

TLC69631-Q1 Automotive 100mA, 8-Channel LED Driver with Integrated Oscillator

1 Features

- AEC-Q100 qualified for automotive applications
 - Grade 1: -40°C to 125°C ambient operating temperature
 - Device HBM classification level H1C
 - Device CDM classification level C4B
- [Functional Safety-Capable](#)
 - Documentation available to aid functional safety system design
- 8 integrated current sinks
 - Programmable 16-bit PWM / Hybrid dimming
 - Programmable 7-bit analog dot correction (DC)
 - Maximum output current / voltage: 100mA / 16V
- Integrated 33MHz oscillator
 - 16-bit PWM output in 500Hz
 - $>20\text{KHz}$ refresh rate with enhanced spectrum (ES) PWM
- High speed communication
 - Serial peripheral interface (SPI)
 - Data rates up to 17Mbps
- Power efficiency optimization
 - Adaptive headroom voltage control (AHVC)
 - Device power save mode (PSM)
- EMI mitigation
 - Interface: programmable buffer driving capability
 - Current sinks: phase shifting / spread spectrum
- Protection and Diagnostic
 - LED: open / short detection / health check
 - Current sink: adjacent-pin short / health check
 - Interface: CRC / command error / time-out error
 - Device: under voltage / ISET out of range / thermal shutdown

- Automotive Cluster Display
- Automotive Head-up Display

3 Description

The TLC69631-Q1 is a LED driver with 8 constant current sink channels which could provide up to 16-bit individual pixel-level LED PWM control. The additional 7-bit dot correction (DC) is also implemented to each channel to control peak current. Each device shares data stream by serial peripheral interface (SPI) which supports up to 511 devices connection. The interface is [software compatible with LED drivers in the same group](#) which can be applied to different application scenarios based on LED current and total LED number.

To optimize overall systematic power efficiency, the device is equipped with adaptive headroom voltage control (AHVC) scheme to optimize headroom voltage across each channel and device. Only the OUT7 pin from the last device of daisy chain is required to be programmed as FB pin to optimize LED supply voltage from DC/DC.

The TLC69631-Q1 is equipped diagnostics for LED, current sink, communication and device.

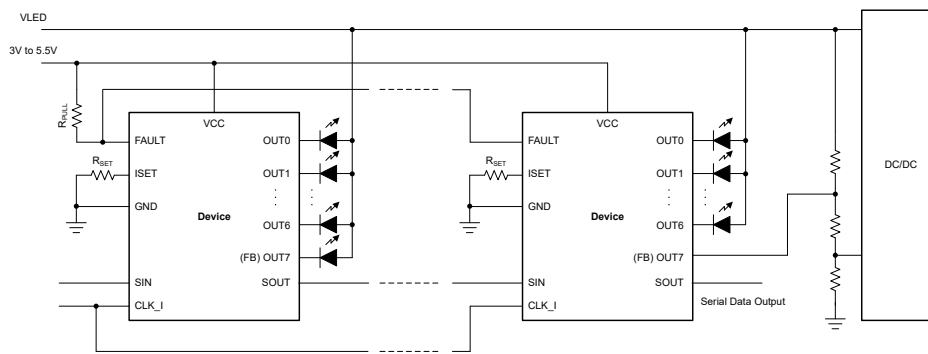
Packaging Information

PART NUMBER	PACKAGE ⁽¹⁾	BODY SIZE (NOM)
TLC69631-Q1	X2QFN (16) Wettable flank	2.5mm × 2.5mm
	SOT-23-THIN (16)	4.2mm × 2mm

(1) For all available packages, see the orderable addendum at the end of the data sheet.

2 Applications

- Automotive Central information Display



Simplified Schematic



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4 Device Comparison

PART NUMBER	CHANNEL NUMBER	MAX. CHANNEL CURRENT	FUNCTIONAL SAFETY CLASSIFICATION	INTERFACE	SOFTWARE COMPATIBLE
TLC69621-Q1	8	60mA	Functional Safety-Capable	SPI	Group 1
TLC69624-Q1	24				
TLC69627-Q1	48				
TLC69631-Q1	8	100mA			
TLC69634-Q1	24				
TLC69637-Q1	48				
TLC69622-Q1	8	60mA	Functional Safety-Compliant	SPI	Group 2
TLC69625-Q1	24				
TLC69628-Q1	48				
TLC69632-Q1	8	100mA			
TLC69635-Q1	24				
TLC69638-Q1	48				
TLC69623-Q1	8	60mA	Functional Safety-Compliant	CSI	Group 3
TLC69626-Q1	24				
TLC69629-Q1	48				
TLC69633-Q1	8	100mA			
TLC69636-Q1	24				
TLC69639-Q1	48				

5 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.

5.1 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.

5.2 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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5.3 Trademarks

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

5.4 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.

5.5 Glossary

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

6 Revision History

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

DATE	REVISION	NOTES
March 2025	*	Initial Release

7 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.

