

TPS6288x-Q1 2.8V to 6V Input, 12A, 20A, 24A, and 30A Automotive, Fast Transient, Stackable, Dual-Phase Step-Down Converter With I²C Interface

1 Features

- AEC-Q100 qualified for automotive applications
 - Temperature grade 1: -40°C to 125°C T_{A}
 - -40°C to 150°C junction temperature range
- **Functional Safety-Compliant**
 - Developed for functional safety applications
 - Documentation available to aid ISO 26262 system design up to ASIL D (SEooC)
- Input voltage range: 2.8V to 6V
- Selectable output voltage ranges for AVS / DVS
 - Three ranges; V_{out} from 0.4V to 1.2V
- Output voltage accuracy: $\pm 0.5\%$
- 7m Ω and 4.5m Ω internal power MOSFETs
- External compensation
- Switching frequency options of 1.5MHz, 2.25MHz, 2.5MHz, or 3MHz
- Forced PWM or power save mode operation
- 3.4MHz I²C-compatible interface with CRC
- Output voltage selection by I²C i/f or VSELx pins
- Optional stacked operation
- Differential remote sense
- Input and output overvoltage protection
- Thermal pre-warning and thermal shutdown
- Output discharge
- Optional spread spectrum clocking
- Power-good output with window comparator with adjustable thresholds
- Package with wettable flanks

2 Applications

- ADAS camera, [ADAS sensor fusion](#)
- [Surround view ECU](#)
- [Hybrid and reconfigurable cluster](#)
- [Head unit, Telematics control unit](#)

3 Description

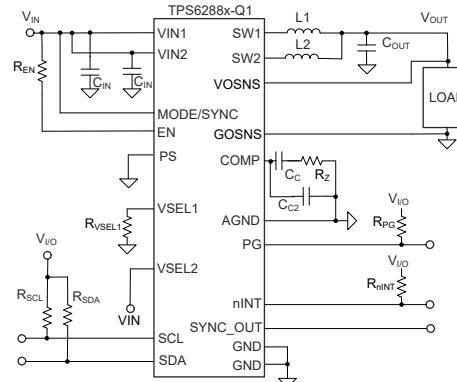
The TPS62880-Q1, TPS62881-Q1, TPS62882-Q1, and TPS62883-Q1 are a family of pin-to-pin 12A, 20A, 24A, and 30A synchronous, dual-phase, step-down DC/DC converters. The TPS6288x-Q1 implement an enhanced DCS-Control scheme that combines fast transient response with fixed frequency operation. Dual-phase operation reduces the input and output voltage ripple and also enables the use of smaller inductors per phase. At medium to heavy loads, the devices operate in Pulse Width Modulation (PWM) mode and automatically enter discontinuous conduction mode at light load to maintain high efficiency over the entire load

current range. The devices can also be forced into PWM mode operation for smallest output voltage ripple. The devices provide 0.5% DC output voltage accuracy across the recommended input voltage and temperature range. Differential remote sense allows for accurate voltage control directly at the load. The I²C compatible interface is operational as long as the supply voltage is above the UVLO threshold. The interface offers several control, monitoring, and warning features, such as voltage monitoring and temperature warnings. Dynamic voltage scaling allows the load power consumption to adapt to the performance needs of the application. The default start-up voltage is selectable by the VSELx pins. The switching frequency is factory programmed to 2.25MHz with options for 1.5MHz, 2.5MHz, or 3MHz. The TPS6288x-Q1 can be synchronized to an external clock. Stacking allows to operate up to five devices in parallel to support a total output current of up to 150A. The PS pin along with the SYNC_OUT pin define a device as a primary or secondary device. The phase shift of the secondary devices is defined by the VSEL1 and VSEL2 pins to either 30°, 60°, 90°, or 120°. See the [Device Options](#) table for details.

