

LP8764-Q1 Four-Phase, 20-A Buck Converter With Integrated Switches

1 Features

- AEC-Q100 Qualified with the following results:
 - Input voltage: 2.8 V to 5.5 V
 - Device temperature grade 1: -40°C to $+125^{\circ}\text{C}$ ambient operating temperature range
 - Device HBM ESD classification Level 2
 - Device CDM ESD classification Level C4B
- Functional Safety-Compliant
 - Developed for functional safety applications
 - Documentation available to aid ISO 26262 system design up to ASIL-D
 - Documentation available to aid IEC 61508 system design up to SIL-3
 - Systematic capability up to ASIL-D
 - Hardware integrity up to ASIL-D
 - Windowed voltage and over-current monitors
 - Watchdog with selectable trigger / Q&A mode
 - Level or PWM error signal monitoring (ESM)
 - Thermal monitoring with high temperature warning and thermal shutdown
 - Bit-integrity (CRC) error detection on configuration registers and non-volatile memory
- 4 high-efficiency step-down DC/DC converters:
 - Output voltage: 0.3 V to 3.34 V (0.3 V to 1.9 V for multi-phase outputs)
 - Maximum output current: 5 A per phase, up to 20 A with 4-phase configuration
 - Programmable output voltage slew-rate: 0.5 mV/ μs to 33 mV/ μs
 - Switching frequency: 2.2 MHz or 4.4 MHz
- 10 configurable general purpose I/O (GPIO)
- SPMI interface for multi-PMIC synchronization
- Input overvoltage monitor (OVP) and undervoltage lockout (UVLO)

2 Applications

- [Advanced driver assistance systems \(ADAS\)](#)
- [Front camera](#)
- [Surround view system ECU](#)
- [Long range radar](#)
- [Sensor fusion](#)
- [Domain controller](#)

3 Description

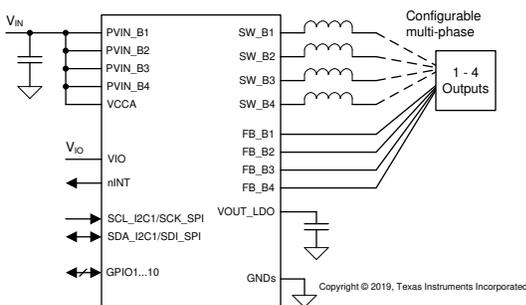
The LP8764-Q1 device is designed to meet the power management requirements of the latest processors and platforms in various safety-relevant automotive and industrial applications. The device has four step-down DC/DC converter cores, that are configurable for five different phase configurations from one 4-phase output to four 1-phase outputs. The device settings can be changed by I²C-compatible serial interface or by a SPI serial interface.

The automatic PFM/PWM (AUTO mode) operation together with the automatic phase adding and phase shedding maximizes efficiency over a wide output-current range. The LP8764-Q1 device supports remote differential voltage sensing for multiphase outputs to compensate IR drop between the regulator output and the point-of-load (POL) that improves the accuracy of the output voltage. The switching clock can be forced to PWM mode and the phases are interleaved. The switching can be synchronized to an external clock and spread-spectrum mode can be enabled to minimize the disturbances.

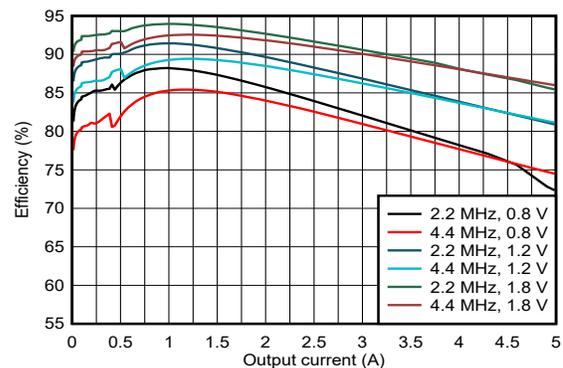
Device Information

PART NUMBER	PACKAGE ⁽¹⁾	BODY SIZE (NOM)
LP8764-Q1	VQFN-HR (32)	5.50mm × 5.00mm

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



Simplified Schematic



Efficiency vs Output Current (1-phase), $V_{IN} = 3.3\text{V}$



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4 Device and Documentation Support

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.
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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
November 2024	*	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.

