

TLC69612QPWPRQ1 Datasheet



<https://www.DiGi-Electronics.com>

DiGi Electronics Part Number	TLC69612QPWPRQ1-DG
Manufacturer	Texas Instruments
Manufacturer Product Number	TLC69612QPWPRQ1
Description	IC
Detailed Description	LED Driver IC 16 Output Linear Shift Register PWM Dimming 60mA 28-HTSSOP



Tel: +00 852-30501935

RFQ Email: Info@DiGi-Electronics.com

DiGi is a global authorized distributor of electronic components.

Purchase and inquiry

Manufacturer Product Number:

TLC69612QPWRQ1

Series:

-

Type:

Linear

Internal Switch(s):

No

Voltage - Supply (Min):

3V

Voltage - Output:

20V

Frequency:

-

Applications:

Backlight

Grade:

Automotive

Mounting Type:

Surface Mount

Supplier Device Package:

28-HTSSOP

Manufacturer:

Texas Instruments

Product Status:

Active

Topology:

Shift Register

Number of Outputs:

16

Voltage - Supply (Max):

5.5V

Current - Output / Channel:

60mA

Dimming:

PWM

Operating Temperature:

-40°C ~ 125°C (TA)

Qualification:

AEC-Q100

Package / Case:

28-PowerTSSOP (0.173", 4.40mm Width)

TLC696x1-Q1 16-Channel, Automotive Local Dimming Backlight LED Driver

1 Features

- AEC-Q100 qualified for automotive applications:
 - Device temperature grade 1: -40°C to $+125^{\circ}\text{C}$, T_A
 - Device HBM ESD classification level 2
 - Device CDM ESD classification level C4B
- Functional Safety-Capable:
 - Documentation available to aid functional safety system design
- Operating voltage V_{CC} range: 3V to 5.5V
- 16 constant current sinks with high precision:
 - Maximum output current / voltage:
 - 30mA / 20V: TLC69601-Q1
 - 60mA / 20V: TLC69611-Q1
 - 30mA / 50V: TLC69651-Q1
 - 60mA / 50V: TLC69661-Q1
 - Device-to-device error: $\pm 2\%$ (typ.)
 - Channel-to-channel error: $\pm 2\%$ (typ.)
- Flexible dimming control:
 - Global 8-bit Maximum Current (MC) setting
 - Brightness resolution: up to 15-bit
 - PWM / hybrid control mode
- High speed daisy chain interface:
 - I/O voltage compatible with: 1.8V / 3.3V
 - Data transfer rate: up to 20MHz
- High system efficiency:
 - Adaptive headroom voltage control (AHVC)
 - Ultra-low device power consumption:
 - Standby mode: $I_{CC} \leq 200\mu\text{A}$
 - Normal mode: $I_{CC} \leq 3.5\text{mA}$
- EMI enhancement:
 - Programmable interface driving capability
 - Integrated 4 phase-shifting schemes
- Diagnostics:
 - LED open / short detection for each zone
 - Device thermal shutdown detection
 - Report interface option:
 - UART and interrupt pin (INT)
 - Two-wire output: CLK_O and SOUT

2 Applications

- LCD local dimming backlight:
 - Automotive central information display
 - Automotive cluster display
 - Automotive heads-up display

3 Description

TLC696x1-Q1 is a 16-channel, constant current sink driver. Each device integrates 16 constant current sinks with SRAM for brightness storage. The device connects to each other by two-wire serial interface in daisy chain topology and supports up to 1024 devices for 16,000 local dimming zones.

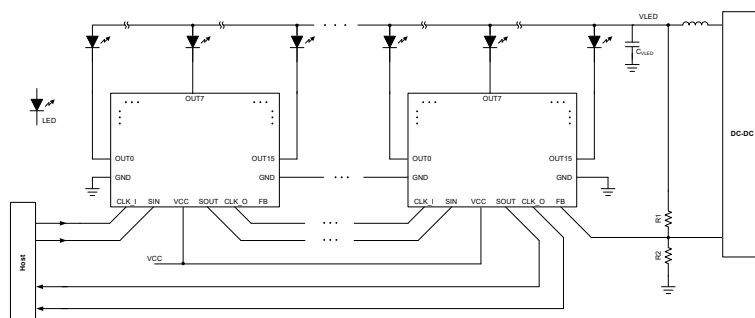
To optimize system efficiency, the device is equipped with adaptive headroom voltage control scheme to directly control DC/DC. Only the FB pin from last device in serial chain should be connected to DC/DC to achieve simplified system layout. The device also integrates minimum brightness update latency, black insertion and VRR features to improve display quality.

TLC696x1-Q1 has three error flags: LED open detection (LOD), LED short detection (LSD) and thermal shutdown detection (TSD) for diagnostic. The device implements two options for readback including UART/INT and SOUT/CLK_O which is programmable by register.

Device Information

PART NUMBER	PACKAGE ⁽¹⁾	BODY SIZE (NOM)
TLC696x1-Q1	WQFN (24) Wettable flank	4mm × 4mm
	HTSSOP (28)	9.7mm × 4.4mm

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



Simplified Schematic



Table of Contents

1 Features	1	4.3 Trademarks.....	3
2 Applications	1	4.4 Electrostatic Discharge Caution.....	3
3 Description	1	4.5 Glossary.....	3
4 Device and Documentation Support	3	5 Revision History	3
4.1 Receiving Notification of Documentation Updates.....	3	6 Mechanical, Packaging, and Orderable Information	4
4.2 Support Resources.....	3		

4 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.

4.1 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on [ti.com](https://www.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.

4.2 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.

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](#).

4.3 Trademarks

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

4.4 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.

4.5 Glossary

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

5 Revision History

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

DATE	REVISION	NOTES
June 2023	*	Initial Release

6 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.

