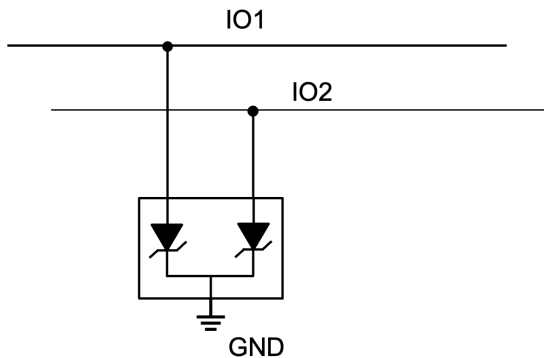# MMBZ30VCL-Q1 Dual Channel ESD Protection

1 Features

- Ultra Low I/O capacitance = 4.5pF (typical)
- Low leakage current <25nA
- Unidirectional ESD protection for 2 channels or Bidirectional for 1 channel
- IEC 61000-4-2 ESD protection:
  - ±30kV contact discharge
  - ±30kV air-gap discharge
- ISO 10605 (330pF, 330Ω) ESD protection:
  - ±25kV contact discharge
  - ±30kV air-gap discharge
- AEC-Q101 qualified
- Temperature range: –55°C to +150°C
- Leaded packages used for automatic optical inspection (AOI)

2 Applications

- Automotive in-vehicle networks
  - Controller area network (CAN)
  - Local interconnect network (LIN)

3 Description

The MMBZ30VCL-Q1 is a dual channel unidirectional or single channel bidirectional ESD in a common cathode configuration. The device's low capacitance and low leakage features enable use in high speed applications. The low dynamic resistance allows low clamping voltage to help protect systems against transient events. This protection is key as automotive systems require a high level of robustness and reliability when they control safety devices.
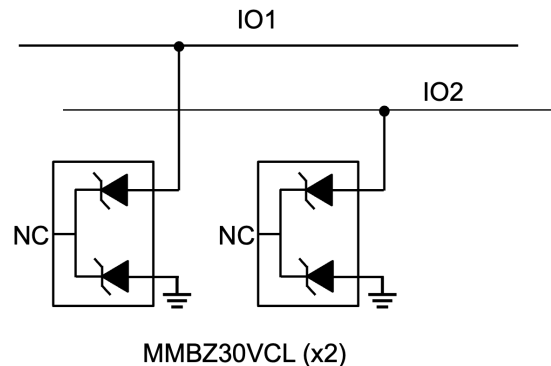
The MMBZ30VCL-Q1 is packaged in the SOT-23, providing two channels of robust transient protection in one space-efficient form factor.

Package Information

PART NUMBER	PACKAGE [1]	PACKAGE SIZE [2]
MMBZ30VCL-Q1	DBZ (SOT-23, 3)	2.92mm × 2.37mm

(1) For more information, see Section 8.
(2) The package size (length × width) is a nominal value and includes pins, where applicable.

Typical Application

Table of Contents

Product Folder Links: *MMBZ30VCL-Q1*

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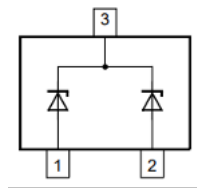
Figure 4-1. DBZ Package, 3-Pin SOT-23 (Top View)

Table 4-1. Pin Functions

PIN		DESCRIPTION
NAME	NO.	
AN1	1	Anode of diode 1
AN2	2	Anode of diode 2
CC	3	Common Cathode

5 Specifications

5.1 Absolute Maximum Ratings

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

		MIN	MAX	UNIT
P_{PP}	IEC 61643-321 Power (t_p - 10/1000µs) at 25°C		20	W
I_{PP}	IEC 61643-321 Current (t_p - 10/1000µs) at 25°C		0.5	A
T_A	Operating free-air temperature	-55	150	
T_J	Junction temperature	-55	150	°C
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.

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	Contact discharge[1]	ISO 10605, 150pF, 330Ω, IO	± 30000	V
			ISO 10605, 330pF, 330Ω, IO	± 25000	
		Air-gap discharge	ISO 10605, 150pF, 330Ω, IO	± 30000	
			ISO 10605, 330pF, 330Ω, IO	± 30000	

(1)   Measured from pin1/pin2 to pin3

5.5 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

Product Folder Links: *MMBZ30VCL-Q1*

5.6 Thermal Information

THERMAL METRIC [1]		MMBZ30VCL-Q1 DBZ (SOT-23) 3 PINS	UNIT
$R_{\theta JA}$	Junction-to-ambient thermal resistance	262.6	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	147.0	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	96.1	°C/W
Ψ_{JT}	Junction-to-top characterization parameter	33.5	°C/W
Ψ_{JB}	Junction-to-board characterization parameter	95.4	°C/W
$R_{\theta JC(bot)}$	Junction-to-case (bottom) thermal resistance	N/A	°C/W