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)
LP876411B4RQKRQ1	Active	Production	VQFN-HR (RQK) 32	3000 LARGE T&R	Yes	SN	Level-2-260C-1 YEAR	-40 to 125	LP8764 11B4-Q1
LP876411B4RQKRQ1.A	Active	Production	VQFN-HR (RQK) 32	3000 LARGE T&R	Yes	SN	Level-2-260C-1 YEAR	-40 to 125	LP8764 11B4-Q1
LP876411B5RQKRQ1	Active	Production	VQFN-HR (RQK) 32	3000 LARGE T&R	Yes	SN	Level-2-260C-1 YEAR	-40 to 125	LP8764 11B5-Q1
LP876411B5RQKRQ1.A	Active	Production	VQFN-HR (RQK) 32	3000 LARGE T&R	Yes	SN	Level-2-260C-1 YEAR	-40 to 125	LP8764 11B5-Q1
LP876440C0RQKRQ1	Active	Production	VQFN-HR (RQK) 32	3000 LARGE T&R	Yes	SN	Level-2-260C-1 YEAR	-40 to 125	LP8764 40C0-Q1
LP876440C0RQKRQ1.A	Active	Production	VQFN-HR (RQK) 32	3000 LARGE T&R	Yes	SN	Level-2-260C-1 YEAR	-40 to 125	LP8764 40C0-Q1
LP876441B1RQKRQ1	Active	Production	VQFN-HR (RQK) 32	3000 LARGE T&R	Yes	NIPDAU SN	Level-2-260C-1 YEAR	-40 to 125	LP8764 41B1-Q1
LP876441B1RQKRQ1.A	Active	Production	VQFN-HR (RQK) 32	3000 LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 125	LP8764 41B1-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.

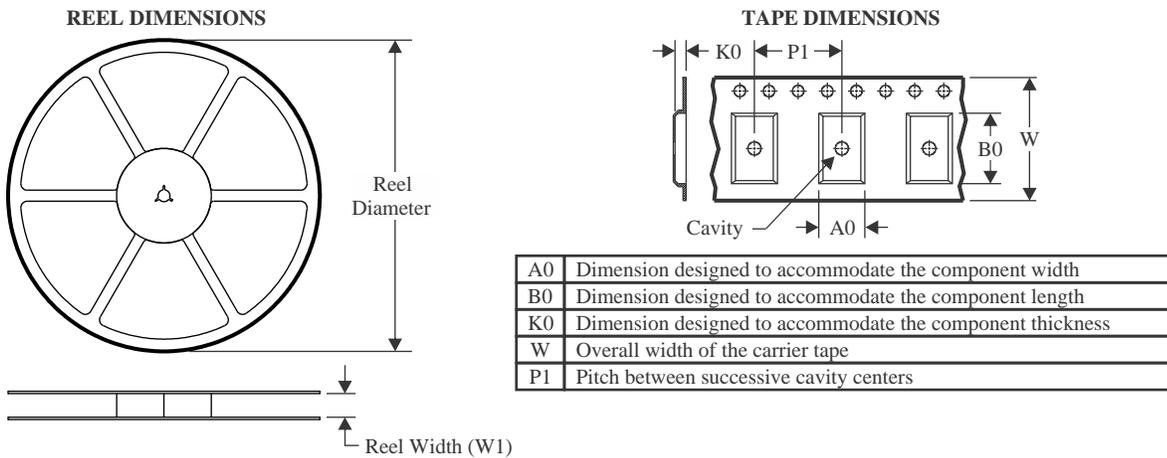
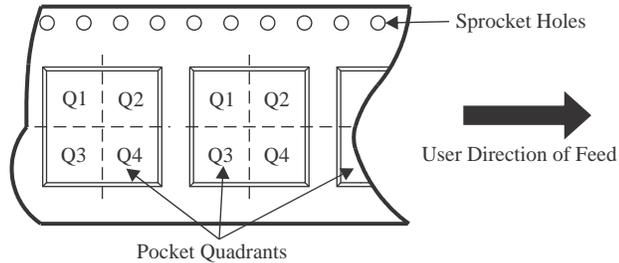
(5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will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

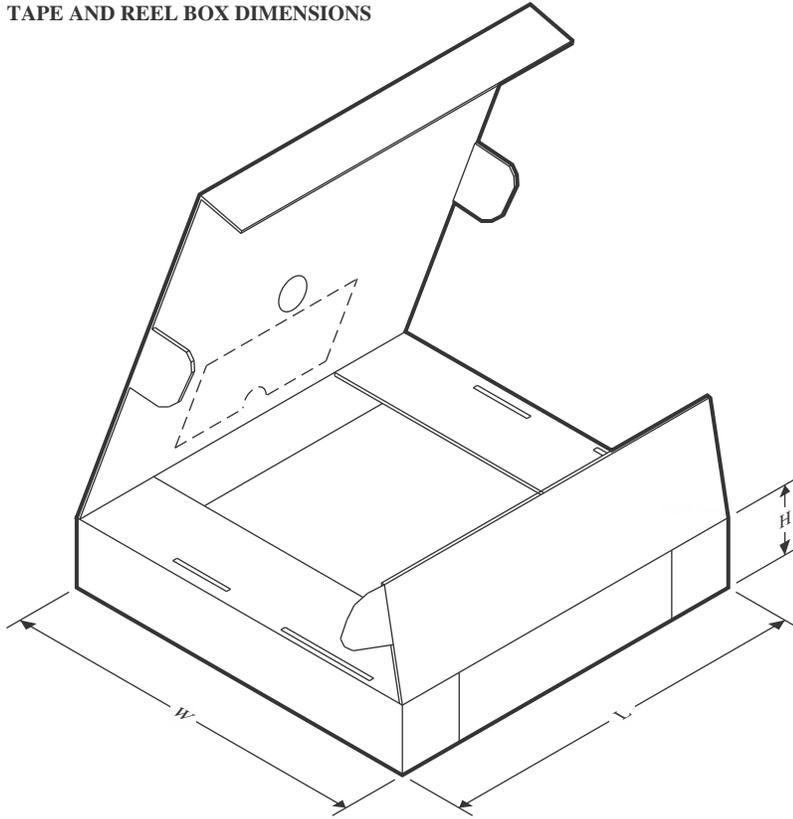
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TAPE AND REEL INFORMATION

