DRV3256-Q1 具有高级保护和诊断功能的集成式三相 48V 汽车栅极驱动器单元 (GDU)

1 特性

- 符合面向汽车应用的 AEC-Q100 标准：
  - 器件环境温度等级 0：–40°C 至 +150°C
  - 器件 HBM ESD 分类等级 2
  - 器件 CDM ESD 分类等级 C4B
- 以符合功能安全标准为目标
  - 专为功能安全应用开发
  - 在发布量产版本时将会提供有助于进行 ISO 26262 系统设计的文档
  - 系统可满足 ASIL D 等级要求
- 3 个 N 沟道半桥栅极驱动器
  - 2A/2.5A 最大峰值栅极驱动电流
  - 针对 48V 应用进行优化的电源架构
  - 12V/48V 双电源架构
  - 直流链路电源 (DHCP) 的瞬态绝对最大额定值为 95V
  - 可支持 90V MOSFET 工作电压范围的 105V 自举电压
  - 自举电荷泵可支持 100% 占空比
- 集成 1 个 (DRV3256A-Q1) 或 3 个 (DRV3256-Q1) 电流分流放大器
- 集成可配置主动短路 (ASC) 功能
  - 低侧 (DRV3256A-Q1) 或低侧和高侧 (DRV3256-Q1/DRV3256B-Q1) ASC 支持
  - 低侧和高侧 ASC 支持
  - 提供器件引脚控制
  - 故障处理能力
- 具有 CRC 功能的串行外设接口 (SPI)
- 支持 3.3V 和 5V 逻辑输入
- 高级保护功能
  - 电池电压监测器
  - MOSFET V_{DS} 过流监测器
  - R_{shunt} 过流监测器
  - MOSFET V_{GS} 栅极故障监测器
  - 模拟内置自检
  - 内部稳压器和时钟监测器
  - 器件热警告和热关断
  - 故障状态指示器引脚

2 应用

- 汽车类 48V 电机驱动系统
  - 带式和集成式起动发电机和电动发电机
  - 电动助力转向
  - eTurbo 和 eBooster
  - 变速器控制和驱动
  - 油泵、变速器和水泵
  - HVAC 压缩机和风扇

3 说明

DRV3256-Q1 系列器件为 适用于 48V 汽车电机驱动应用的高度集成三相栅极驱动器。这些器件专门设计用于通过提供 2A 峰值拉电流和 2.5A 峰值灌电流（栅极驱动）以及 90V MOSFET 瞬态过压支持来为大功率电机驱动应用提供支持。使用高效的自举架构可充分降低栅极驱动器的功率损耗和自发热。电荷泵使栅极驱动器能够支持 100% PWM 占空比控制。

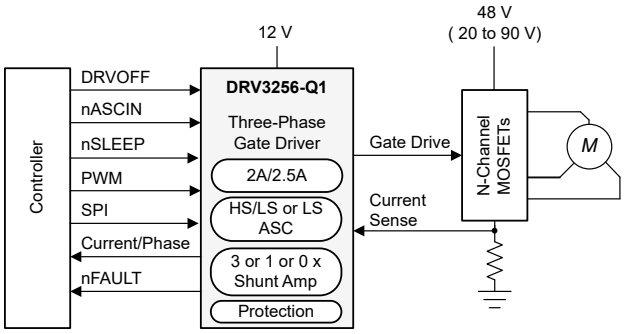
广泛的诊断、监测和保护功能可支持稳健的电机驱动系统设计。该器件集成了高度可配置的主动短路 (ASC) 功能，支持实施所选的外部 MOSFET，从而快速响应系统故障并免除对外部元件的需求。

可选择提供三个或单个低侧电流分流放大器，以支持基于电阻器的低侧电流检测。

封装信息

器件型号(1)	封装	封装尺寸（标称值）
DRV3256-Q1(2)	HTQFP (64)	10.00mm × 10.00mm

(1) 请参阅数据表末尾的可订购产品附录。
(2) 对于所有可用的器件型号，请参阅器件比较表。



简化版原理图

Table of Contents

4 Revision History

注：以前版本的页码可能与当前版本的页码不同

Changes from Revision B (August 2022) to Revision C (December 2022)	Page
• Added DRV3256P-Q1 device variant in the Device Comparison Table and packaging information tables	0

