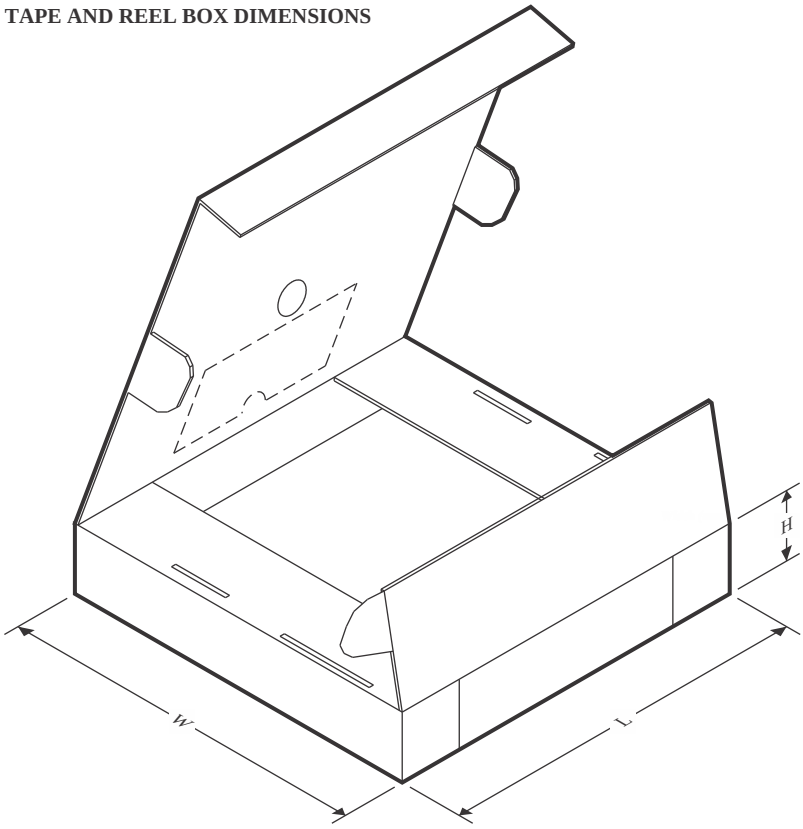
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
ESD2CAN24DBZRQ1	SOT-23	DBZ	3	3000	180.0	8.4	2.9	3.35	1.35	4.0	8.0	Q3
ESD2CAN24DCKRQ1	SC70	DCK	3	3000	178.0	9.0	2.4	2.5	1.2	4.0	8.0	Q3
ESD2CANFD24DBZRQ1	SOT-23	DBZ	3	3000	180.0	8.4	2.9	3.35	1.35	4.0	8.0	Q3
ESD2CANXL24DBZRQ1	SOT-23	DBZ	3	3000	180.0	8.4	2.9	3.35	1.35	4.0	8.0	Q3