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
LP876411B4RQKRQ1	VQFN-HR	RQK	32	3000	330.0	12.4	5.25	5.75	1.05	8.0	12.0	Q1
LP876411B5RQKRQ1	VQFN-HR	RQK	32	3000	330.0	12.4	5.25	5.75	1.05	8.0	12.0	Q1
LP876440C0RQKRQ1	VQFN-HR	RQK	32	3000	330.0	12.4	5.25	5.75	1.05	8.0	12.0	Q1
LP876441B1RQKRQ1	VQFN-HR	RQK	32	3000	330.0	12.4	5.25	5.75	1.05	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)
LP876411B4RQKRQ1	VQFN-HR	RQK	32	3000	367.0	367.0	38.0
LP876411B5RQKRQ1	VQFN-HR	RQK	32	3000	367.0	367.0	38.0
LP876440C0RQKRQ1	VQFN-HR	RQK	32	3000	367.0	367.0	38.0
LP876441B1RQKRQ1	VQFN-HR	RQK	32	3000	367.0	367.0	38.0

GENERIC PACKAGE VIEW

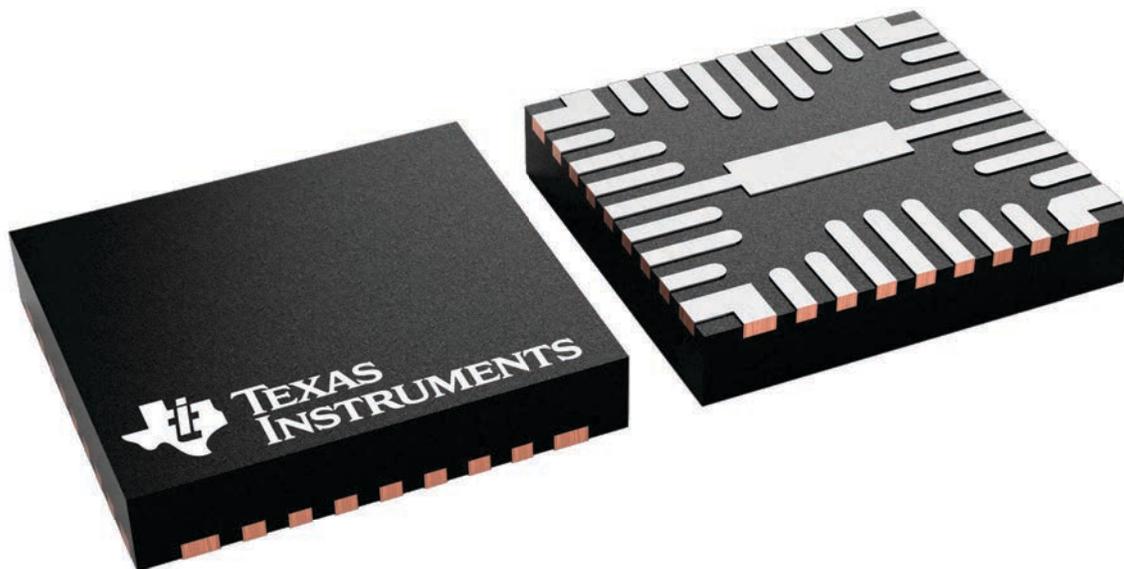
RQK 32

VQFN-HR - 1 mm max height

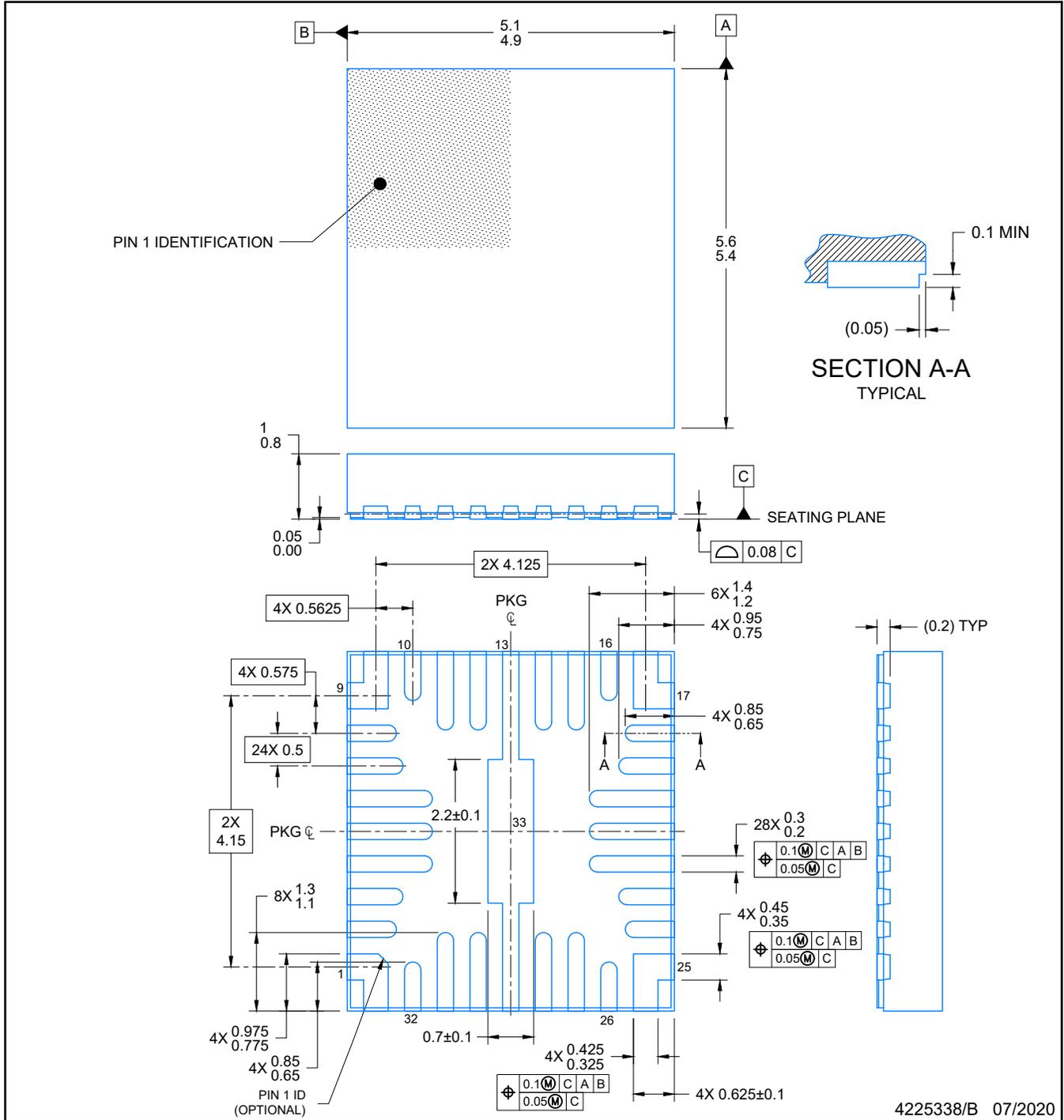
5 x 5.5, 0.5 mm pitch

PLASTIC QUAD FLATPACK - NO LEAD

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

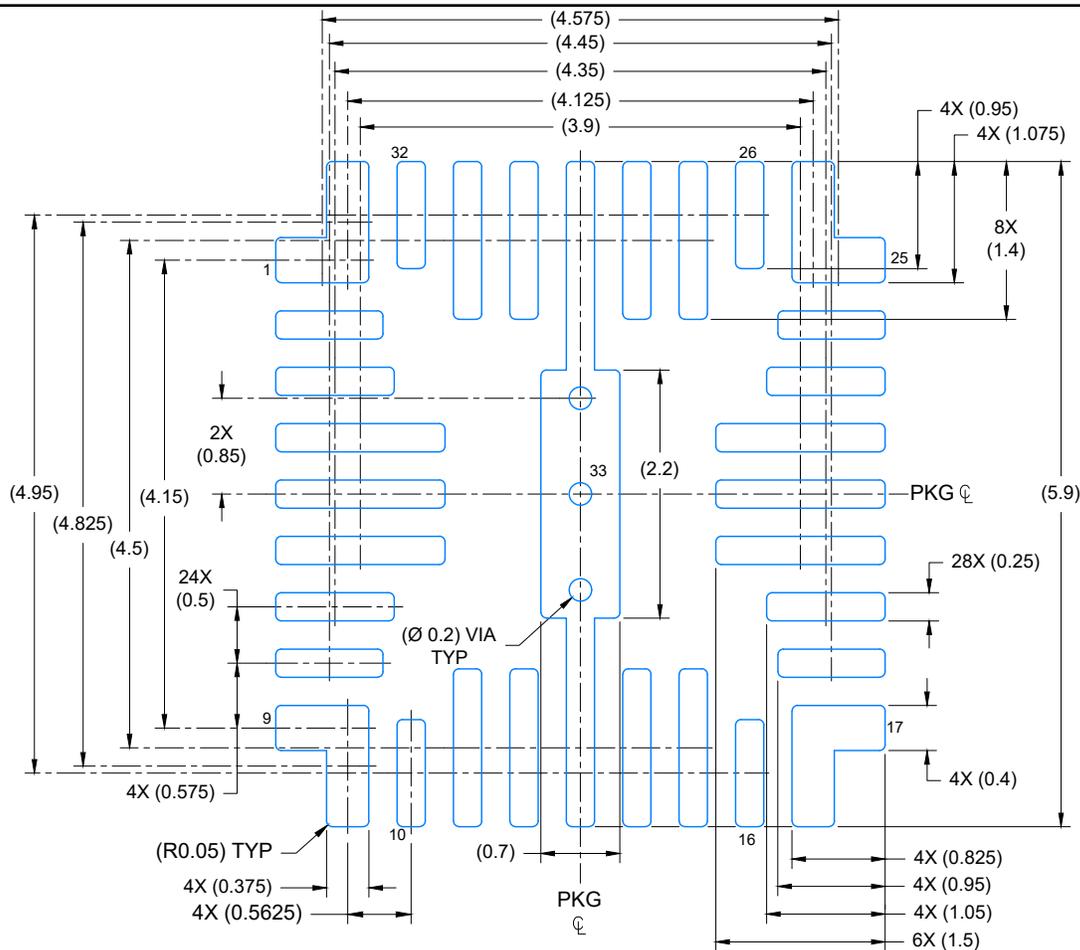


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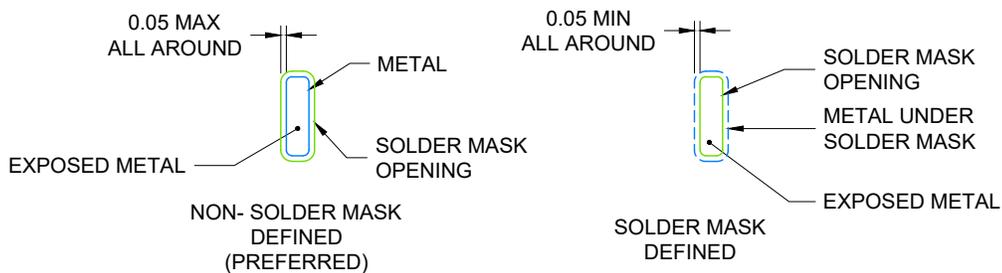


NOTES:

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.



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 15X



SOLDER MASK DETAILS
NOT TO SCALE

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NOTES: (continued)

