ULC1001 Configurable Ultrasonic PWM Modulator With I/V Sense Amplifiers

1 Features

- Integrated Programmable Cleaning Modes
  - Water (expelling)
  - Deice (melting and expelling)
  - Mud (dehydrating and expelling)
  - Auto-cleaning (detecting mass and expelling)
  - Custom cleaning modes
- Embedded algorithms
  - Lens system calibration
  - Automatic mass detection
  - Power regulation
  - System diagnostics
- System diagnostics
  - Driver fault reporting
  - Lens system fault reporting
  - Transducer temperature regulation
- Wide-drive frequency range
  - High-efficiency direct drive (10kHz - 5MHz)
  - AD modulation (<50kHz)
- I^2C user interface
- Clock source required
  - External oscillator (10MHz, 5ppm recommended)
- Power supplies
  - IOVDD: 3.3V
- 32-pin, QFN-HR package

2 Applications

- Thermal Imaging Camera
- Traffic Monitoring Camera
- Machine Vision Camera
- Wireless Security Camera
- Drone Vision

3 Description

The ULC1001 is a configurable PWM modulator with current and voltage sensing capabilities specifically for piezo-based lens cleaning systems.

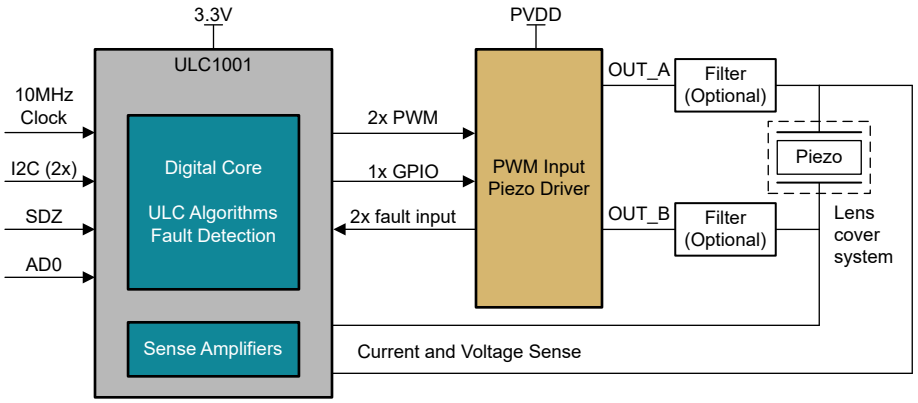
An on-chip, low-latency DSP supports Texas Instruments' proprietary algorithms designed for lens cleaning. The ULC1001 and work together to create an Ultrasonic Lens Cleaning system.

The ULC1001 device is available in a 32-pin QFN-HR package for a compact PCB footprint.

Device Information

PART NUMBER	PACKAGE(1)	PACKAGE SIZE(2)
ULC1001	HRQFN	4.5mm × 5.0mm

(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 and includes pins, where applicable.



Simplified Application

Table of Contents

4 Revision History

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

Changes from Revision A (December 2022) to Revision B (March 2024)	Page
• New application diagram	1

Changes from Revision * (December 2020) to Revision A (December 2022)	Page
• Updated device status to production data	1