Changes from Revision A (July 2022) to Revision B (August 2022)	Page
• 更新了 DRV3256B-Q1 的器件状态	1

Changes from Revision * (June 2022) to Revision A (July 2022)	Page
• 更新了 DRV3256-Q1 的器件状态	1

Device Comparison Table

PART NUMBER	DEVICE VARIANT	MAX GATE DRIVE CURRENT	SHUNT AMPLIFIERS	Active Short Circuit (HS = High-Side, LS = Low-Side)
DRV3256-Q1	DRV3256A-Q1	2 A or 2.5 A	1	LS only
	DRV3256B-Q1	2 A or 2.5 A	0	HS and LS
	DRV3256-Q1	2 A or 2.5 A	3	HS and LS
	DRV3256P-Q1(1)	2 A or 2.5 A	3	HS and LS

(1) DRV3256P-Q1 supports Watchdog Timer function, VGLPU_CTRL, PVDD_UV2_LVL2, SD_MODE_SEL register bits in addition to the features of the device variant DRV3256-Q1.

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 DRV3256-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 接收文档更新通知

要接收文档更新通知，请导航至 ti.com 上的器件产品文件夹。点击 *订阅更新* 进行注册，即可每周接收产品信息更改摘要。有关更改的详细信息，请查看任何已修订文档中包含的修订历史记录。

5.3 支持资源

TI E2E™ 支持论坛是工程师的重要参考资料，可直接从专家获得快速、经过验证的解答和设计帮助。搜索现有解答或提出自己的问题可获得所需的快速设计帮助。

链接的内容由各个贡献者“按原样”提供。这些内容并不构成 TI 技术规范，并且不一定反映 TI 的观点；请参阅 TI 的《使用条款》。

5.4 Trademarks

TI E2E™ is a trademark of Texas Instruments.
所有商标均为其各自所有者的财产。

5.5 静电放电警告

静电放电 (ESD) 会损坏这个集成电路。德州仪器 (TI) 建议通过适当的预防措施处理所有集成电路。如果不遵守正确的处理和安装程序，可能会损坏集成电路。

ESD 的损坏小至导致微小的性能降级，大至整个器件故障。精密的集成电路可能更容易受到损坏，这是因为非常细微的参数更改都可能会导致器件与其发布的规格不相符。

5.6 术语表

TI 术语表　　本术语表列出并解释了术语、首字母缩略词和定义。

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.

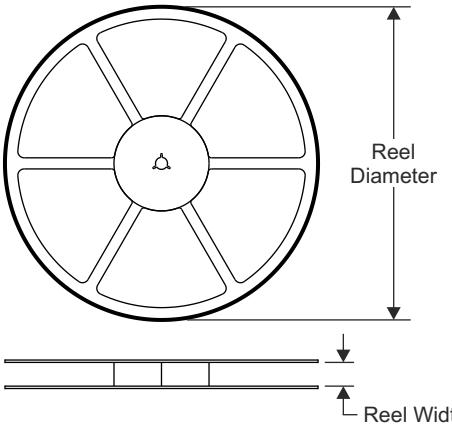
6.1 Package Option Addendum

Packaging Information

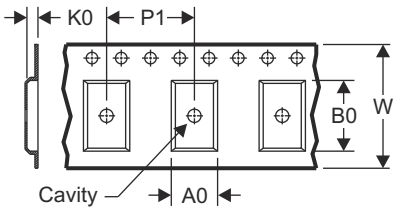
Orderable Device	Status	Package Type	Package Drawing	Pins	Package Qty	Eco Plan	Lead/Ball Finish	MSL Peak Temp	Op Temp (°C)	Device Marking
DRV3256AEPAPRQ1	ACTIVE	HTQFP	PAP	64	1000	RoHS & Green	NIPDAU	Level-3-260C-168 HR	-40 to 150	DRV3256A
DRV3256EPAPRQ1	ACTIVE	HTQFP	PAP	64	1000	RoHS & Green	NIPDAU	Level-3-260C-168 HR	-40 to 150	DRV3256
DRV3256BEPAPRQ1	ACTIVE	HTQFP	PAP	64	1000	RoHS & Green	NIPDAU	Level-3-260C-168 HR	-40 to 150	DRV3256B
DRV3256PEPAPRQ1	ACTIVE	HTQFP	PAP	64	1000	RoHS & Green	NIPDAU	Level-3-260C-168 HR	-40 to 150	DRV3256P