Device Information

| PART NUMBER | CURRENT RATING ⁽¹⁾ | BODY SIZE (NOM) |
|-------------|-------------------------------|-----------------|
| TPS62880-Q1 | 12A | 4mm × 5mm |
| TPS62881-Q1 | 20A | |
| TPS62882-Q1 | 24A | |
| TPS62883-Q1 | 30A | |

(1) See the [Device Options](#) table.



Simplified Schematic



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. UNLESS OTHERWISE NOTED, this document contains PRODUCTION DATA.

Table of Contents

| | | | |
|--|----------|---|----------|
| 1 Features | 1 | 5.2 Support Resources..... | 5 |
| 2 Applications | 1 | 5.3 Trademarks..... | 5 |
| 3 Description | 1 | 5.4 Electrostatic Discharge Caution..... | 5 |
| 4 Device Options | 3 | 5.5 Glossary..... | 5 |
| 5 Device and Documentation Support | 5 | 6 Revision History | 5 |
| 5.1 Receiving Notification of Documentation Updates..... | 5 | 7 Mechanical, Packaging, and Orderable Information | 6 |

4 Device Options

| DEVICE NUMBER | OUTPUT CURRENT | START-UP VOLTAGE and I ² C DEVICE ADDRESS FOR PRIMARY DEVICE | I ² C DEVICE ADDRESS / PHASE SHIFT FOR SECONDARY DEVICE(S) | SOFT-START TIME / DEFAULT SWITCHING FREQUENCY AND OTHER CONFIGURATION SETTINGS |
|------------------------------------|----------------|--|---|---|
| TPS62880QFWRADRQ1 | 12A | Vo1 = 0.850V; I2C1 = 0x38 Vo2 = 0.750V; I2C2 = 0x39 Vo3 = 0.875V; I2C3 = 0x3A Vo4 = 0.800V; I2C4 = 0x3B | I2C1 = 0x3C / 30° I2C2 = 0x3D / 60° I2C3 = 0x3E / 90° I2C4 = 0x3F / 120° | td _(Ramp) = 1ms f _{SW} = 2.25MHz SOFT_STOP_EN = 1 DROOPEN = 0 DROOPRESISTANCE = 00b PGTH = ±5% REG_CRC_EN = 1 |
| TPS6288001QFWRADRQ1 ⁽¹⁾ | 12A | Vo1 = 0.750V; I2C1 = 0x18 Vo2 = 0.800V; I2C2 = 0x19 Vo3 = 1.050V; I2C3 = 0x1A Vo4 = 0.800V; I2C4 = 0x1B | I2C1 = 0x1C / 30° I2C2 = 0x1D / 60° I2C3 = 0x1E / 90° I2C4 = 0x1F / 120° | td _(Ramp) = 1ms f _{SW} = 2.25MHz SOFT_STOP_EN = 1 DROOPEN = 0 DROOPRESISTANCE = 00b PGTH = ±5% REG_CRC_EN = 1 |
| TPS62881QFWRADRQ1 | 20A | Vo1 = 0.850V; I2C1 = 0x38 Vo2 = 0.750V; I2C2 = 0x39 Vo3 = 0.875V; I2C3 = 0x3A Vo4 = 0.800V; I2C4 = 0x3B | I2C1 = 0x3C / 30° I2C2 = 0x3D / 60° I2C3 = 0x3E / 90° I2C4 = 0x3F / 120° | td _(Ramp) = 1ms f _{SW} = 2.25MHz SOFT_STOP_EN = 1 DROOPEN = 0 DROOPRESISTANCE = 00b PGTH = ±5% REG_CRC_EN = 1 |