PACKAGE OPTION ADDENDUM

PACKAGING INFORMATION

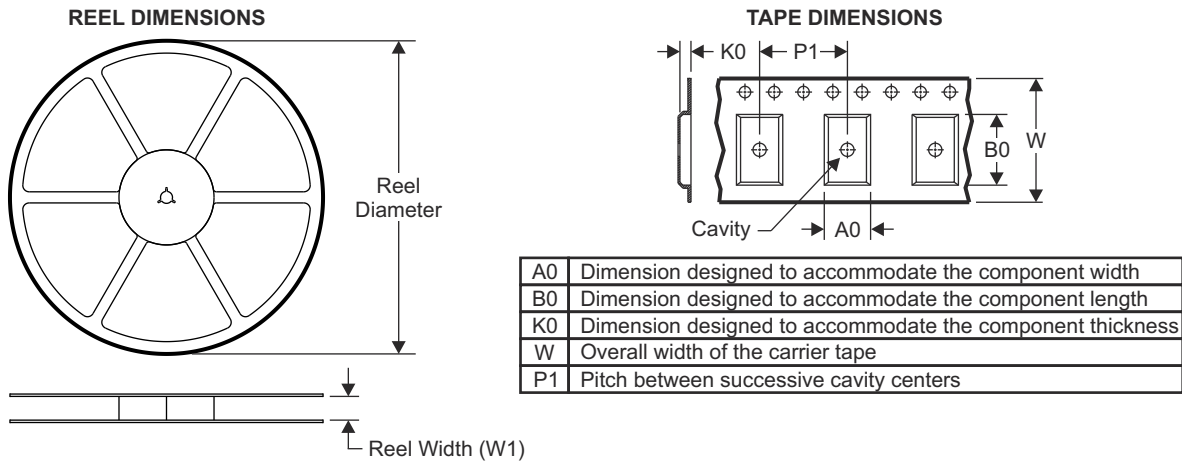
Orderable part number	Status (1)	Material type (2)	Package Pins	Package qty Carrier	RoHS (3)	Lead finish/Ball material (4)	MSL rating/Peak reflow (5)	Op temp (°C)	Part marking (6)
TLC69631QDYRQ1	Active	Production	SOT-23-THIN (DYY) 16	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	69622Q1
TLC69631QRUJRQ1	Active	Production	X2QFN (RUJ) 16	5000 LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-40 to 125	22Q

- (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.

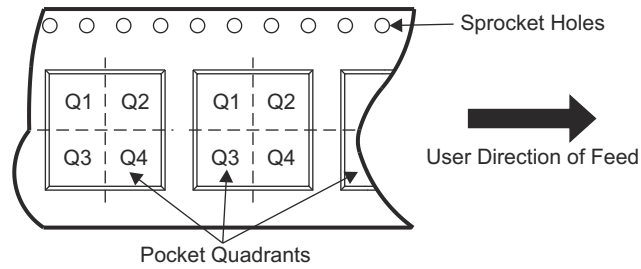
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7.1 Tape and Reel Information

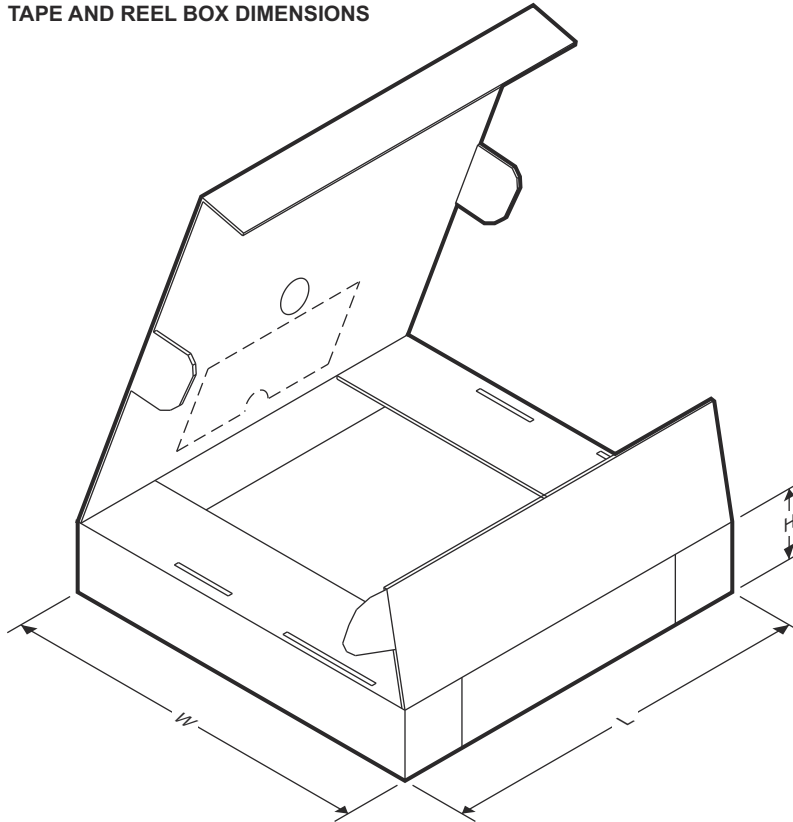


QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



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
TLC69631QDYRQ1	SOT-23-THIN	DYY	16	3000	300	12.4	4.8	3.6	1.6	8	12	Q3
TLC69631QRUJRQ1	X2QFN	RUJ	16	5000	180	8.4	1.8	1.8	0.48	4	8	Q1