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

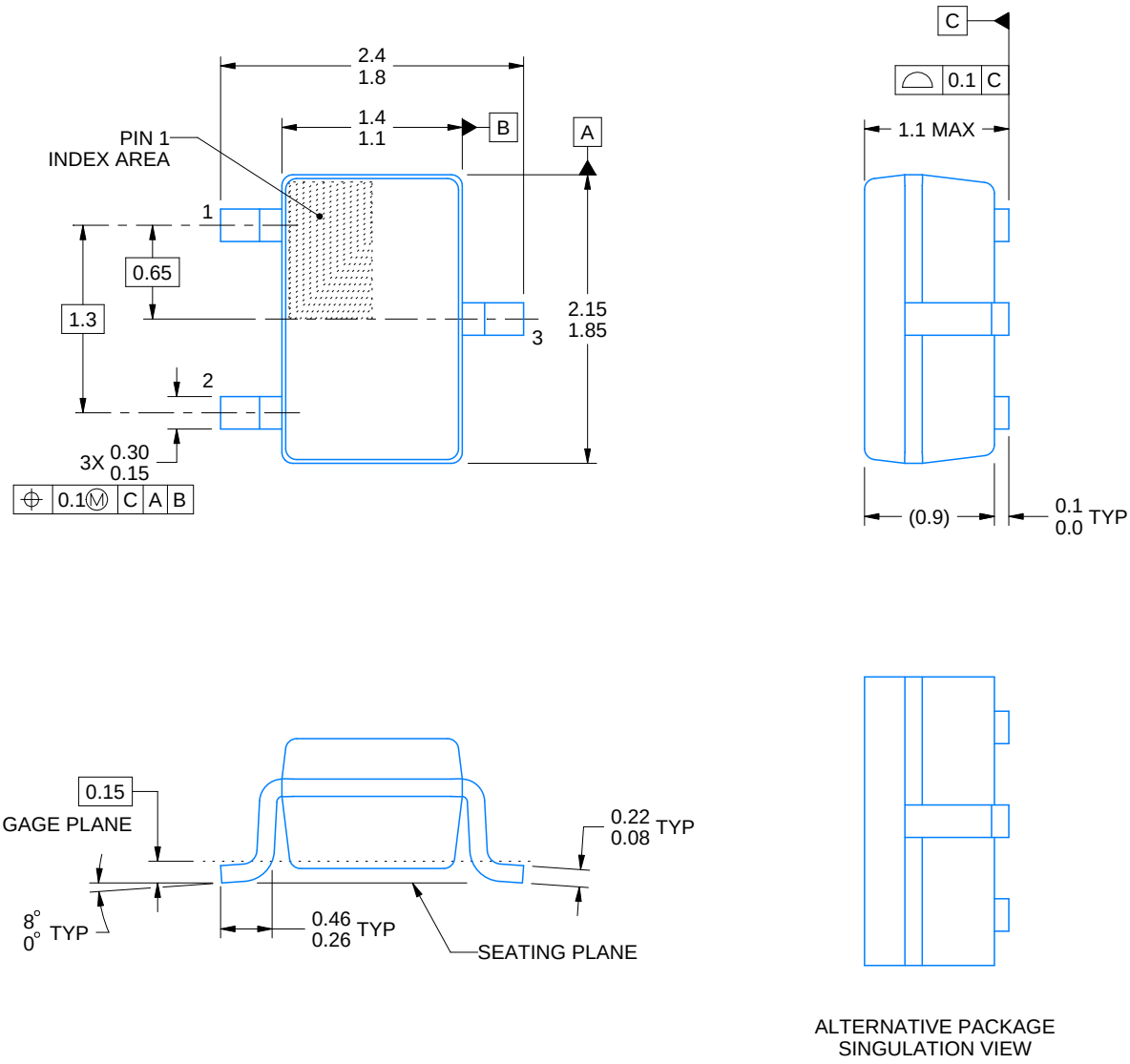
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
ESD2CAN24DBZRQ1	SOT-23	DBZ	3	3000	210.0	185.0	35.0
ESD2CAN24DCKRQ1	SC70	DCK	3	3000	190.0	190.0	30.0
ESD2CANFD24DBZRQ1	SOT-23	DBZ	3	3000	210.0	185.0	35.0
ESD2CANXL24DBZRQ1	SOT-23	DBZ	3	3000	210.0	185.0	35.0

DCK0003A

PACKAGE OUTLINE

SOT-SC70 - 1.1 max height

SMALL OUTLINE TRANSISTOR SC70

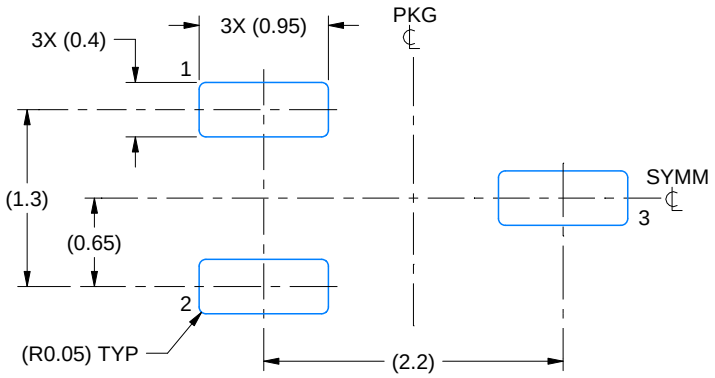


ALTERNATIVE PACKAGE
SINGULATION VIEW

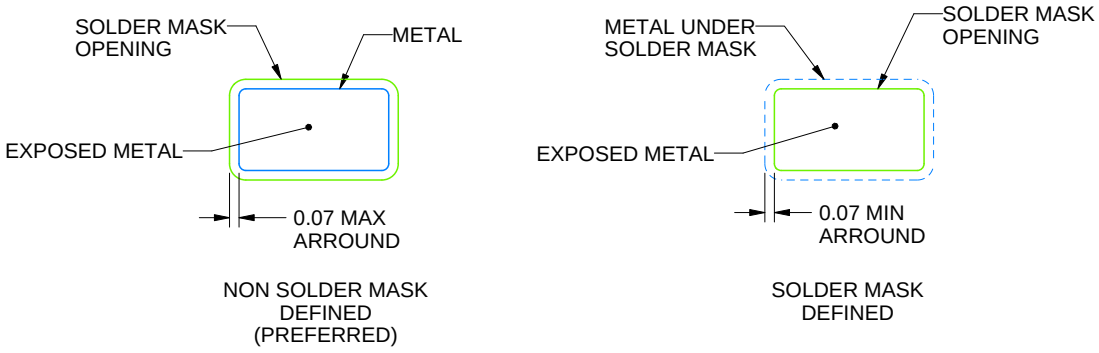
4220745/D 06/2024

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.
3. Body dimensions do not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.25mm per side