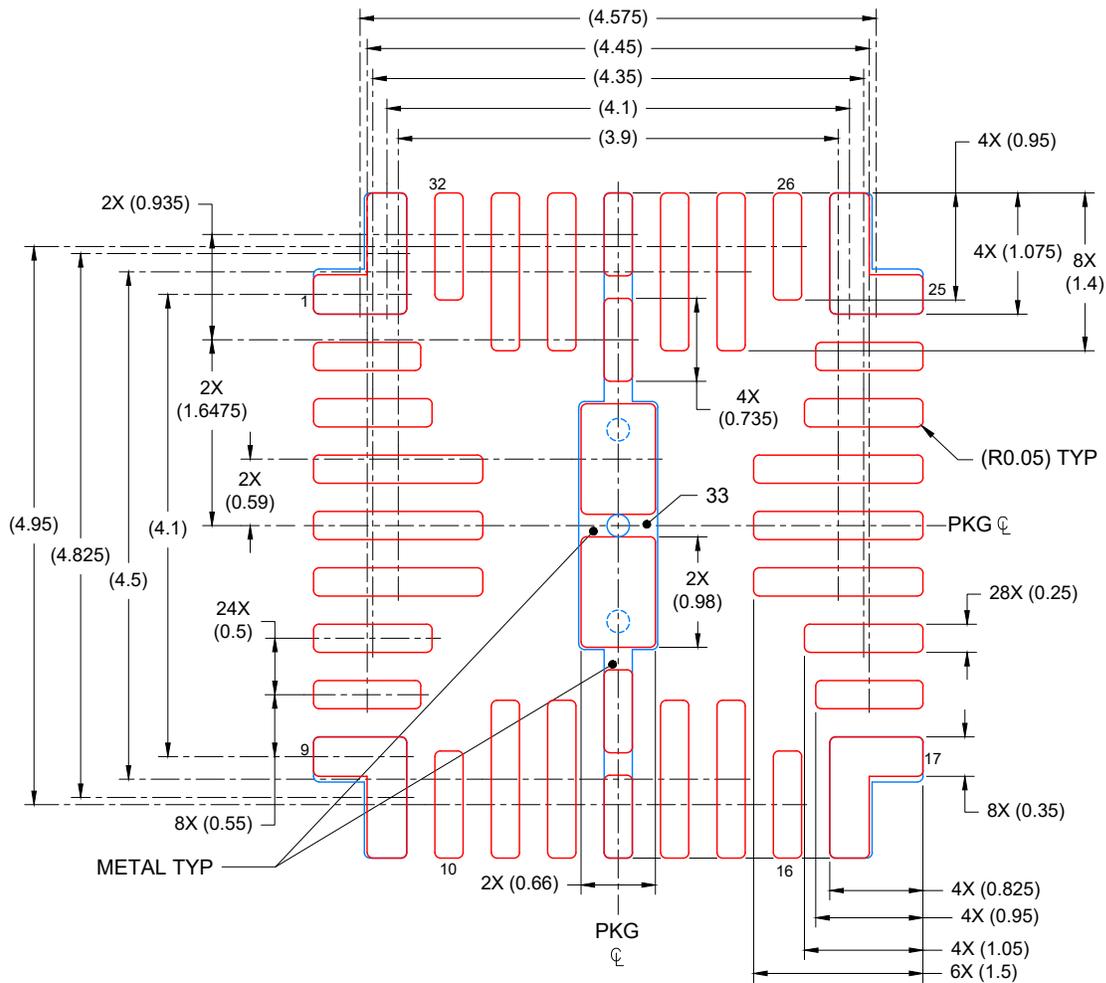
3. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/sluea271).
4. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