6.2 Tape and Reel Information

REEL DIMENSIONS

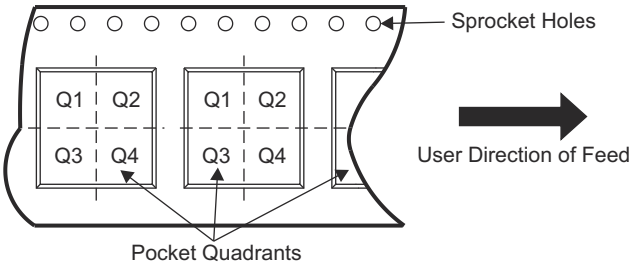


TAPE DIMENSIONS



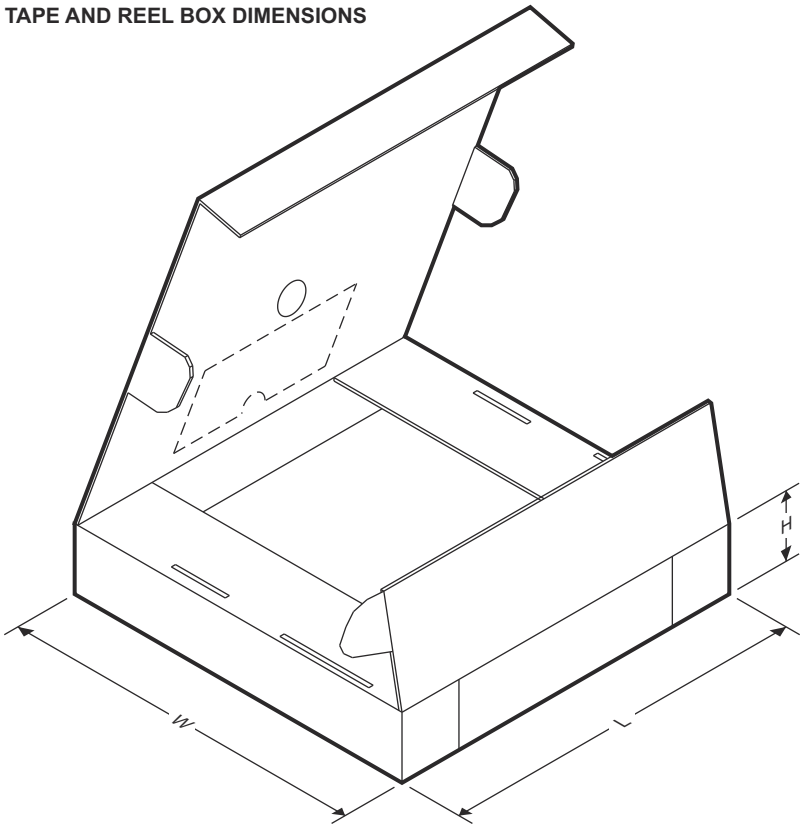
A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

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
DRV3256AEPAPRQ1	HTQFP	PAP	64	1000	330.0	24.4	13.0	13.0	1.5	16.0	24.0	Q2
DRV3256EPAPRQ1	HTQFP	PAP	64	1000	330.0	24.4	13.0	13.0	1.5	16.0	24.0	Q2
DRV3256BEPAPRQ1	HTQFP	PAP	64	1000	330.0	24.4	13.0	13.0	1.5	16.0	24.0	Q2
DRV3256PEPAPRQ1	HTQFP	PAP	64	1000	330.0	24.4	13.0	13.0	1.5	16.0	24.0	Q2

