

# DRV3255-Q1 Integrated 3-Phase 48-V Automotive Gate Driver Unit (GDU) with Advanced Protection and Diagnostics

## 1 Features

- AEC-Q100 qualified for automotive applications:
  - Device ambient temperature grade 0:  $-40^{\circ}\text{C}$  to  $+150^{\circ}\text{C}$
  - Device HBM ESD classification level 2
  - Device CDM ESD classification level C4B
- **Functional Safety-Compliant** targeted
  - Developed for functional safety applications
  - Documentation to aid ISO 26262 system design will be available upon production release
  - Systematic capability up to ASIL D targeted
- Three N-Channel half-bridge gate driver
  - 3.5-A/4.5-A max peak gate drive current
  - Power architecture optimized for 48-V applications
  - 12-V/48-V split supply architecture
  - 95-V transient absolute maximum rating of DC link power supply (DHCP)
  - 105-V Bootstrap voltage to support 90-V MOSFET operating voltage range
  - Bootstrap with charge pump for 100% duty cycle
- Integrated configurable Active Short Circuit (ASC) function
  - Low-side and High-side ASC support
  - Device pin control available
  - Fault handling capability
- Serial peripheral interface (SPI) with CRC
- Supports 3.3-V and 5-V logic inputs
- Advanced protection features
  - Battery voltage monitors
  - MOSFET  $V_{DS}$  overcurrent monitors
  - MOSFET  $V_{GS}$  gate fault monitors
  - Analog built in self test
  - Internal regulator and clock monitors
  - Device thermal warning and shutdown
  - Fault condition indicator pins

## 3 Description

The DRV3255-Q1 device is a highly-integrated three phase gate driver for 48-V automotive motor drive applications. The device is specifically designed to support high-power motor drive applications by providing 3.5-A peak source and 4.5-A peak sink gate drive currents, and 90-V MOSFET transient over voltage support. A highly efficient bootstrap architecture is used to minimize power losses and self-heating of the gate drivers. A charge pump allows for the gate drivers to support 100% PWM duty cycle control.

A wide range of diagnostics, monitoring, and protection features supports a robust motor drive system design. A highly configurable Active Short Circuit (ASC) function which enables selected external MOSFETs is integrated to achieve the fast response to system faults and to eliminate the needs of external components.

### Package Information

| PART NUMBER <sup>(1)</sup> | PACKAGE    | BODY SIZE (NOM)     |
|----------------------------|------------|---------------------|
| DRV3255-Q1                 | HTQFP (64) | 10.00 mm × 10.00 mm |

(1) See the orderable addendum at the end of the data sheet.

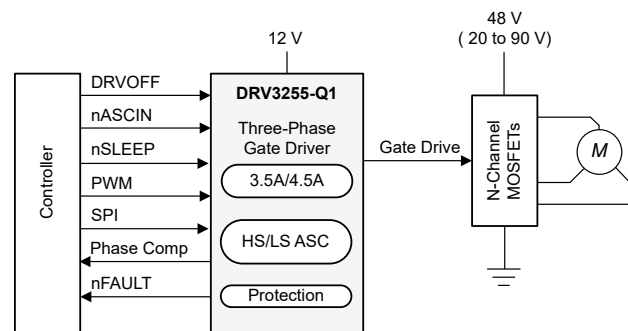


Figure 3-1. Simplified Schematic

## 2 Applications

- Automotive 48-V Mild Hybrid Motor Drives
  - Belt and integrated starter generators, and Motor generators
  - Electrical Power Steering
  - eTurbos and eBoosters
  - HVAC compressors and fans
  - Transmission control and actuation
  - Oil, transmission, and water pumps



## 4 Revision History

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

| Changes from Revision * (February 2021) to Revision A (August 2022) | Page              |
|---------------------------------------------------------------------|-------------------|
| • Updated the device status for DRV3255-Q1.....                     | <a href="#">1</a> |

## 5 Device and Documentation Support

### 5.1 Device Support

#### 5.1.1 Device Nomenclature

[Device Nomenclature](#) shows a legend for reading the complete orderable device name for the DRV3255-Q1 device

### 5.2 Documentation Support

For related documentation see the following:

- Texas Instruments, [How to Build a Small, Functionally Safe 48-V, 30-kW MHEV Motor-Drive System White paper](#)
- Texas Instruments, [How to optimize a motor-driver design for 48-V starter generators Technical article](#)
- Texas Instruments, [System Design Considerations for High-Power Motor Driver Applications Application note](#)
- Texas Instruments, [Driving parallel MOSFETs using the DRV3255-Q1 Application brief](#)
- Texas Instruments, [A basic brushless gate driver design – part 3: integrated vs. discrete half bridges Technical article](#)
- Texas Instruments, [PowerPAD™ Thermally Enhanced Package application report](#)
- Texas Instruments, [PowerPAD™ Made Easy application report](#)
- Texas Instruments, [Sensored 3-Phase BLDC Motor Control Using MSP430 application report](#)

#### 5.2.1 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 [Subscribe to updates](#) 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.

### 5.3 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.

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### 5.4 Trademarks

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All trademarks are the property of their respective owners.

### 5.5 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.

### 5.6 Glossary

[TI Glossary](#) This glossary lists and explains terms, acronyms, and definitions.

