DS90UB971-Q1 FPD-Link IV 7.55-Gbps Serializer With CSI-2 Interface for 8MP+ Cameras, RADAR & Other Sensors

1 Features

- AEC-Q100 Qualified for automotive applications:
  - Device temperature: -40 to 115°C ambient operating temperature range specified for electrical performance
- 7.55Gbps (6Gbps Video Payload) supports high-speed sensors including 8MP+ imagers
- Power-over-Coax (PoC) compatible transceiver
- Single MIPI D-PHY port with 4 lanes
  - Compliant to MIPI D-PHY v2.1
  - 1 Clock lane and 1, 2, or 4 configurable data lanes
  - Up to 1.5Gbps/lane, 6Gbps/port
  - Supports polarity pin inversion (p/n)
  - 16 Virtual channels
- Single port MIPI CSI-2 receiver
  - Compliant to MIPI CSI-2 v2.1
  - Supports multiple data types and multi-exposure
- Advanced data protection and diagnostics including CRC data protection, sensor data integrity check, I2C write protection, voltage and temperature measurement, programmable alarm and line fault detection
- Flexible programmable output clock generator
- Supports single-ended coaxial or Shielded-Twisted-Pair (STP) cable
- Ultra-low latency bidirectional I2C and GPIO control channel enables ISP control from ECU
- Single 1.8V power supply
- Compatible with DS90UB9702-Q1, DS90UB954-Q1, DS90UB936-Q1, DS90UB960-Q1, DS90UB962-Q1 deserializers
- Pin compatible with DS90UB953-Q1, DS90UB953A-Q1, DS90UB935-Q1, DS90UB951-Q1 serializers
- Small 5mm × 5mm VQFN package and solution size for compact sensor module designs
- Functional Safety-Compliant
  - Developed for functional safety applications
  - Documentation available to aid ISO 26262 system design up to ASIL B

2 Applications

- Automotive Driver Assistance Systems (ADAS)
  - Surround View Systems (SVS)
  - Camera Monitor Systems (CMS)
  - Forward Vision Cameras (FC)
  - Driver Monitoring Systems (DMS)
  - Rear-View Cameras (RVC)
  - Automotive satellite RADAR & LIDAR modules
  - Time-of-Flight (ToF) sensors
- Security and surveillance cameras
- Industrial and medical imaging

3 Description

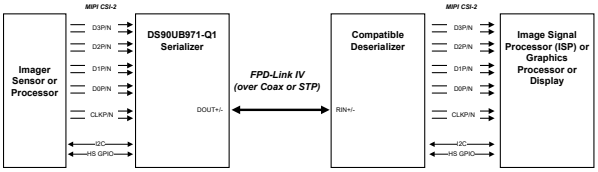
The DS90UB971-Q1 serializer represents the first generation in FPD-Link IV serializers and is designed to support ultra-high-speed raw data sensors including 8MP+ Imagers, satellite RADAR, LIDAR, and Time-of-Flight (ToF) sensors. The chip delivers an 7.55Gbps forward channel and an ultra-low latency, 47.1875Mbps bidirectional control channel and supports power over a single coax (PoC) or STP cable. The DS90UB971-Q1 features advanced data protection and diagnostic features to support ADAS and automotive functional safety. Together with a companion deserializer, the DS90UB971-Q1 delivers precise multi-camera sensor clock and sensor synchronization.

The DS90UB971-Q1 is fully AEC-Q100 qualified with a wide temperature range of –40°C to 115°C. The serializer comes in a small 5mm × 5mm VQFN package for space-constrained sensor applications.

Device Information

PART NUMBER	PACKAGE (1)	BODY SIZE (NOM) (2)
DS90UB971-Q1	VQFN (32)	5.00mm × 5.00mm

(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.



Typical Application

4 Device and Documentation Support

4.1 Related Documentation

For safety documentation please contact TI.

For related documentation see the following:

- *I2C Communication Over FPD-Link III with Bidirectional Control Channel*
- *I2C Bus Pull-Up Resistor Calculation*

4.2 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.