TAPE AND REEL BOX DIMENSIONS



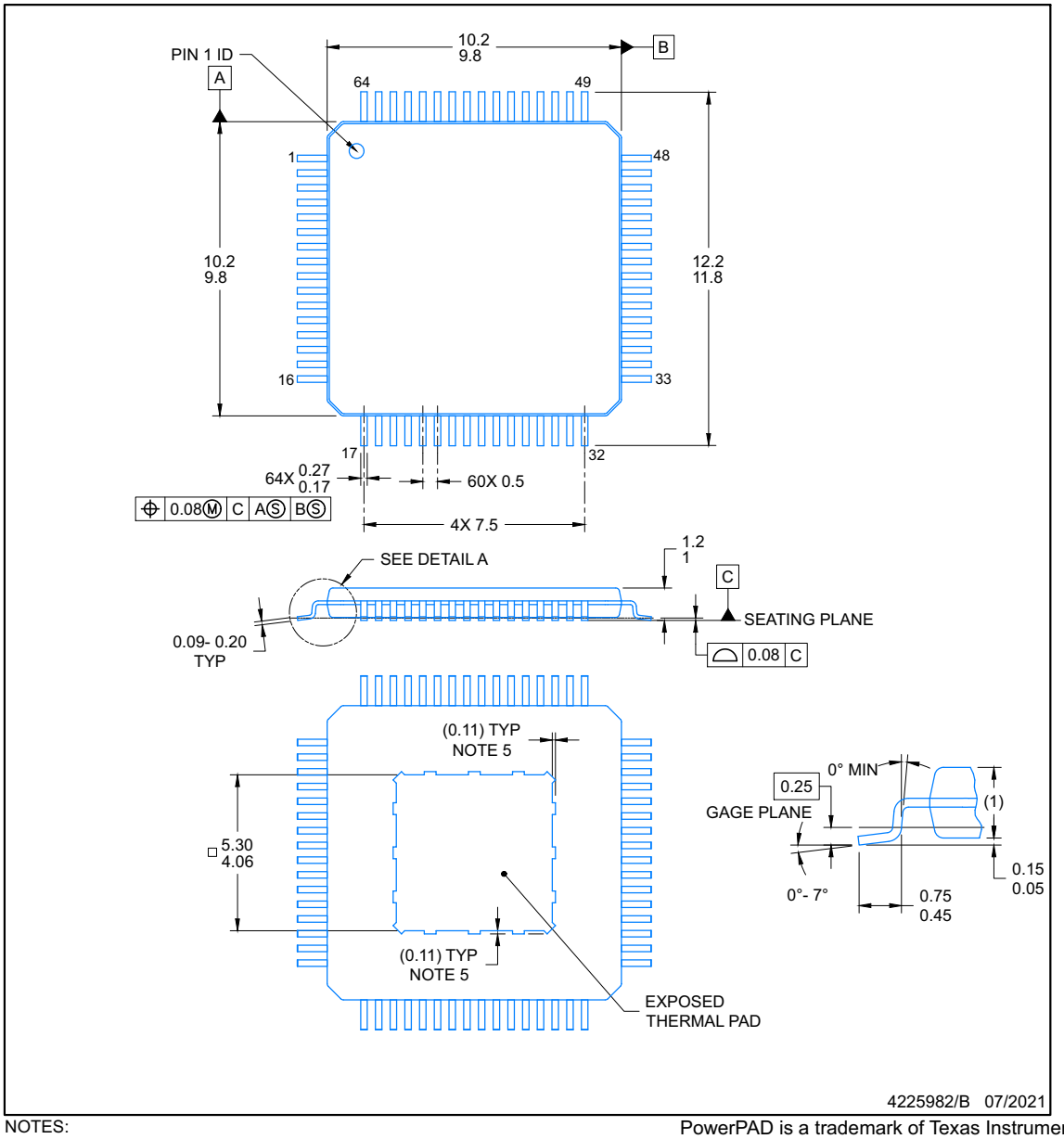
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
DRV3256AEPAPRQ1	HTQFP	PAP	64	1000	10.0	10.0	1.0
DRV3256EPAPRQ1	HTQFP	PAP	64	1000	10.0	10.0	1.0
DRV3256BEPAPRQ1	HTQFP	PAP	64	1000	10.0	10.0	1.0
DRV3256PEPAPRQ1	HTQFP	PAP	64	1000	10.0	10.0	1.0