## 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.

## 6.1 Package Option Addendum

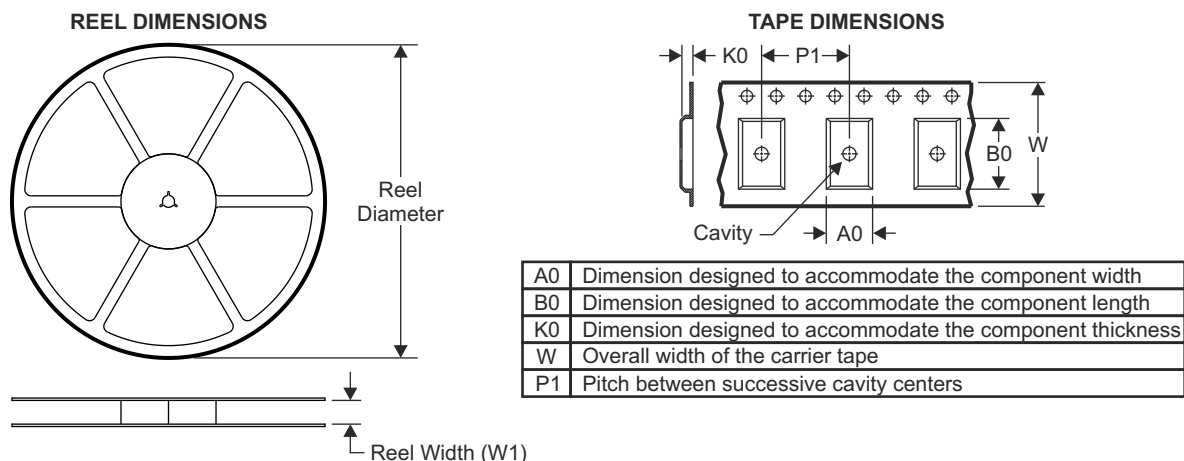
### Packaging Information

| Orderable Device | Status | Package Type | Package Drawing | Pins | Package Qty | Eco Plan     | Lead/Ball Finish | MSL Peak Temp           | Op Temp (°C) | Device Marking |
|------------------|--------|--------------|-----------------|------|-------------|--------------|------------------|-------------------------|--------------|----------------|
| DRV3255EPAP RQ1  | ACTIVE | HTQFP        | PAP             | 64   | 1000        | RoHS & Green | NIPDAU           | Level 3-260C-1<br>68 HR | -40 to 150   | DRV3255        |

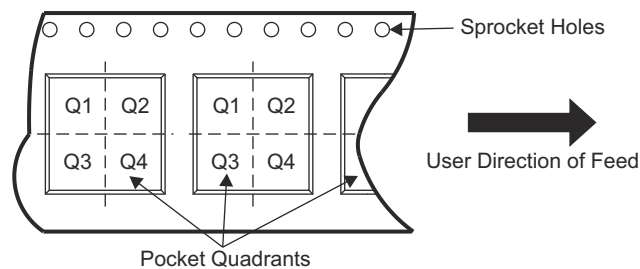
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## 6.2 Tape and Reel Information

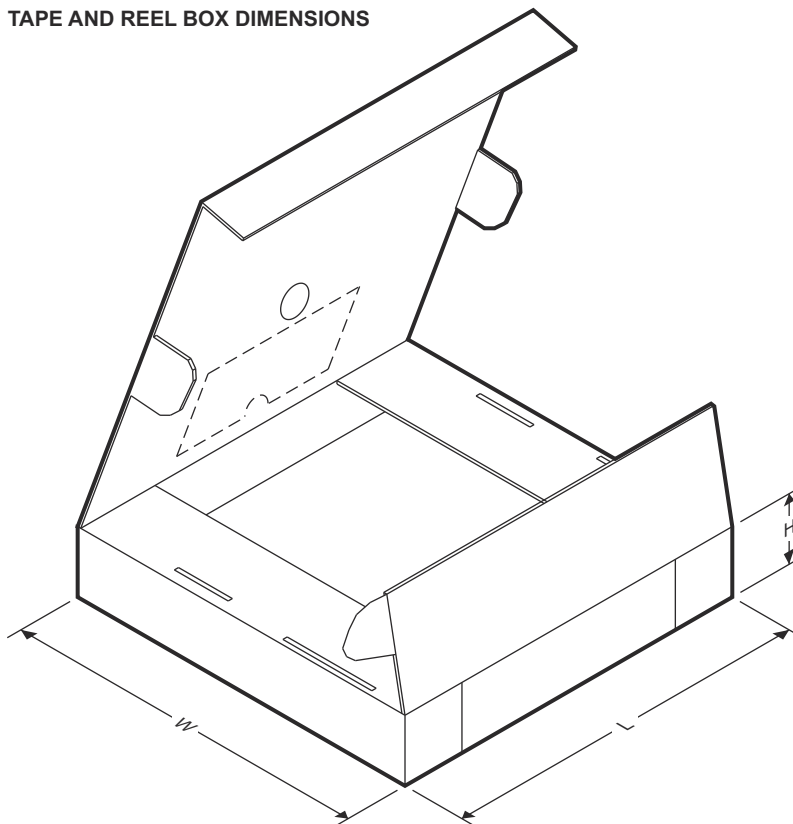


### QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



| 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 |
|----------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| DRV3255EPAPRQ1 | HTQFP        | PAP             | 64   | 1000 | 330.0              | 24.4               | 13.0    | 13.0    | 1.5     | 16.0    | 24.0   | DRV3255       |

