

# TPS65036x-Q1 Automotive Camera, Radar and MCU PMIC

## 1 Features

- Qualified for automotive applications
- AEC-Q100 qualified with following results:
  - Device operates from 4V to 35V input supply
  - Device temperature grade 1: -40°C to +125°C
- Functional Safety -compliant
  - Developed for functional safety applications
  - Documentation available to aid ISO26262 and IEC61508 system design
  - Systematic integrity up to ASIL-D
  - Systematic integrity up to SIL-3
  - Hardware integrity up to ASIL-B
  - Hardware integrity up to SIL-2
  - Under/overvoltage monitors with Built-In Self-Test
  - Watchdog (trigger or Q&A), Error Signal Monitor
  - Temperature warning and thermal shutdown
- Wide-VIN step-down converter BUCK1
  - $V_{IN}$  range from 4V to 35V
  - $V_{OUT}$  range from 3V to 5.5V
  - Output current up to 2000mA
  - 2.2MHz switching frequency
- Two Low-VIN step-down converters BUCK2, BUCK3:
  - $V_{IN}$  range from 3.0V to 5.5V
  - $V_{OUT}$  range from 0.6V to 3.4V
  - Output current up to 2700mA peak
  - 2.2MHz or 4.4MHz switching frequency
- One low dropout (LDO) regulator:
  - $V_{IN}$  range from 3.0V to 5.5V
  - $V_{OUT}$  range from 1.8V to 3.4V
  - Up to 300mA output current
  - Low noise and high PSRR
- 3.5mm × 3.5mm 24-pin VQFN with wettable flanks

## 2 Applications

- Automotive camera modules
  - Surround view camera modules
  - Rear view camera modules
  - DMS (driver monitoring systems)
  - Power over coax (POC) camera modules
  - E-mirror camera modules
- Automotive radar modules
  - Ultra-short range radar
  - Kick-to-open
  - Park assist and automated parking
  - Driver monitor systems
  - Vehicle occupancy detection, child presence detection (CPD)

- Vehicle intruder detection
- Seat belt monitoring
- Safety MCU power
  - OBC, DC/DC, zonal controller
  - Inverter and motor control (traction inverter)
  - Heating and cooling (automotive HVAC compressor module)

## 3 Description

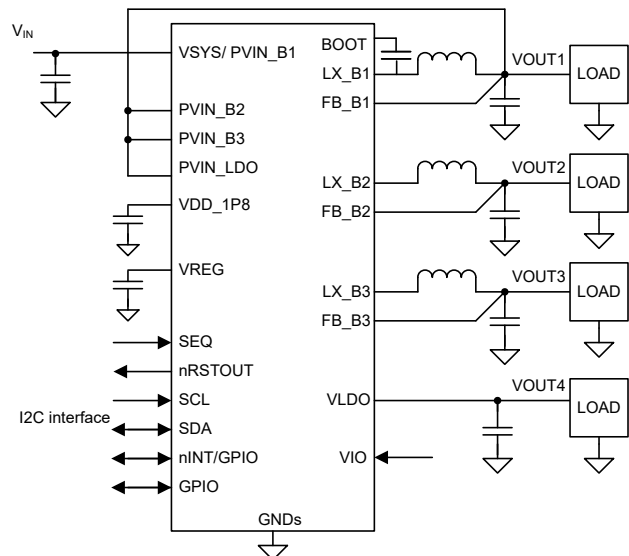
The TPS65036x-Q1 device is a highly integrated power management IC for automotive camera and radar modules and MCU power. This device combines three step-down converters and one low-dropout (LDO) regulator. The BUCK1 step-down converter has an input voltage range up to 35V. All converters can operate in a forced fixed-frequency PWM mode or an AutoPFM mode and support optional spread-spectrum modulation (SSM) for EMI reduction. The LDO can supply 300mA and operate with an input voltage range from 3V to 5.5V. The TPS65036x-Q1 support low power mode with control from pin or I2C.

The TPS65036x-Q1 is available in a 24-pin VQFN package (3.5mm × 3.5mm).