5 Mechanical, Packaging, and Orderable Information

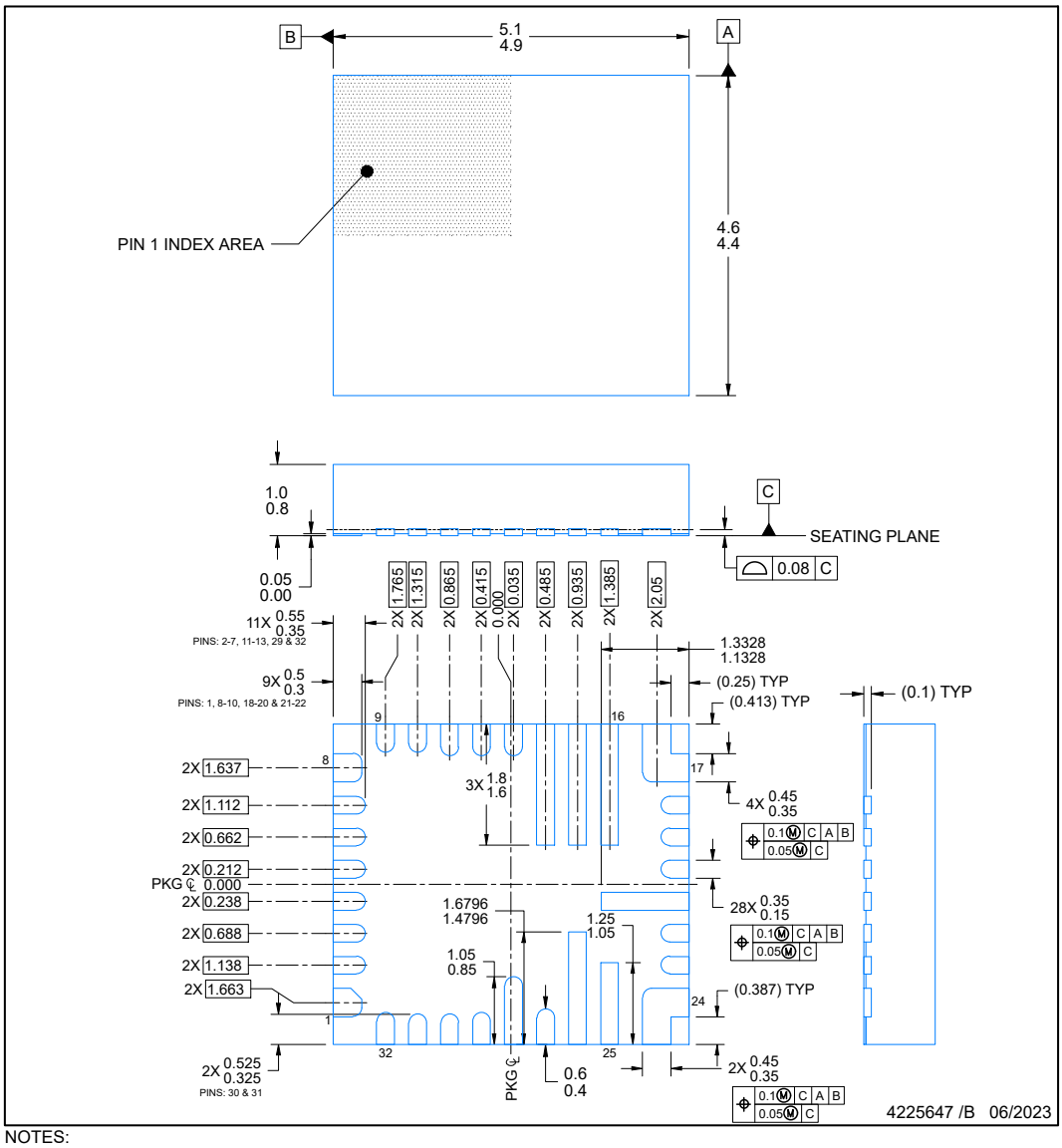
The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

PACKAGE OUTLINE

RQT0032A

VQFN-HR - 1 mm max height

PLASTIC QUAD FLATPACK- NO LEAD



NOTES:

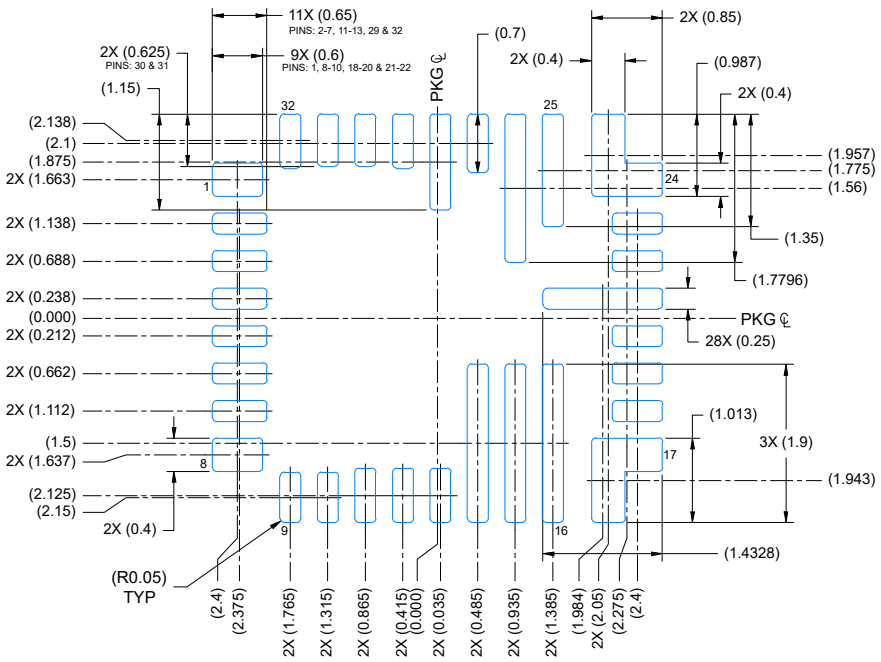
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.