## TAPE AND REEL BOX DIMENSIONS

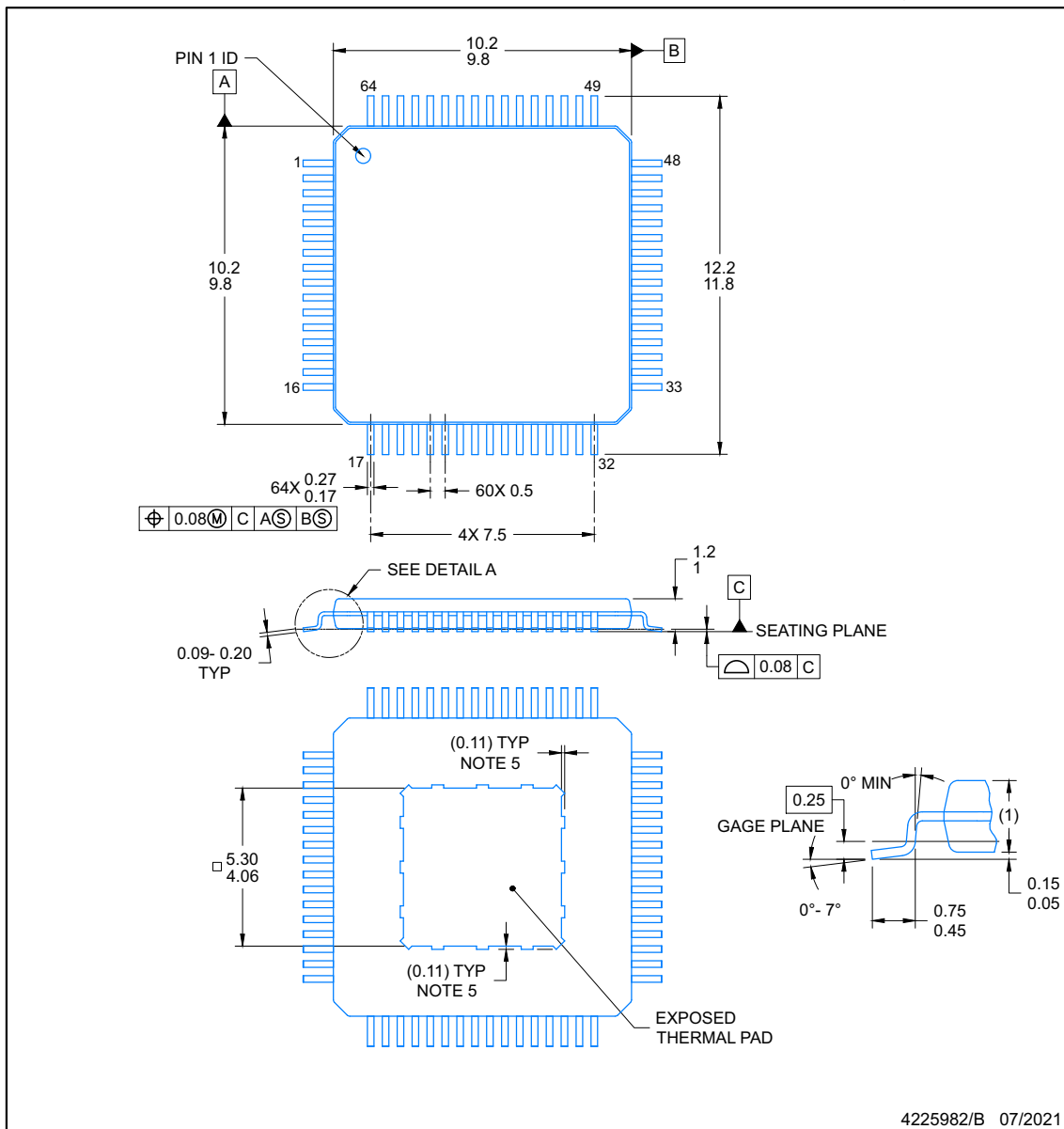


| Device         | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|----------------|--------------|-----------------|------|------|-------------|------------|-------------|
| DRV3255EPAPRQ1 | HTQFP        | PAP             | 64   | 1000 | 10.0        | 10.0       | 1.0         |

# PAP0064N

## PACKAGE OUTLINE HTQFP - 1.2 mm max height

PLASTIC QUAD FLATPACK



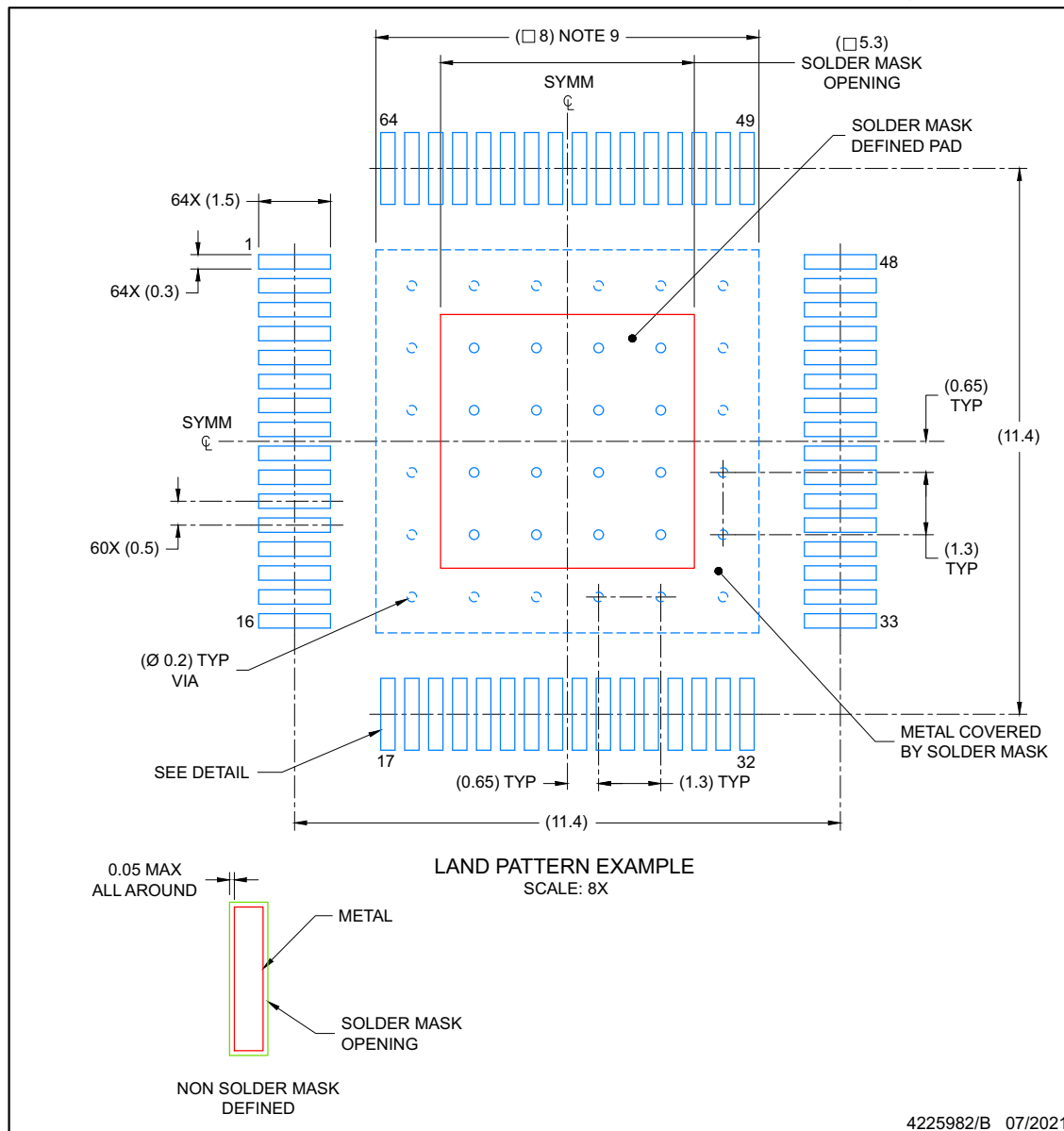
NOTES:

PowerPAD is a trademark of Texas Instruments

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. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 per side.
4. Body width does not include interlead flash. Interlead flash shall not exceed 0.50 per side.
5. Strap features may not be present.
6. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.

**EXAMPLE BOARD LAYOUT****HTQFP - 1.2 mm max height****PAP0064N**

PLASTIC QUAD FLATPACK



NOTES: (continued)

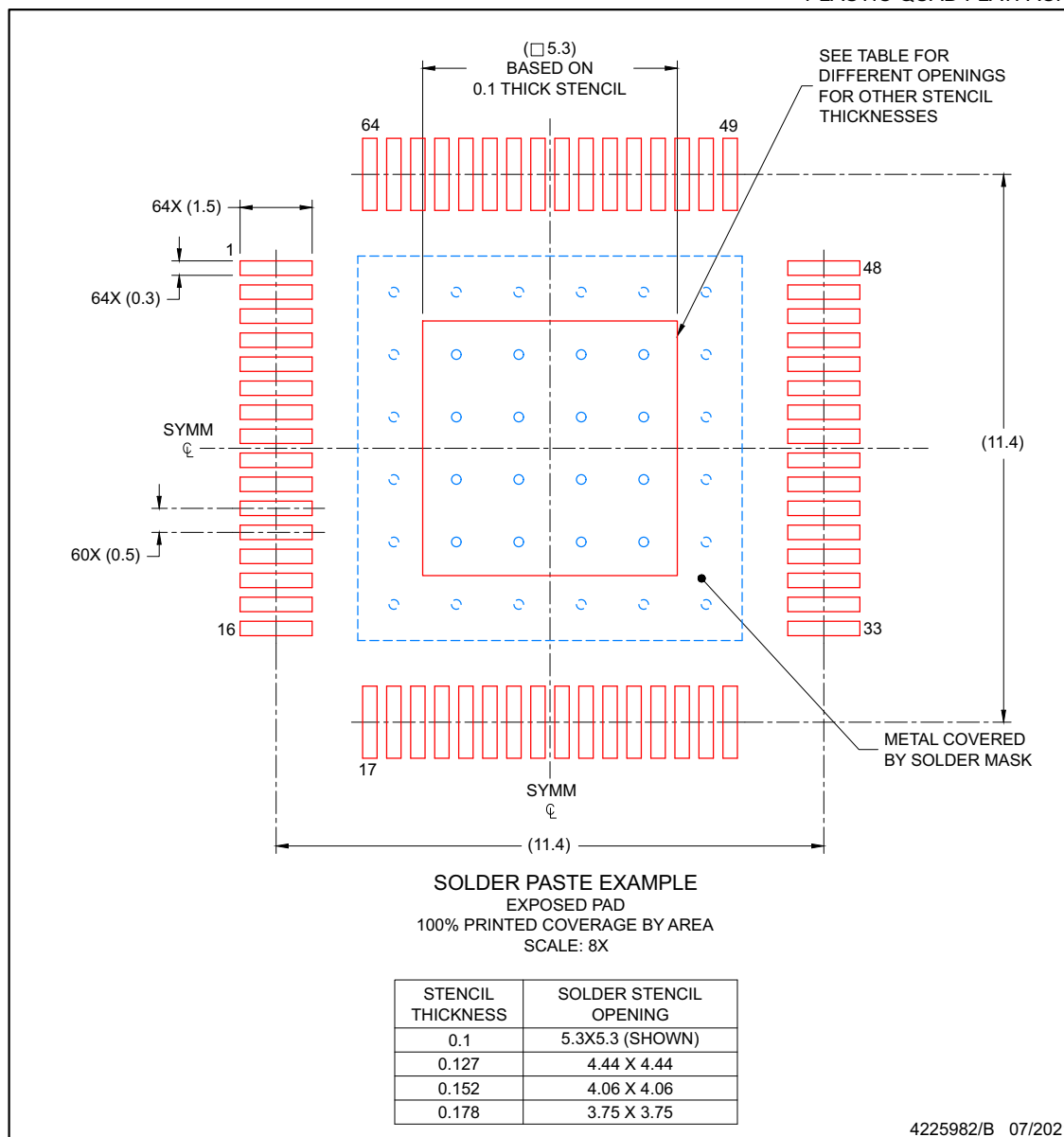
7. Publication IPC-7351 may have alternate designs.
8. Solder mask tolerances between and around signal pads can vary based on board fabrication site.
9. This package is designed to be soldered to a thermal pad on the board. Refer to technical brief, PowerPAD Thermally Enhanced Package, Texas Instruments Literature No. SLMA002 ([www.ti.com/lit/slma002](http://www.ti.com/lit/slma002)) and SLMA004 ([www.ti.com/lit/slma004](http://www.ti.com/lit/slma004)).