TAPE AND REEL BOX DIMENSIONS



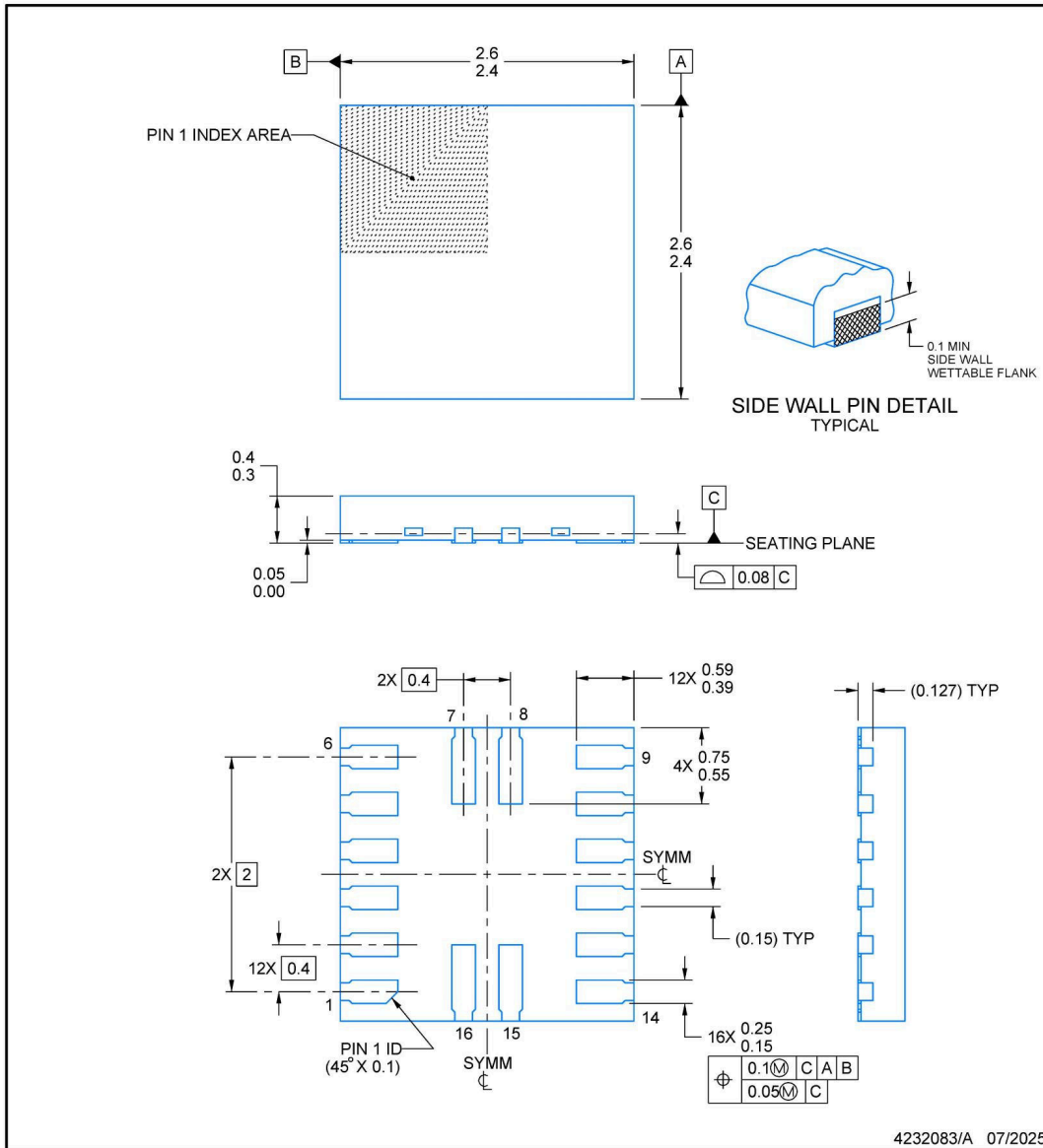
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TLC69631QDYRQ1	SOT-23-THIN	DYY	16	3000	336.6	336.6	31.8
TLC69631QRUJRQ1	X2QFN	RUJ	16	5000	210	185	35



RUJ0016B

PACKAGE OUTLINE
X2QFN - 0.4 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



NOTES:

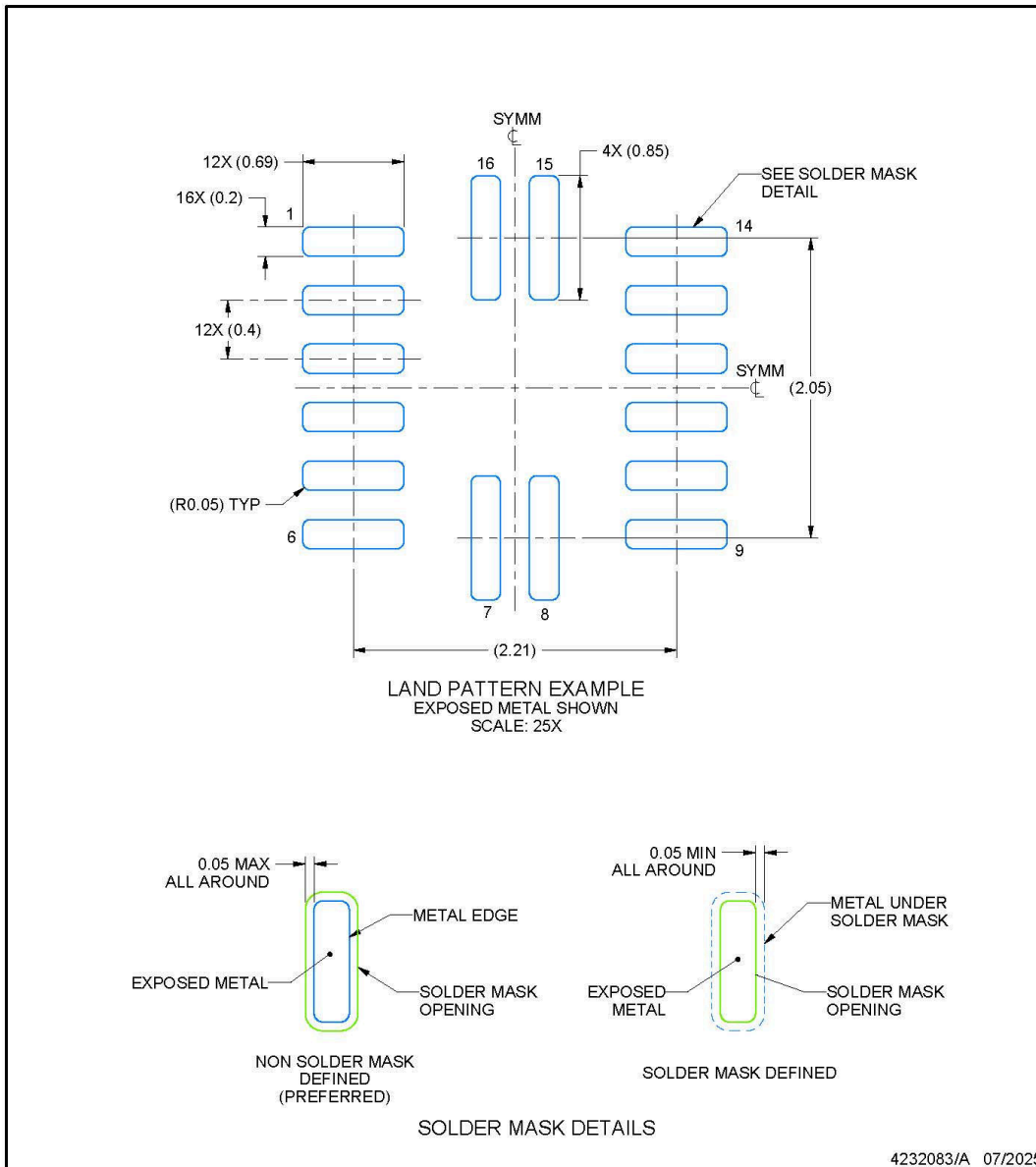
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.

EXAMPLE BOARD LAYOUT

RUJ0016B

X2QFN - 0.4 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



NOTES: (continued)