### Package Information

PART NUMBER	PACKAGE <sup>(1)</sup>	PACKAGE SIZE (NOM)
TPS65036x-Q1	VQFN (24)	3.5mm × 3.5mm

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



**TPS65036x-Q1 Application Circuit**



The specific orderable part numbers supported are as follows:

TPS65036xyyRAYRQ1 where:

**TPS65036xyyRAYRQ1**

- Q1**: Automotive AEC-Q100 Qualified (if applicable)
- R**: tape and reel (3000 units/reel) (other shipping options may be included in the future as this field is not specific to device or functional safety performance)
- RAY**: package designator
- yy**: OTP part number variant: (A1, A3...etc.)  
(OTP determines the default register values for OTP based customer configuration registers)
- x** = Version
  - 0: Non-Functional Safety Applications
  - 1: Camera Applications with Functional Safety – Wait-for-PowerCycle, no watchdog, 2.2MHz
  - 2: Camera Applications with Functional Safety – Wait-for-PowerCycle or SAFE-state, no watchdog, 2.2MHz
  - 3: Camera Applications with Functional Safety – Wait-for-PowerCycle or SAFE-state, with watchdog, 2.2MHz
  - 4: User Programmable with all Functionality and Functional Safety Options
  - 5: Radar Applications with Functional Safety, 4.4MHz
  - 6: Safety MCU Applications with Functional Safety, 2.2MHz
  - 7: Reduced Output Current with all Functionality and Functional Safety Options
  - 8: Industrial Version (no Q1) with all Functionality and Functional Safety Options

TPS65036: device family and base part number

## Table of Contents

<b>1 Features</b> .....	1	4.4 Trademarks.....	4
<b>2 Applications</b> .....	1	4.5 Electrostatic Discharge Caution.....	4
<b>3 Description</b> .....	1	4.6 Glossary.....	4
<b>4 Device and Documentation Support</b> .....	4	<b>5 Revision History</b> .....	4
4.1 Device Support.....	4	<b>6 Mechanical, Packaging, and Orderable Information</b> ....	4
4.2 Receiving Notification of Documentation Updates.....	4	6.1 Package Option Addendum.....	5
4.3 Support Resources.....	4	6.2 Tape and Reel Information.....	6

## 4 Device and Documentation Support

### 4.1 Device Support

#### 4.1.1 Third-Party Products Disclaimer

TI'S PUBLICATION OF INFORMATION REGARDING THIRD-PARTY PRODUCTS OR SERVICES DOES NOT CONSTITUTE AN ENDORSEMENT REGARDING THE SUITABILITY OF SUCH PRODUCTS OR SERVICES OR A WARRANTY, REPRESENTATION OR ENDORSEMENT OF SUCH PRODUCTS OR SERVICES, EITHER ALONE OR IN COMBINATION WITH ANY TI PRODUCT OR SERVICE.

### 4.2 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.

### 4.3 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](#).

### 4.4 Trademarks

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

### 4.5 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.

### 4.6 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.

Changes from Revision * (May 2024) to Revision A (December 2024)	Page
• Changed the device status from Advance Information to Production Data.....	1