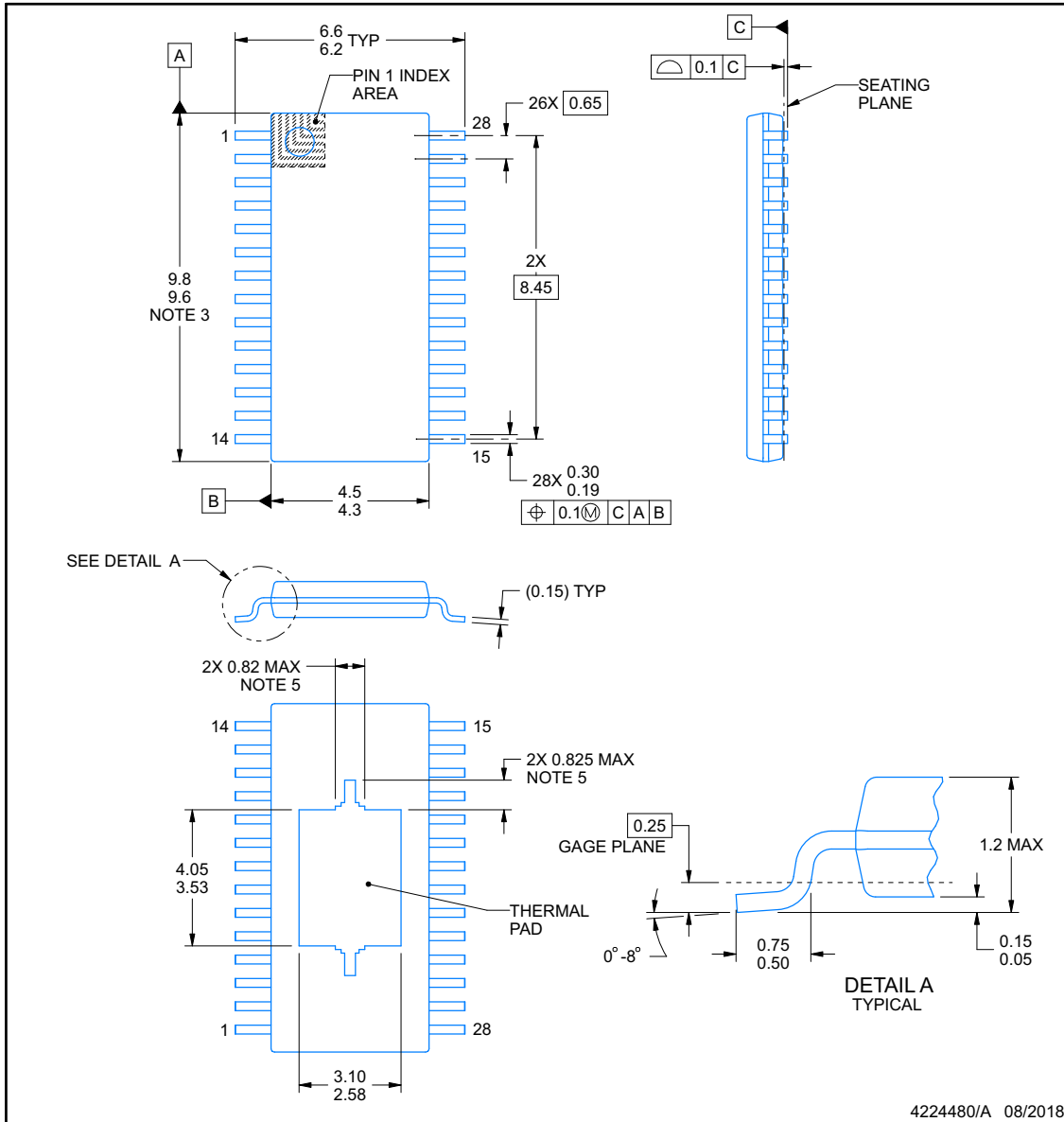


PACKAGE OUTLINE

PWP0028M

PowerPAD™ TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



4224480/A 08/2018

NOTES:

PowerPAD is a trademark of Texas Instruments.

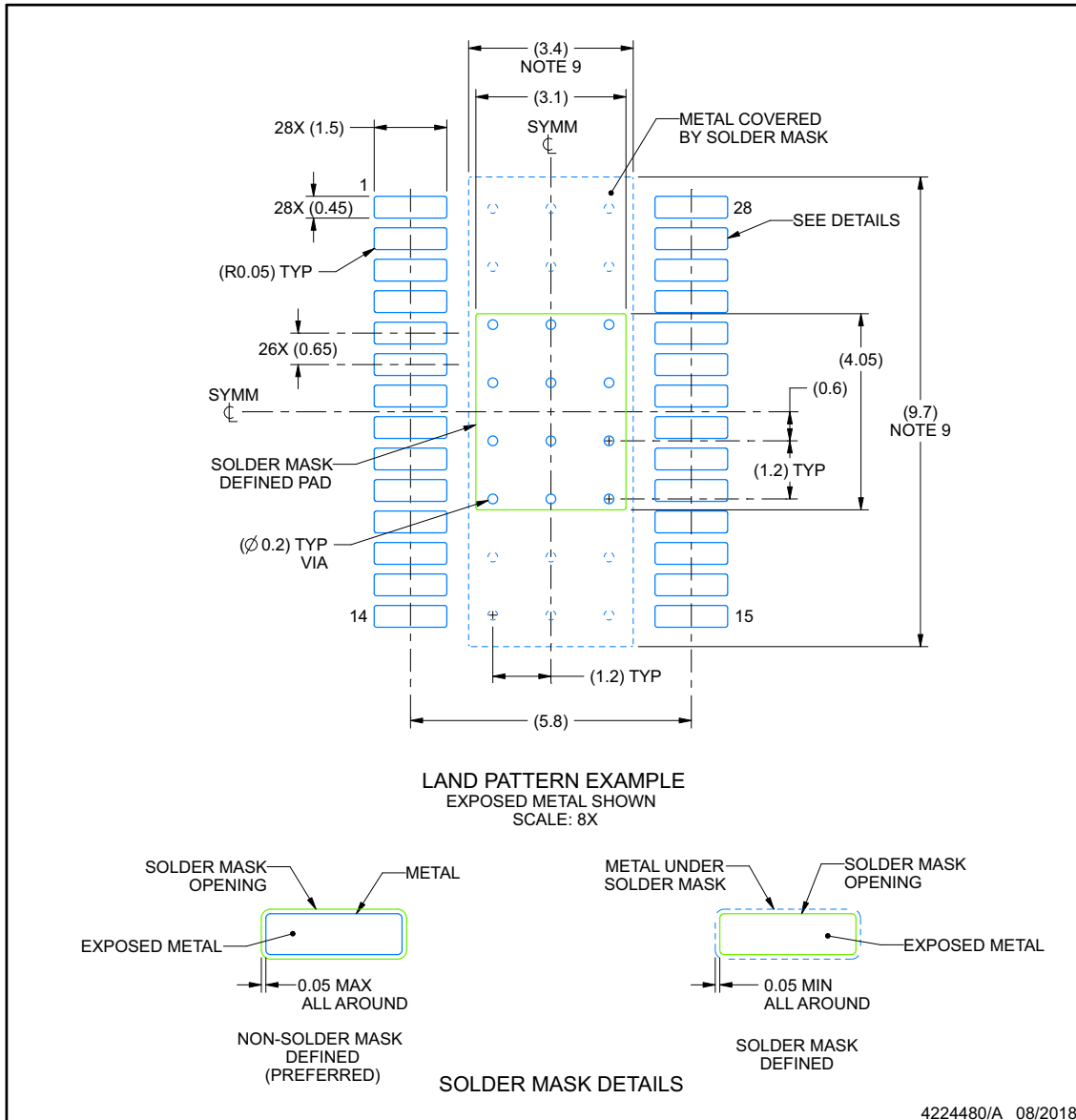
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. Reference JEDEC registration MO-153.
5. Features may differ or may not be present.

EXAMPLE BOARD LAYOUT

PWP0028M

PowerPAD™ TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



NOTES: (continued)