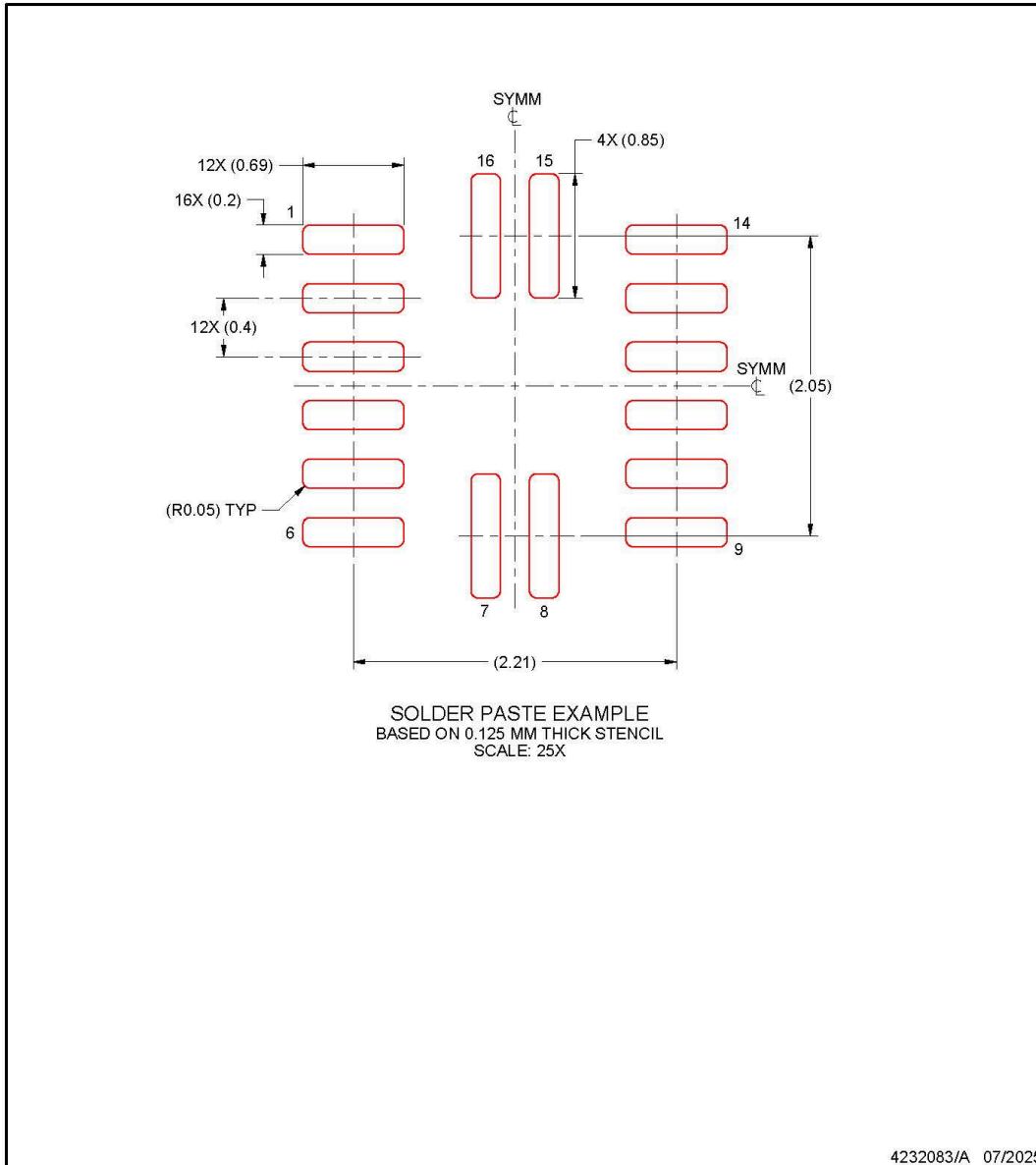
3. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/slua271).

EXAMPLE STENCIL DESIGN

RUJ0016B

X2QFN - 0.4 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



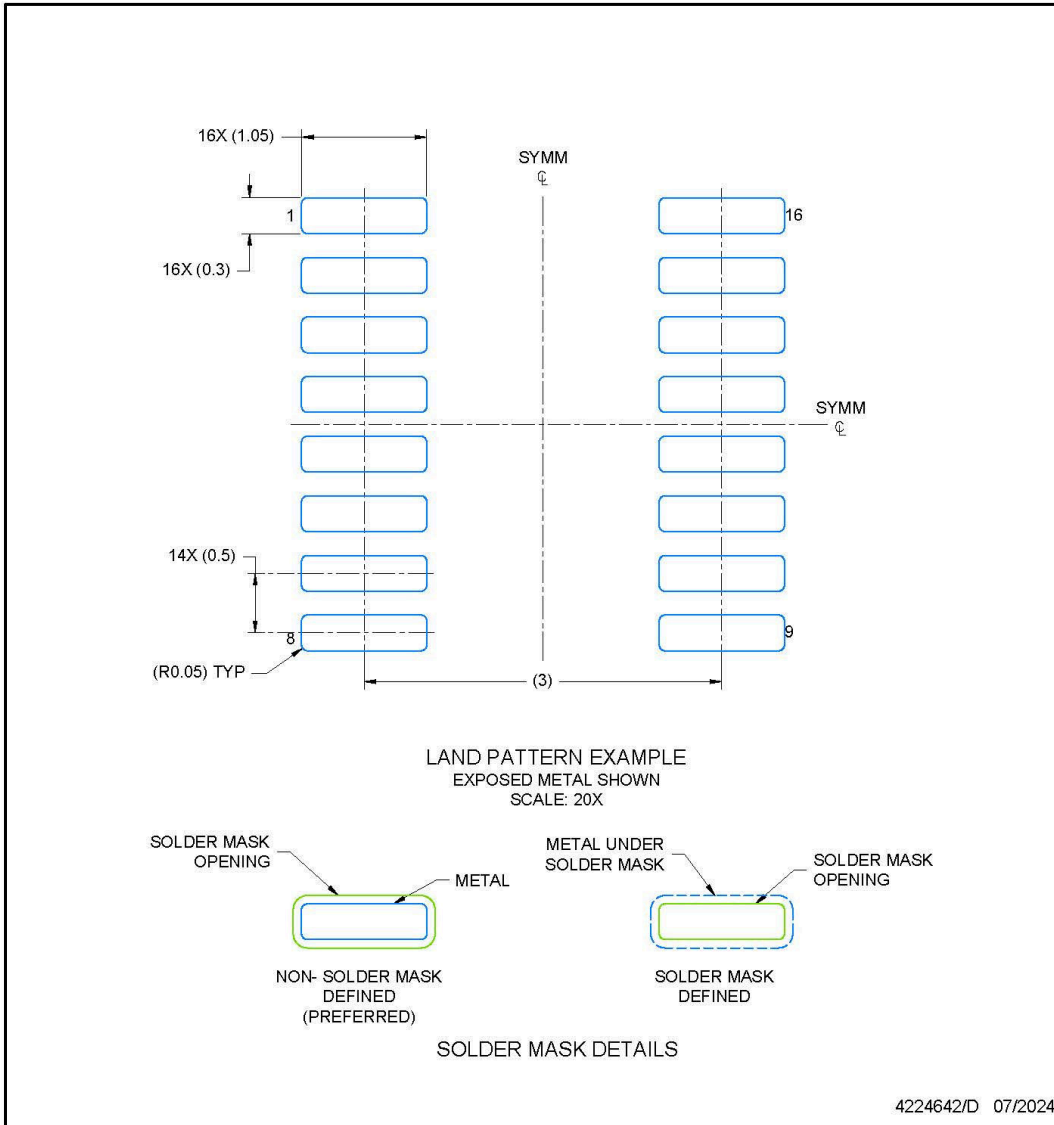
NOTES: (continued)

4. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.

DYY0016A

EXAMPLE BOARD LAYOUT
SOT-23-THIN - 1.1 mm max height

PLASTIC SMALL OUTLINE



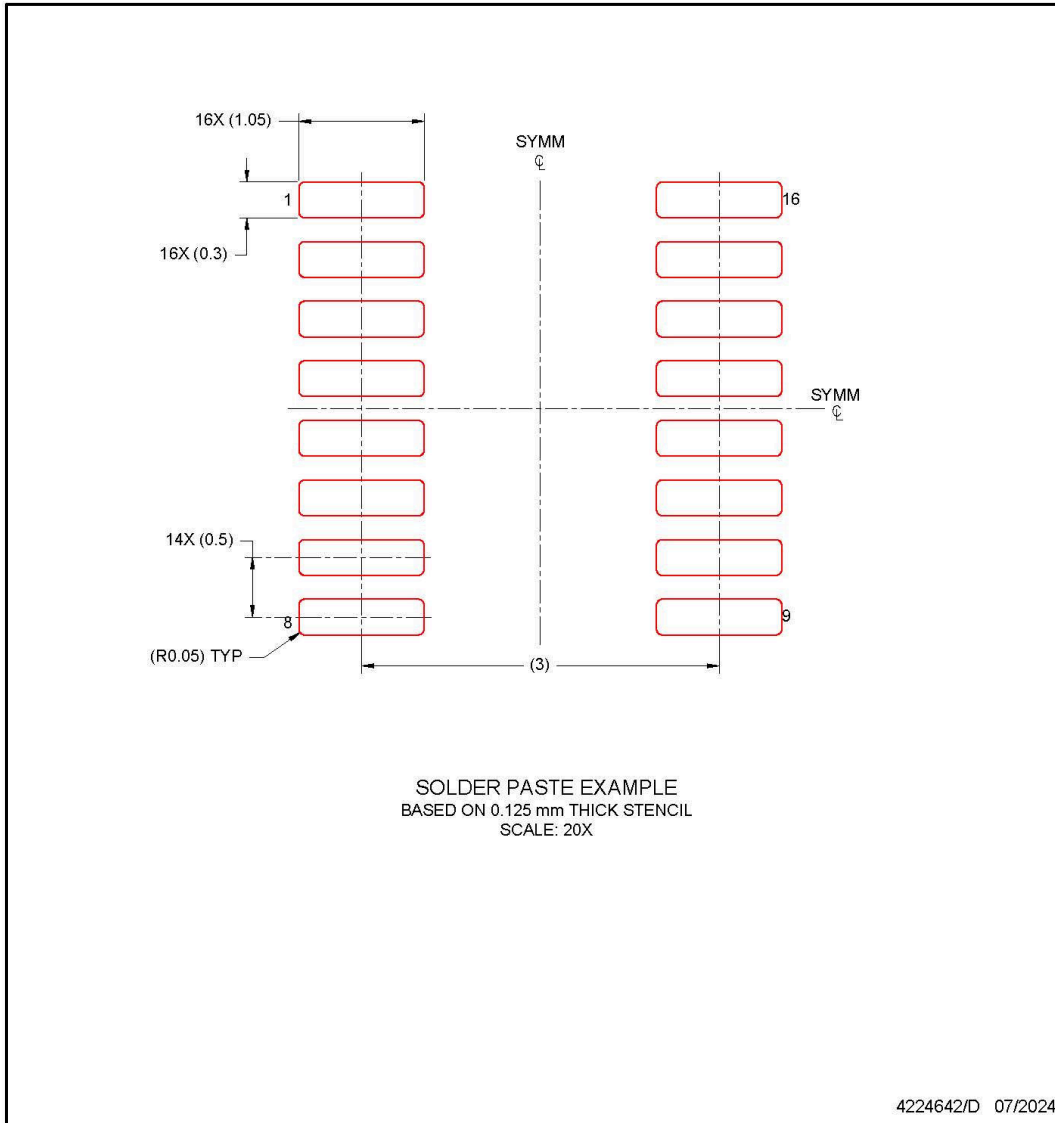
NOTES: (continued)

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

DYY0016A

**EXAMPLE STENCIL DESIGN
SOT-23-THIN - 1.1 mm max height**

PLASTIC SMALL OUTLINE



NOTES: (continued)

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

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)
TLC69631QDYRQ1	Active	Production	SOT-23-THIN (DYY) 16	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	69631Q1

(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.