## 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.

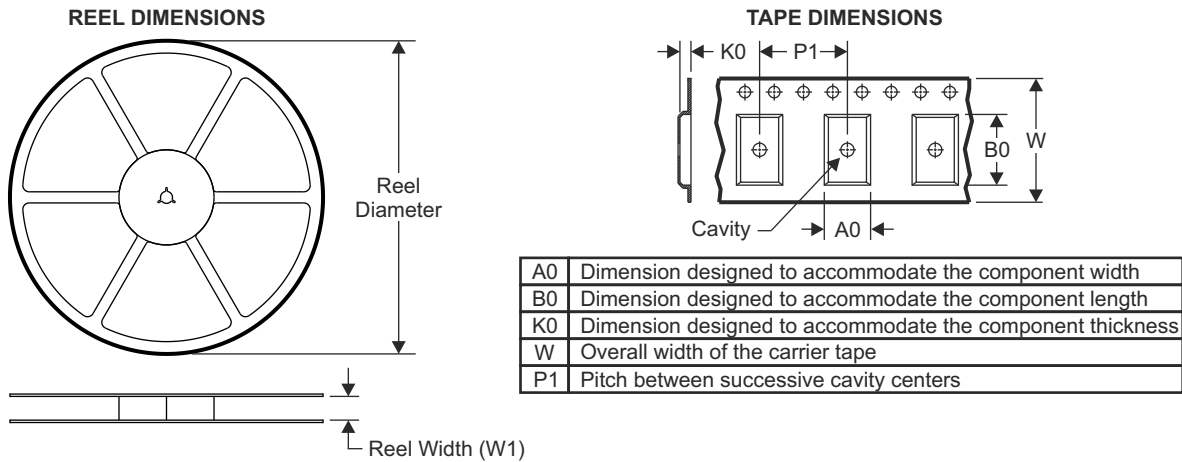
## 6.1 Package Option Addendum

### Packaging Information

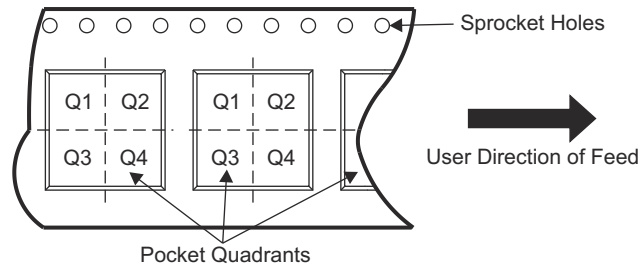
Orderable Device (Preview)	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish <sup>(4)</sup>	MSL Peak Temp <sup>(3)</sup>	Op Temp (°C)	Device Marking <sup>(5) (6)</sup>
TPS65036601RAYRQ1	ACTIVE	VQFN-HR	RAY	24	3000	RoHS & Green	NIPDAU	Level2-260C	-40°C to 125°C	O036601Q1
PTPS65036200RAYRQ1	PREVIEW	VQFN-HR	RAY	24	3000	RoHS & Green	NIPDAU	Level2-260C	-40°C to 125°C	PO036XXQ1
PTPS65036501RAYRQ1	PREVIEW	VQFN-HR	RAY	24	3000	RoHS & Green	NIPDAU	Level2-260C	-40°C to 125°C	PO036XXQ1

- (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.  
**PRE\_PROD** Unannounced device, not in production, not available for mass market, nor on the web, samples not available.  
**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) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.  
**TBD:** The Pb-Free/Green conversion plan has not been defined.  
**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.  
**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.  
**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)
- (3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.
- (4) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.
- (5) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device
- (6) 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.  
**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.

## 6.2 Tape and Reel Information

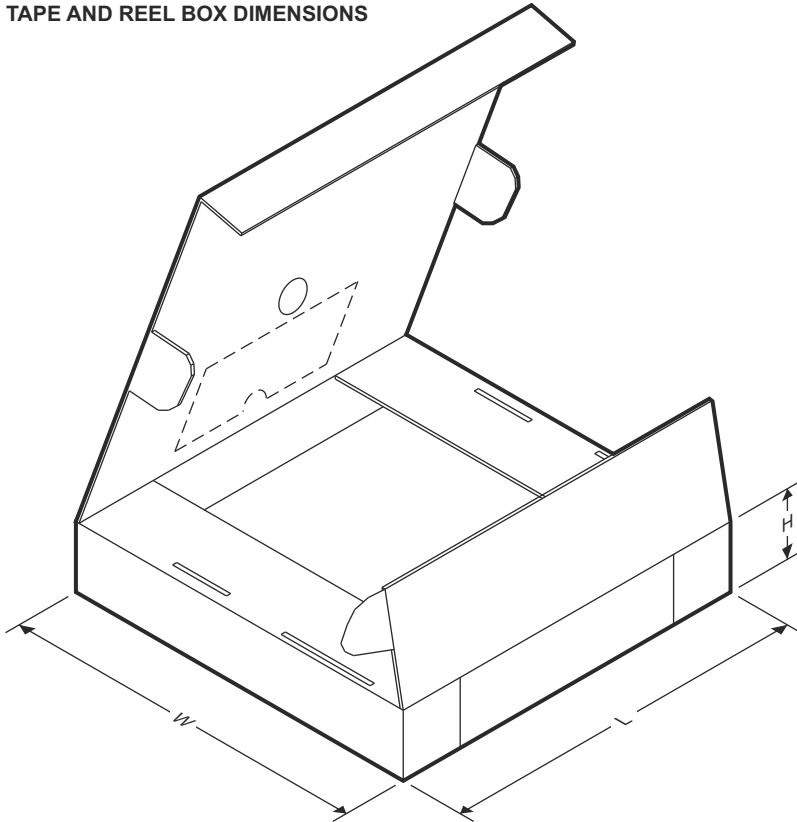


### QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE

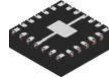


Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
TPS65036601RAYRQ1	VQFN	RAY	24	3000	330.0	12.4	3.75	3.75	1.15	8.0	12	Q2
PTPS65036200RAYRQ1	VQFN	RAY	24	3000	330.0	12.4	3.75	3.75	1.15	8.0	12	Q2
PTPS65036501RAYRQ1	VQFN	RAY	24	3000	330.0	12.4	3.75	3.75	1.15	8.0	12	Q2