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:18X

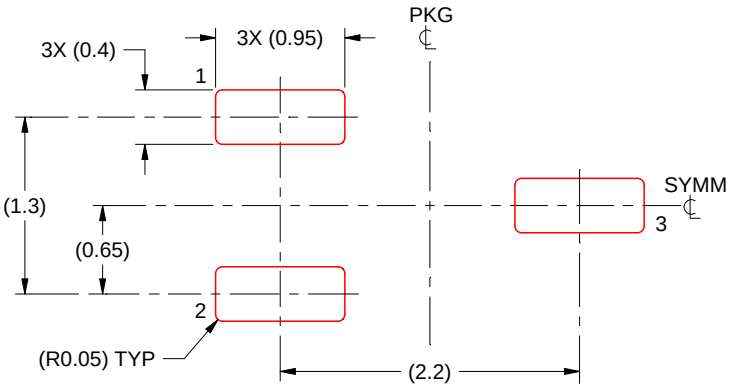


SOLDER MASK DETAILS

4220745/D 06/2024

NOTES: (continued)

4. Publication IPC-7351 may have alternate designs.
5. 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:18X

4220745/D 06/2024

NOTES: (continued)

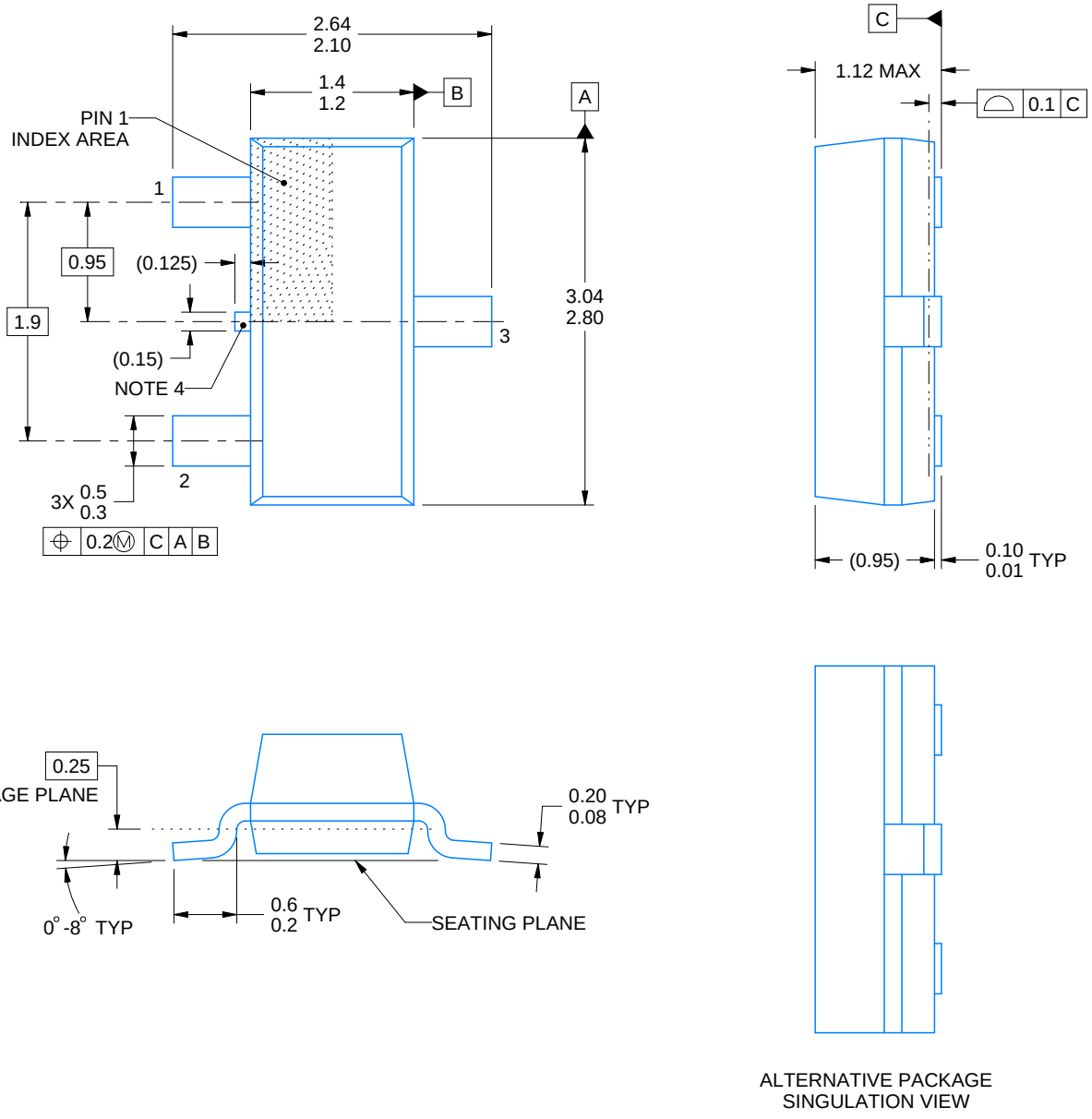
6. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
7. Board assembly site may have different recommendations for stencil design.

