TLC69699-Q1 Automotive SPI-Compatible Connectivity for TLC696xx-Q1 Device Family

1 Features

- AEC-Q100 qualified for automotive applications
  - Grade 1: –40°C to 125°C ambient temperature
  - Device HBM classification level H3A
  - Device CDM classification level C5
- Functional Safety-Capable:
  - Documentation available to aid functional safety system design
- Operating voltage V_{CC} range: 2.5V to 5.5V
- SPI peripheral
  - Data transfer rate up to 20MHz
  - Support multiple peripherals with one controller
- Continuous Clock Serial Interface (CCSI) Controller and Peripheral
  - Data transfer rate up to 20MHz
  - Programmable clock jitter for EMI enhancement
- Diagnostics
  - Open-drain FAULT pin
  - SPI communication loss detection
  - CRC for SPI communication
  - Continuous clock watchdog
  - CCSI data integrity
- Data ready interrupt for availability of data

2 Applications

- SPI compatible connectivity for TLC696x0/1/2/4/8-Q1

3 Description

The TLC69699-Q1 SPI-compatible connectivity enables TLC696xx-Q1 device family to be controlled using a standard SPI controller. The device features an internal oscillator to generate the continuous clock required by the TLC696xx-Q1 device family. Jitter can be added to the continuous clock for EMI enhancement. The transmitted data is aligned to the continuous clock to maintain the timing requirements of the CCSI interface.

TLC69699-Q1 incorporates reporting of faults in both the TLC696xx-Q1 daisy chain and TLC69699-Q1 internal. Data transmission of register and brightness to the TLC696xx-Q1 daisy chain is CRC protected by TLC69699-Q1. In addition, both the data and continuous clock lines are guarded by TLC69699-Q1 for stuck-at faults.

Package Information

PART NUMBER	PACKAGE(1)	PACKAGE SIZE(2)
TLC69699-Q1	SOT-23-THN (14)	4.20mm x 2.00mm
	WSON (12) Wettable flank	3.00mm x 3.00mm

(1) For all available packages, see the orderable addendum at the end of the data sheet.
(2) The package size (length × width) is a nominal value.

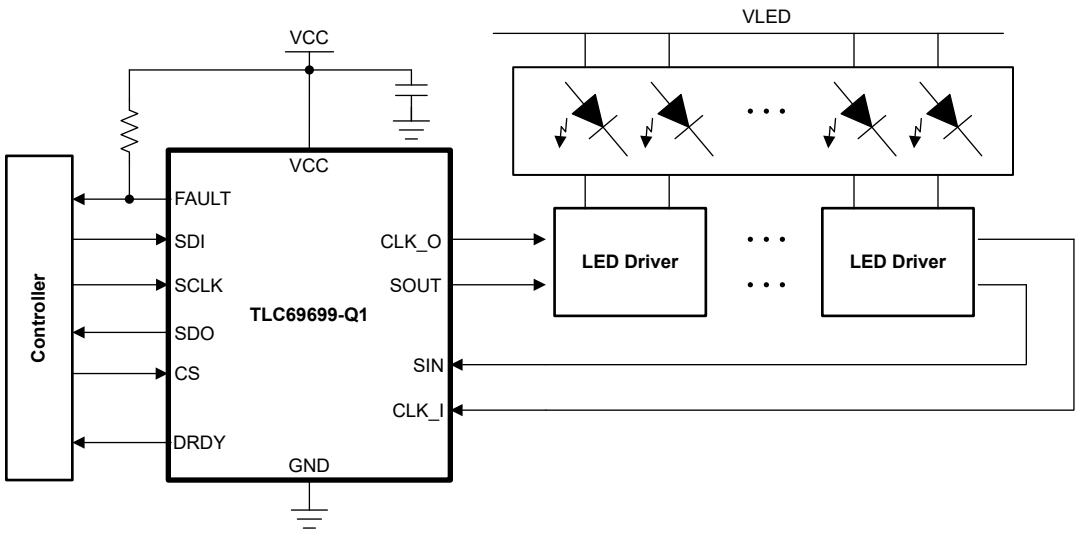


Figure 3-1. Typical Application Diagram

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. PRODUCTION DATA.

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2 Applications....1
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4 Device Comparison

Table 4-1. Device Comparison

PART NUMBER	MATERIAL	PACKAGE
TLC69699-Q1	TLC69699QDYYRQ1	SOT-23-THN (14)
	TLC69699QDRRRQ1	WSON (12)

5 Pin Configuration and Functions

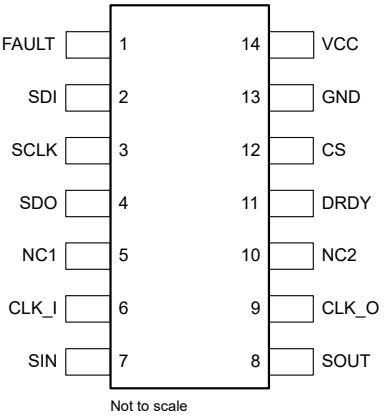


Figure 5-1. TLC69699-Q1 DYY Package 14-pin SOT-23-THN Top View

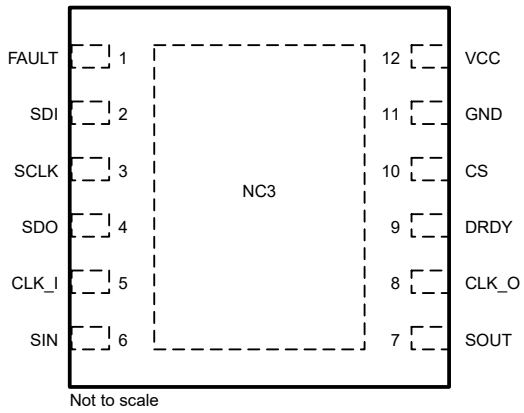


Figure 5-2. TLC69699-Q1 DRR Package 12-pin WSON with Exposed Thermal Pad Top View

Table 5-1. Pin Functions

PIN			TYPE[1]	DESCRIPTION
NAME	DYY NO.	DRR NO.		
FAULT	1	1	O	Fault indicator pin
SDI	2	2	I	SPI Serial Data Input
SCLK	3	3	I	SPI Serial Clock Input
SDO	4	4	O	SPI Serial Data Output
NC1	5	-	NC	No connection. Can be used for signal routing.
CLK_I	6	5	I	CCSI continuous clock input
SIN	7	6	I	CCSI Serial Data Input
SOUT	8	7	O	CCSI Serial Data Output
CLK_O	9	8	O	CCSI Serial Clock Output
NC2	10	-	NC	No connection. Can be used for signal routing.
DRDY	11	9	O	Data ready interrupt.
CS	12	10	I	SPI Chip Select
GND	13	11	G	Ground pin (must connect to Ground)
VCC	14	12	P	VCC Power Supply Input
NC3	-	Exposed Pad	NC	No connection. Need to be electrically isolated from any signal except Ground.

