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; Vout from 0.4V to 1.2V
- Output voltage accuracy: ±0.5%
- 7mΩ and 4.5mΩ 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

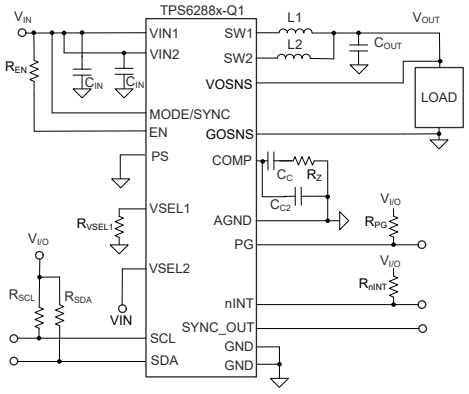
3 Description

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 5 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 Section 4 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 *Section 4* table.



Simplified Schematic

Table of Contents

4 Device Options

DEVICE NUMBER	OUTPUT CURRENT	START-UP VOLTAGE and I²C DEVICE ADDRESS FOR PRIMARY DEVICE	I²C DEVICE ADDRESS / PHASE SHIFT FOR SECONDARY DEVICE(S)	SOFT-START TIME / DEFAULT SWITCHING FREQUENCY AND OTHER CONFIGURATION SETTINGS
TPS62880QFWRADRQ1(1)	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(1)	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(1)	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(1)	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 I²C DEVICE ADDRESS FOR PRIMARY DEVICE	I²C DEVICE ADDRESS / PHASE SHIFT FOR SECONDARY DEVICE(S)	SOFT-START TIME / DEFAULT SWITCHING FREQUENCY AND OTHER CONFIGURATION SETTINGS
TPS6288380QFWRADRQ1(1)	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 = ±8% REG_CRC_EN = 1

(1) Preview information (not Advance Information)

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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5.4 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 * (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)
TPS62883QFWRADRQ1	Active	Production	VQFN-HR (RAD) | 25	3000 | LARGE T&R	-	NIPDAU	Level-2-260C-1 YEAR	-40 to 125	TPS6288 3-Q1
XTPS62883QFWRADRQ1	Active	Preproduction	VQFN-HR (RAD) | 25	3000 | LARGE T&R	-	Call TI	Call TI	-40 to 125	
XTPS62883QFWRADRQ1.A	Active	Preproduction	VQFN-HR (RAD) | 25	3000 | LARGE T&R	-	Call TI	Call TI	-40 to 125	

(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.

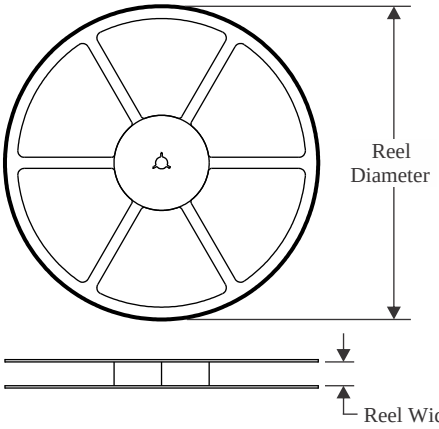
(5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will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

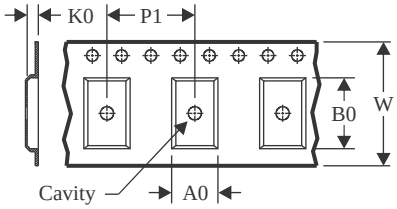
Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