EXAMPLE BOARD LAYOUT

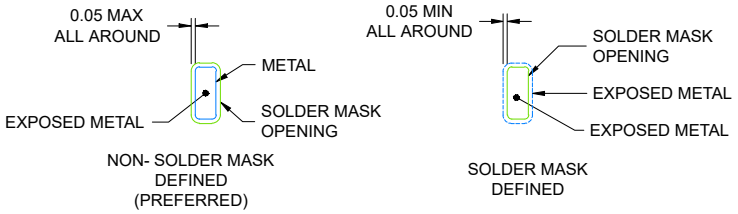
RQT0032A

VQFN-HR - 1 mm max height

PLASTIC QUAD FLATPACK- NO LEAD



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 14X



SOLDER MASK DETAILS

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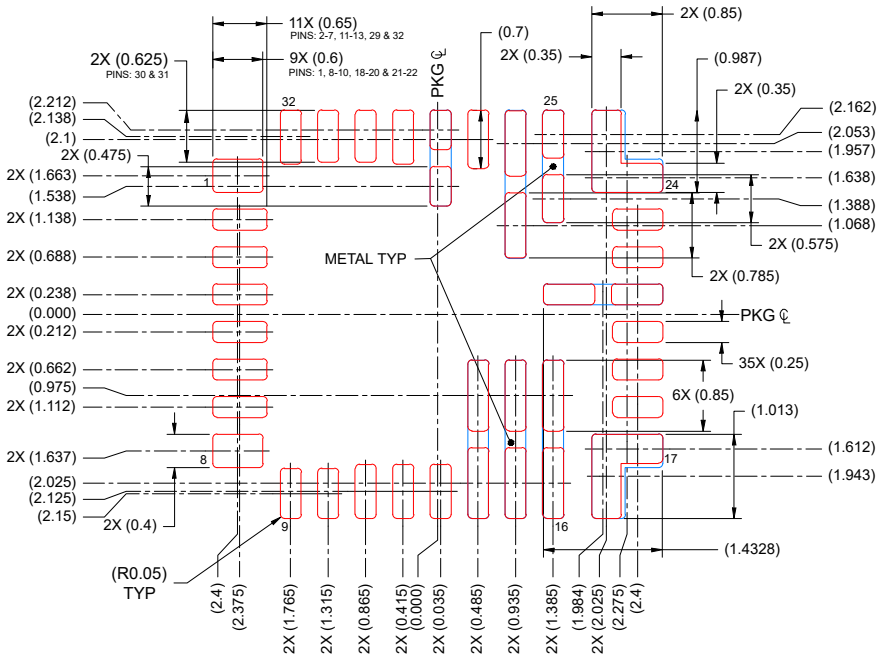
NOTES: (continued)

3. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/slua271) .
4. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

RQT0032A — **VQFN-HR - 1 mm max height**

PLASTIC QUAD FLATPACK- NO LEAD



SOLDER PASTE EXAMPLE
BASED ON 0.1 mm THICK STENCIL
SCALE: 14X

PRINTED COVERAGE BY AREA
PAD 14,15,16: 89%
PAD 21: 85%
PAD 17& 24: 90%
PAD 25: 84%
PAD 26: 88%
PAD 28: 82%

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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.

5.1 Package Option Addendum

Packaging Information

Orderable Device	Status(1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan(2)	Lead/Ball Finish(6)	MSL Peak Temp(3)	Op Temp (°C)	Device Marking(4) (5)
ULC1001RQTR	ACTIVE	VQFN-HR	RQT	32	3000	RoHS & Green	NIPDAU	Level-1-260C-1 year	-40 to 125	1001, ULC

(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 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) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) 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.

(6) 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.