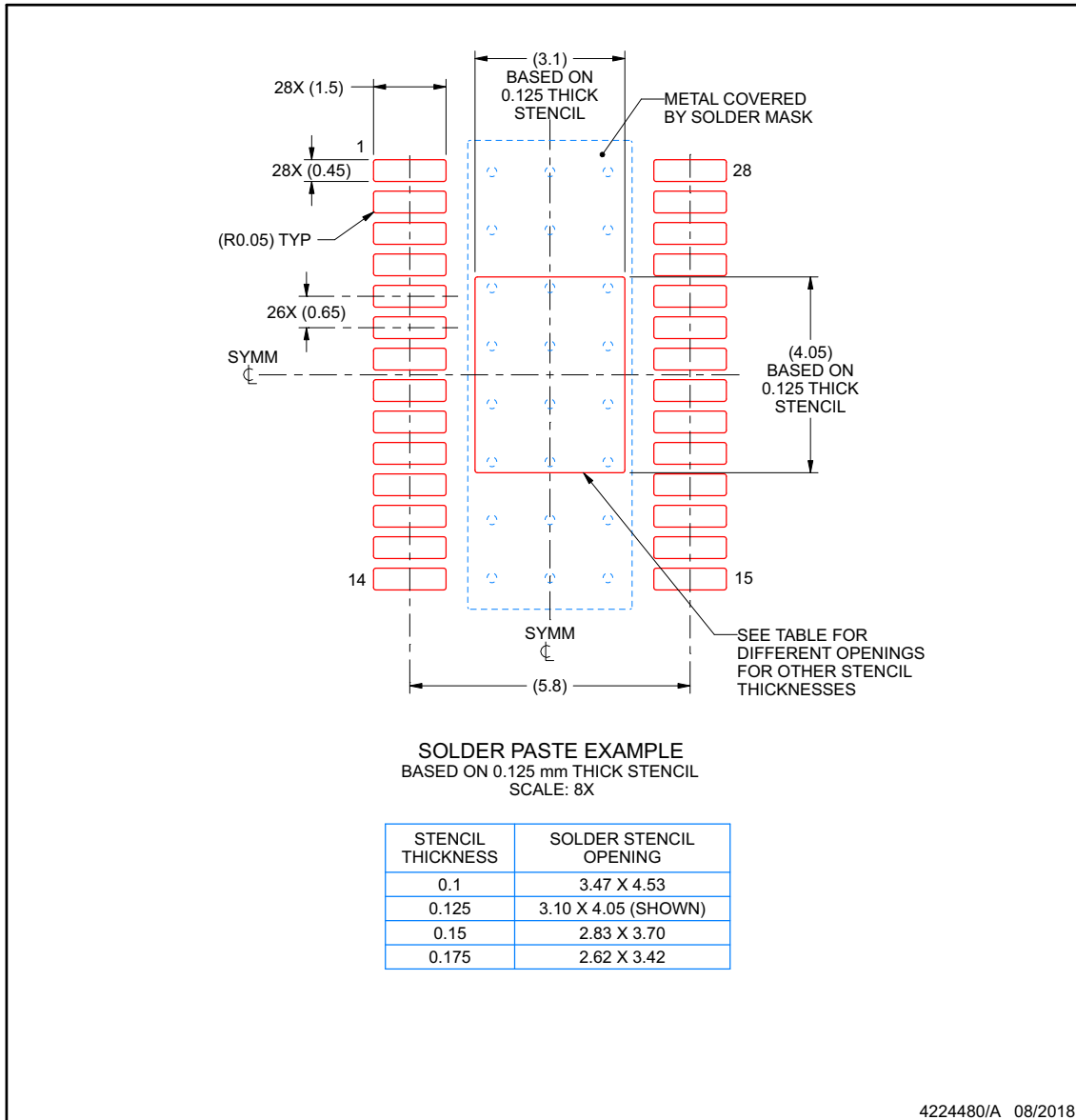
6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.
8. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature numbers SLMA002 (www.ti.com/lit/slma002) and SLMA004 (www.ti.com/lit/slma004).
9. Size of metal pad may vary due to creepage requirement.
10. Vias are optional depending on application, refer to device data sheet. It is recommended that vias under paste be filled, plugged or tented.

EXAMPLE STENCIL DESIGN

PWP0028M

PowerPAD™ TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE

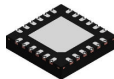


NOTES: (continued)

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

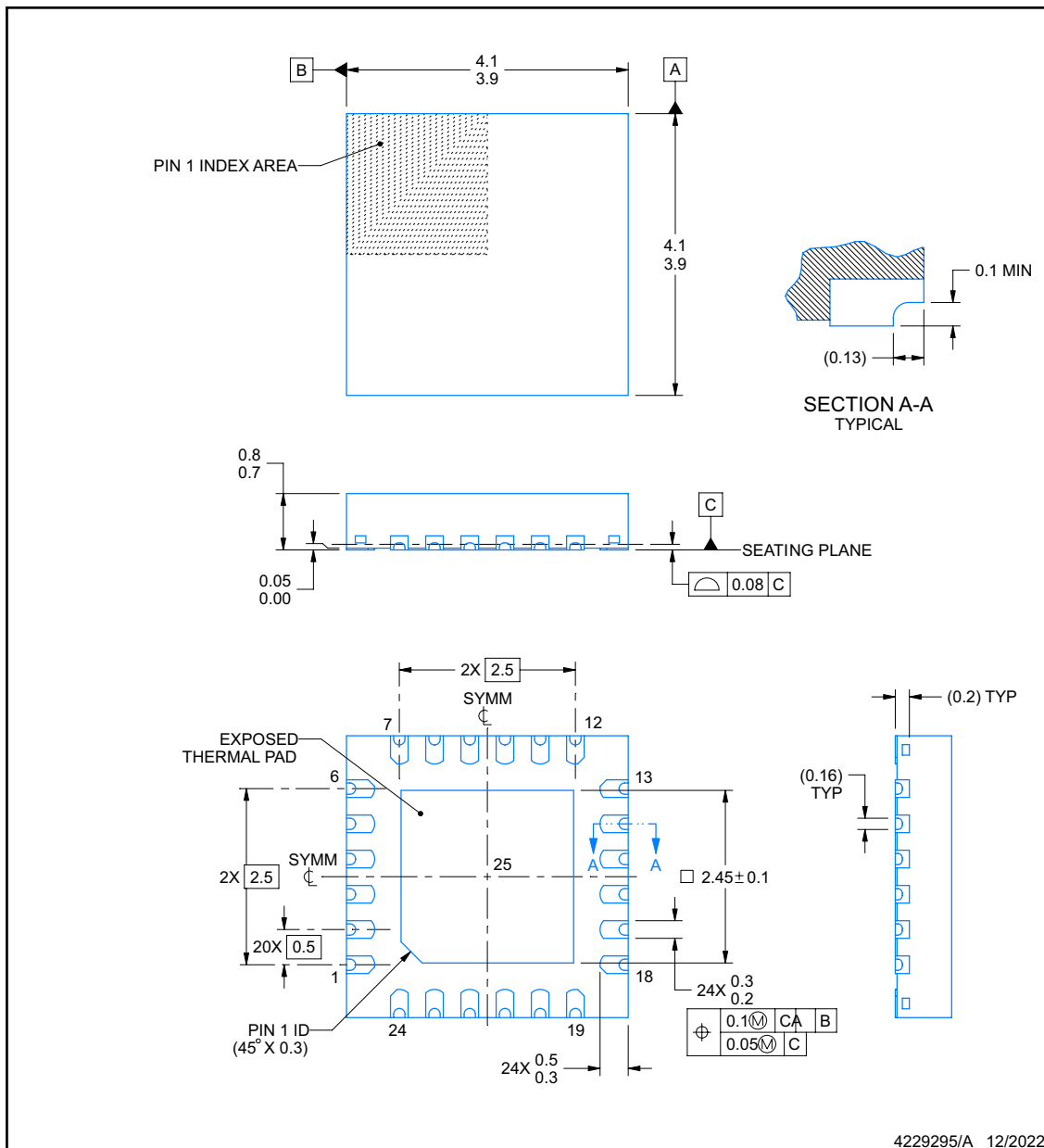
PACKAGE OUTLINE

RTW0024N



WQFN - 0.8 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



NOTES:

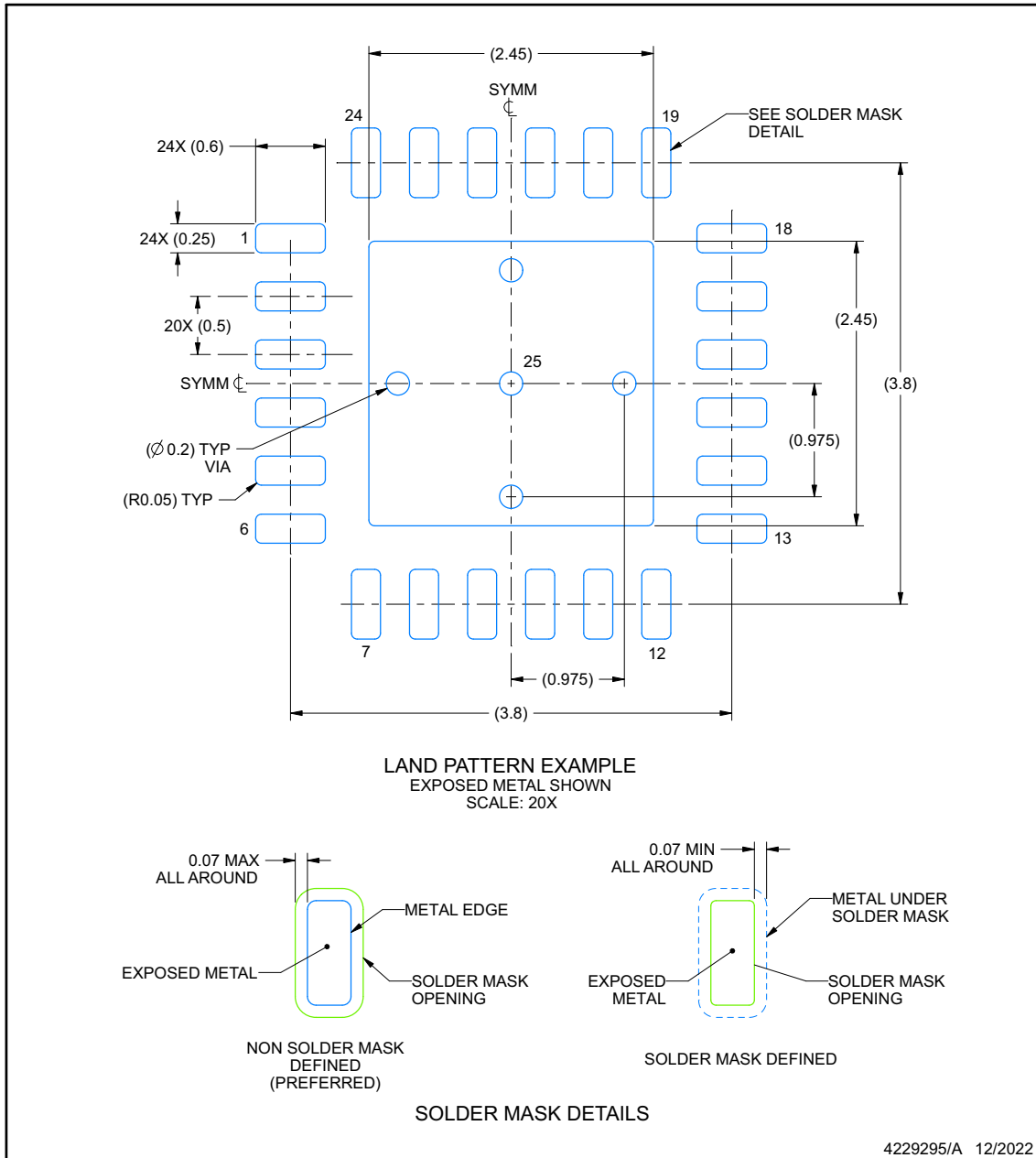
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.

EXAMPLE BOARD LAYOUT

RTW0024N

WQFN - 0.8 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



NOTES: (continued)

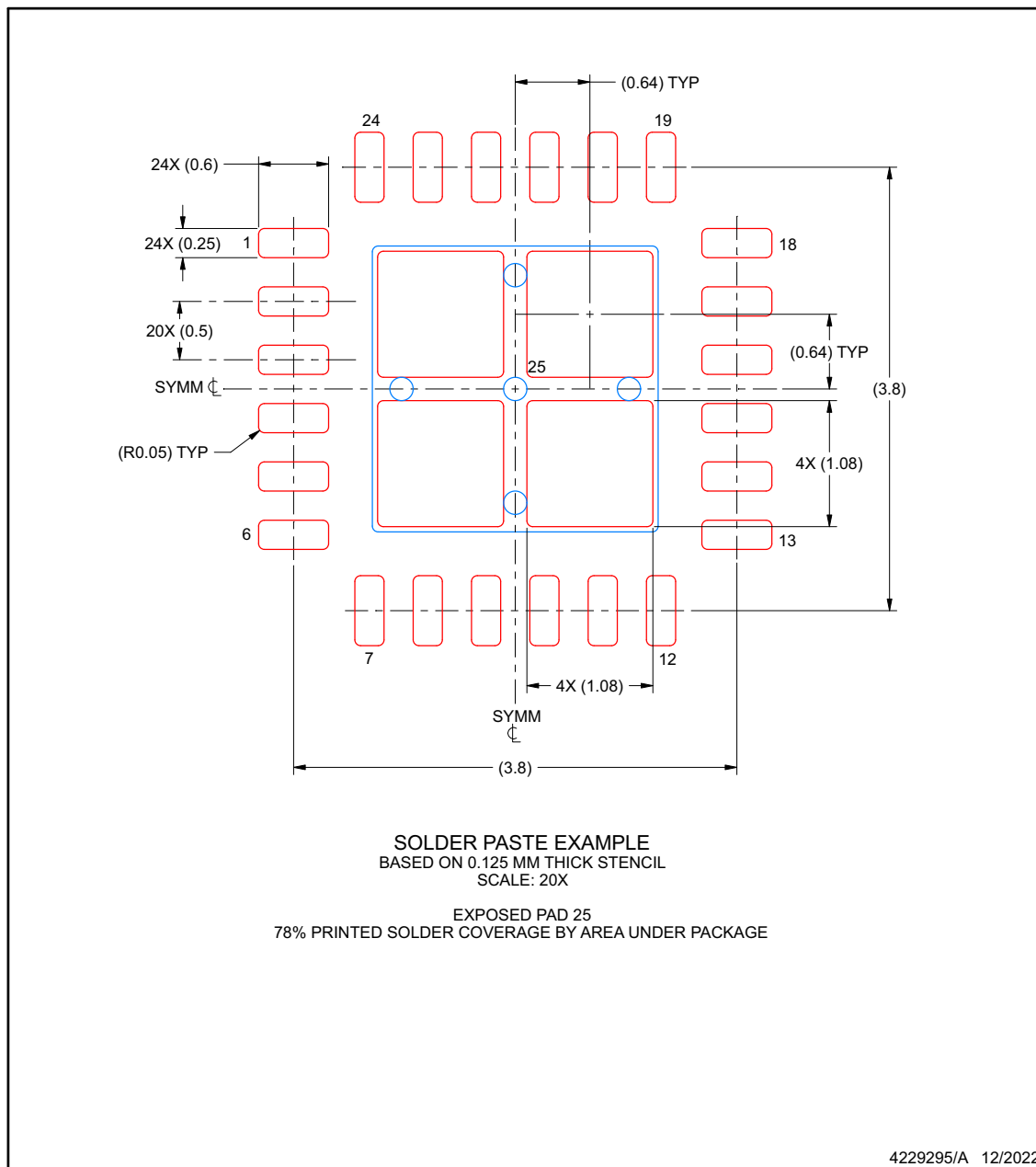
- This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/slua271).
- Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.

EXAMPLE STENCIL DESIGN

RTW0024N

WQFN - 0.8 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



NOTES: (continued)

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

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
TLC69601QPWRQ1	ACTIVE	HTSSOP	PWP	28	2000	RoHS & Green	NIPDAU	Level-3-260C-168 HR	-40 to 125	69601Q	Samples
TLC69601QRTWRQ1	ACTIVE	WQFN	RTW	24	3000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	69601Q	Samples
TLC69611QPWRQ1	ACTIVE	HTSSOP	PWP	28	2000	RoHS & Green	NIPDAU	Level-3-260C-168 HR	-40 to 125	69611Q	Samples
TLC69611QRTWRQ1	ACTIVE	WQFN	RTW	24	3000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	69611Q	Samples
TLC69651QPWRQ1	ACTIVE	HTSSOP	PWP	28	2000	RoHS & Green	NIPDAU	Level-3-260C-168 HR	-40 to 125	69651Q	Samples
TLC69651QRTWRQ1	ACTIVE	WQFN	RTW	24	3000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	69651Q	Samples
TLC69661QPWRQ1	ACTIVE	HTSSOP	PWP	28	2000	RoHS & Green	NIPDAU	Level-3-260C-168 HR	-40 to 125	69661Q	Samples
TLC69661QRTWRQ1	ACTIVE	WQFN	RTW	24	3000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	69661Q	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.