(1) I = Input, O = Output, G = Ground, P = Power, NC = Not Connected.

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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 Device Support

6.2 Documentation Support

6.2.1 Related Documentation

6.3 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.

6.4 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.

6.5 Trademarks

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

6.6 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.

6.7 Glossary

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

7 Revision History

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

DATE	REVISION	NOTES
October 2024	*	Initial Release

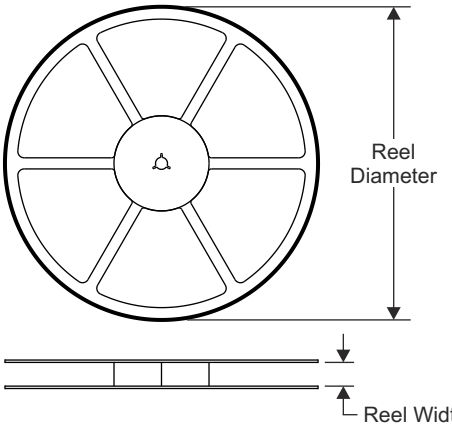
8 Mechanical, Packaging, and Orderable Information

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.

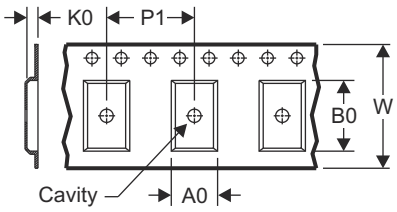
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8.1 Tape and Reel Information

REEL DIMENSIONS

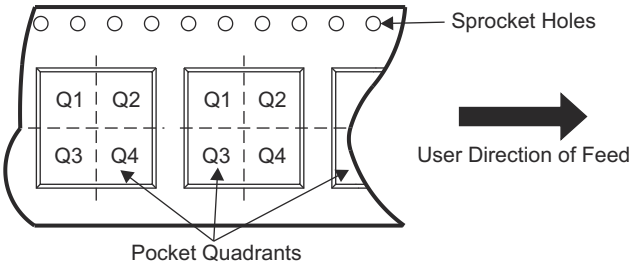


TAPE DIMENSIONS



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

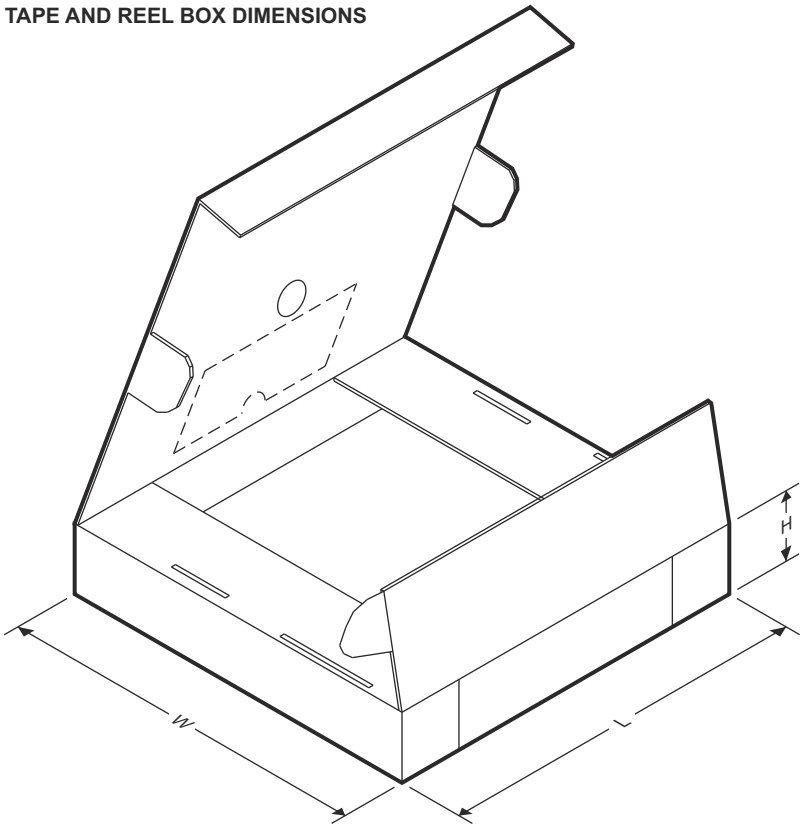
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



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
TLC69699QDYYRQ1	SOT-23-THN	DYY	14									
TLC69699QDRRRQ1	WSON	DRR	12									

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TAPE AND REEL BOX DIMENSIONS



Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TLC69699QDYYRQ1	SOT-23-THN	DYY	14				
TLC69699QDRRRQ1	WSON	DRR	12				