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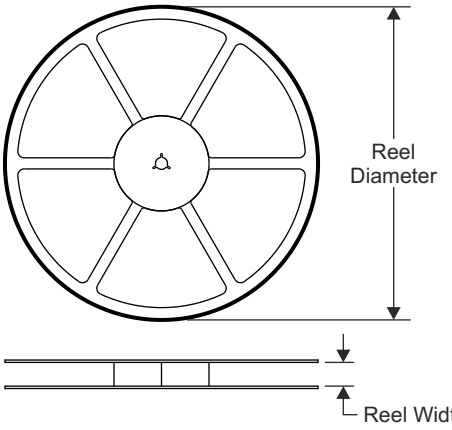
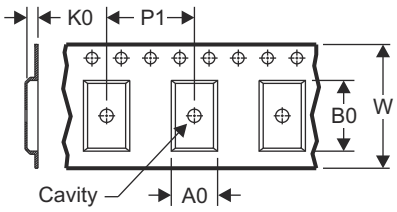
5.2 Tape and Reel Information

REEL DIMENSIONS

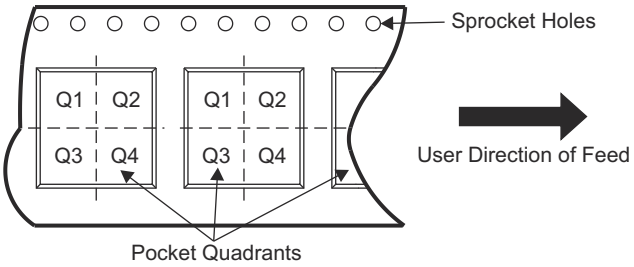


TAPE DIMENSIONS



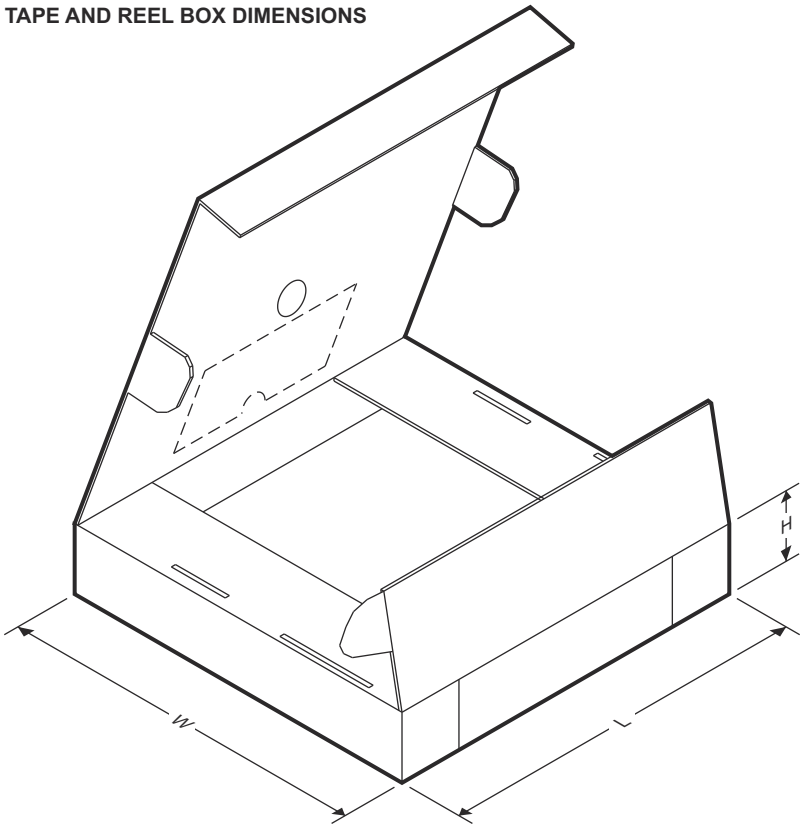
A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

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
ULC1001RQTR	VQFN-HR	RTQ	32	3000	330.0	12.4	4.8	5.3	1.15	8.0	12.0	Q2

TAPE AND REEL BOX DIMENSIONS



Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
ULC1001RQTR	VQFN-HR	RTQ	32	3000	367.0	367.0	35.0