| TPS6288101QFWRADRQ1 ⁽¹⁾ | 20A | Vo1 = 0.750V; I2C1 = 0x18 Vo2 = 0.800V; I2C2 = 0x19 Vo3 = 1.050V; I2C3 = 0x1A Vo4 = 0.800V; I2C4 = 0x1B | I2C1 = 0x1C / 30° I2C2 = 0x1D / 60° I2C3 = 0x1E / 90° I2C4 = 0x1F / 120° | td _(Ramp) = 1ms f _{SW} = 2.25MHz SOFT_STOP_EN = 1 DROOPEN = 0 DROOPRESISTANCE = 00b PGTH = ±5% REG_CRC_EN = 1 |
| TPS62882QFWRADRQ1 | 24A | Vo1 = 0.850V; I2C1 = 0x38 Vo2 = 0.750V; I2C2 = 0x39 Vo3 = 0.875V; I2C3 = 0x3A Vo4 = 0.800V; I2C4 = 0x3B | I2C1 = 0x3C / 30° I2C2 = 0x3D / 60° I2C3 = 0x3E / 90° I2C4 = 0x3F / 120° | td _(Ramp) = 1ms f _{SW} = 2.25MHz SOFT_STOP_EN = 1 DROOPEN = 0 DROOPRESISTANCE = 00b PGTH = ±5% REG_CRC_EN = 1 |
| TPS6288280QFWRADRQ1 | 24A | Vo1 = 0.850V; I2C1 = 0x38 Vo2 = 0.750V; I2C2 = 0x39 Vo3 = 0.875V; I2C3 = 0x3A Vo4 = 0.800V; I2C4 = 0x3B | I2C1 = 0x3C / 30° I2C2 = 0x3D / 60° I2C3 = 0x3E / 90° I2C4 = 0x3F / 120° | td _(Ramp) = 1ms f _{SW} = 2.25MHz SOFT_STOP_EN = 1 DROOPEN = 0 DROOPRESISTANCE = 00b PGTH = ±8% REG_CRC_EN = 1 |
| TPS62883QFWRADRQ1 | 30A | Vo1 = 0.850V; I2C1 = 0x38 Vo2 = 0.750V; I2C2 = 0x39 Vo3 = 0.875V; I2C3 = 0x3A Vo4 = 0.800V; I2C4 = 0x3B | I2C1 = 0x3C / 30° I2C2 = 0x3D / 60° I2C3 = 0x3E / 90° I2C4 = 0x3F / 120° | td _(Ramp) = 1ms f _{SW} = 2.25MHz SOFT_STOP_EN = 1 DROOPEN = 0 DROOPRESISTANCE = 00b PGTH = ±5% REG_CRC_EN = 1 |
| TPS6288301QFWRADRQ1 ⁽¹⁾ | 30A | Vo1 = 0.750V; I2C1 = 0x18 Vo2 = 0.800V; I2C2 = 0x19 Vo3 = 1.050V; I2C3 = 0x1A Vo4 = 0.800V; I2C4 = 0x1B | I2C1 = 0x1C / 30° I2C2 = 0x1D / 60° I2C3 = 0x1E / 90° I2C4 = 0x1F / 120° | td _(Ramp) = 1ms f _{SW} = 2.25MHz SOFT_STOP_EN = 1 DROOPEN = 0 DROOPRESISTANCE = 00b PGTH = ±5% REG_CRC_EN = 1 |

| DEVICE NUMBER | OUTPUT CURRENT | START-UP VOLTAGE and I ² C DEVICE ADDRESS FOR PRIMARY DEVICE | I ² C DEVICE ADDRESS / PHASE SHIFT FOR SECONDARY DEVICE(S) | SOFT-START TIME / DEFAULT SWITCHING FREQUENCY AND OTHER CONFIGURATION SETTINGS |
|---------------------|----------------|--|---|---|
| TPS6288380QFWRADRQ1 | 30A | Vo1 = 0.850V; I2C1 = 0x38 Vo2 = 0.750V; I2C2 = 0x39 Vo3 = 0.875V; I2C3 = 0x3A Vo4 = 0.800V; I2C4 = 0x3B | I2C1 = 0x3C / 30° I2C2 = 0x3D / 60° I2C3 = 0x3E / 90° I2C4 = 0x3F / 120° | $td_{(Ramp)} = 1\text{ms}$ $f_{SW} = 2.25\text{MHz}$ SOFT_STOP_EN = 1 DROOPEN = 0 DROOPRESISTANCE = 00b PGTH = $\pm 8\%$ REG_CRC_EN = 1 |

(1) Preview information (not Production Data)

5 Device and Documentation Support

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.