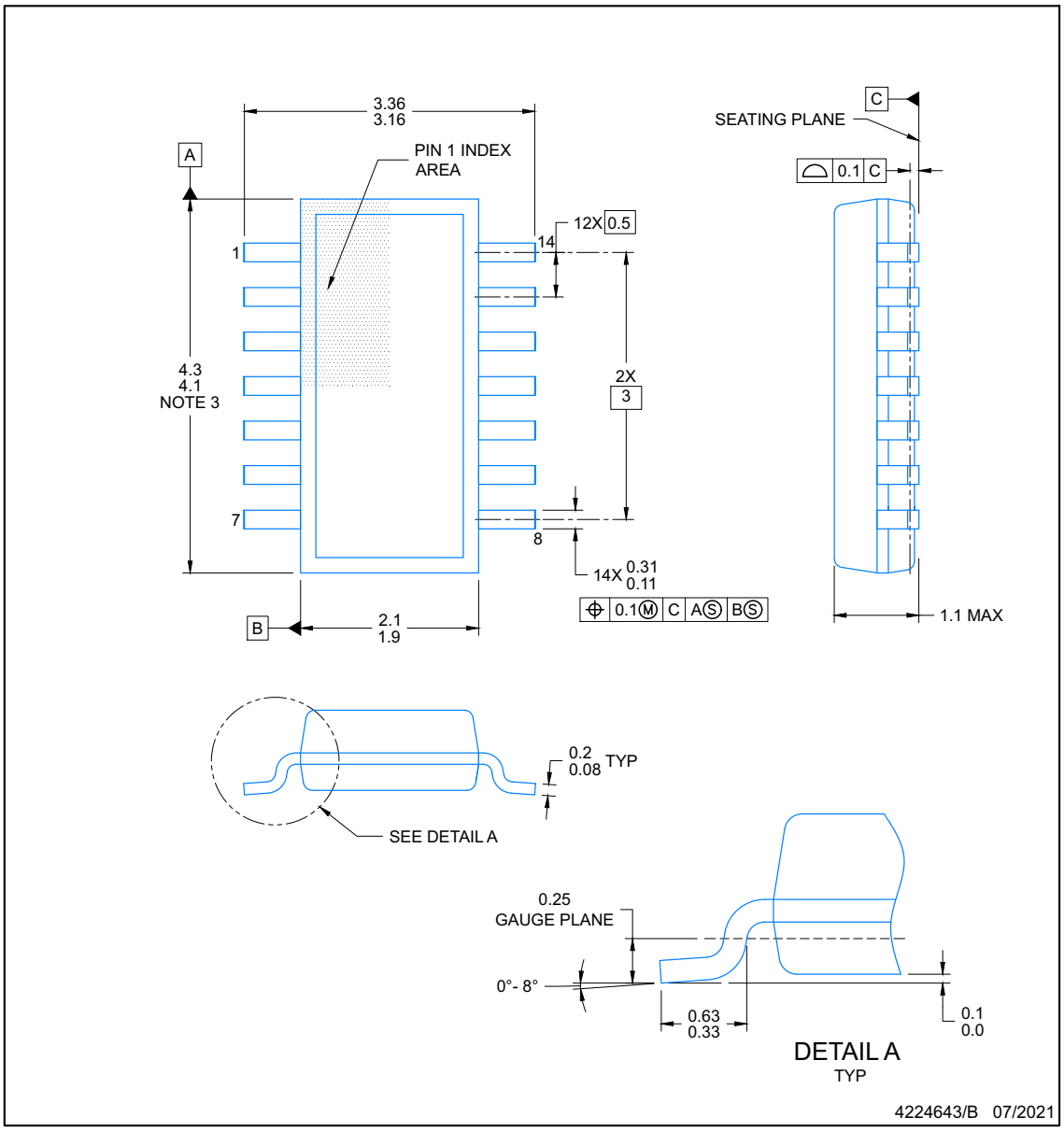
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8.2 Mechanical Data

PACKAGE OUTLINE

DYY0014A **SOT-23-THIN - 1.1 mm max height**

PLASTIC SMALL OUTLINE



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 AB

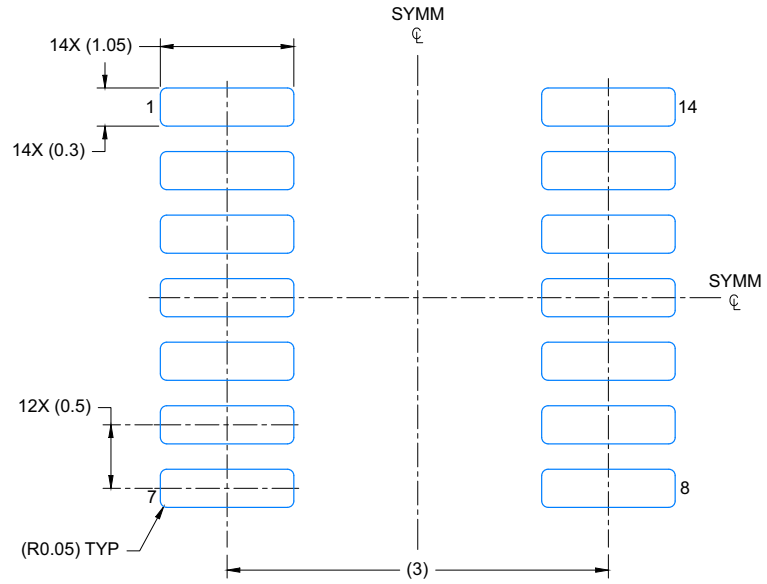
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EXAMPLE BOARD LAYOUT

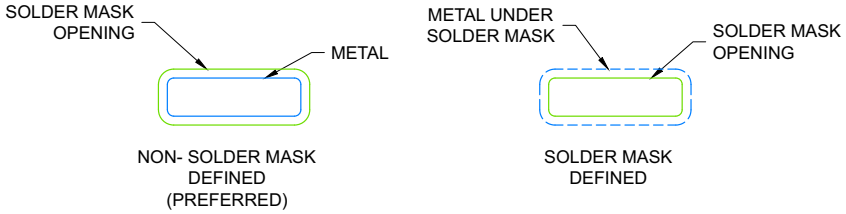
DYY0014A

SOT-23-THIN - 1.1 mm max height

PLASTIC SMALL OUTLINE



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 20X



SOLDER MASK DETAILS

4224643/B 07/2021

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.

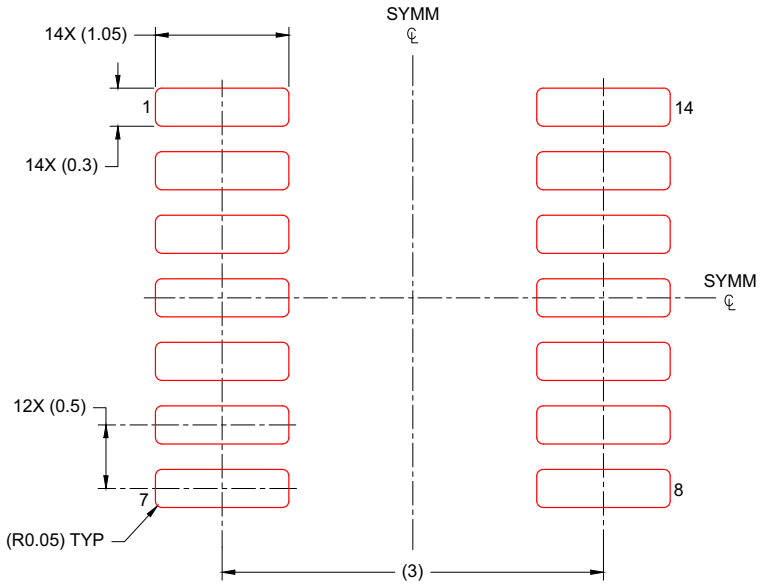
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EXAMPLE STENCIL DESIGN

DYY0014A

SOT-23-THIN - 1.1 mm max height

PLASTIC SMALL OUTLINE



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

4224643/B 07/2021

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.