GENERIC PACKAGE VIEW

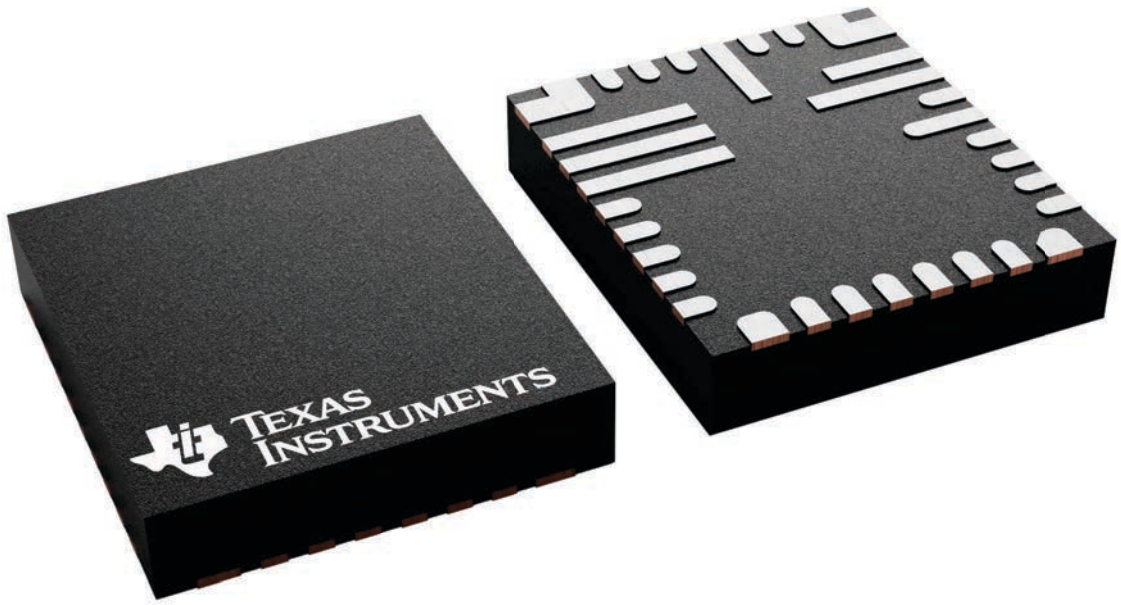
RQT 32

VQFN-HR - 1 mm max height

5 x 4.5, 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.



PACKAGE OUTLINE

RQT0032A

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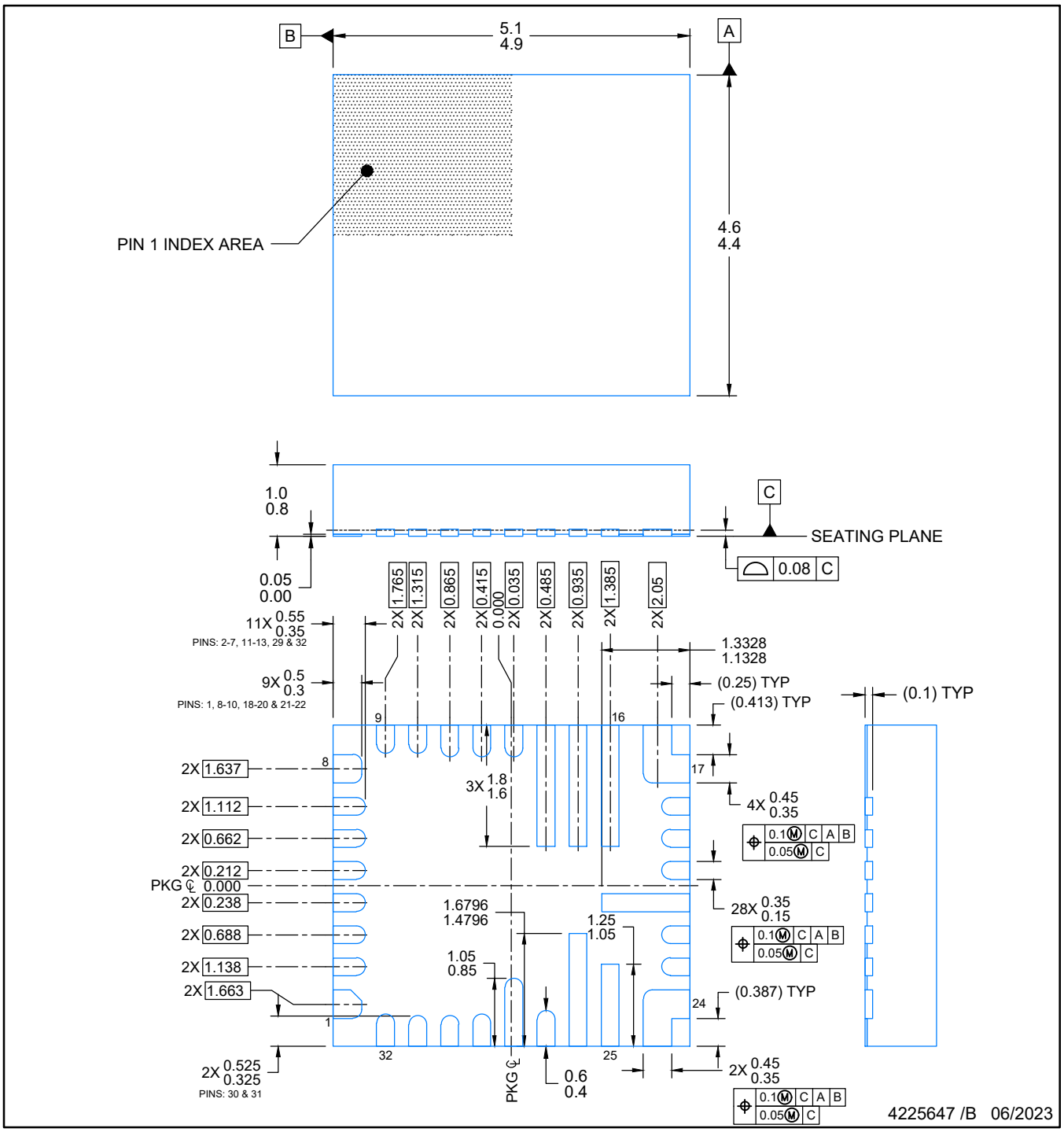