## EXAMPLE STENCIL DESIGN

**PAP0064N**

**HTQFP - 1.2 mm max height**

PLASTIC QUAD FLATPACK



NOTES: (continued)

9. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
10. Board assembly site may have different recommendations for stencil design.

## PACKAGING INFORMATION

| Orderable part number          | Status<br>(1) | Material type<br>(2) | Package   Pins   | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C) | Part marking<br>(6) |
|--------------------------------|---------------|----------------------|------------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| <a href="#">DRV3255EPAPRQ1</a> | Active        | Production           | HTQFP (PAP)   64 | 1000   LARGE T&R      | Yes         | NIPDAU                               | Level-3-260C-168 HR               | -40 to 150   | DRV3255<br>Q1       |
| DRV3255EPAPRQ1.A               | Active        | Production           | HTQFP (PAP)   64 | 1000   LARGE T&R      | Yes         | NIPDAU                               | Level-3-260C-168 HR               | -40 to 150   | DRV3255<br>Q1       |

<sup>(1)</sup> **Status:** For more details on status, see our [product life cycle](#).

<sup>(2)</sup> **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.

<sup>(3)</sup> **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

<sup>(4)</sup> **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.

<sup>(5)</sup> **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.

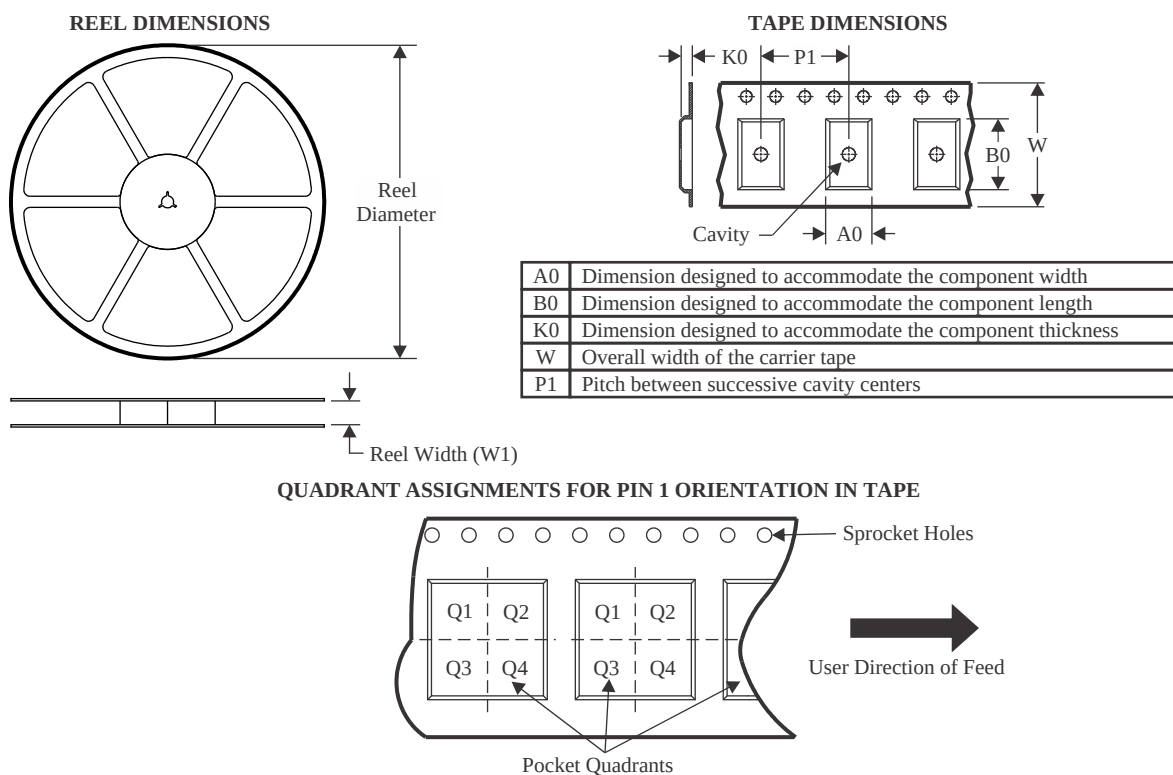
<sup>(6)</sup> **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