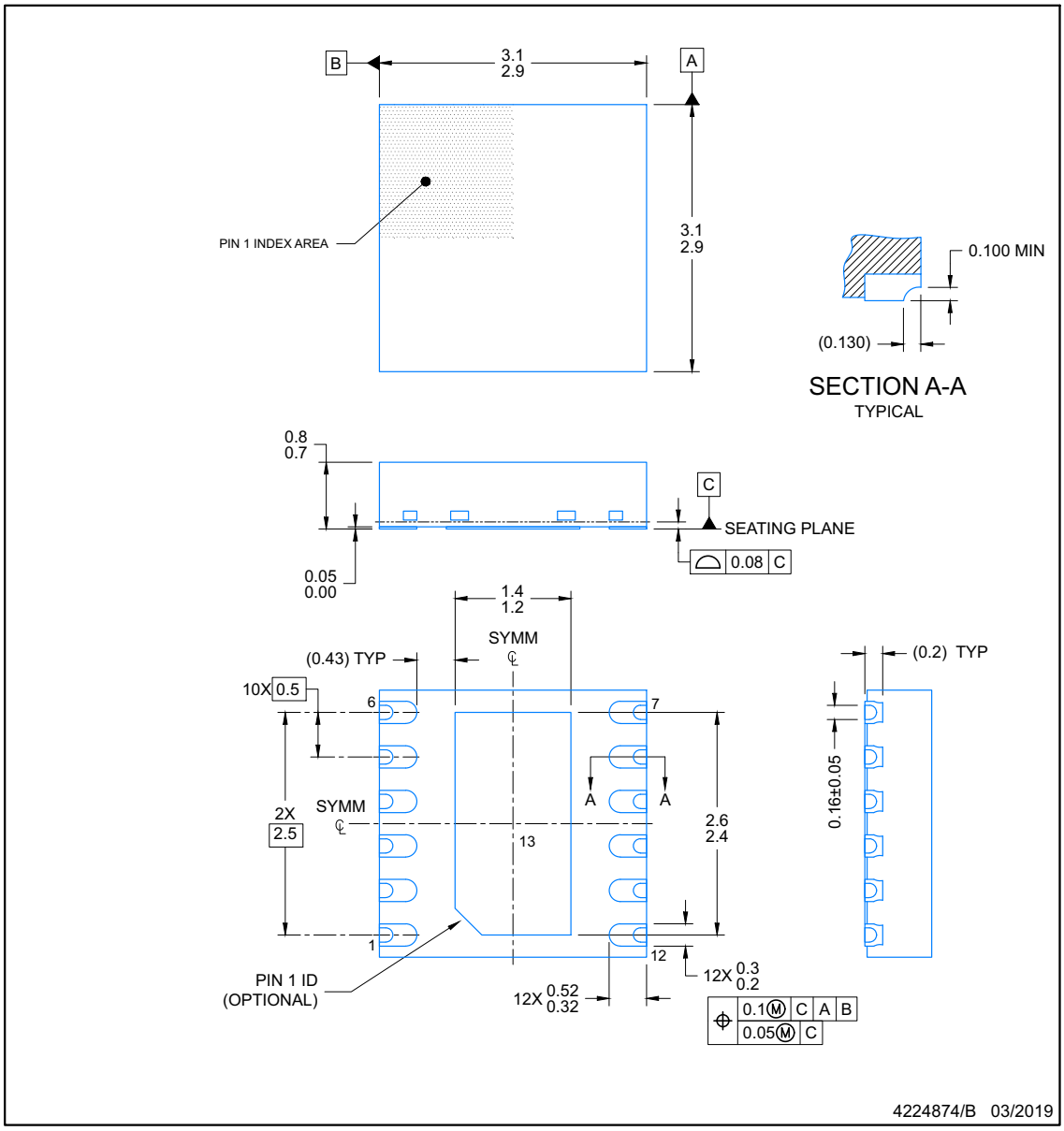
Copyright © 2024 Texas Instruments Incorporated

PACKAGE OUTLINE

DRR0012E

WSON - 0.8 mm max height

PLASTIC QUAD FLAT PACK- 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 optimal thermal and mechanical performance.

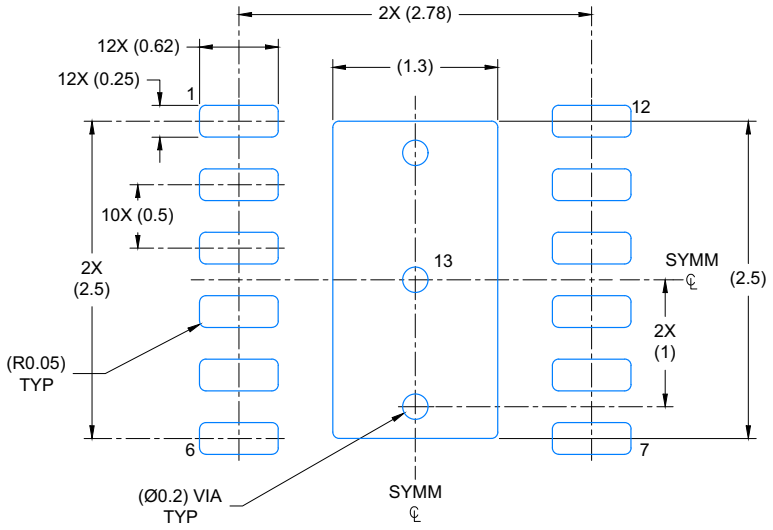
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EXAMPLE BOARD LAYOUT

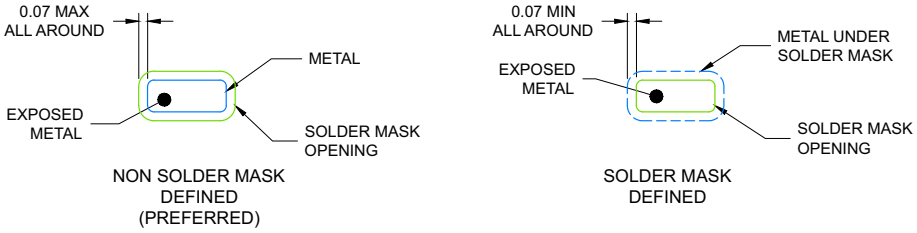
DRR0012E

WSON - 0.8 mm max height

PLASTIC QUAD FLAT PACK- NO LEAD



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 20X



SOLDER MASK DETAILS

4224874/B 03/2019

NOTES: (continued)