PACKAGE OUTLINE

DBZ0003A

SOT-23 - 1.12 mm max height

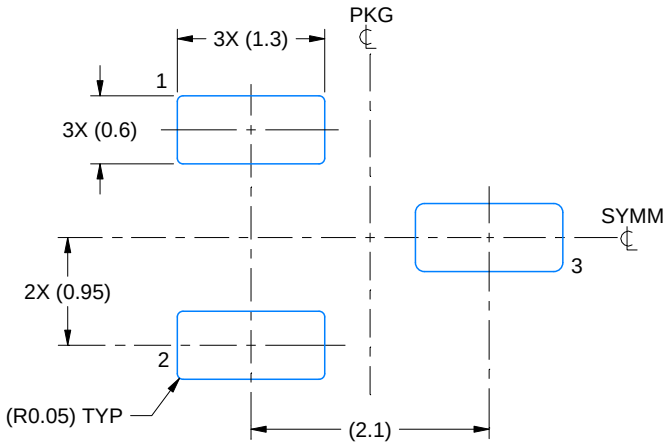
SMALL OUTLINE TRANSISTOR



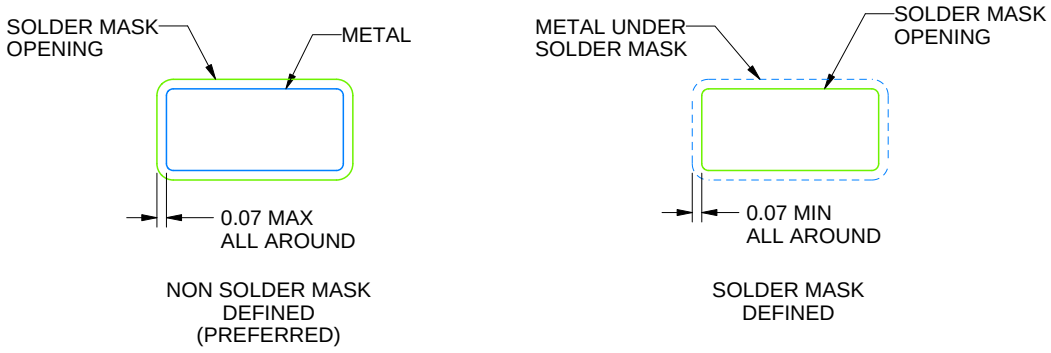
4214838/E 06/2024

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.
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



LAND PATTERN EXAMPLE
SCALE:15X

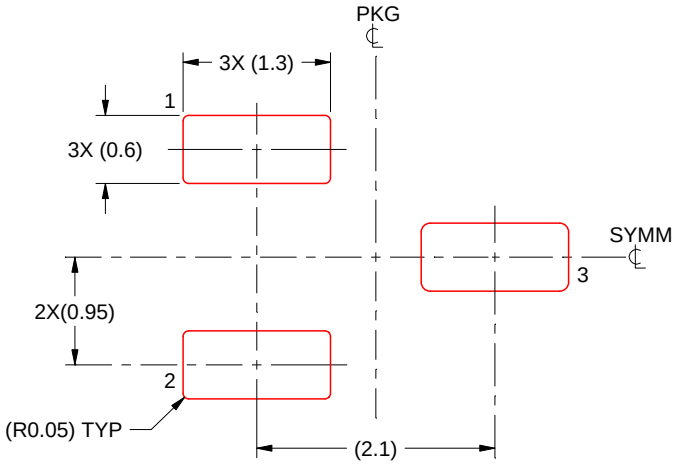


SOLDER MASK DETAILS

4214838/E 06/2024

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.



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

4214838/E 06/2024

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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