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

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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 * (December 2023) to Revision A (January 2025)	Page
• Added safety related certification bullet	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.

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
DS90UB971RHBRQ1	ACTIVE	VQFN	RHB	32	3000	RoHS & Green	NIPDAU	Level-3-260C-168 HR	-40 to 115	UB971Q	Samples
DS90UB971RHBTQ1	ACTIVE	VQFN	RHB	32	250	RoHS & Green	NIPDAU	Level-3-260C-168 HR	-40 to 115	UB971Q	Samples

(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.
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) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".
RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.
Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

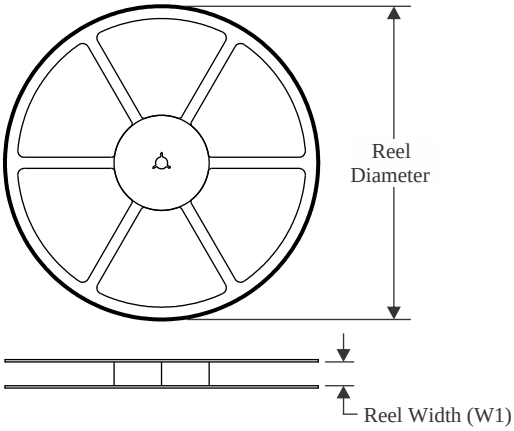
(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(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.

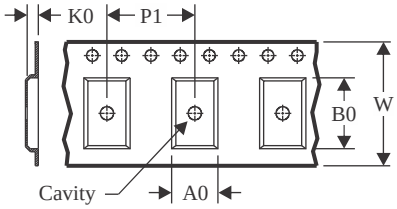
(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

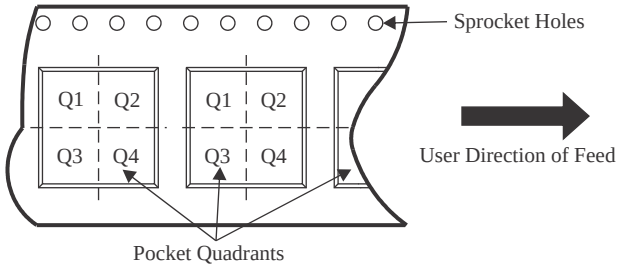


TAPE DIMENSIONS



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

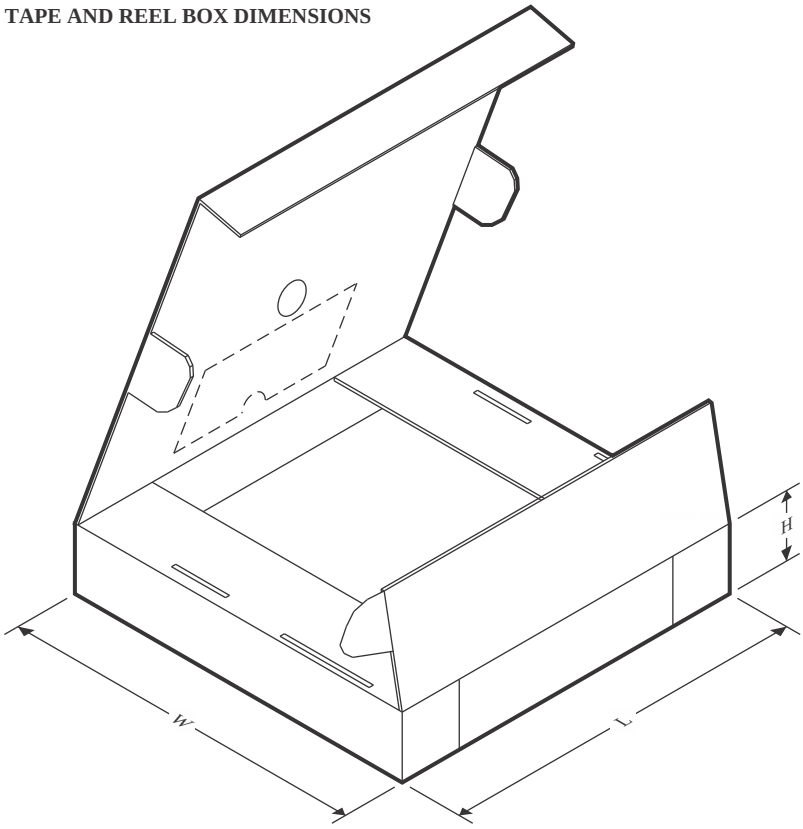
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
DS90UB971RHBRQ1	VQFN	RHB	32	3000	330.0	12.4	5.3	5.3	1.1	8.0	12.0	Q2
DS90UB971RHBTQ1	VQFN	RHB	32	250	180.0	12.4	5.3	5.3	1.1	8.0	12.0	Q2