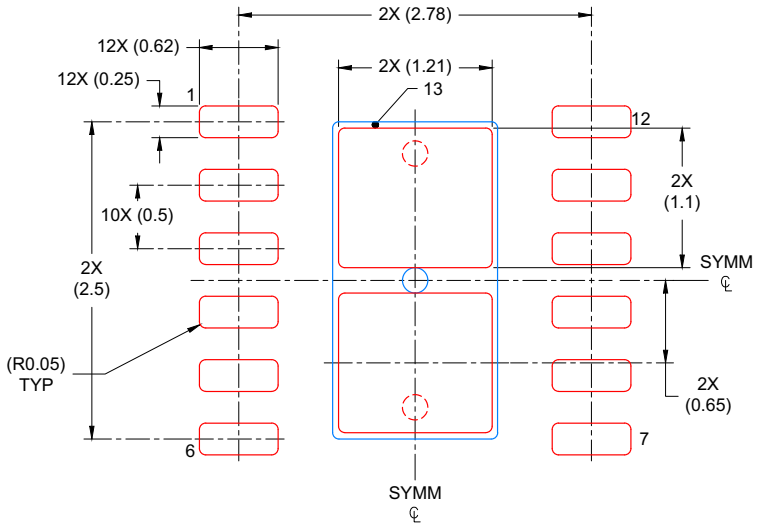
4. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/slua271).
5. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown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

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EXAMPLE STENCIL DESIGN

DRR0012E — **WSON - 0.8 mm max height**

PLASTIC QUAD FLAT PACK- NO LEAD



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL

EXPOSED PAD
82% PRINTED COVERAGE BY AREA
SCALE: 20X

4224874/B 03/2019

NOTES: (continued)

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

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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)
TLC69699QDRRRQ1	Active	Production	WSON (DRR) | 12	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	9699NQ
TLC69699QDRRRQ1.A	Active	Production	WSON (DRR) | 12	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	See TLC69699QDRRRQ1	9699NQ
TLC69699QDYYRQ1	Active	Production	SOT-23-THIN (DYY) | 14	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	69699TQ
TLC69699QDYYRQ1.A	Active	Production	SOT-23-THIN (DYY) | 14	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	See TLC69699QDYYRQ1	69699TQ

(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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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 TLC69699-Q1 :

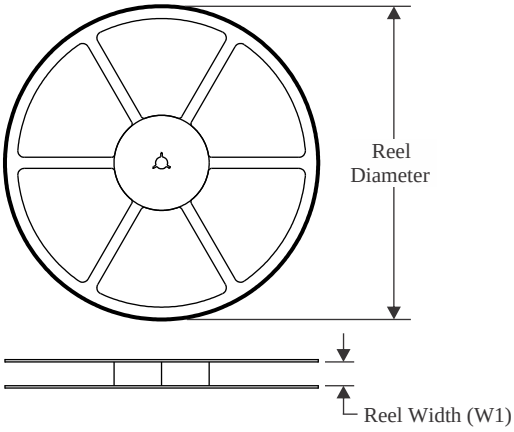
- Catalog : TLC69699

NOTE: Qualified Version Definitions:

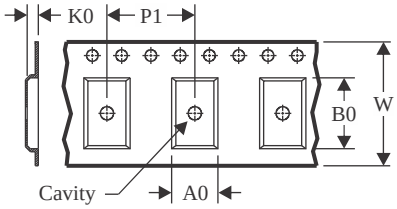
- Catalog - TI's standard catalog product

TAPE AND REEL INFORMATION

REEL DIMENSIONS

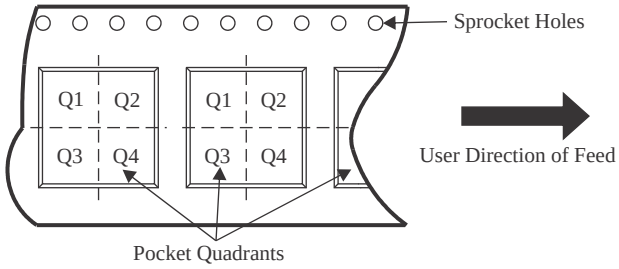


TAPE DIMENSIONS



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

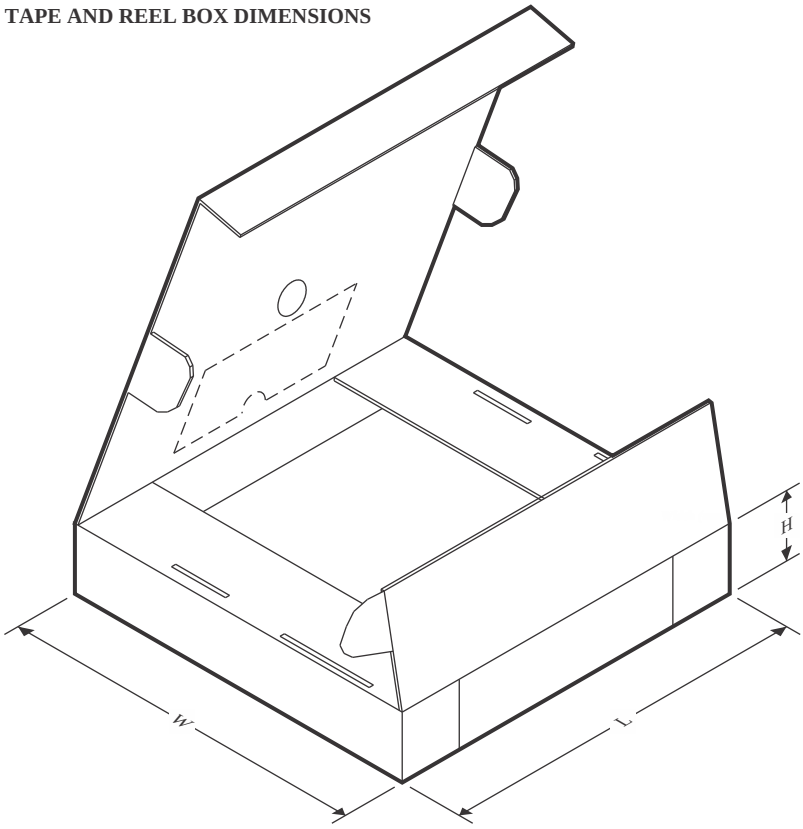
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
TLC69699QDRRRQ1	WSON	DRR	12	3000	330.0	12.4	3.3	3.3	1.1	8.0	12.0	Q2
TLC69699QDYYRQ1	SOT-23-THIN	DYY	14	3000	330.0	12.4	4.8	3.6	1.6	8.0	12.0	Q3