Important Information and Disclaimer:The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and 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.

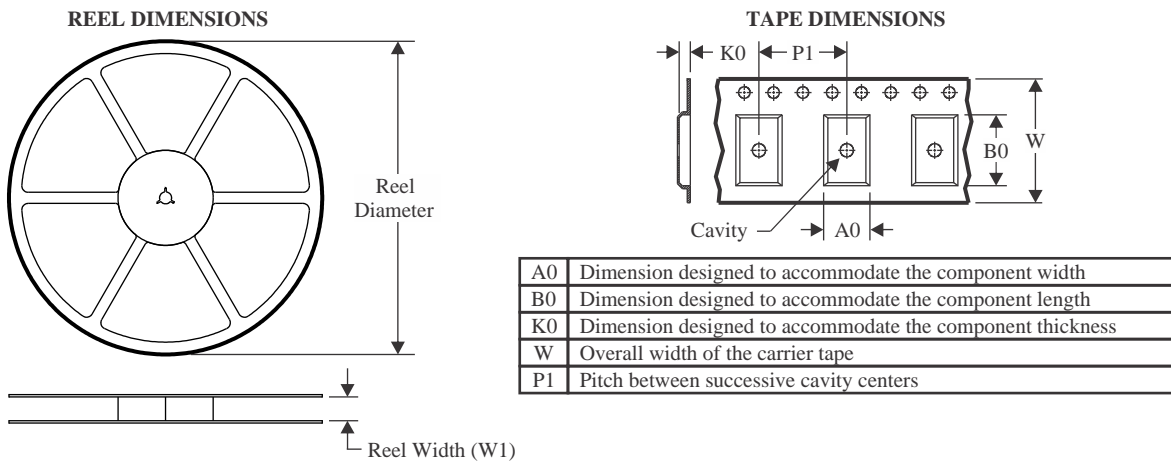
OTHER QUALIFIED VERSIONS OF TLC69601-Q1, TLC69611-Q1, TLC69651-Q1, TLC69661-Q1 :

- Catalog : [TLC69601](#), [TLC69611](#), [TLC69651](#), [TLC69661](#)

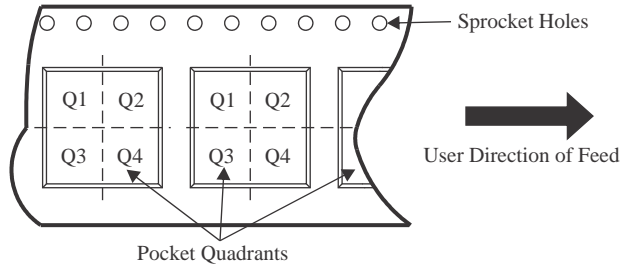
NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product

TAPE AND REEL INFORMATION



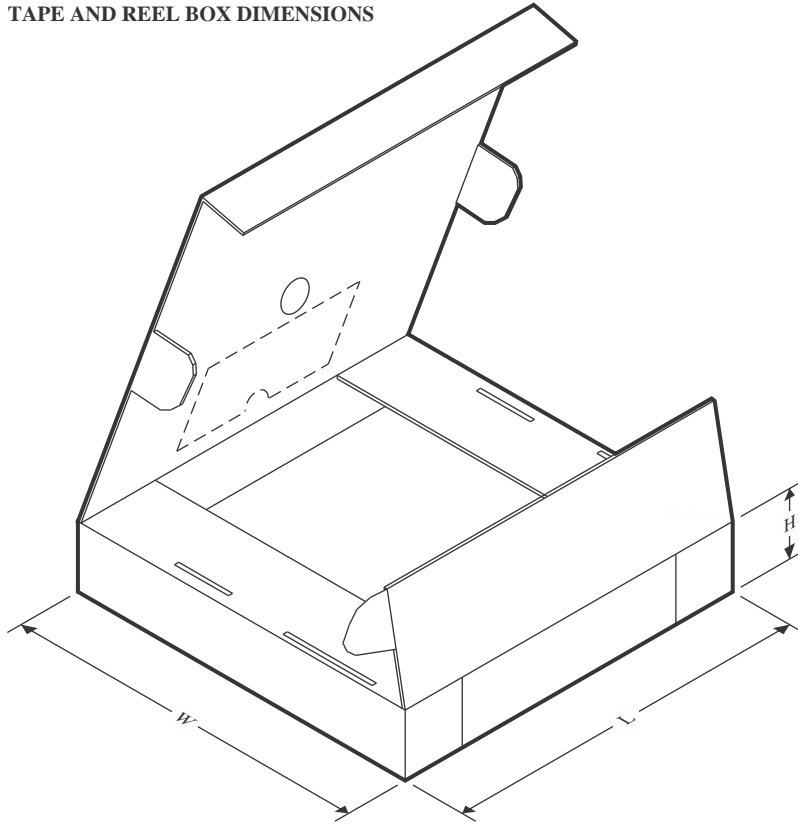
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

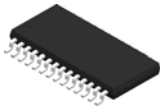
Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
TLC69601QPWPRQ1	HTSSOP	PWP	28	2000	330.0	16.4	6.9	10.2	1.8	12.0	16.0	Q1
TLC69601QRTWRQ1	WQFN	RTW	24	3000	330.0	12.4	4.25	4.25	1.15	8.0	12.0	Q2
TLC69611QPWPRQ1	HTSSOP	PWP	28	2000	330.0	16.4	6.9	10.2	1.8	12.0	16.0	Q1
TLC69611QRTWRQ1	WQFN	RTW	24	3000	330.0	12.4	4.25	4.25	1.15	8.0	12.0	Q2
TLC69651QPWPRQ1	HTSSOP	PWP	28	2000	330.0	16.4	6.9	10.2	1.8	12.0	16.0	Q1
TLC69651QRTWRQ1	WQFN	RTW	24	3000	330.0	12.4	4.25	4.25	1.15	8.0	12.0	Q2
TLC69661QPWPRQ1	HTSSOP	PWP	28	2000	330.0	16.4	6.9	10.2	1.8	12.0	16.0	Q1
TLC69661QRTWRQ1	WQFN	RTW	24	3000	330.0	12.4	4.25	4.25	1.15	8.0	12.0	Q2

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TLC69601QPWPRQ1	HTSSOP	PWP	28	2000	356.0	356.0	35.0
TLC69601QRTWRQ1	WQFN	RTW	24	3000	367.0	367.0	35.0
TLC69611QPWPRQ1	HTSSOP	PWP	28	2000	356.0	356.0	35.0
TLC69611QRTWRQ1	WQFN	RTW	24	3000	367.0	367.0	35.0
TLC69651QPWPRQ1	HTSSOP	PWP	28	2000	356.0	356.0	35.0
TLC69651QRTWRQ1	WQFN	RTW	24	3000	367.0	367.0	35.0
TLC69661QPWPRQ1	HTSSOP	PWP	28	2000	356.0	356.0	35.0
TLC69661QRTWRQ1	WQFN	RTW	24	3000	367.0	367.0	35.0