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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

Changes from Revision A (December 2025) to Revision B (January 2026) Page

| | |
|--|---|
| • Deleted preview label for TPS62880QFWRADRQ1, TPS62881QFWRADRQ1, TPS62882QFWRADRQ1, TPS6288280QFWRADRQ1 and TPS6288380QFWRADRQ1 in the <i>Device Options</i> table..... | 3 |
|--|---|

Changes from Revision * (October 2024) to Revision A (December 2025) Page

| | |
|--|---|
| • Changed document status from Advance Information to Production Data..... | 1 |
| • Added new device spins to Device Options table..... | 3 |

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.

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) |
|-----------------------|---------------|----------------------|--------------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| TPS62880QFWRADRQ1 | Active | Production | VQFN-HR (RAD) 25 | 3000 LARGE T&R | Yes | NIPDAU | Level-2-260C-1 YEAR | -40 to 125 | TPS6288 0-Q1 |
| TPS62881QFWRADRQ1 | Active | Production | VQFN-HR (RAD) 25 | 3000 LARGE T&R | Yes | NIPDAU | Level-2-260C-1 YEAR | -40 to 125 | TPS6288 1-Q1 |
| TPS6288280QWRADRQ1 | Active | Production | VQFN-HR (RAD) 25 | 3000 LARGE T&R | Yes | NIPDAU | Level-2-260C-1 YEAR | -40 to 125 | TPS6288 280-Q1 |
| TPS62882QFWRADRQ1 | Active | Production | VQFN-HR (RAD) 25 | 3000 LARGE T&R | Yes | NIPDAU | Level-2-260C-1 YEAR | -40 to 125 | TPS6288 2-Q1 |
| TPS6288380QWRADRQ1 | Active | Production | VQFN-HR (RAD) 25 | 3000 LARGE T&R | Yes | NIPDAU | Level-2-260C-1 YEAR | -40 to 125 | TPS6288 380-Q1 |
| TPS62883QFWRADRQ1 | Active | Production | VQFN-HR (RAD) 25 | 3000 LARGE T&R | Yes | NIPDAU | Level-2-260C-1 YEAR | -40 to 125 | TPS6288 3-Q1 |

⁽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.

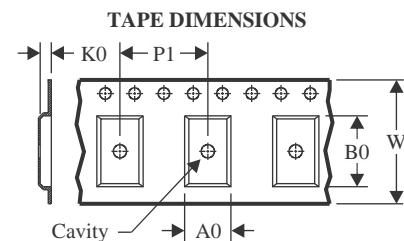
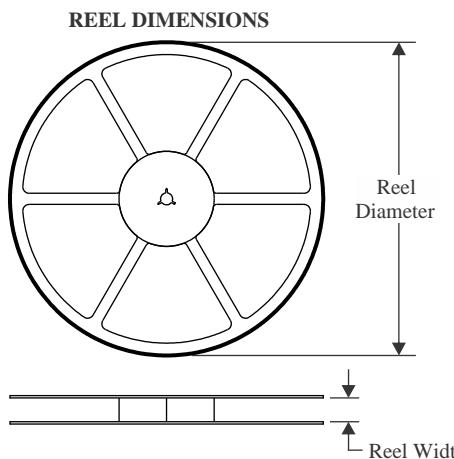
⁽⁵⁾ **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will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