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
DS90UB971RHBRQ1	VQFN	RHB	32	3000	367.0	367.0	35.0
DS90UB971RHBTQ1	VQFN	RHB	32	250	210.0	185.0	35.0

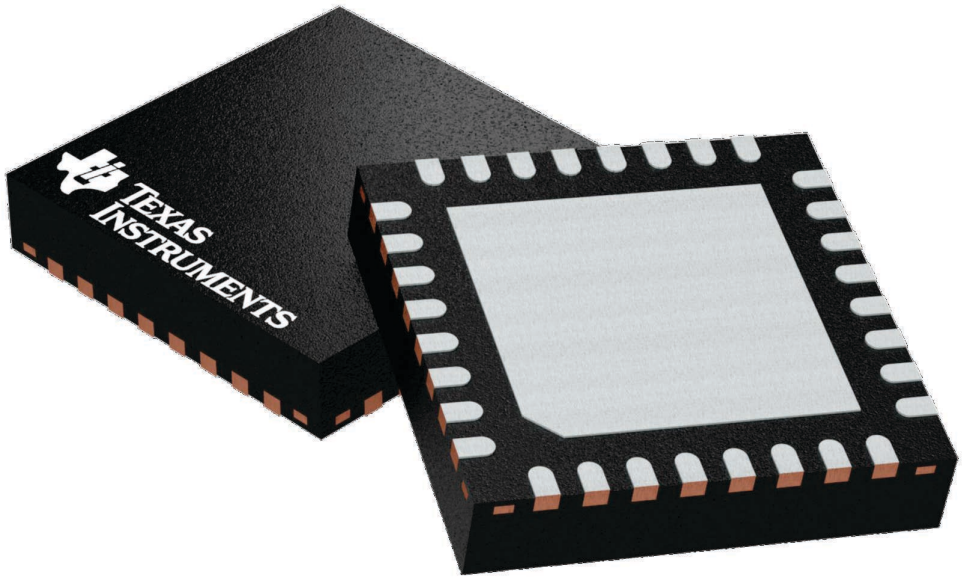
GENERIC PACKAGE VIEW

RHB 32

VQFN - 1 mm max height

5 x 5, 0.5 mm pitch

PLASTIC QUAD FLATPACK - NO LEAD



Images above are just a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.