RQK0032A

VQFN-HR - 1 mm max height

PLASTIC QUAD FLATPACK-NO LEAD



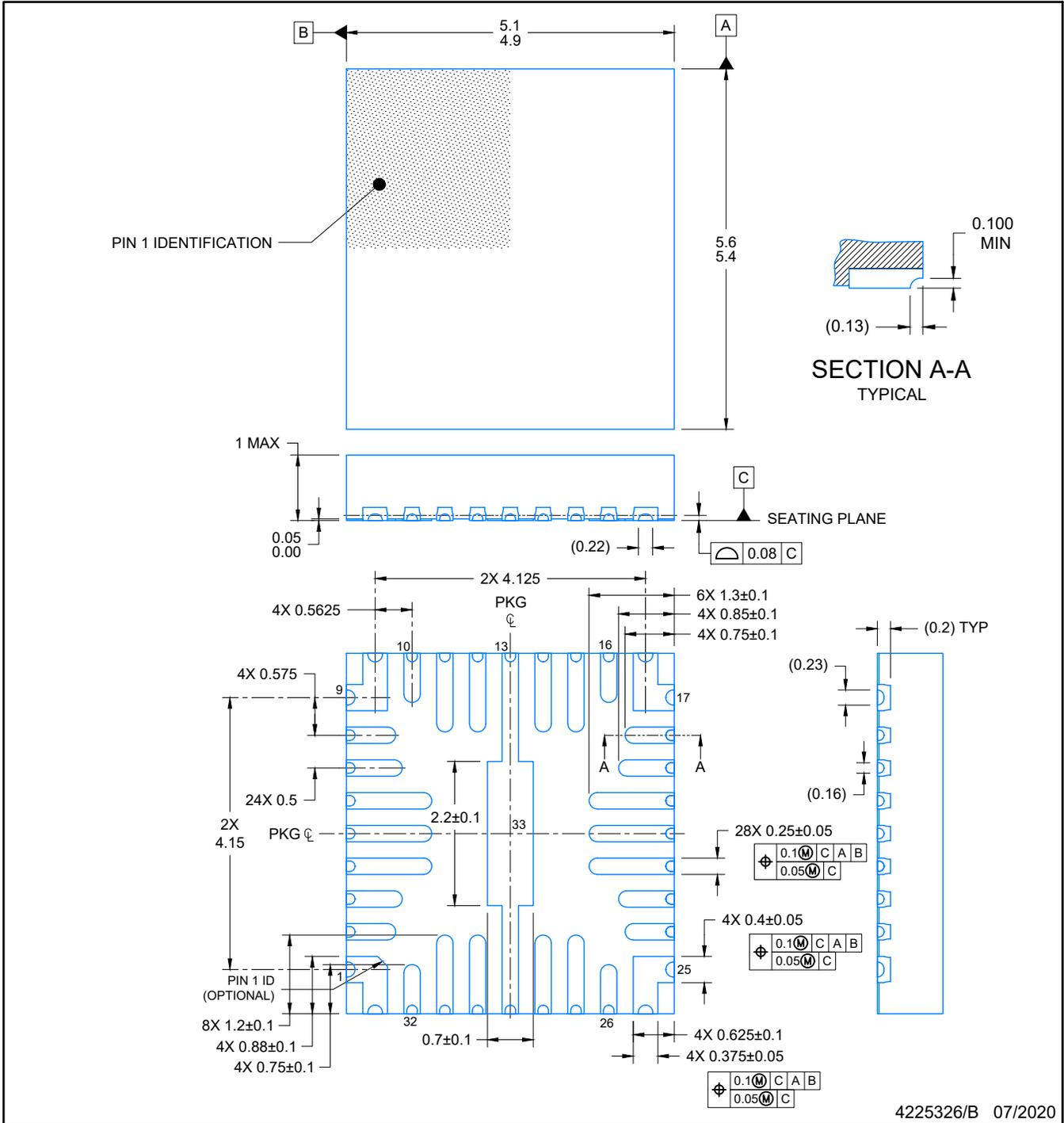
SOLDER PASTE EXAMPLE
BASED ON 0.1mm THICK STENCIL