**TAPE AND REEL BOX DIMENSIONS**



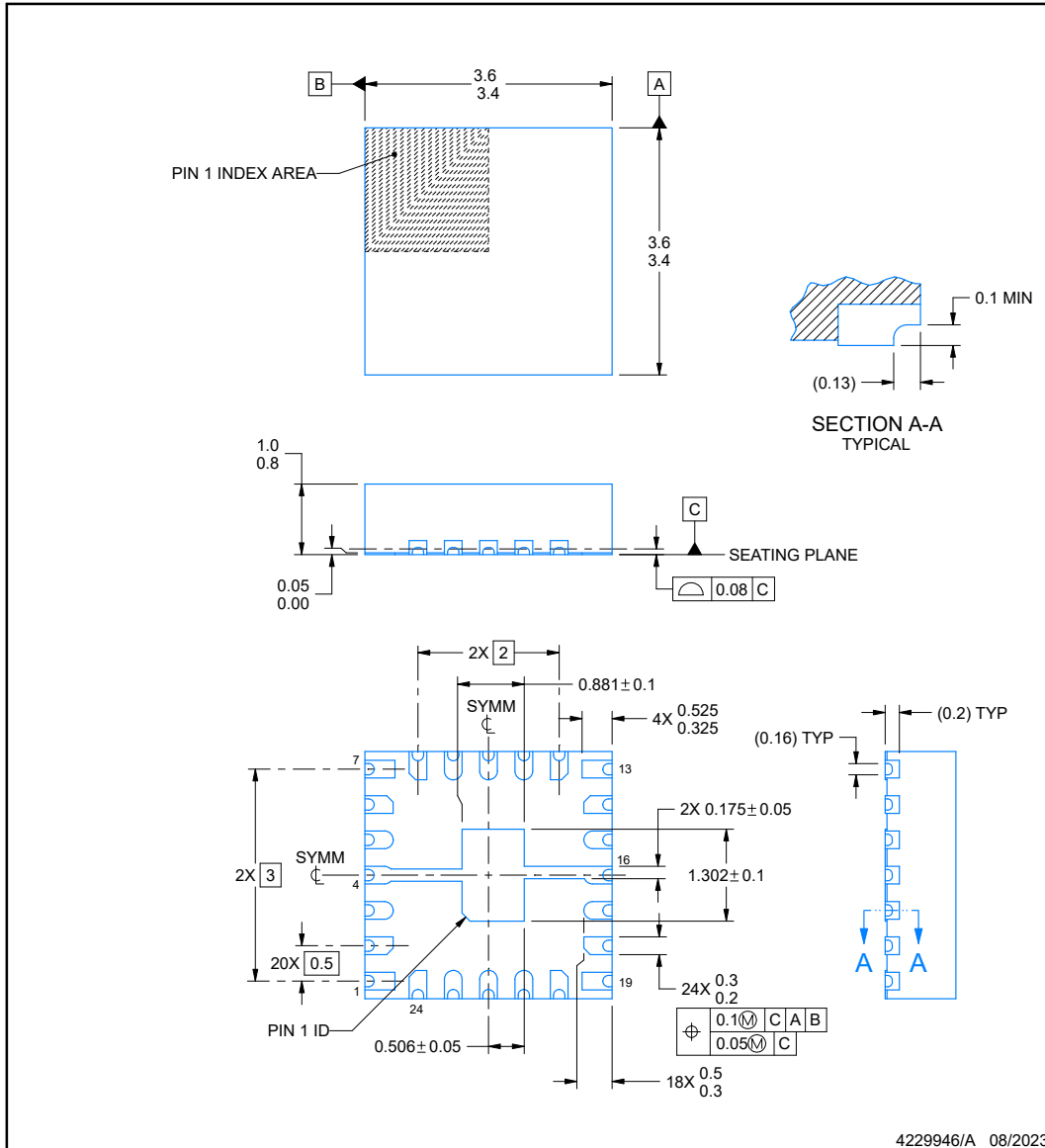
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TPS65036601RAYRQ1	VQFN	RAY	24	3000	367.0	367.0	35.0
TPS65036601RAYRQ1	VQFN	RAY	24	3000	360.0	360.0	35.0
PTPS65036200RAYRQ1	VQFN	RAY	24	3000	367.0	367.0	35.0
PTPS65036200RAYRQ1	VQFN	RAY	24	3000	360.0	360.0	36.0
PTPS65036501RAYRQ1	VQFN	RAY	24	3000	367.0	367.0	35.0
PTPS65036501RAYRQ1	VQFN	RAY	24	3000	360.0	360.0	35.0