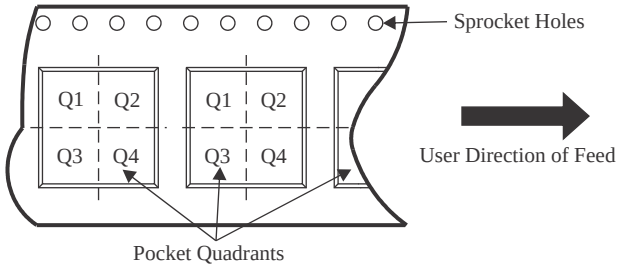


TAPE DIMENSIONS



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

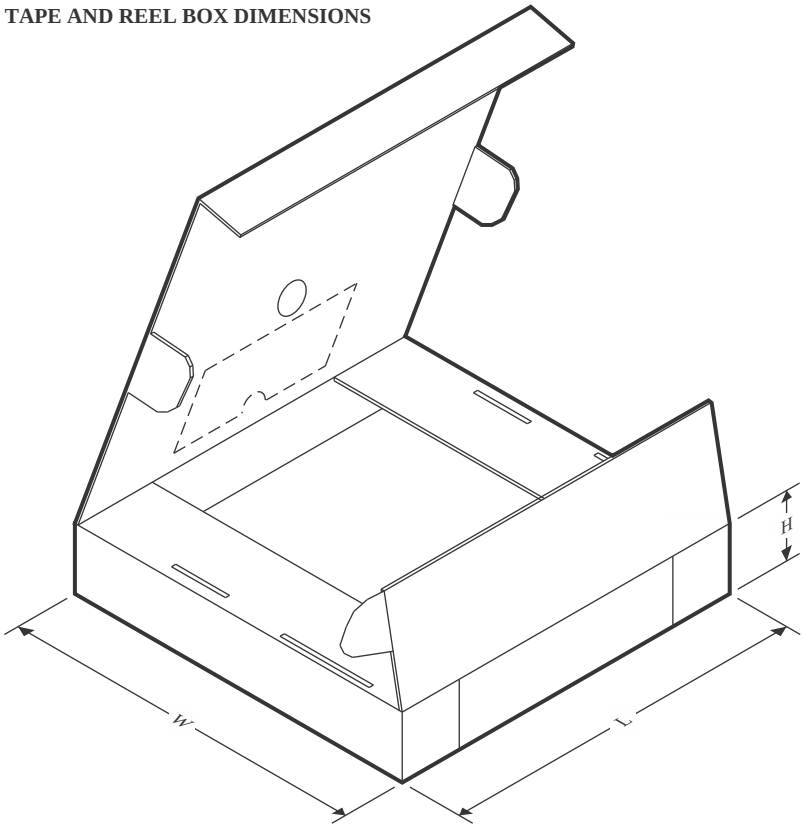
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