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

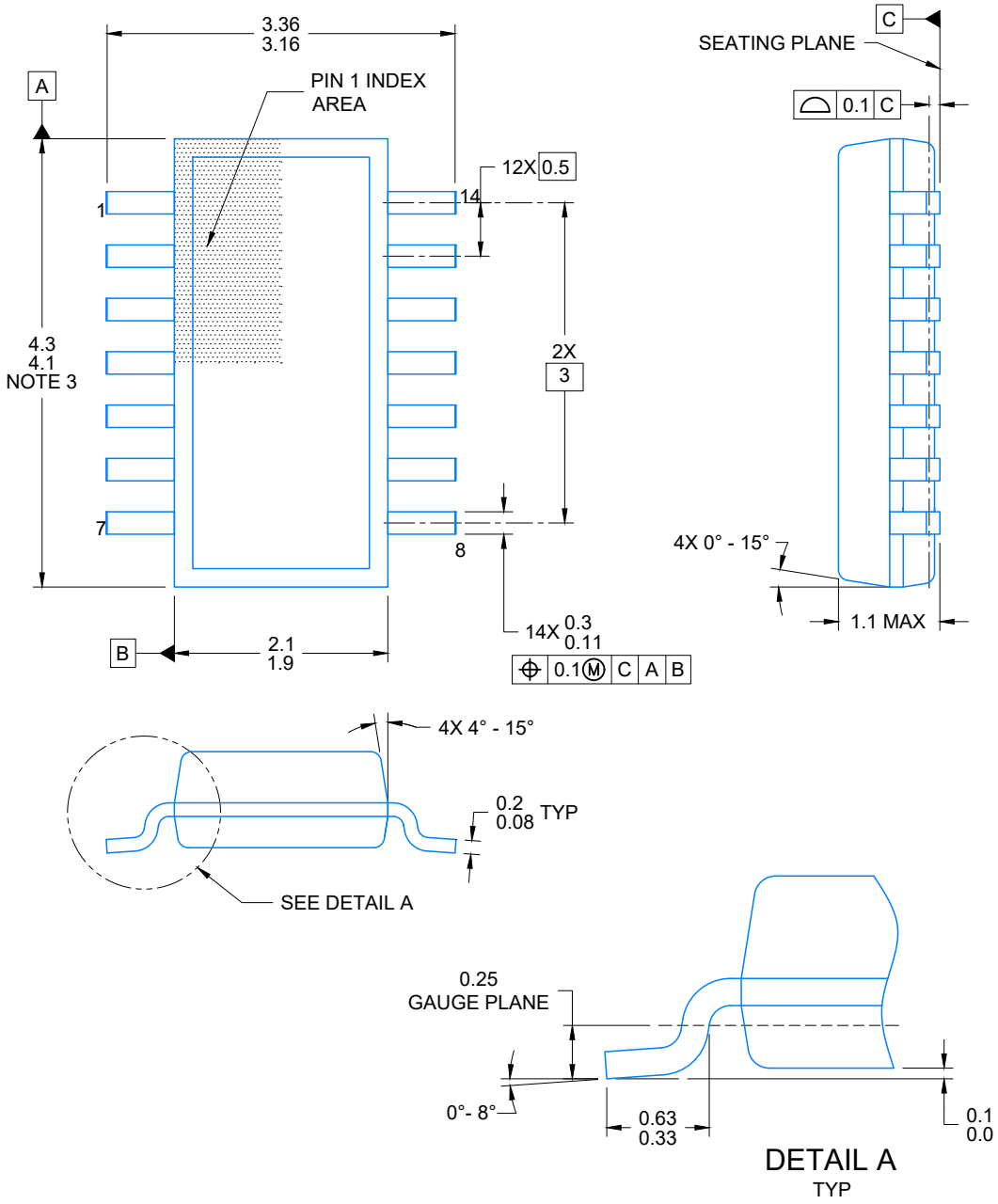
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TLC69699QDRRRQ1	WSON	DRR	12	3000	367.0	367.0	35.0
TLC69699QDYYRQ1	SOT-23-THIN	DYY	14	3000	336.6	336.6	31.8

PACKAGE OUTLINE

DYY0014A

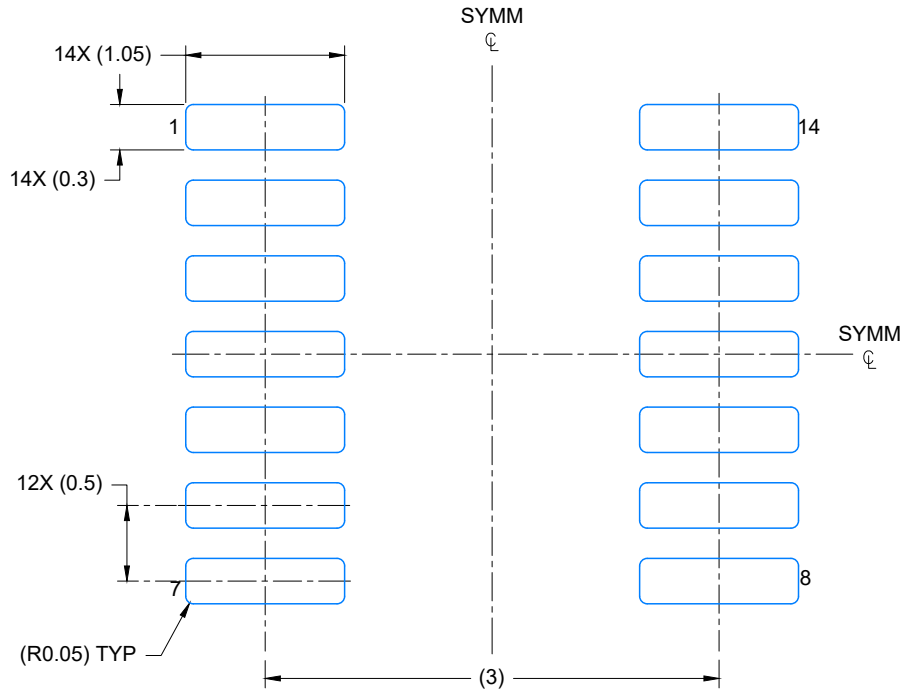
SOT-23-THIN - 1.1 mm max height

PLASTIC SMALL OUTLINE

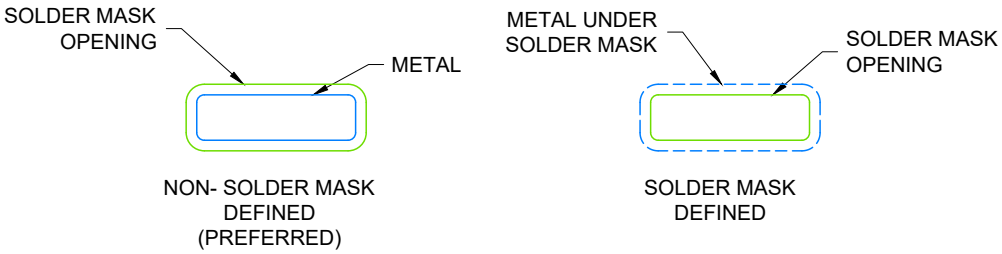


NOTES:

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 AB



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 20X

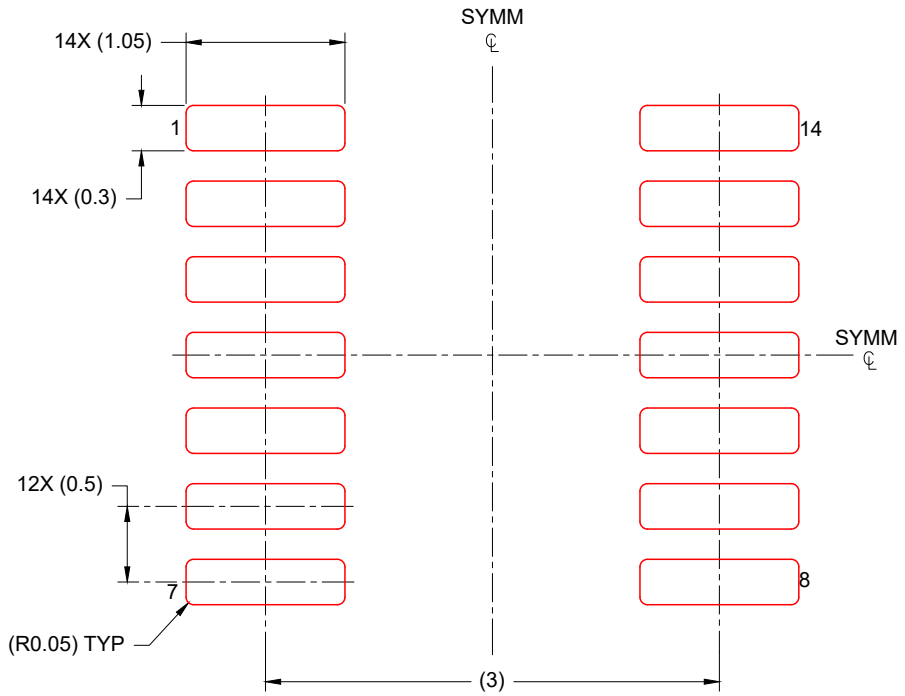


SOLDER MASK DETAILS

4224643/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

4224643/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.

GENERIC PACKAGE VIEW

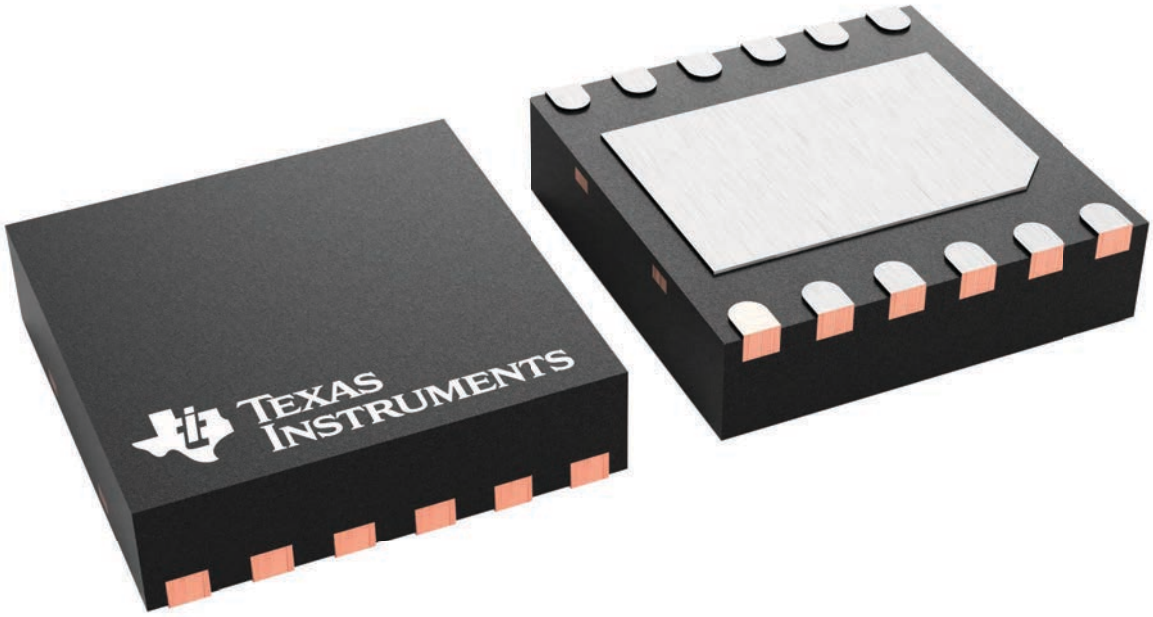
DRR 12

WSON - 0.8 mm max height

3 x 3, 0.5 mm pitch

PLASTIC SMALL OUTLINE - NO LEAD

This image is a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.