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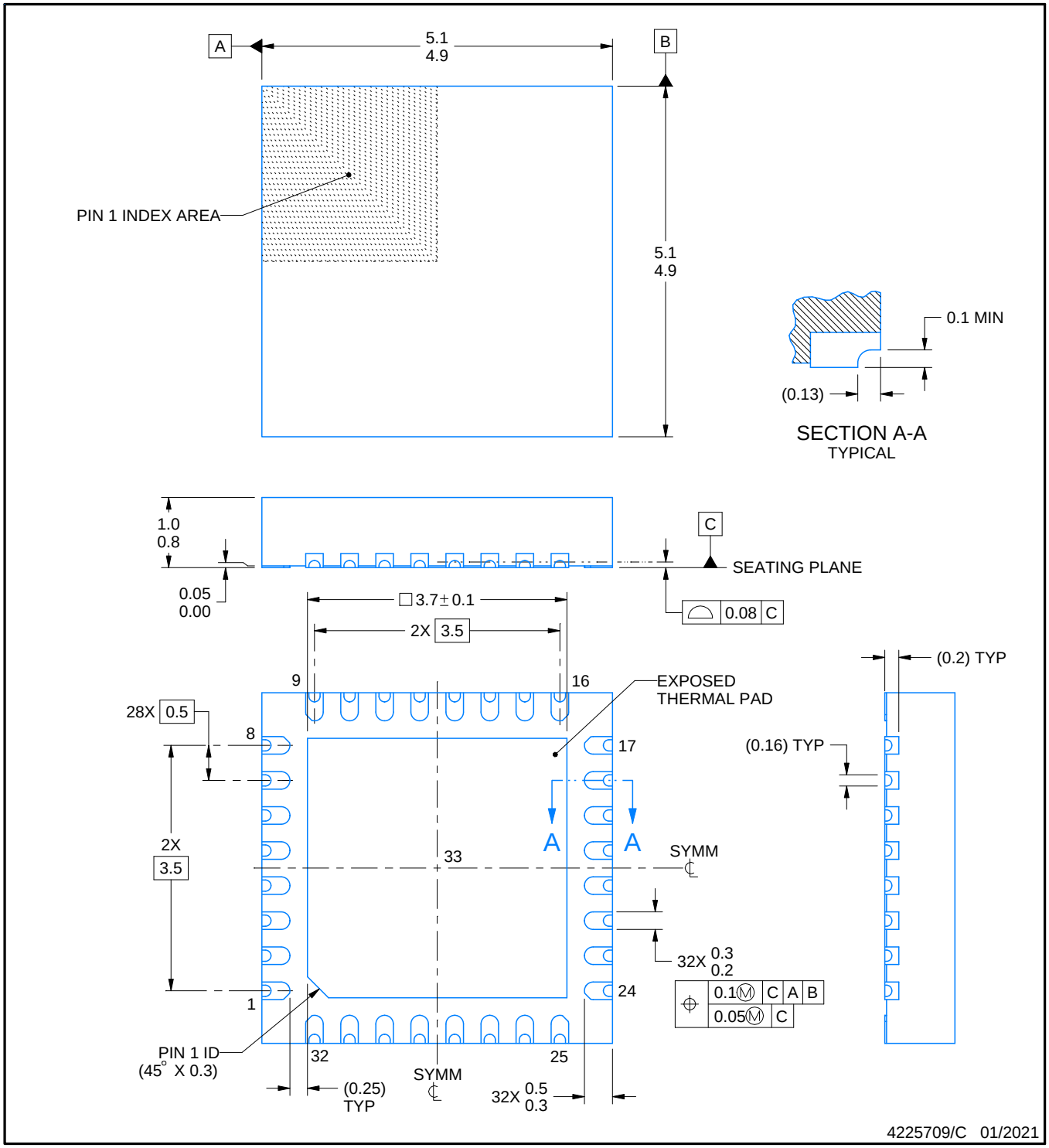
RHB0032U