PIN 1,9,16 & 25: 93%; PIN 13& 29: 79%; PIN 33: 84%
SCALE: 15X

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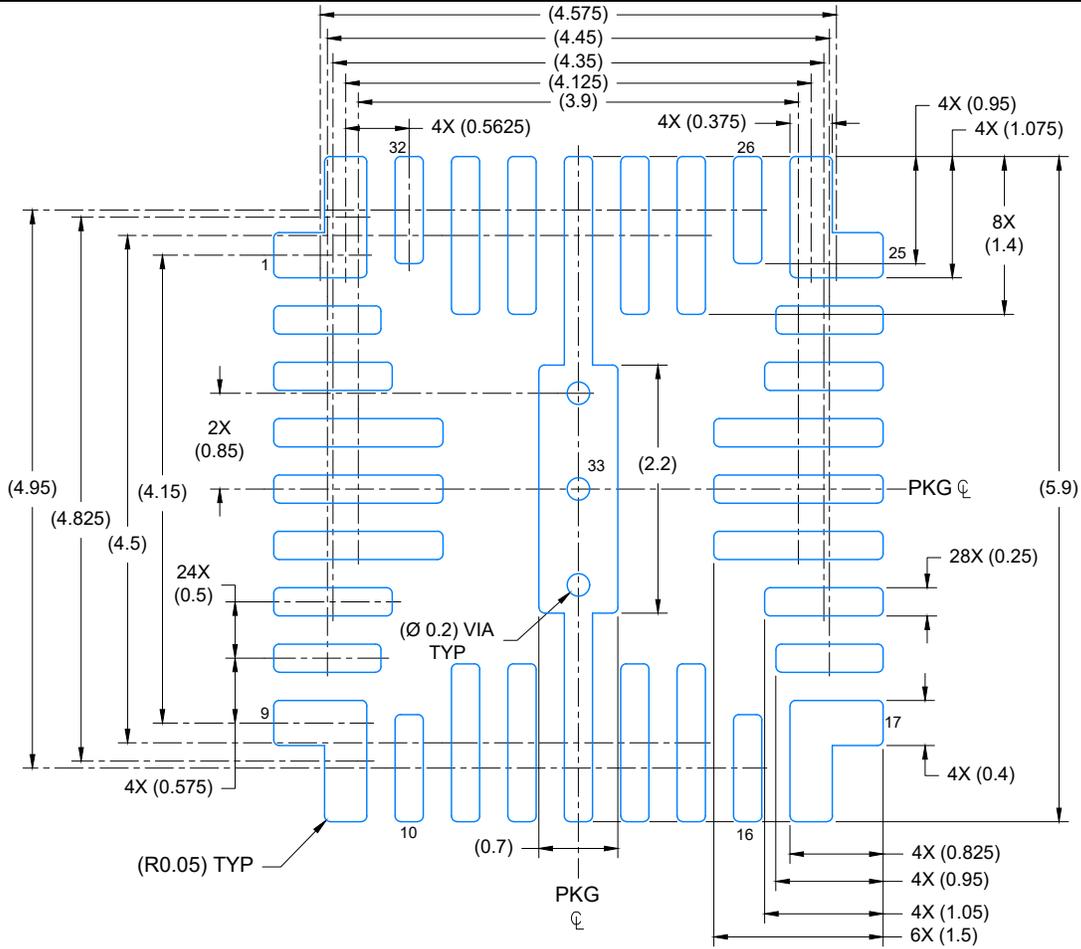
NOTES: (continued)