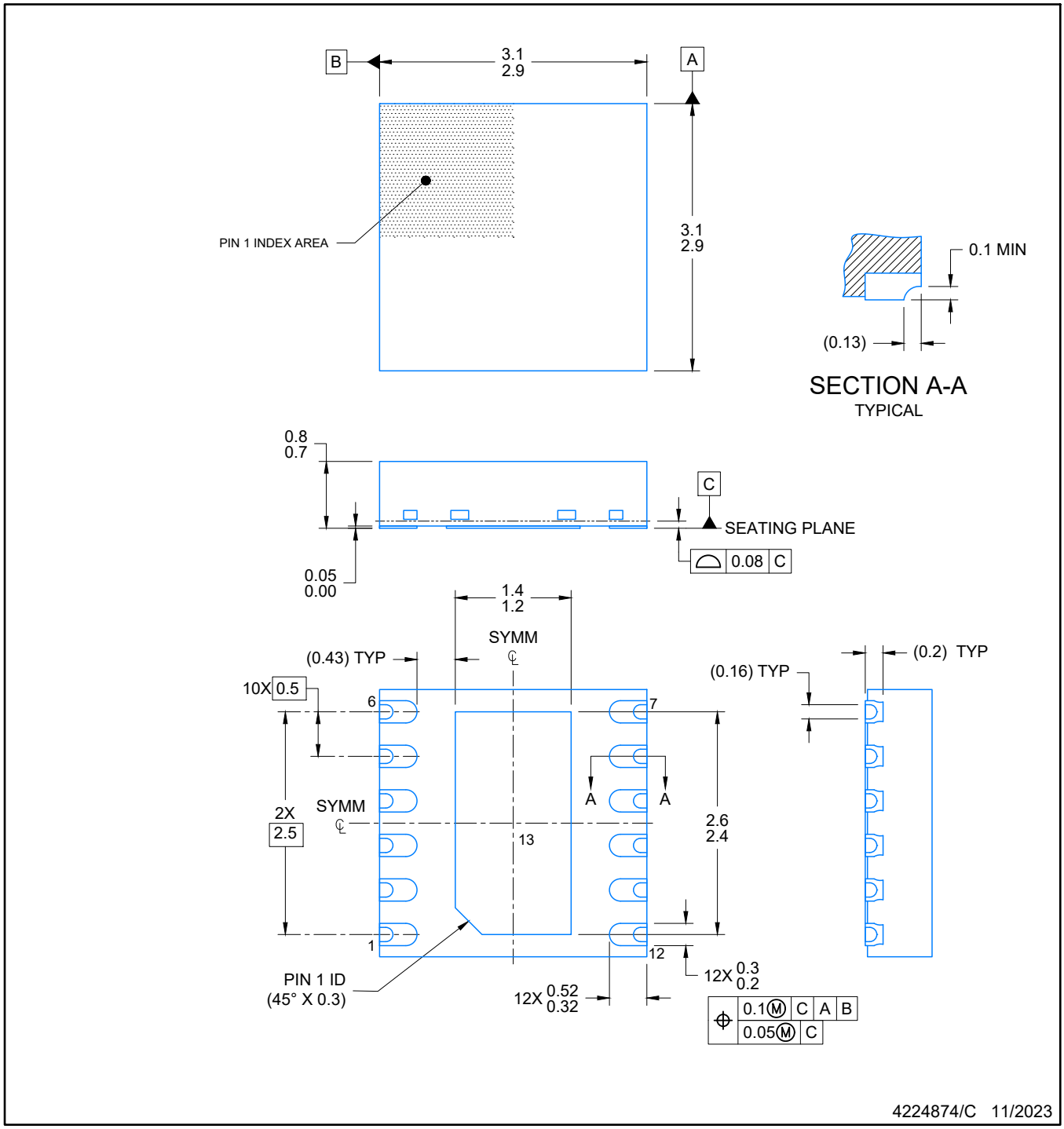
4223490/B

PACKAGE OUTLINE

DRR0012E

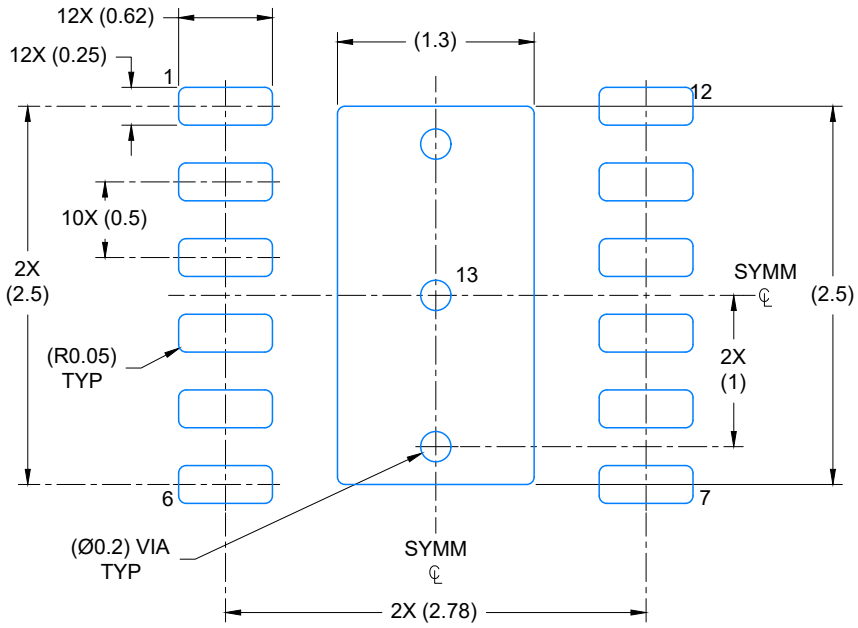
WSON - 0.8 mm max height

PLASTIC QUAD FLAT PACK- NO LEAD

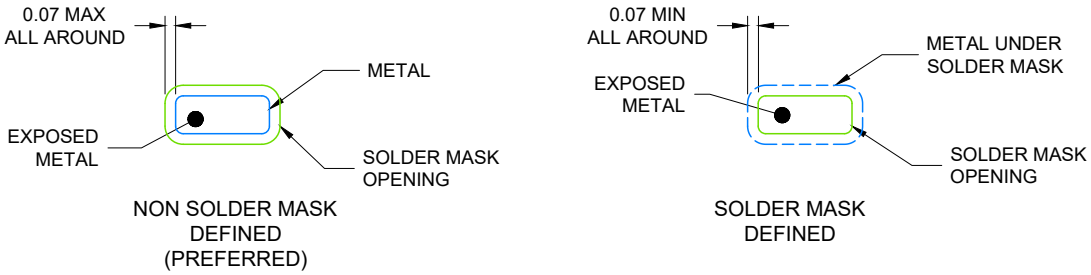


NOTES:

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 optimal thermal and mechanical performance.



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 20X

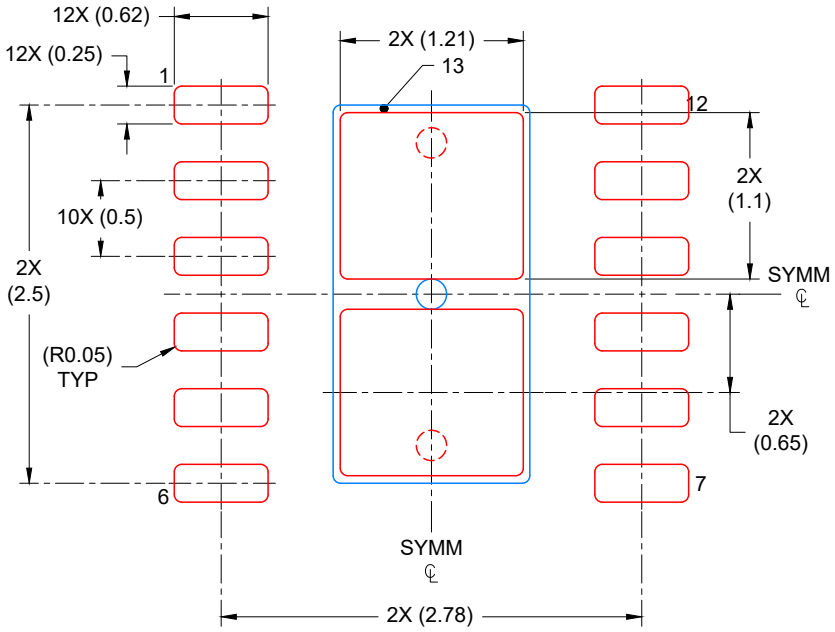


SOLDER MASK DETAILS

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NOTES: (continued)

4. 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) .
5. 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.



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL

EXPOSED PAD
82% PRINTED COVERAGE BY AREA
SCALE: 20X

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NOTES: (continued)

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

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