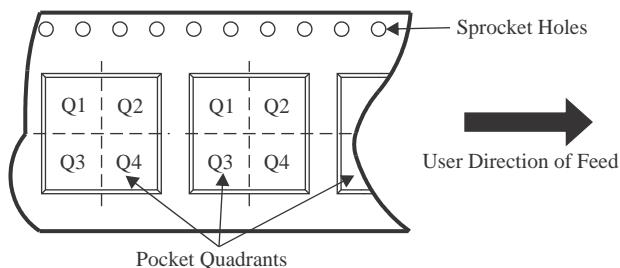
Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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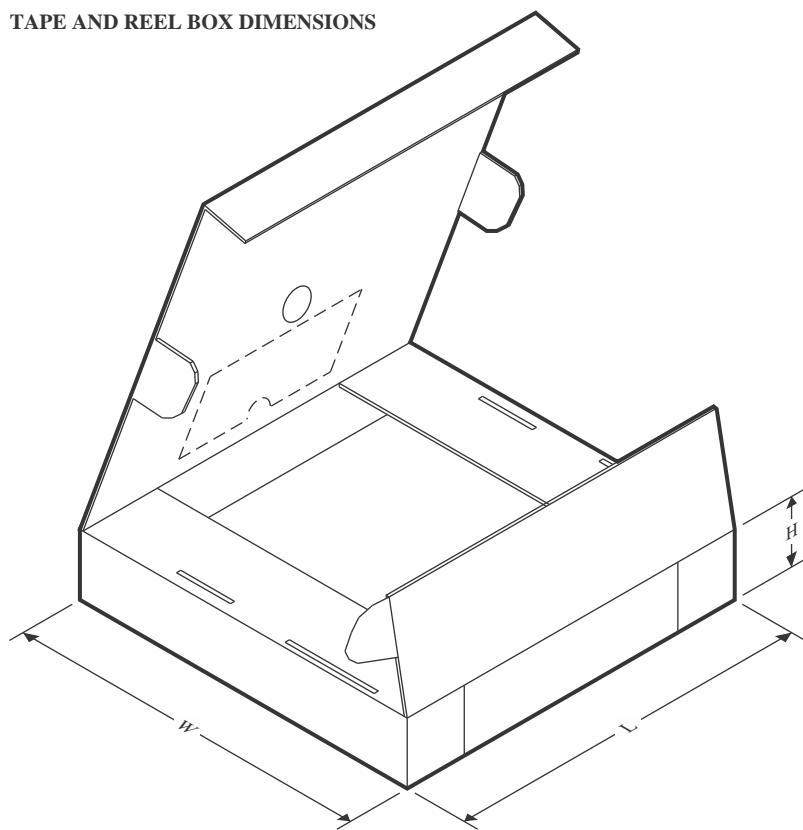
TAPE AND REEL INFORMATION


| | |
|----|---|
| 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 |
|--------------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TPS62880QFWRADRQ1 | VQFN-HR | RAD | 25 | 3000 | 330.0 | 12.4 | 4.3 | 5.3 | 1.3 | 8.0 | 12.0 | Q1 |
| TPS62881QFWRADRQ1 | VQFN-HR | RAD | 25 | 3000 | 330.0 | 12.4 | 4.3 | 5.3 | 1.3 | 8.0 | 12.0 | Q1 |
| TPS6288280QWRADRQ1 | VQFN-HR | RAD | 25 | 3000 | 330.0 | 12.4 | 4.3 | 5.3 | 1.3 | 8.0 | 12.0 | Q1 |
| TPS62882QFWRADRQ1 | VQFN-HR | RAD | 25 | 3000 | 330.0 | 12.4 | 4.3 | 5.3 | 1.3 | 8.0 | 12.0 | Q1 |
| TPS6288380QWRADRQ1 | VQFN-HR | RAD | 25 | 3000 | 330.0 | 12.4 | 4.3 | 5.3 | 1.3 | 8.0 | 12.0 | Q1 |
| TPS62883QFWRADRQ1 | VQFN-HR | RAD | 25 | 3000 | 330.0 | 12.4 | 4.3 | 5.3 | 1.3 | 8.0 | 12.0 | Q1 |