**RAY0024B**

**PACKAGE OUTLINE**  
**VQFN-HR - 1 mm max height**

PLASTIC QUAD FLATPACK - NO LEAD



4229946/A 08/2023

**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.

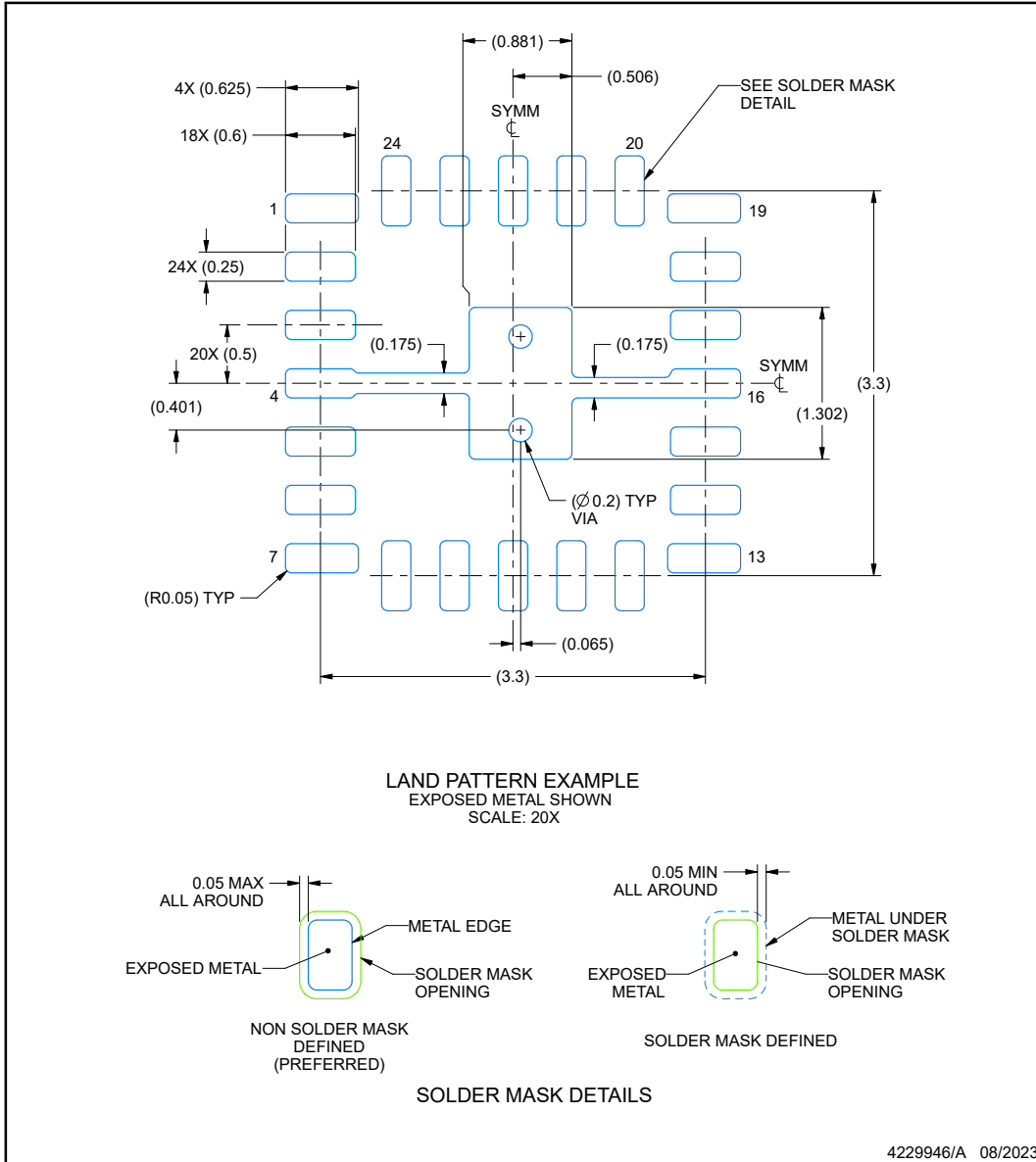


**EXAMPLE BOARD LAYOUT**

**RAY0024B**

**VQFN-HR - 1 mm max height**

PLASTIC QUAD FLATPACK - NO LEAD



NOTES: (continued)