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

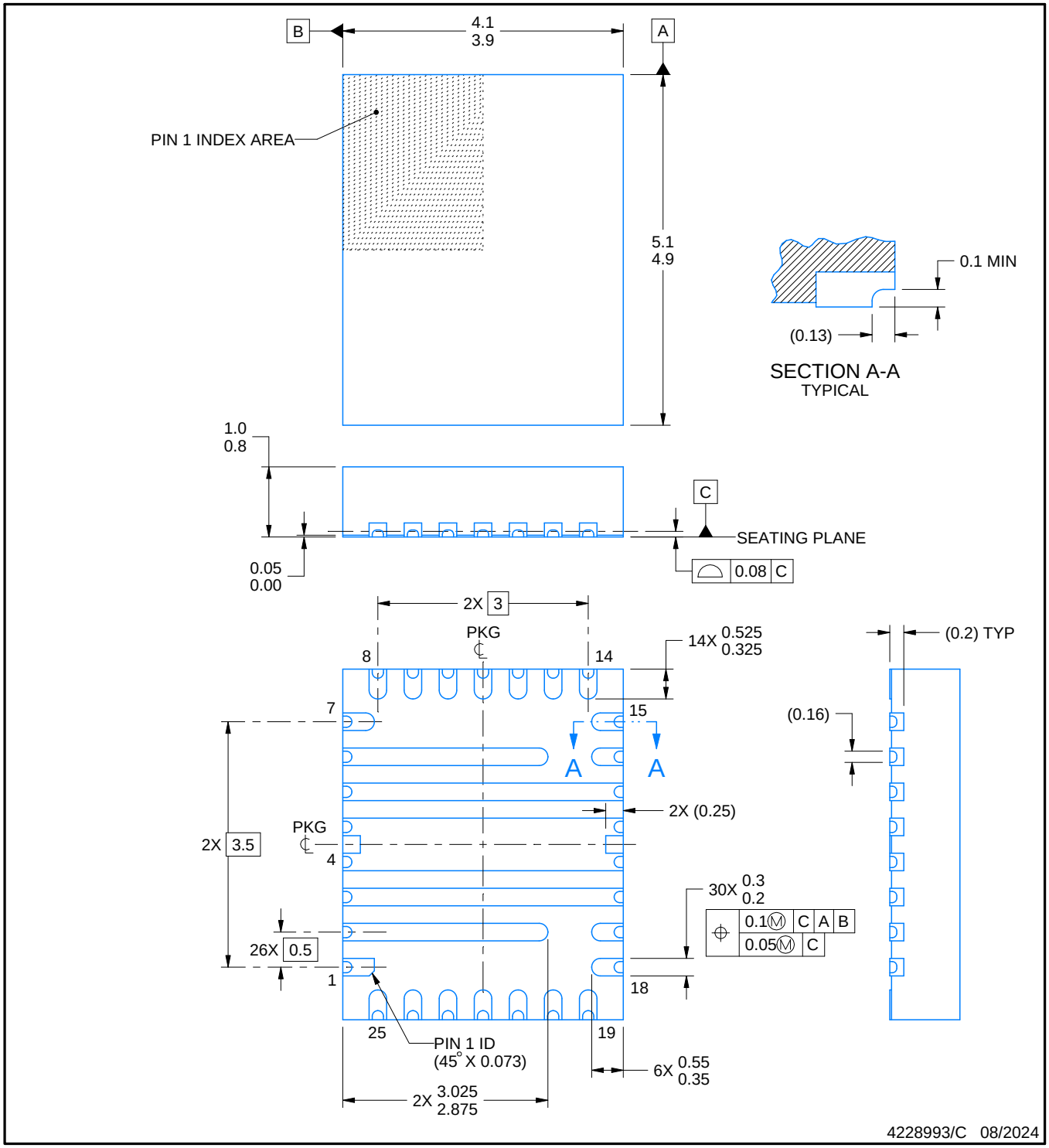
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TPS62883QFWRADRQ1	VQFN-HR	RAD	25	3000	367.0	367.0	35.0