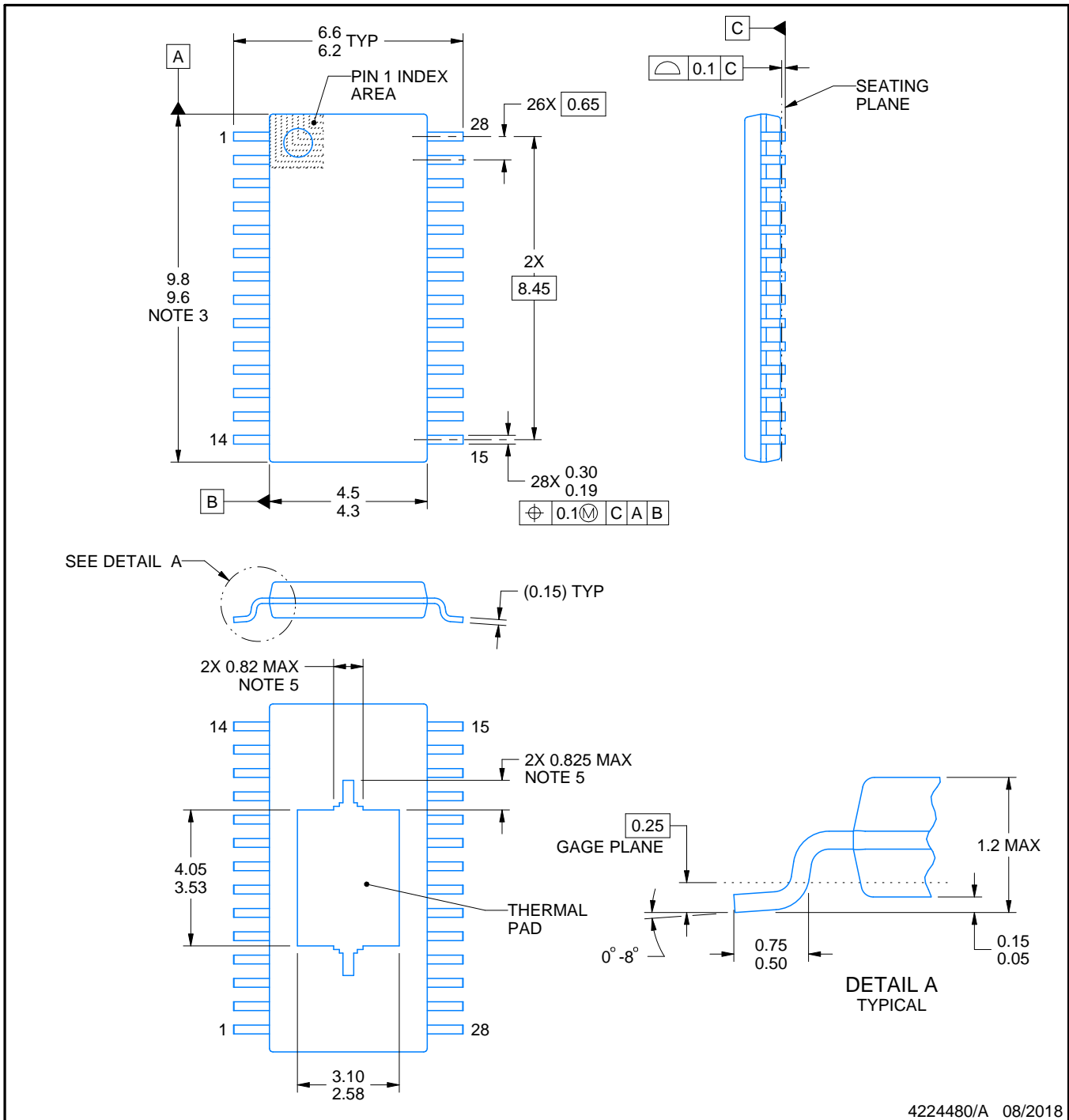


PACKAGE OUTLINE

PWP0028M

PowerPAD™ TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



4224480/A 08/2018

NOTES:

PowerPAD is a trademark of Texas Instruments.

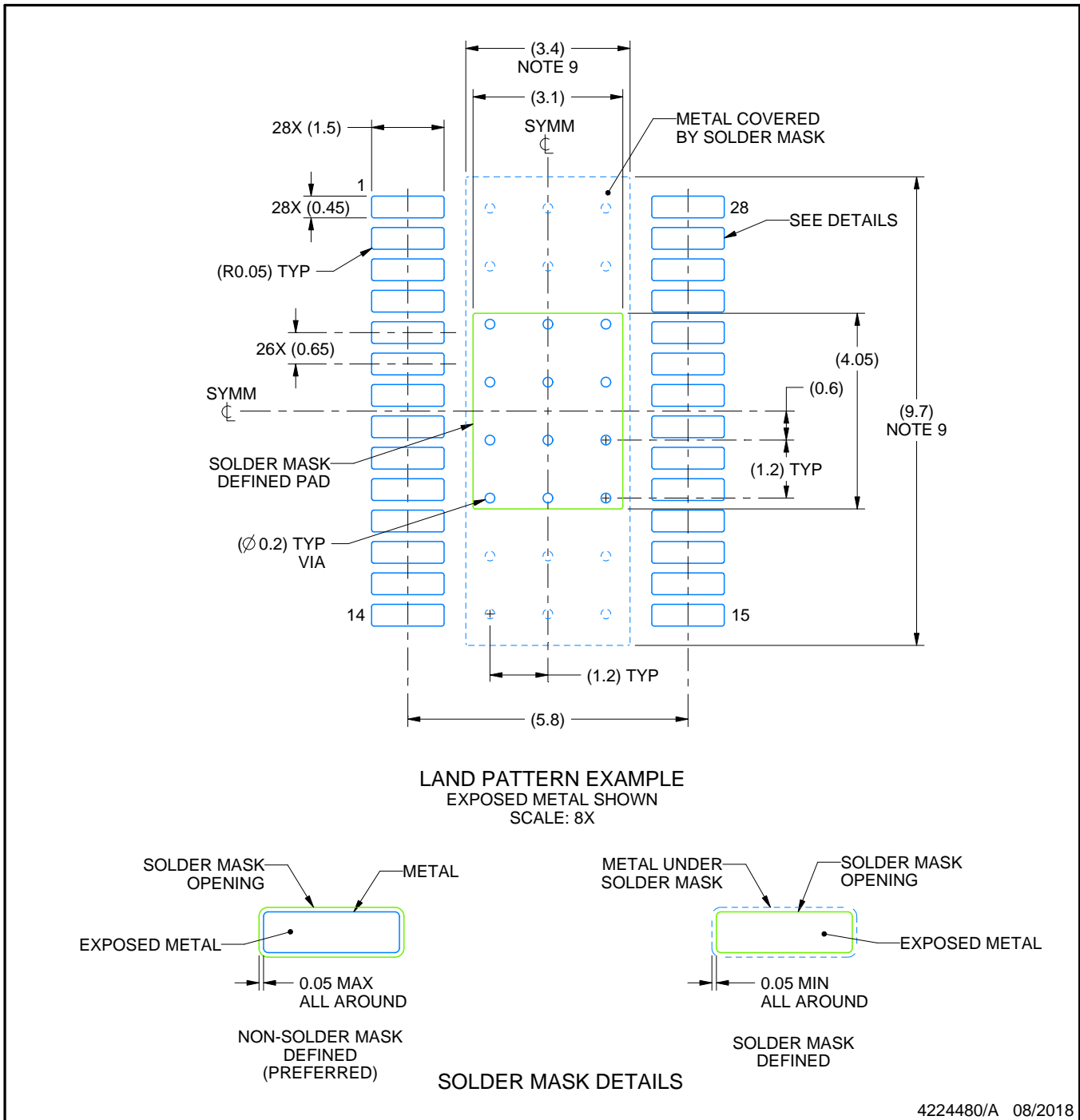
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. Reference JEDEC registration MO-153.
5. Features may differ or may not be present.