PACKAGE OUTLINE

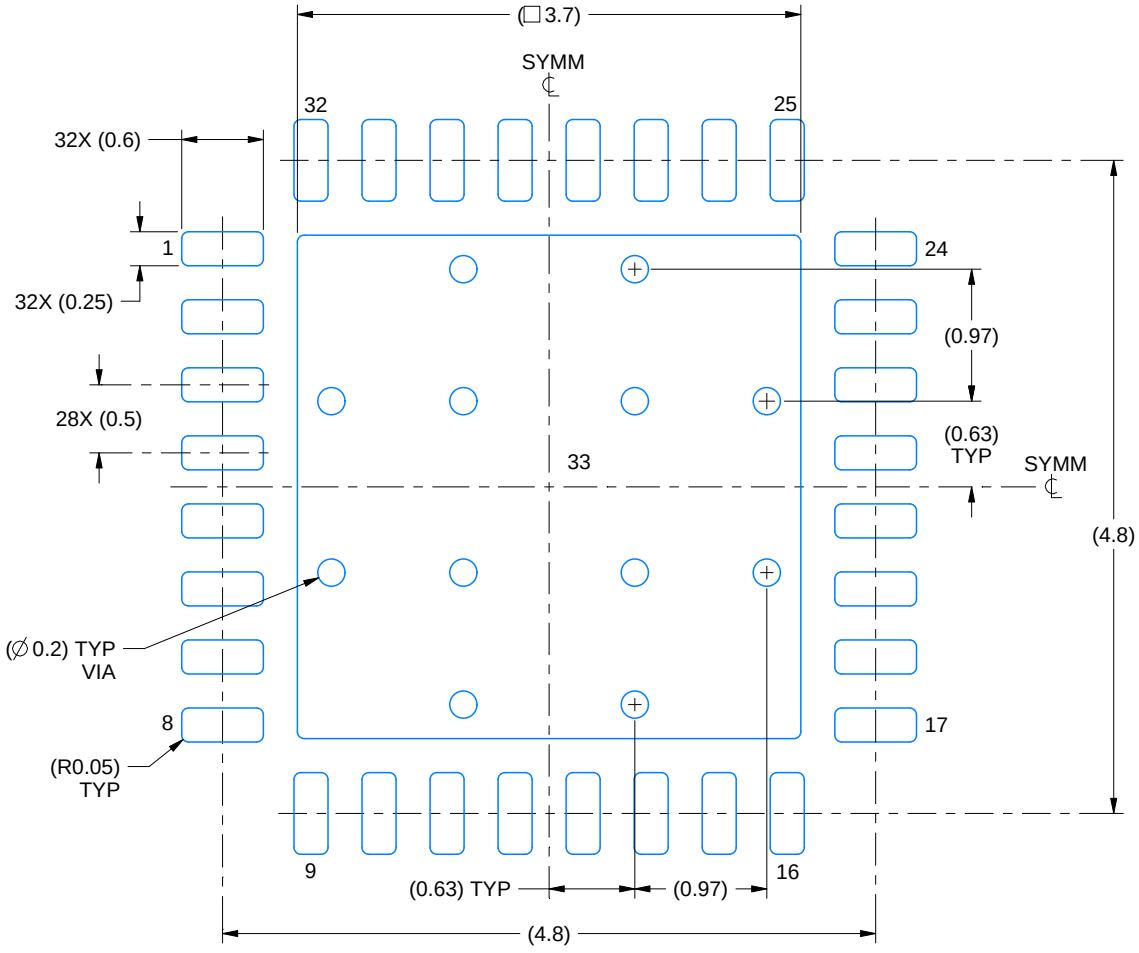
VQFN - 1 mm max height

PLASTIC QUAD FLATPACK - NO LEAD

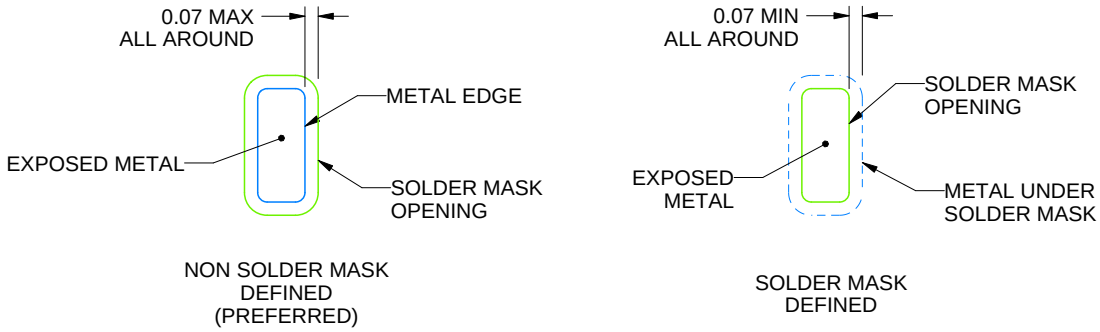


NOTES:

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:18X



NON SOLDER MASK DEFINED (PREFERRED)