PACKAGE OUTLINE

RAD0025A

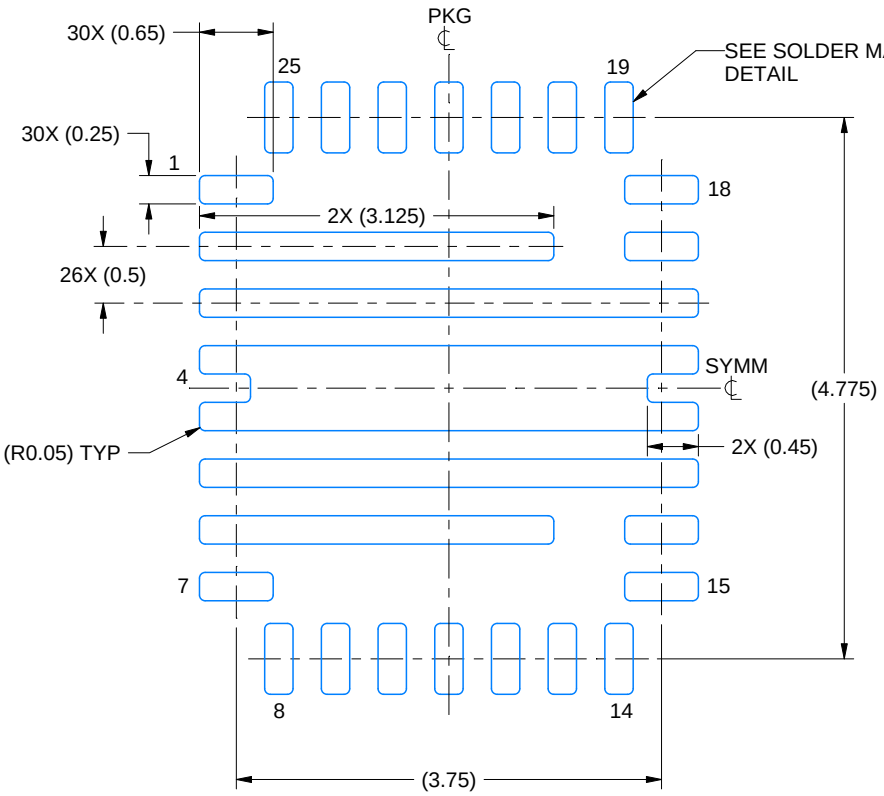
VQFN-HR - 1 mm max height

PLASTIC QUAD FLATPACK - NO LEAD

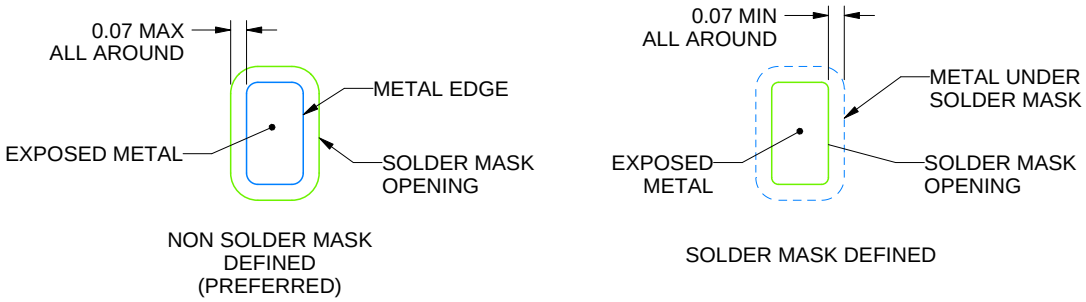


NOTES:

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.



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 15X



SOLDER MASK DETAILS

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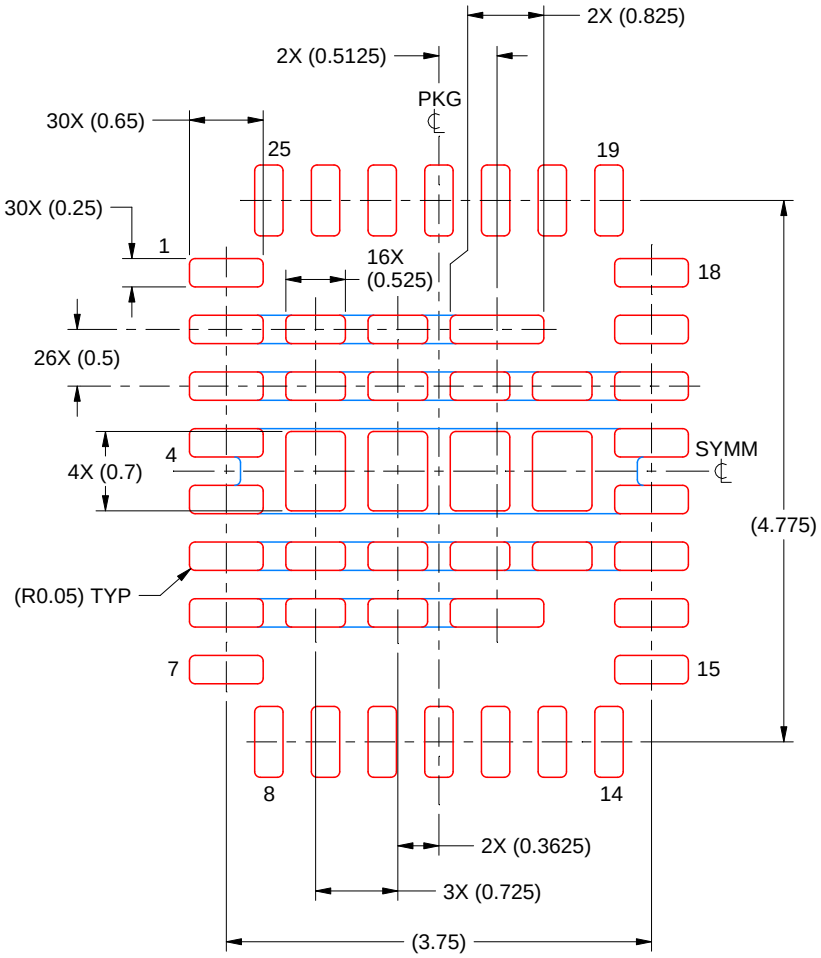
NOTES: (continued)

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).



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%

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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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