EXAMPLE BOARD LAYOUT

PWP0028M

PowerPAD™ TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



NOTES: (continued)

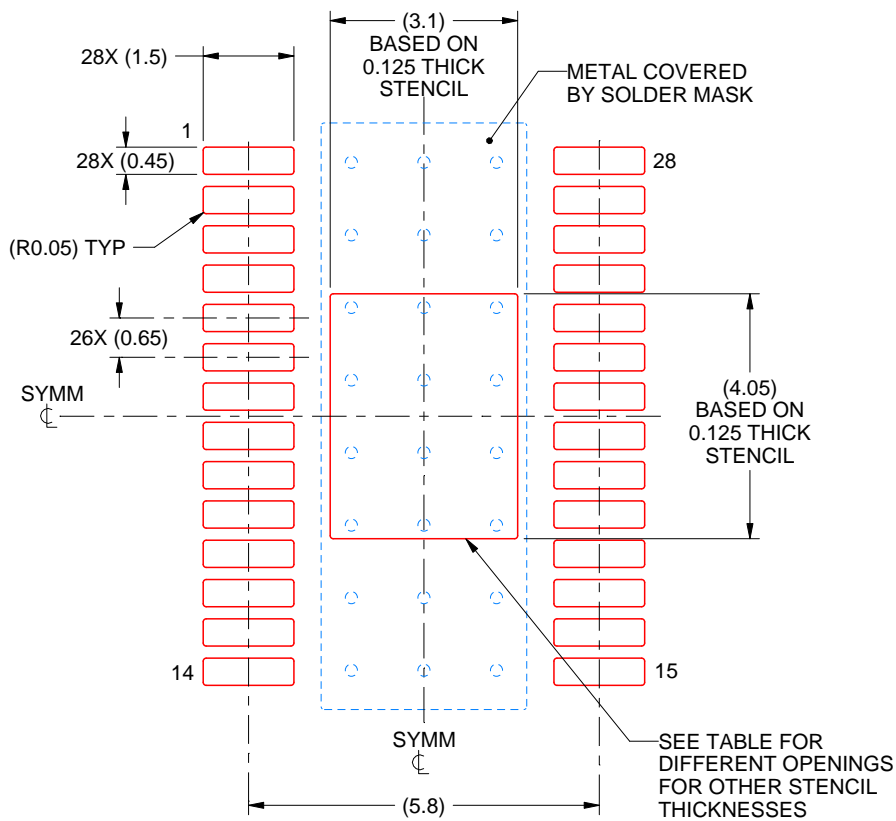
6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.
8. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature numbers SLMA002 (www.ti.com/lit/slma002) and SLMA004 (www.ti.com/lit/slma004).
9. Size of metal pad may vary due to creepage requirement.
10. Vias are optional depending on application, refer to device data sheet. It is recommended that vias under paste be filled, plugged or tented.

EXAMPLE STENCIL DESIGN

PWP0028M

PowerPAD™ TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



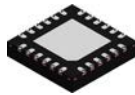
SOLDER PASTE EXAMPLE
 BASED ON 0.125 mm THICK STENCIL
 SCALE: 8X

STENCIL THICKNESS	SOLDER STENCIL OPENING
0.1	3.47 X 4.53
0.125	3.10 X 4.05 (SHOWN)
0.15	2.83 X 3.70
0.175	2.62 X 3.42

4224480/A 08/2018

NOTES: (continued)

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

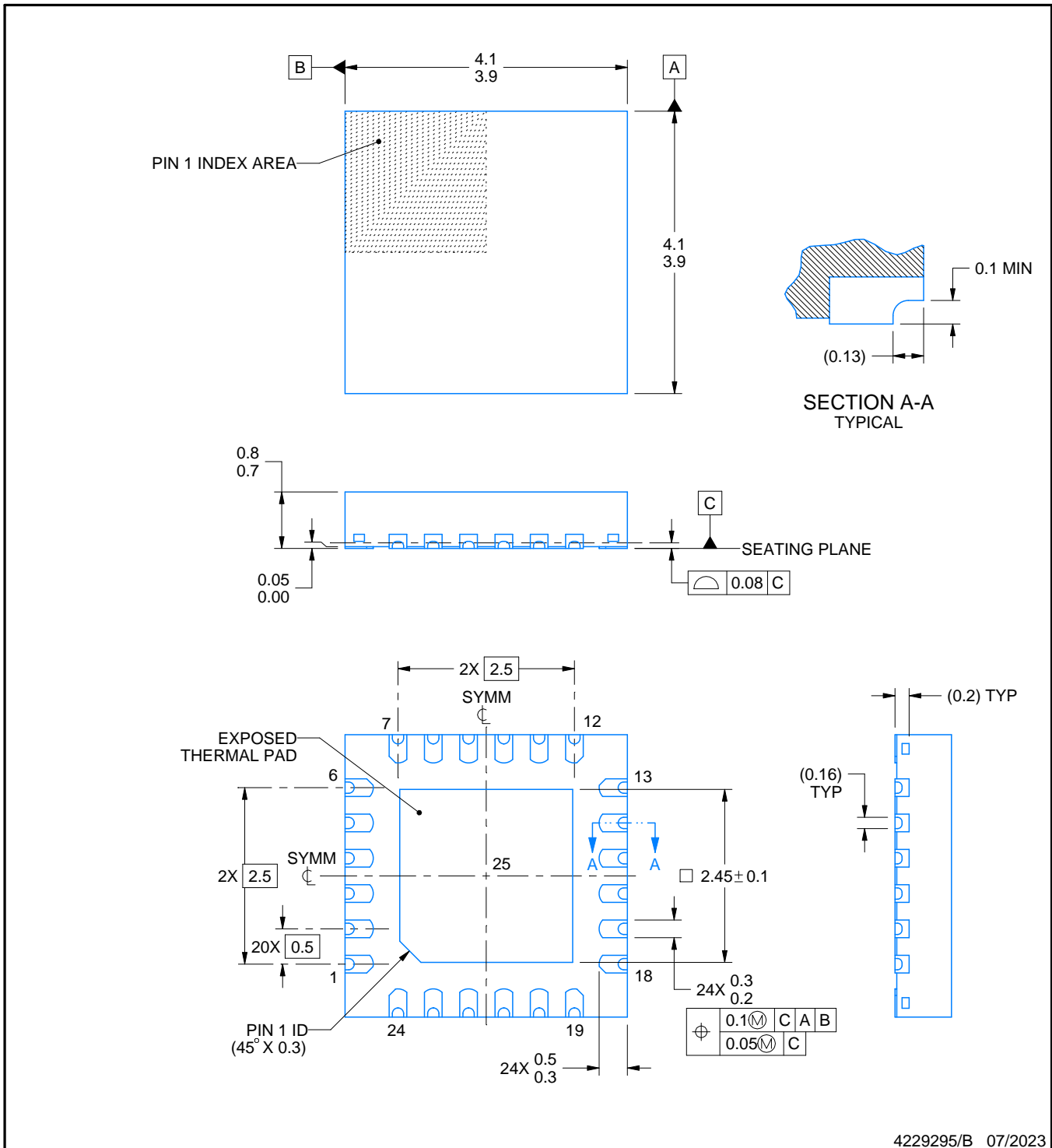


PACKAGE OUTLINE

RTW0024N

WQFN - 0.8 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



4229295/B 07/2023

NOTES:

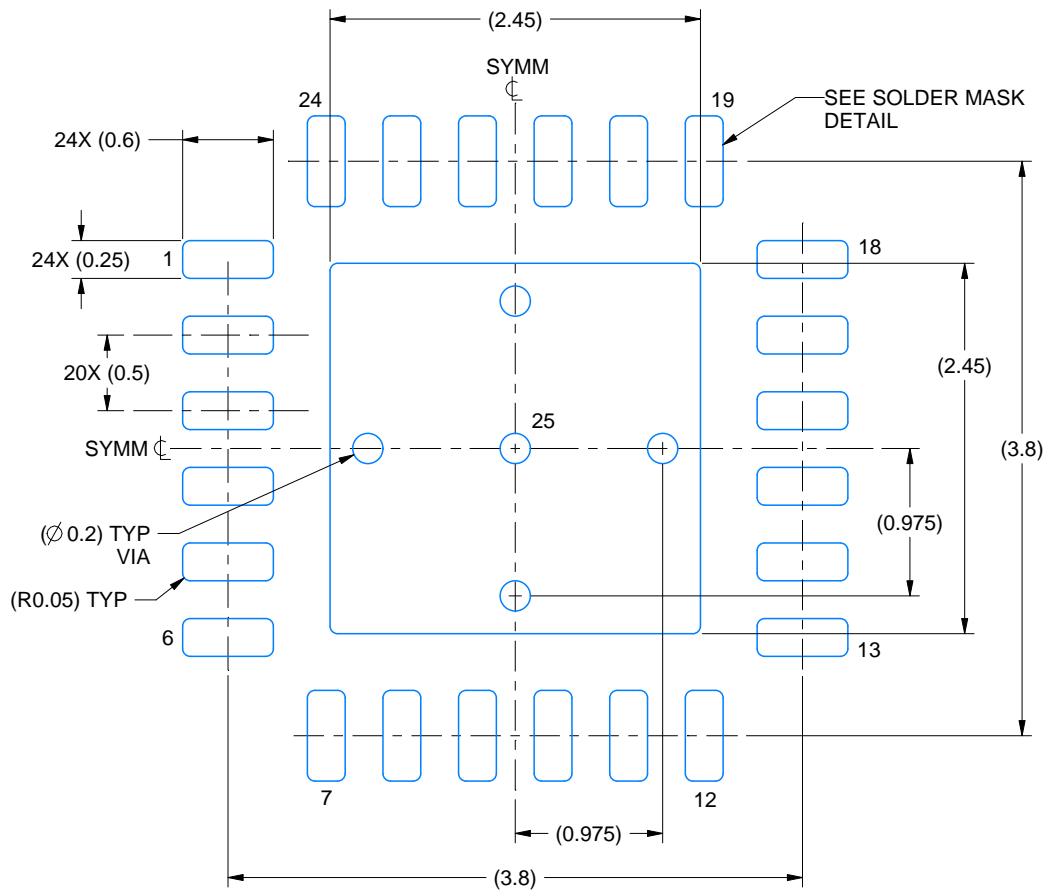
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.
4. Reference JEDEC registration MO-220. For wettable flank, reference IPC document IPC-7093.

EXAMPLE BOARD LAYOUT

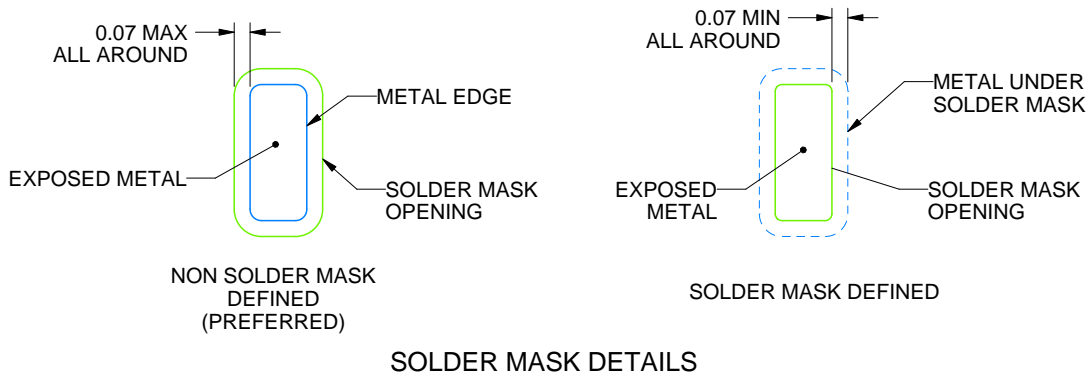
RTW0024N

WQFN - 0.8 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 20X



SOLDER MASK DETAILS

4229295/B 07/2023

NOTES: (continued)

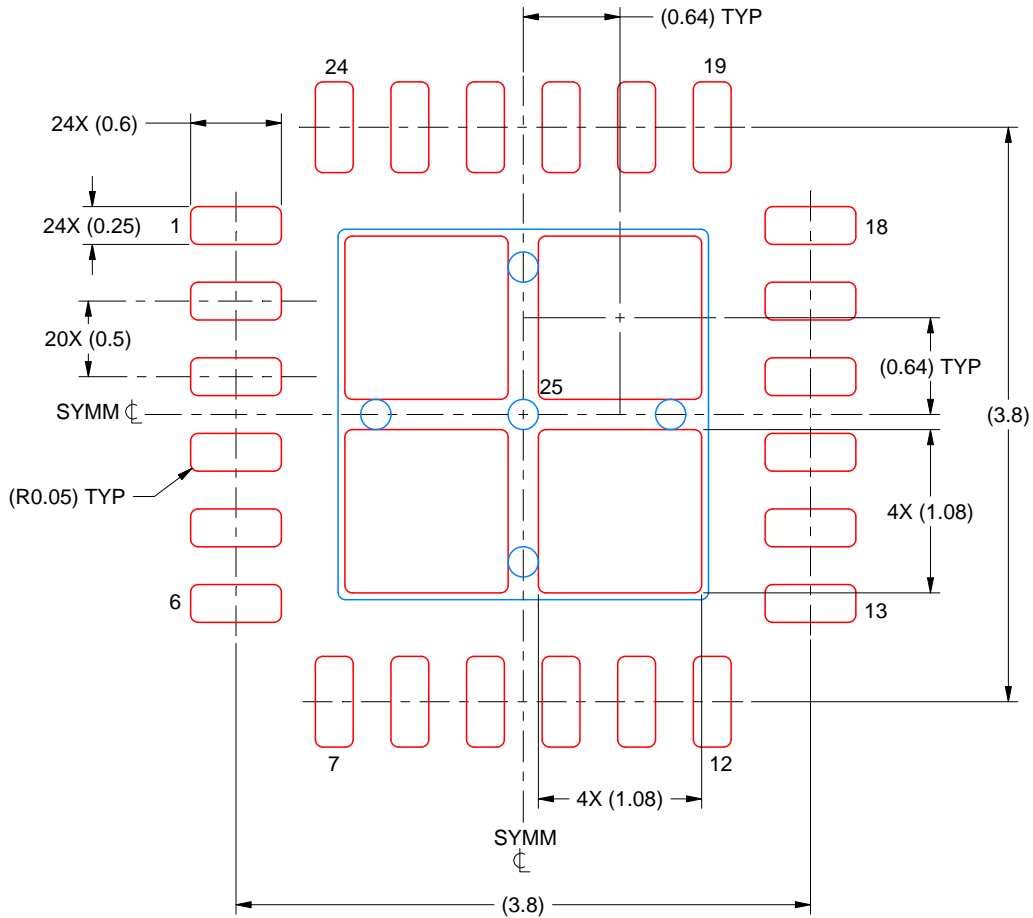
5. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/sluea271).
6. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.

EXAMPLE STENCIL DESIGN

RTW0024N

WQFN - 0.8 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



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

EXPOSED PAD 25
 78% PRINTED SOLDER COVERAGE BY AREA UNDER PACKAGE

4229295/B 07/2023

NOTES: (continued)

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

IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATA SHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, regulatory or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to [TI's Terms of Sale](#) or other applicable terms available either on [ti.com](https://www.ti.com) or provided in conjunction with such TI products. TI's provision of these resources does not expand or otherwise alter TI's applicable warranties or warranty disclaimers for TI products.

TI objects to and rejects any additional or different terms you may have proposed.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2024, Texas Instruments Incorporated

OUR CERTIFICATE

DiGi provide top-quality products and perfect service for customer worldwide through standardization, technological innovation and continuous improvement. DiGi through third-party certification, we strictly control the quality of products and services. Welcome your RFQ to

Email: Info@DiGi-Electronics.com



Tel: +00 852-30501935

RFQ Email: Info@DiGi-Electronics.com

DiGi is a global authorized distributor of electronic components.