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

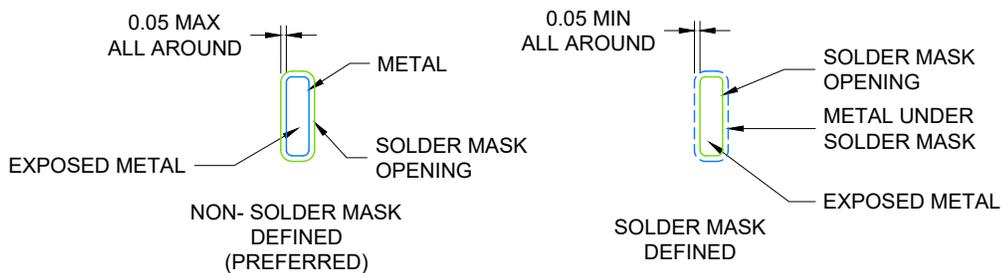


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2. This drawing is subject to change without notice.



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 15X

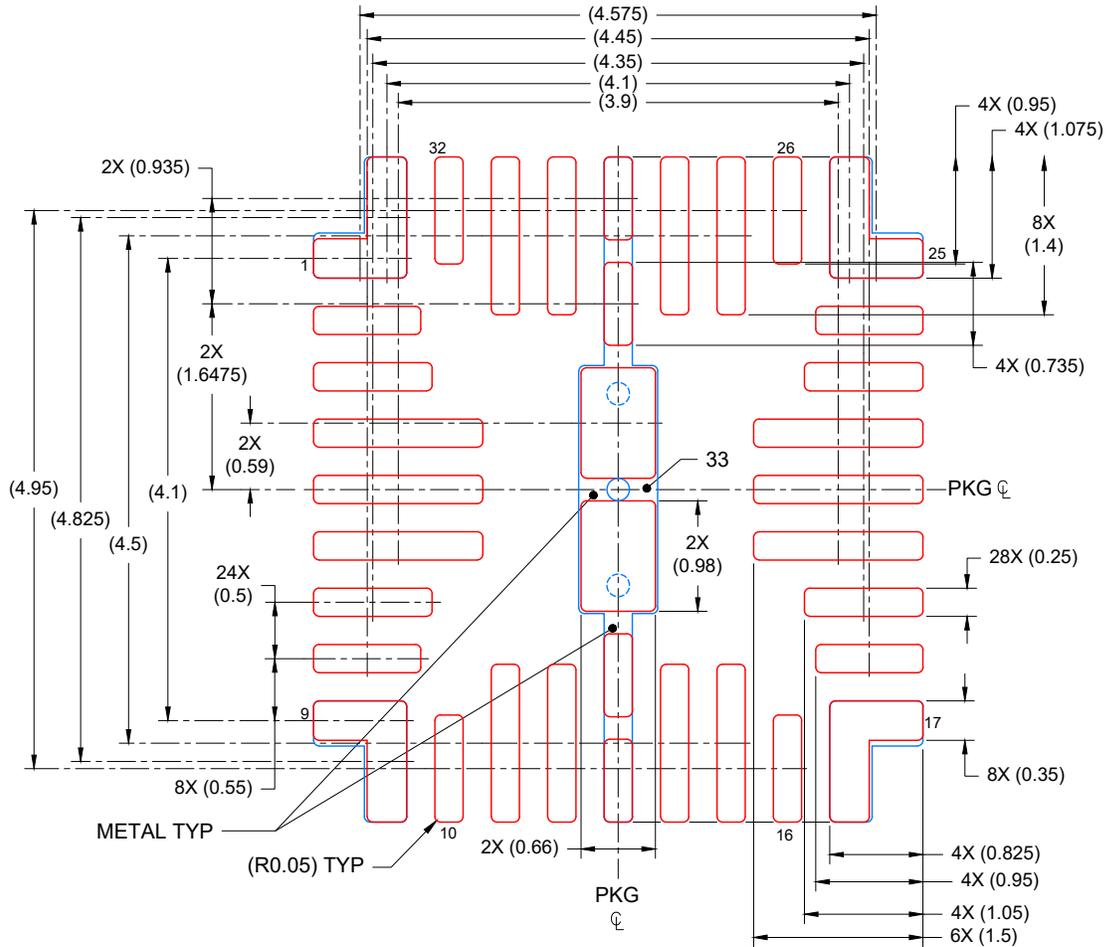


SOLDER MASK DETAILS
NOT TO SCALE

4225326/B 07/2020

NOTES: (continued)

3. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/sluea271).
4. Solder mask tolerances between and around signal pads can vary based on board fabrication site.



SOLDER PASTE EXAMPLE
 BASED ON 0.1mm THICK STENCIL

PIN 1,9,16 & 25: 93%; PIN 13& 29: 79%; PIN 33: 84%
 SCALE: 15X

4225326/B 07/2020

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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