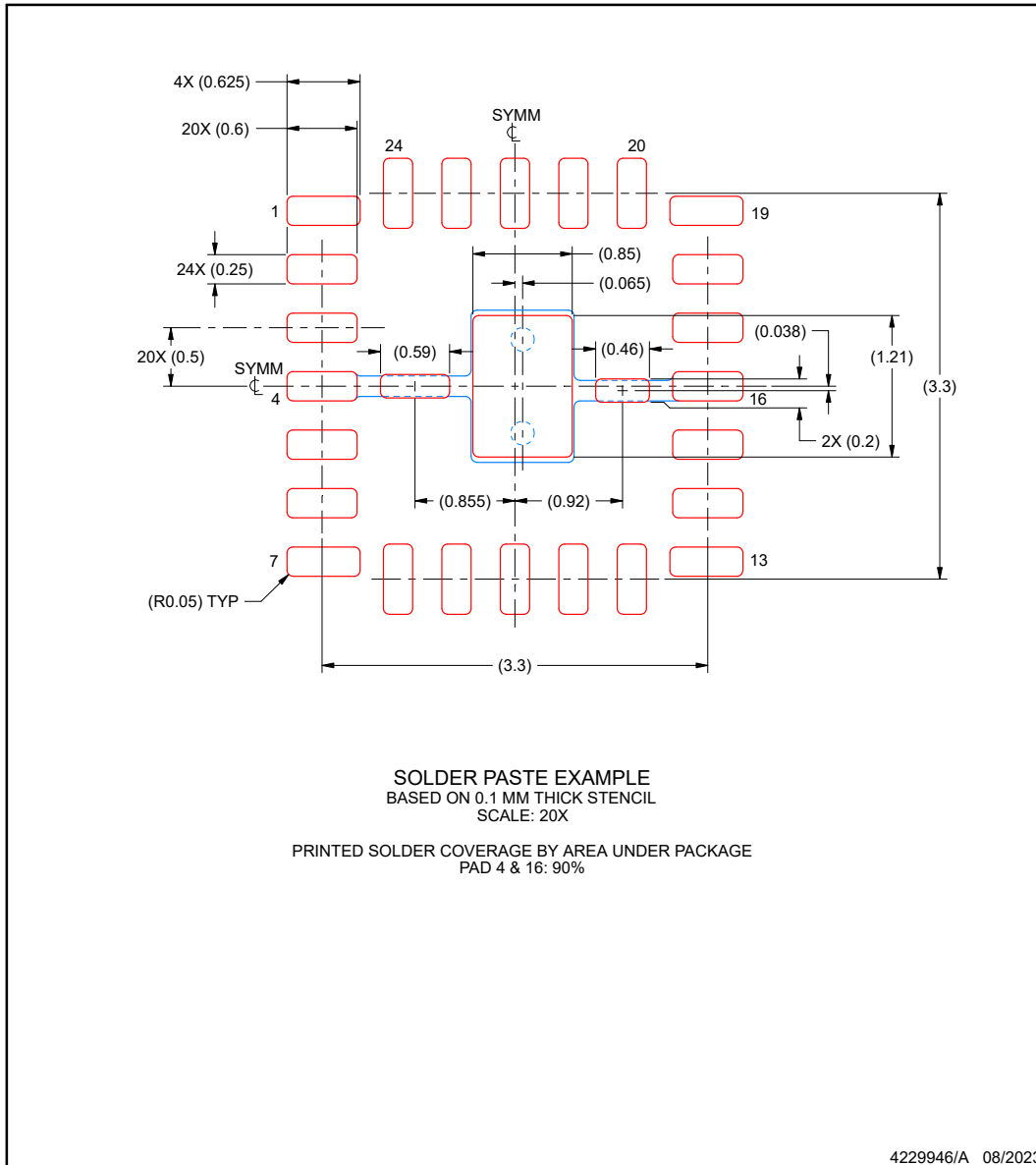
4. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 ([www.ti.com/lit/sluea271](http://www.ti.com/lit/sluea271)).
5. Vias are optional depending on application, refer to device data sheet. If any vias are implemented,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

## EXAMPLE STENCIL DESIGN

**RAY0024B**

**VQFN-HR - 1 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.

## 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