PACKAGE OUTLINE

PAP0064N

HTQFP - 1.2 mm max height

PLASTIC QUAD FLATPACK



NOTES:

PowerPAD is a trademark of Texas Instruments

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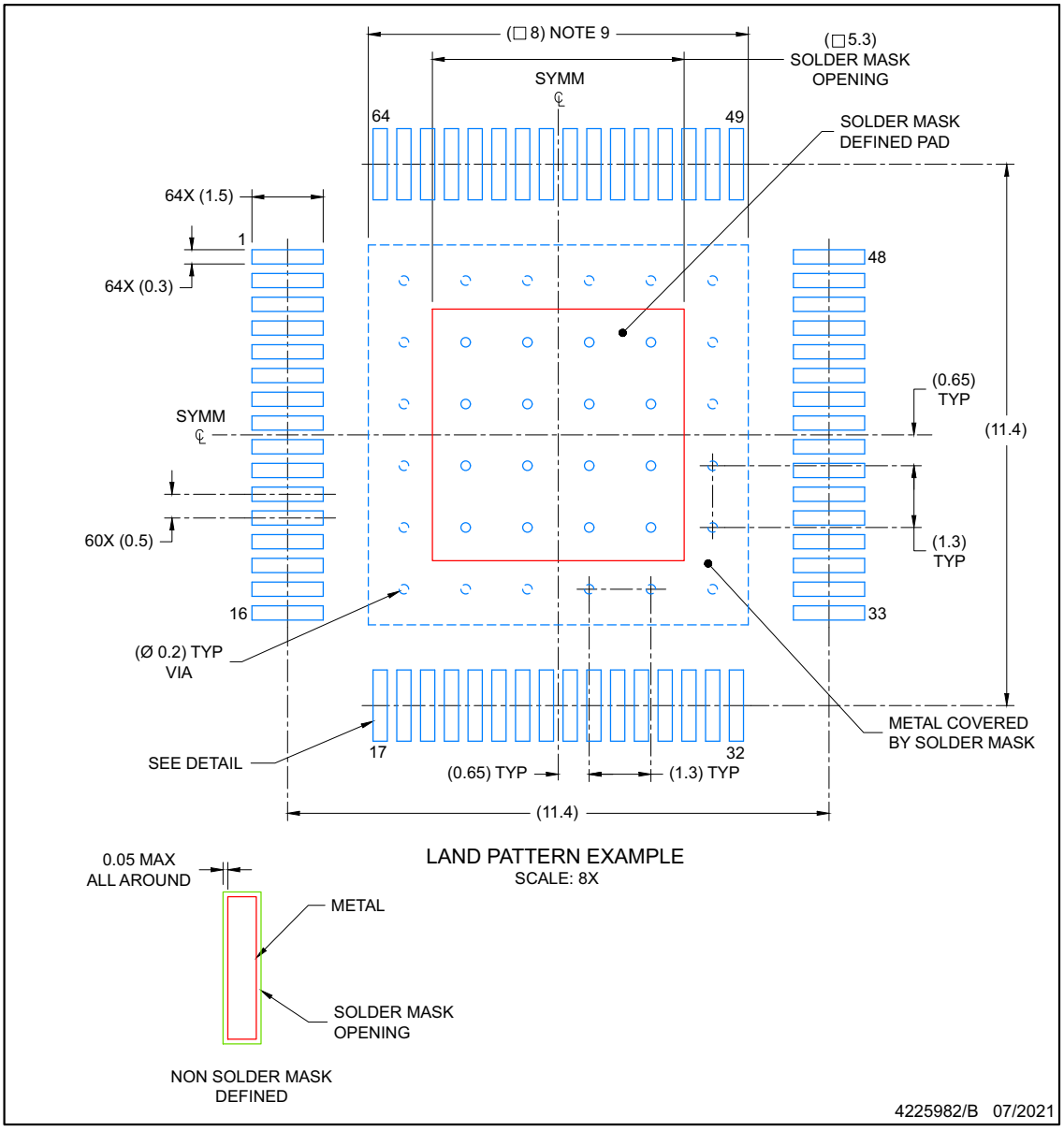
2. This drawing is subject to change without notice.
3. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 per side.
4. Body width does not include interlead flash. Interlead flash shall not exceed 0.50 per side.
5. Strap 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