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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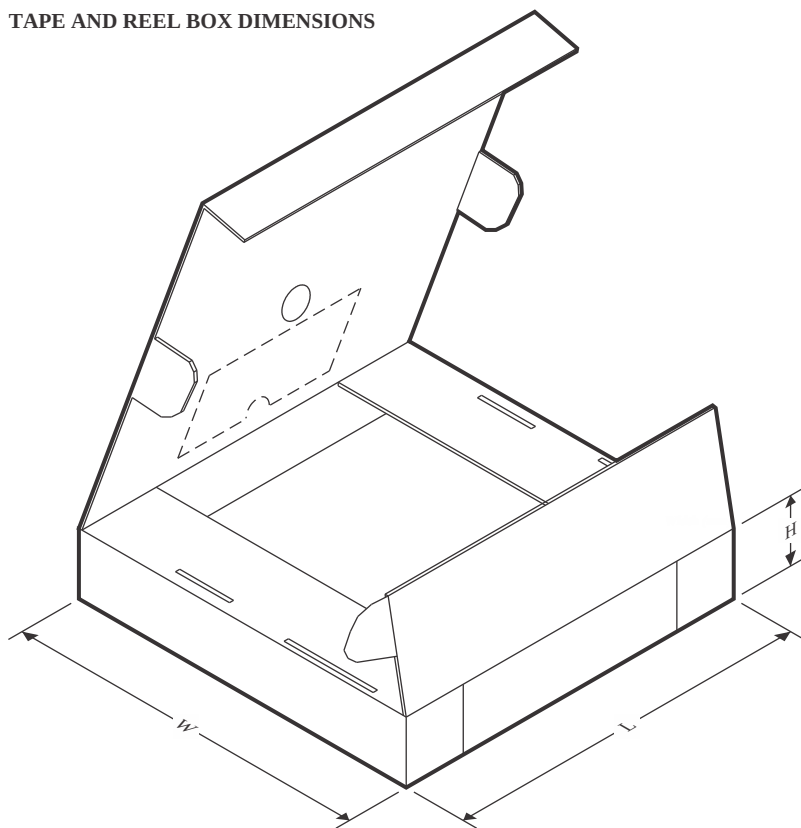
## TAPE AND REEL INFORMATION



\*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 |
|----------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| DRV3255EPAPRQ1 | HTQFP        | PAP             | 64   | 1000 | 330.0              | 24.4               | 13.0    | 13.0    | 1.5     | 16.0    | 24.0   | Q2            |

## TAPE AND REEL BOX DIMENSIONS



\*All dimensions are nominal

| Device         | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|----------------|--------------|-----------------|------|------|-------------|------------|-------------|
| DRV3255EPAPRQ1 | HTQFP        | PAP             | 64   | 1000 | 367.0       | 367.0      | 55.0        |