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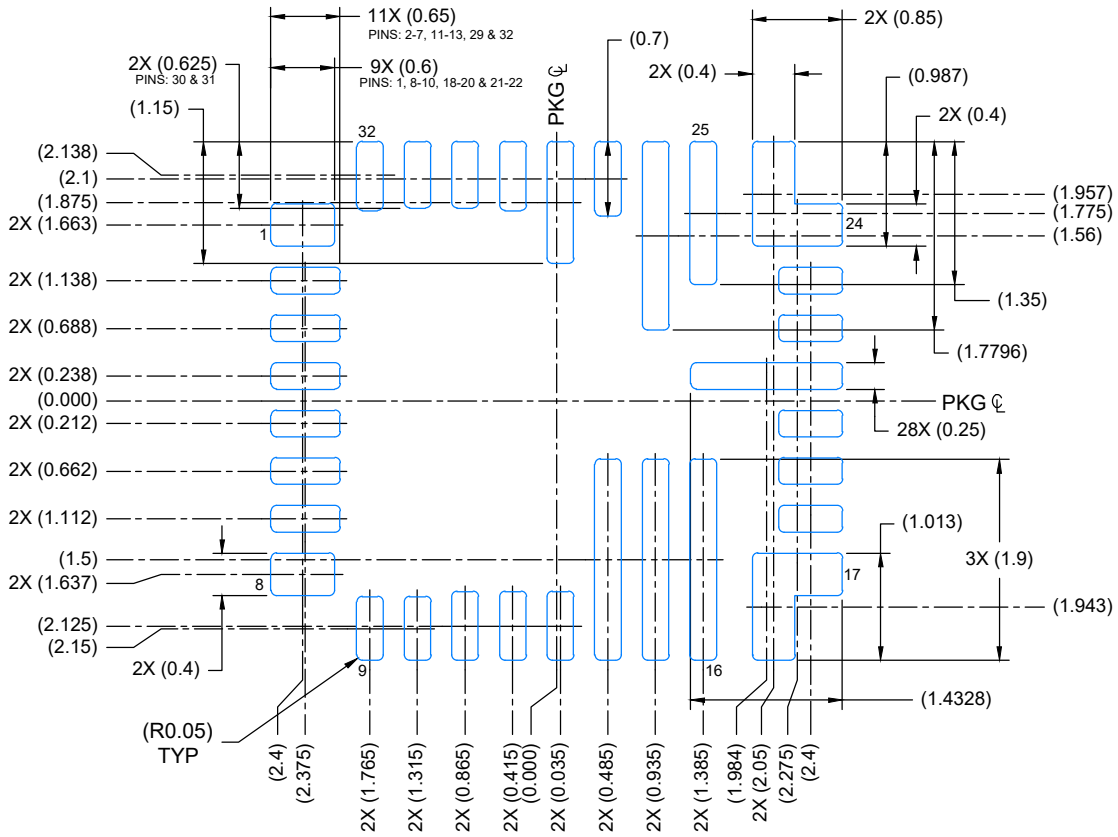