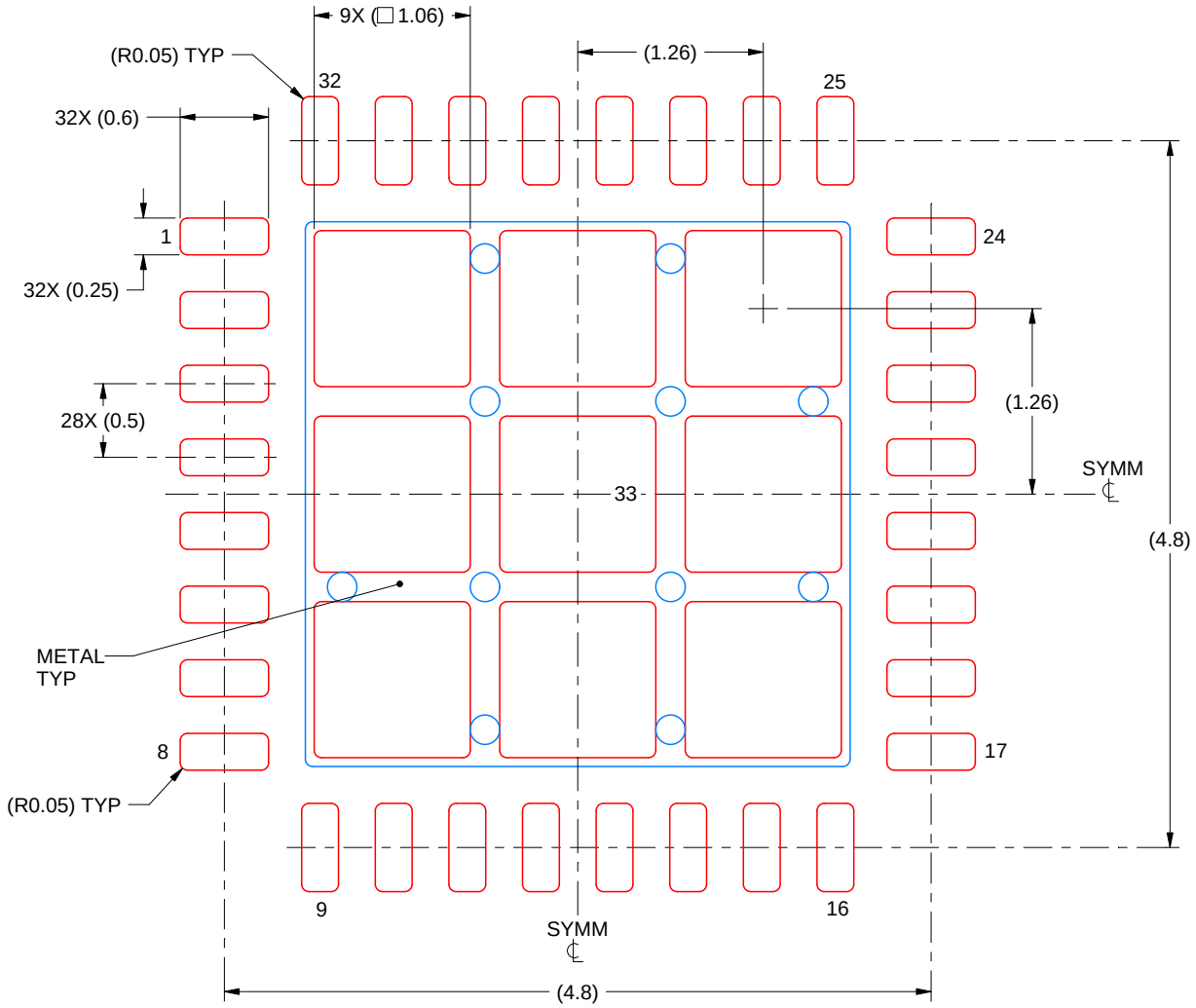
SOLDER MASK DEFINED

SOLDER MASK DETAILS

4225709/C 01/2021

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).
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.



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL

EXPOSED PAD 33:
74% PRINTED SOLDER COVERAGE BY AREA UNDER PACKAGE
SCALE:20X

4225709/C 01/2021

NOTES: (continued)

6. 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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