## GENERIC PACKAGE VIEW

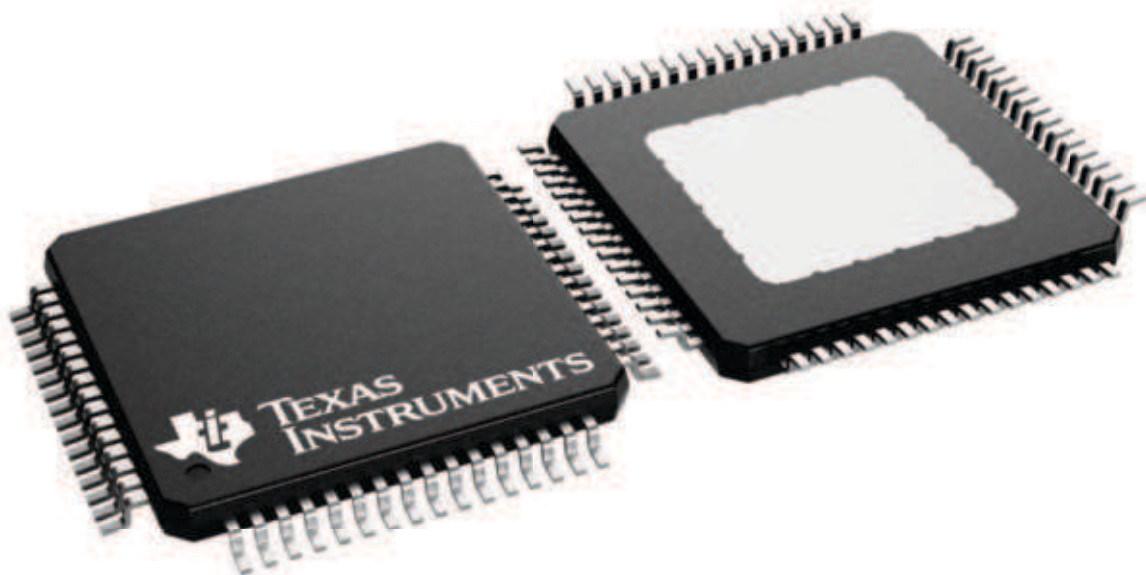
**PAP 64**

**HTQFP - 1.2 mm max height**

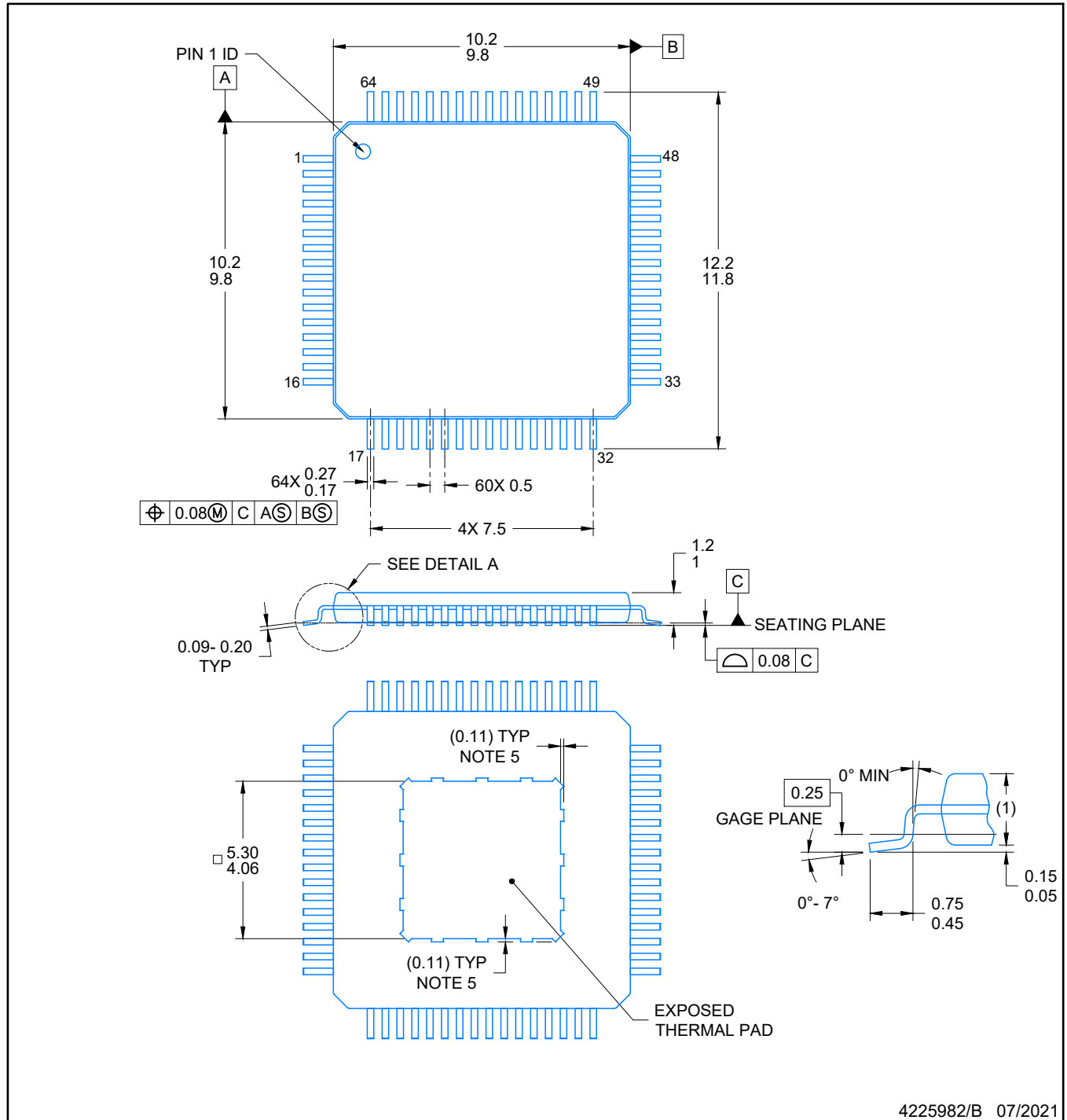
10 x 10, 0.5 mm pitch

QUAD FLATPACK

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



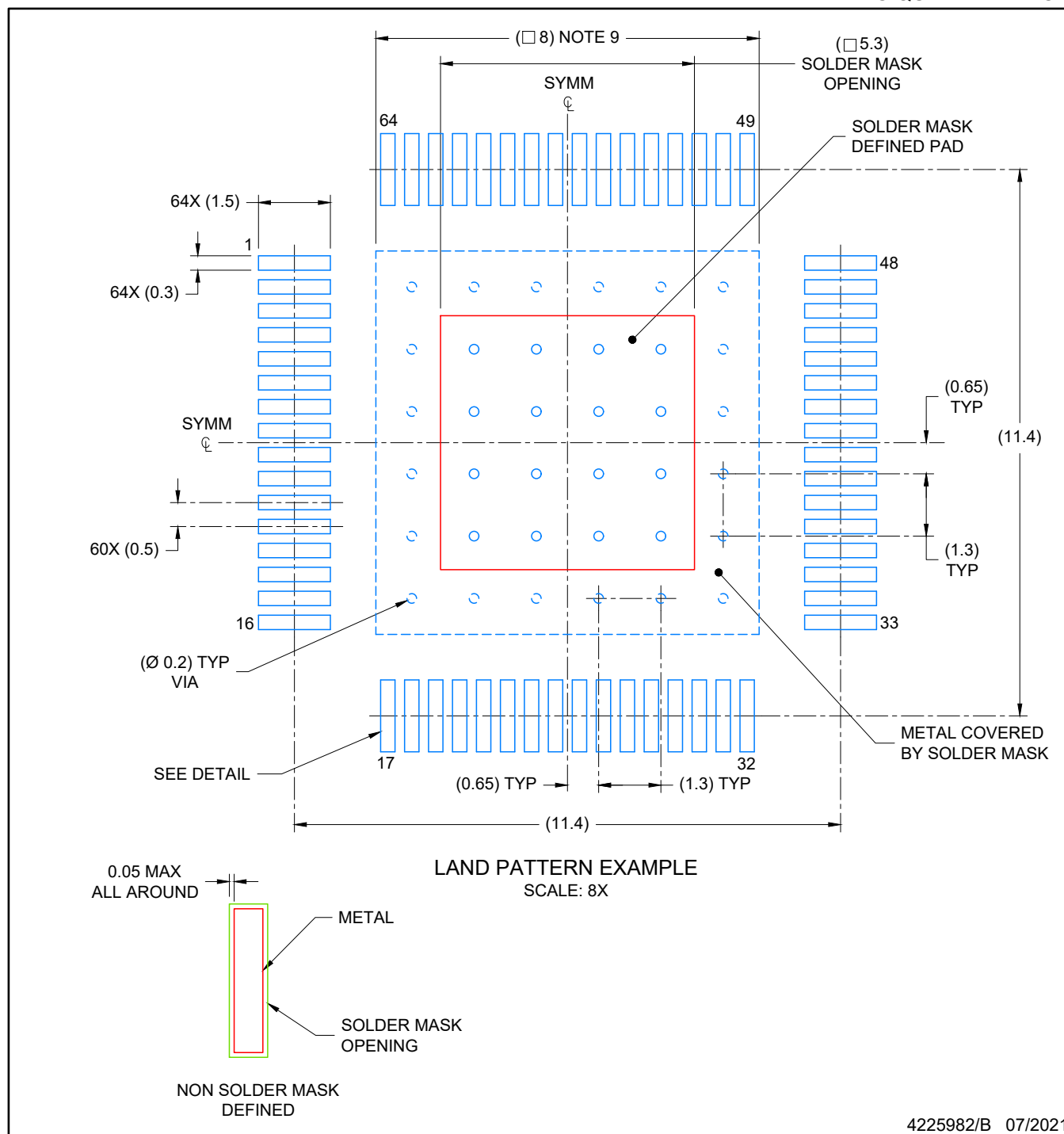
4226442/A



NOTES:

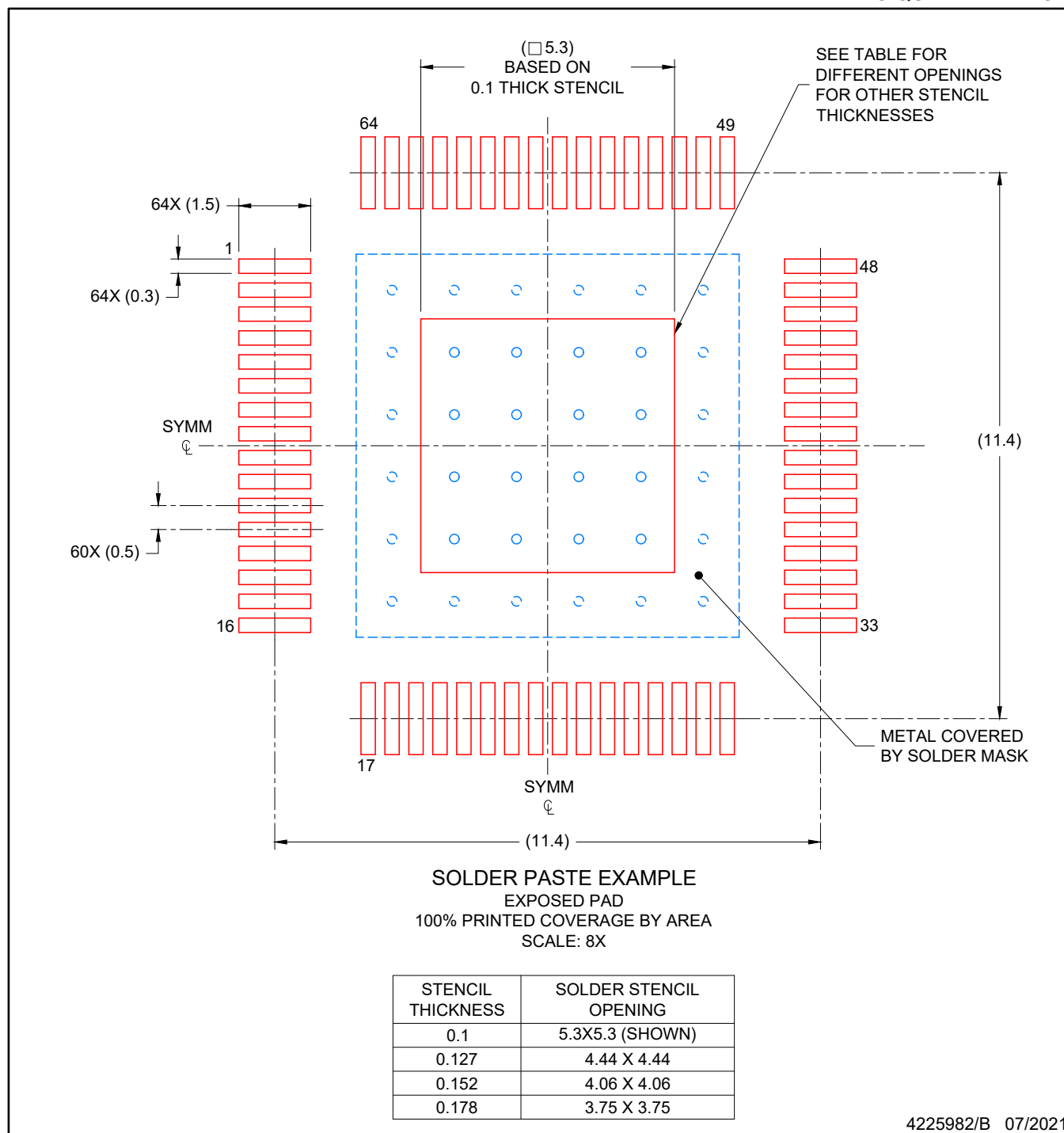
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6. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.



NOTES: (continued)

7. Publication IPC-7351 may have alternate designs.
8. Solder mask tolerances between and around signal pads can vary based on board fabrication site.
9. This package is designed to be soldered to a thermal pad on the board. Refer to technical brief, PowerPAD Thermally Enhanced Package, Texas Instruments Literature No. SLMA002 ([www.ti.com/lit/slma002](http://www.ti.com/lit/slma002)) and SLMA004 ([www.ti.com/lit/slma004](http://www.ti.com/lit/slma004)).



NOTES: (continued)

9. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
10. Board assembly site may have different recommendations for stencil design.

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