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

5.7 Electrical Characteristics

over T_A = 25°C (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_F	Forward Voltage	I_F = 10mA, T_A = 25°C			1.1	V
V_{RWM}	Reverse stand-off voltage	T_A = 25°C			24	V
V_{BR}	Breakdown voltage [1]	I_T = 10mA, T_A = 25°C	24.8		34.8	V
V_{CLAMP}	Clamping voltage [2]	I_{PPM} = 0.5A, t_p = 10/1000µs		31	40	V
I_{LEAK}	Leakage current	V_{IO} = ±24V		1	25	nA
S_Z	Temperature Coefficient	I_Z = 10mA		13		mV/C
C_L	Line capacitance	V_{IO} = 0V, f = 1MHz, V_{pp} = 30mV		4.5		pF

(1) V_{BR} is defined as the voltage when 10mA is applied and before the device enters into the shallow snapback state
(2) Device stressed with 10/1000 µs exponential decay waveform according to IEC 61643-321
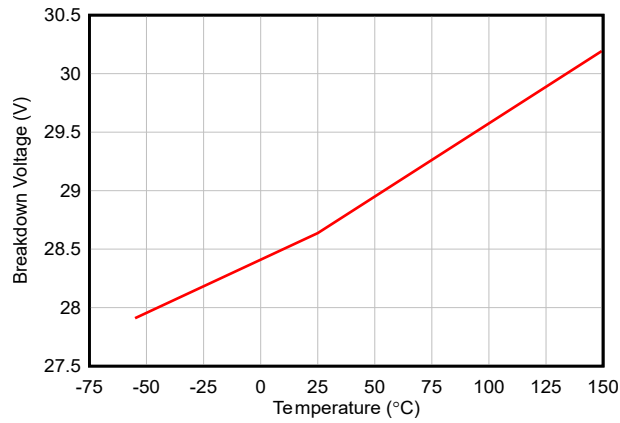
5.8 Typical Characteristics
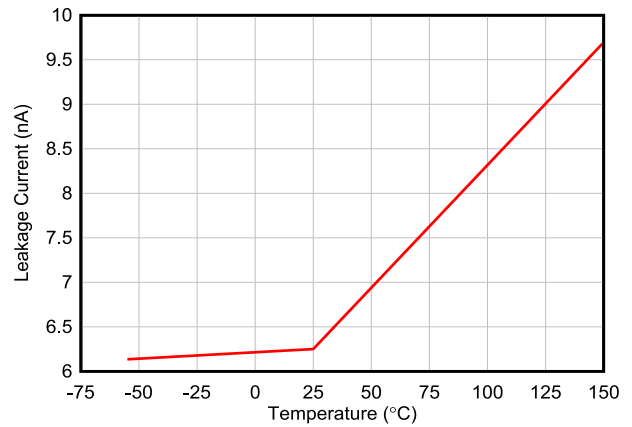

Figure 5-1. Breakdown Voltage vs Temperature
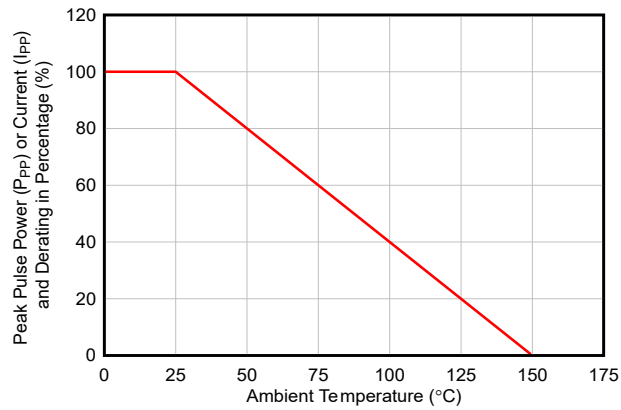

Figure 5-2. Leakage Current vs Temperature

Figure 5-3. Peak Pulse Power Derating Curve

6 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.

6.1 Documentation Support

6.1.1 Related Documentation

For related documentation, see the following:
• Texas Instruments, *ESD Layout Guide* application reports
• Texas Instruments, *Generic ESD Evaluation Module* user's guide
• Texas Instruments, *Picking ESD Diodes for Ultra High-Speed Data Lines* application reports
• Texas Instruments, *Reading and Understanding an ESD Protection* data sheet

6.2 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.

6.3 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.

6.4 Trademarks

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6.5 Electrostatic Discharge Caution

![ESD warning symbol] 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.