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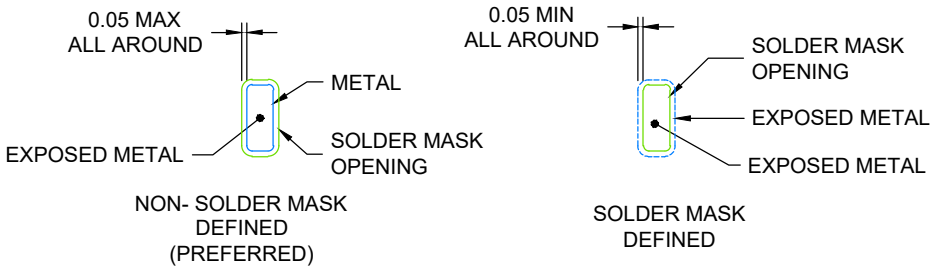

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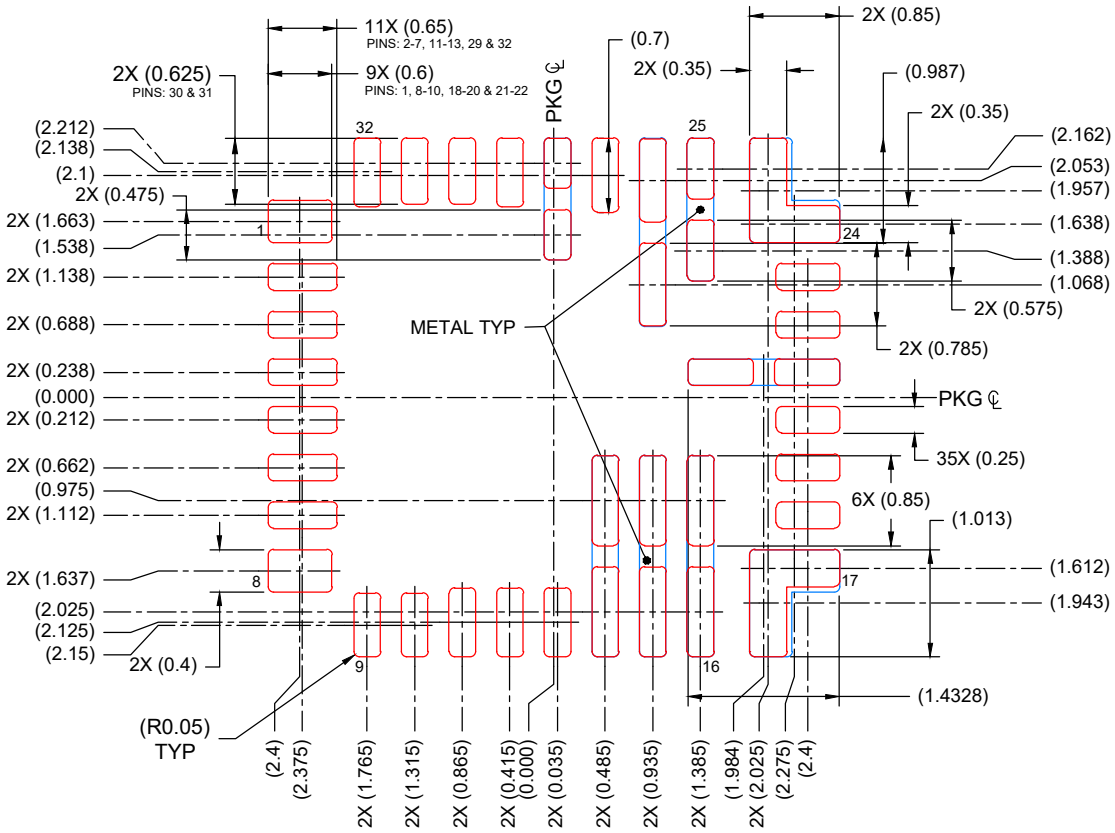

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