TAPE AND REEL BOX DIMENSIONS


*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|--------------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TPS62880QFWRADRQ1 | VQFN-HR | RAD | 25 | 3000 | 367.0 | 367.0 | 35.0 |
| TPS62881QFWRADRQ1 | VQFN-HR | RAD | 25 | 3000 | 367.0 | 367.0 | 35.0 |
| TPS6288280QWRADRQ1 | VQFN-HR | RAD | 25 | 3000 | 367.0 | 367.0 | 35.0 |
| TPS62882QFWRADRQ1 | VQFN-HR | RAD | 25 | 3000 | 367.0 | 367.0 | 35.0 |
| TPS6288380QWRADRQ1 | VQFN-HR | RAD | 25 | 3000 | 367.0 | 367.0 | 35.0 |
| TPS62883QFWRADRQ1 | VQFN-HR | RAD | 25 | 3000 | 367.0 | 367.0 | 35.0 |

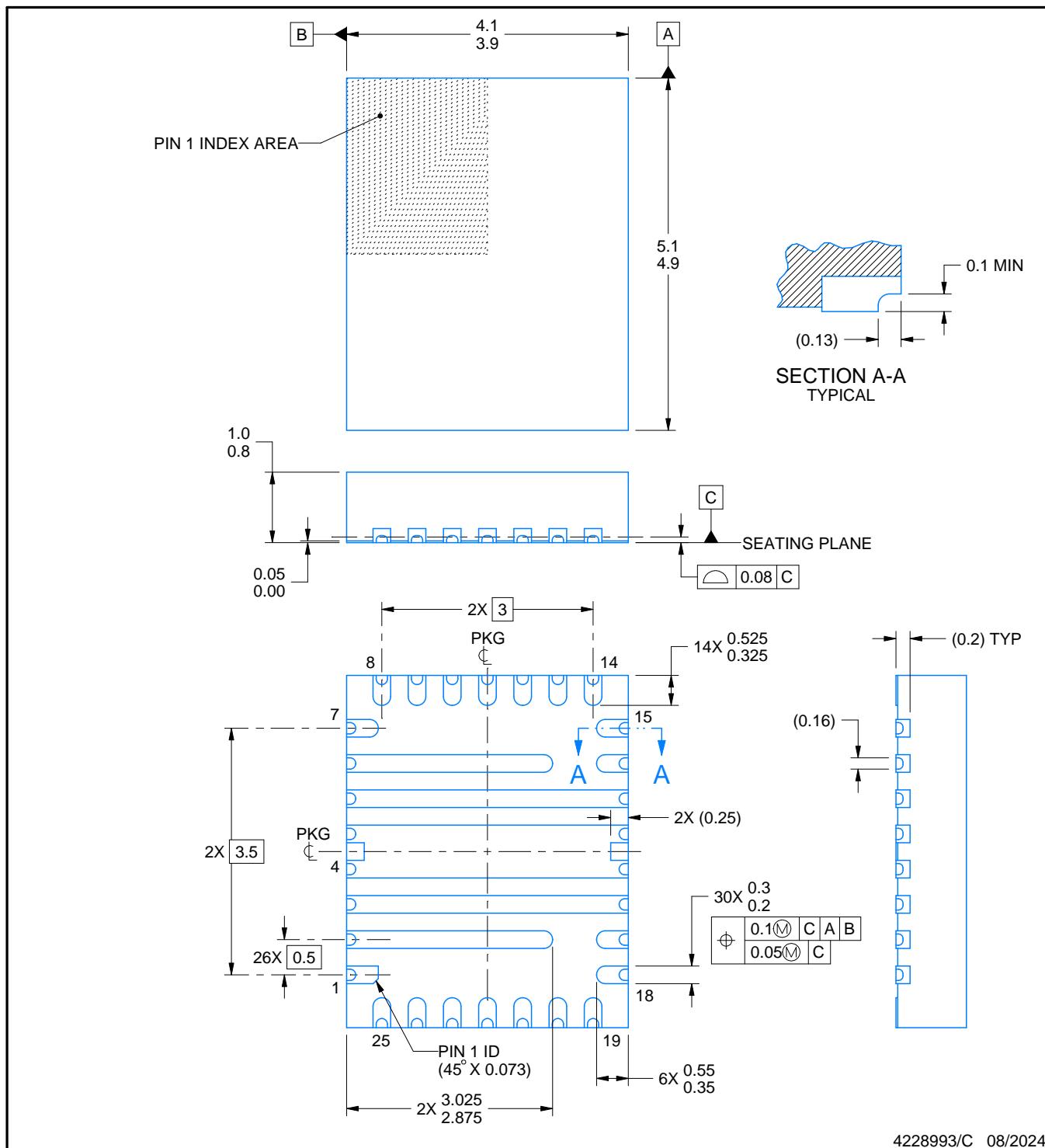
PACKAGE OUTLINE

RAD0025A



VQFN-HR - 1 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



4228993/C 08/2024

NOTES:

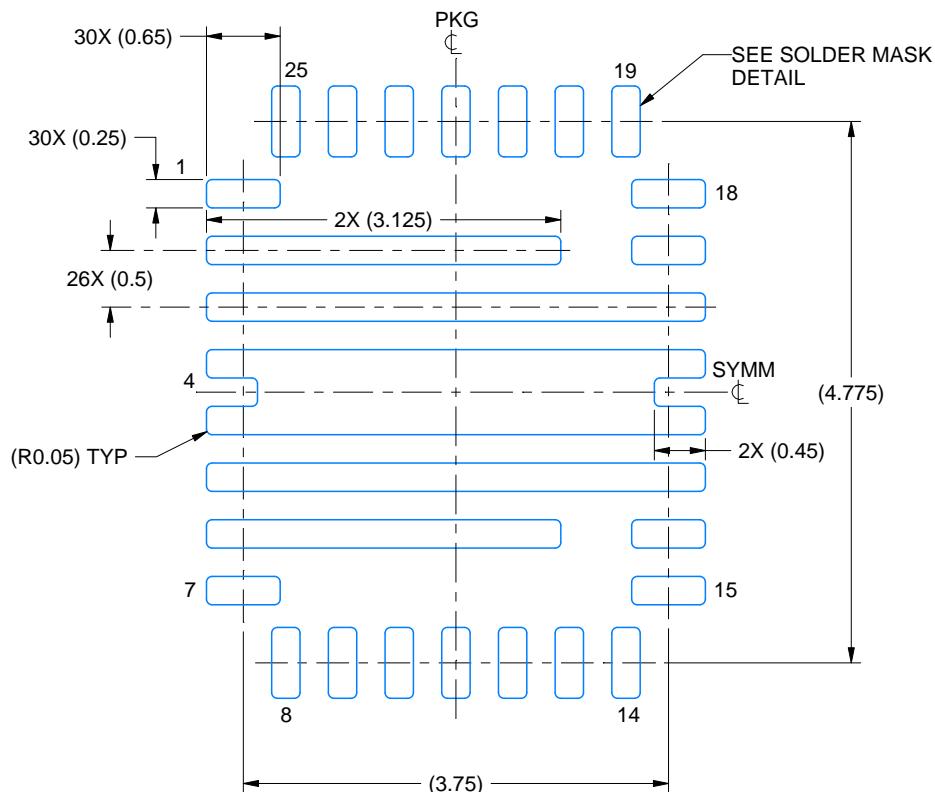
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.