6.6 Glossary

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

7 Revision History

DATE	REVISION	NOTES
November 2024	*	Initial Release

8 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
MMBZ30VCLDBZRQ1	ACTIVE	SOT-23	DBZ	3	3000	RoHS & Green	SN	Level-1-260C-UNLIM	-55 to 150	3IBG	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.

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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 MMBZ30VCL-Q1 :

● Catalog : MMBZ30VCL

NOTE: Qualified Version Definitions:

    ● Catalog - TI's standard catalog product

TAPE AND REEL INFORMATION

REEL DIMENSIONS

Reel Diameter

Reel Width (W1)

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
MMBZ30VCLDBZRQ1	SOT-23	DBZ	3	3000	180.0	8.4	3.2	2.85	1.3	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)
MMBZ30VCLDBZRQ1	SOT-23	DBZ	3	3000	210.0	185.0	35.0

2.64
2.10

1.4
1.2

B

A

PIN 1
INDEX AREA

1

0.95

(0.125)

1.9

(0.15)

NOTE 4

3.04
2.80

3

2

3X 0.5
    0.3

⊕ 0.2Ⓜ C A B

C

1.12 MAX

⌒ 0.1 C

4X 0°-15°

(0.95)

0.10 TYP
0.01

4X 4°-15°

0.25

GAGE PLANE

0.20 TYP
0.08

0°-8° TYP

0.6 TYP
0.2

SEATING PLANE

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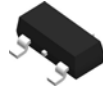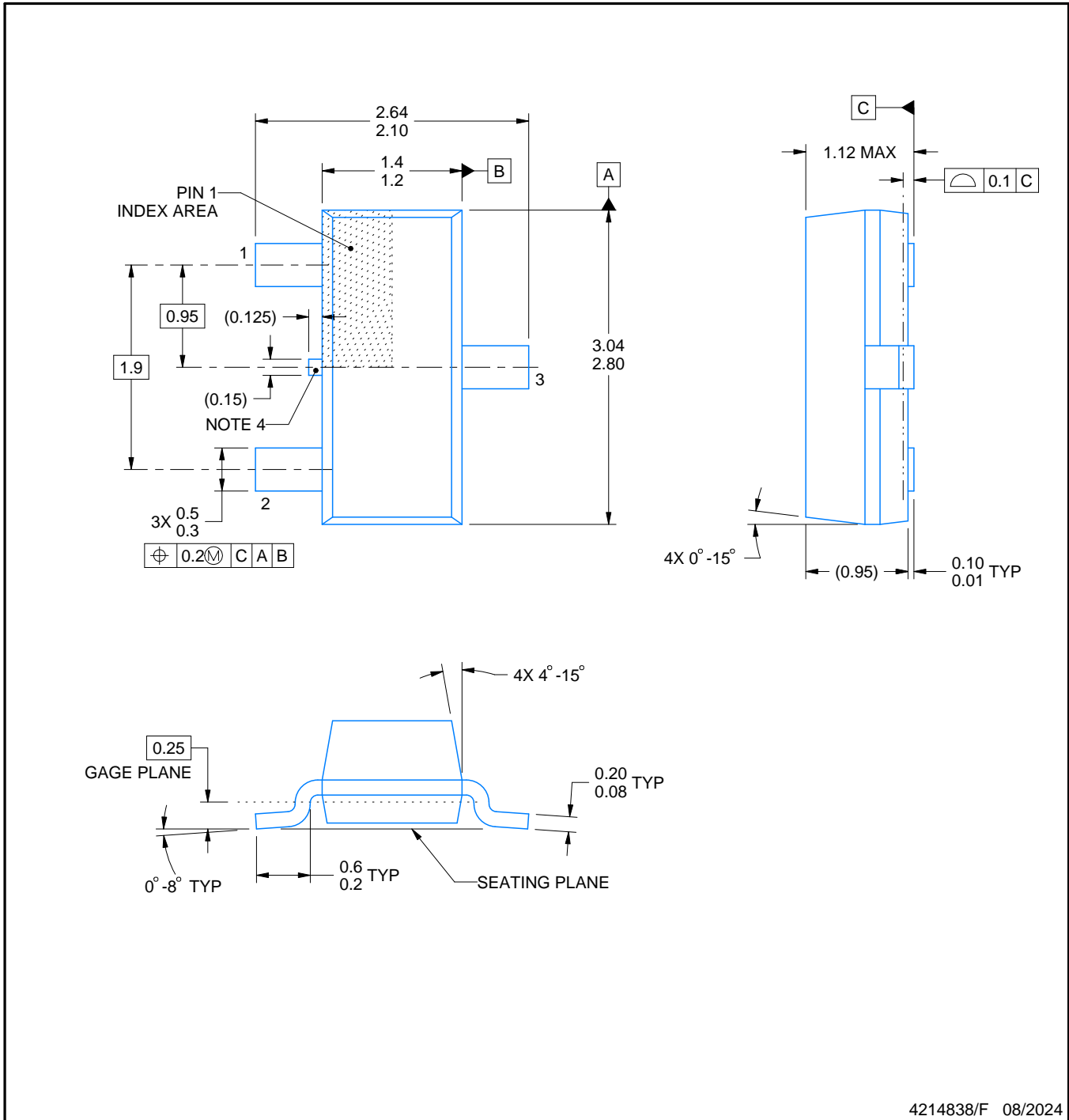
NOTES:

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.
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

PKG ℄

3X (1.3)

1

3X (0.6)

SYMM ℄

3

2X (0.95)

2

(R0.05) TYP

(2.1)
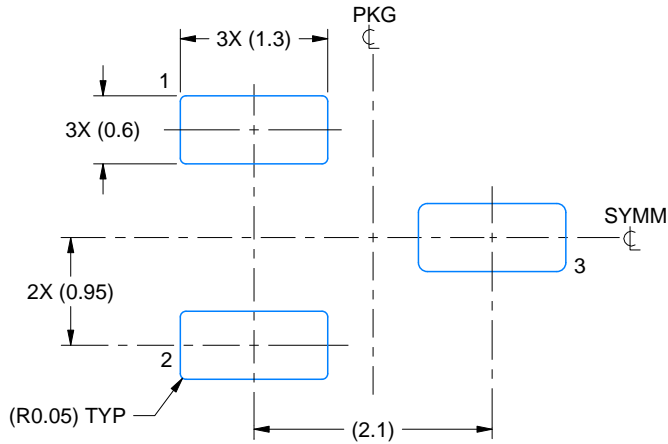
LAND PATTERN EXAMPLE
SCALE:15X

SOLDER MASK OPENING

METAL

0.07 MAX
ALL AROUND

NON SOLDER MASK
DEFINED
(PREFERRED)

METAL UNDER
SOLDER MASK

SOLDER MASK
OPENING

0.07 MIN
ALL AROUND

SOLDER MASK
DEFINED
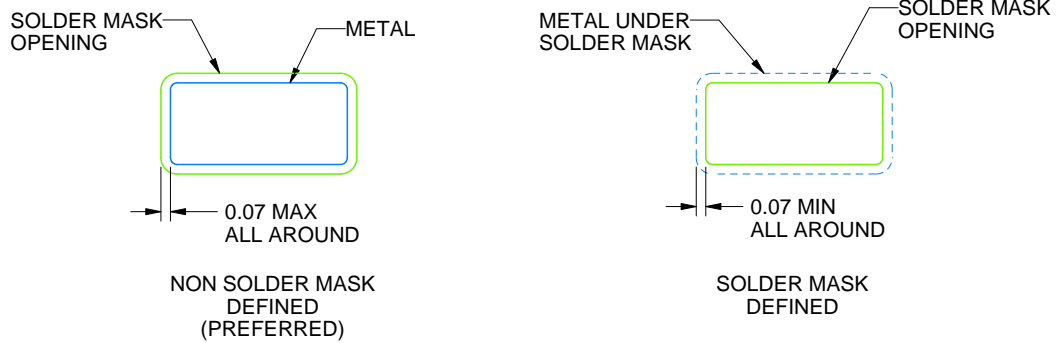
SOLDER MASK DETAILS

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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.

PKG ℄

3X (1.3)

1

3X (0.6)

SYMM ℄

3

2X(0.95)

2

(R0.05) TYP

(2.1)
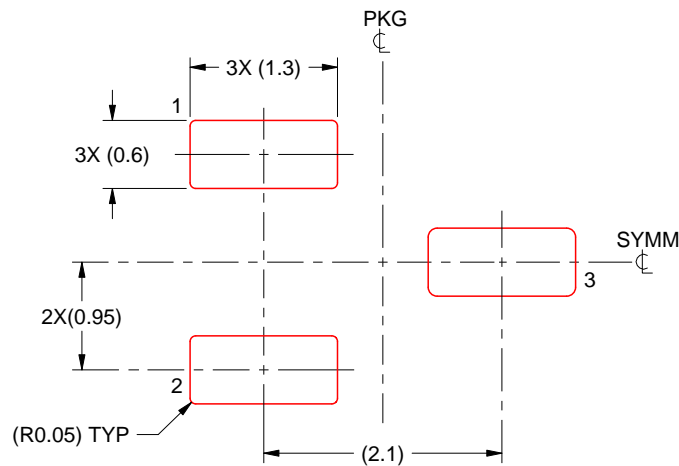
SOLDER PASTE EXAMPLE
BASED ON 0.125 THICK STENCIL
SCALE:15X

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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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