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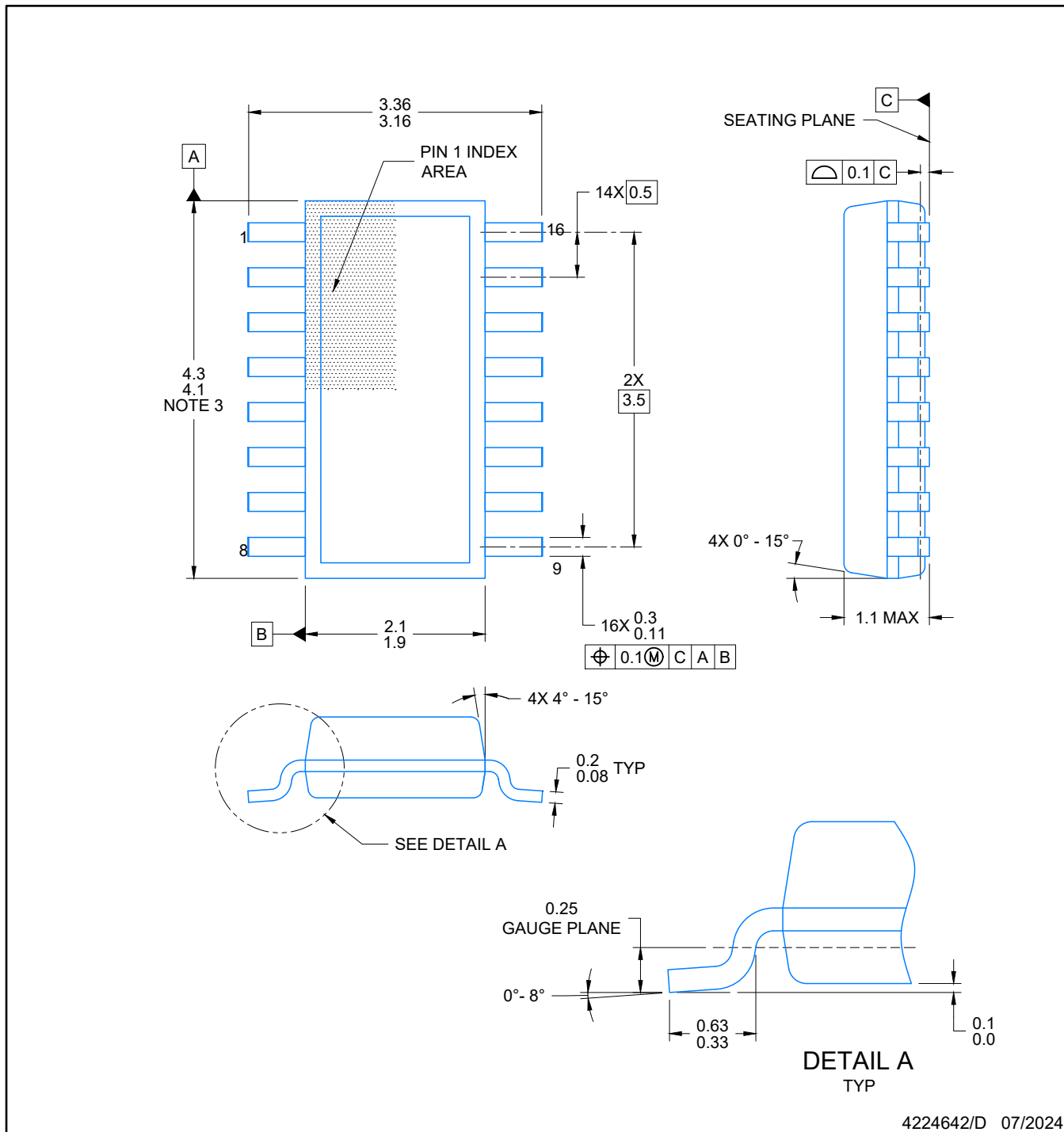
(5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will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