EXAMPLE BOARD LAYOUT

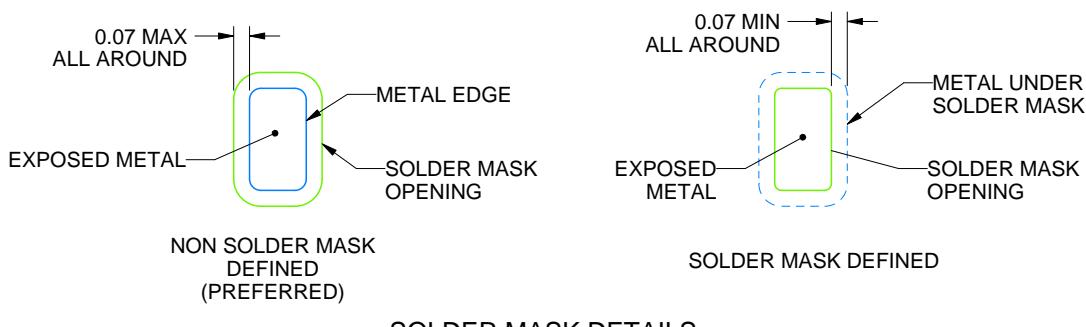
RAD0025A

VQFN-HR - 1 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 15X



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NOTES: (continued)

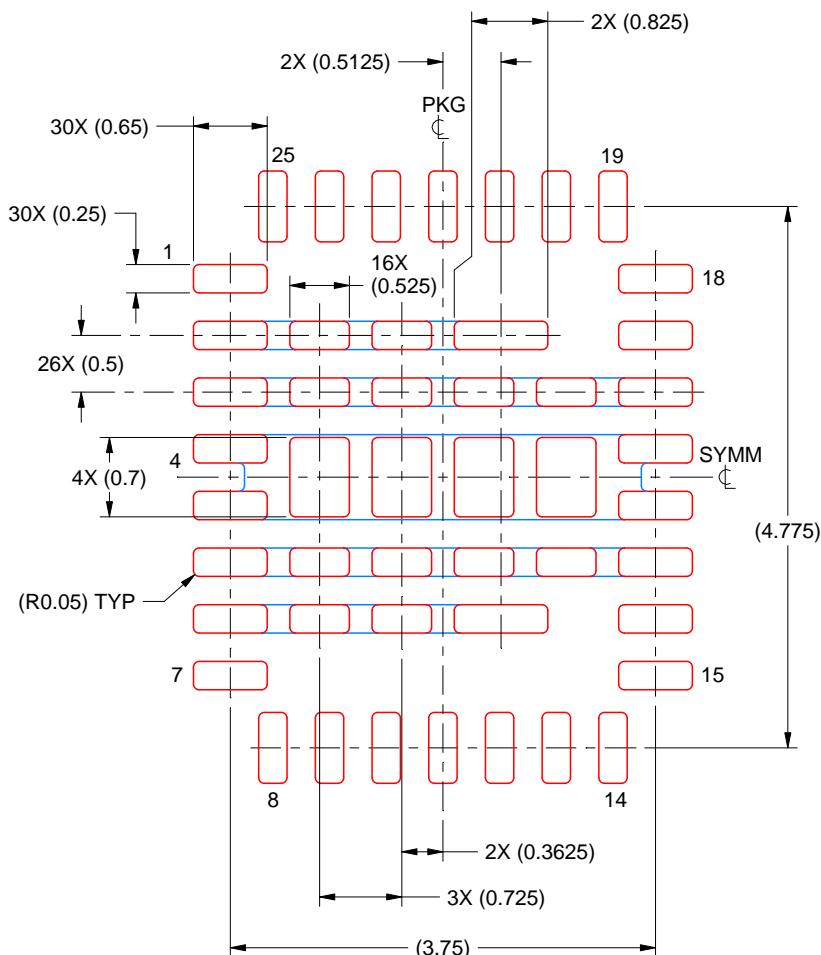
4. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/slua271).

EXAMPLE STENCIL DESIGN

RAD0025A

VQFN-HR - 1 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



SOLDER PASTE EXAMPLE
BASED ON 0.125 MM THICK STENCIL
SCALE: 15X

PRINTED SOLDER COVERAGE BY AREA UNDER PACKAGE
PADS 2 & 6: 80%
PADS 3 & 5: 77%
PAD 4: 69%

4228993/C 08/2024

NOTES: (continued)

5. 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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