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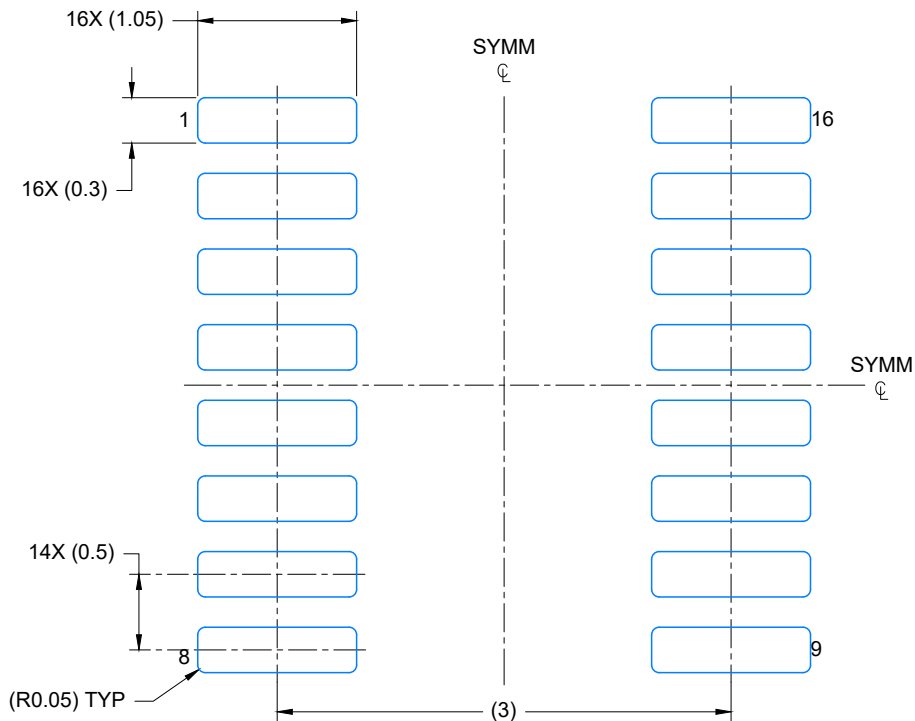
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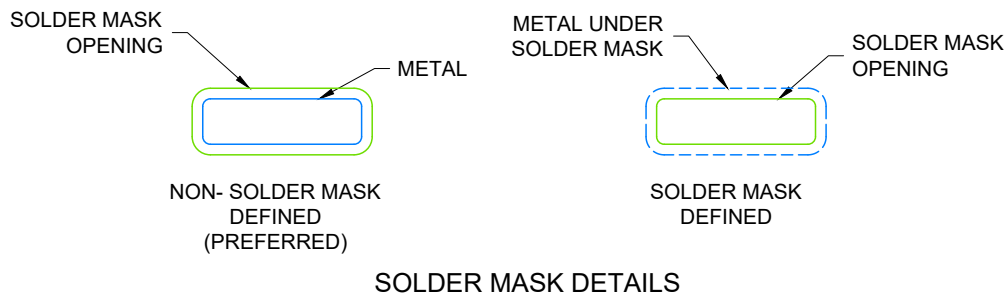
4224642/D 07/2024

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. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.50 per side.
5. Reference JEDEC Registration MO-345, Variation AA



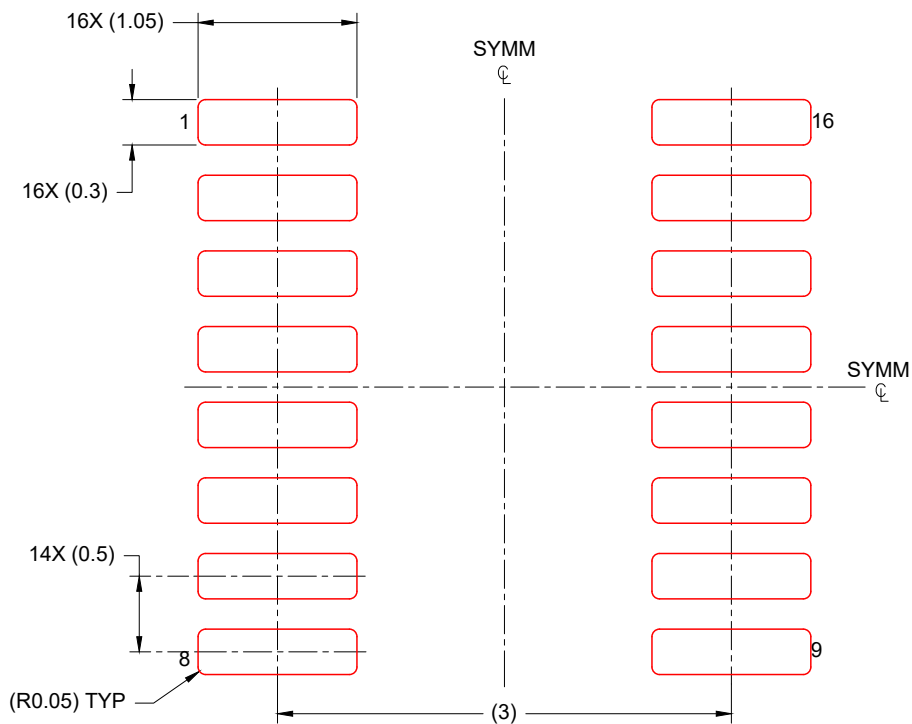
LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 20X



4224642/D 07/2024

NOTES: (continued)

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



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE: 20X

4224642/D 07/2024

NOTES: (continued)

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

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Last updated 10/2025