PAP0064N

HTQFP - 1.2 mm max height

PLASTIC QUAD FLATPACK



NOTES: (continued)

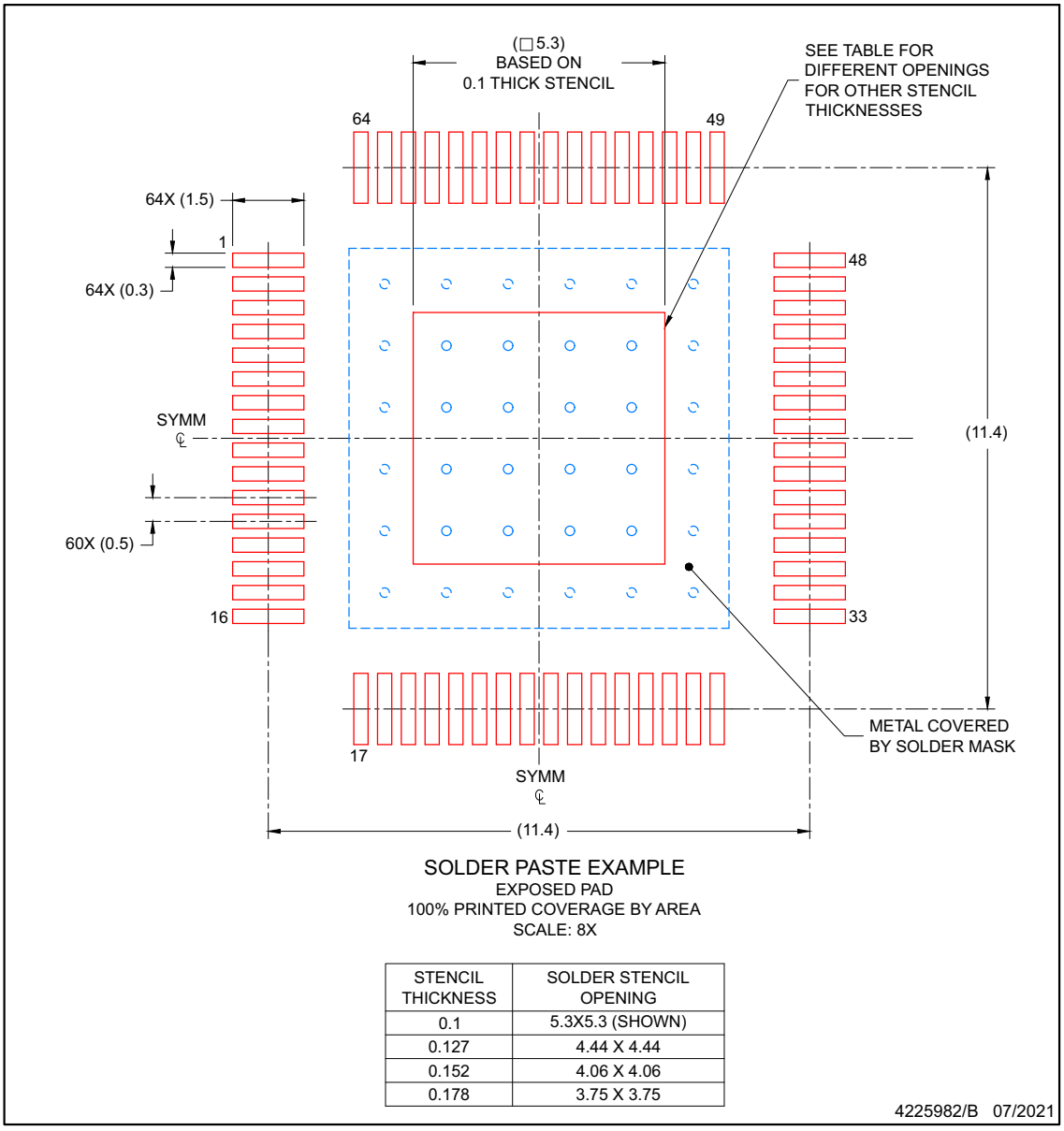
7. Publication IPC-7351 may have alternate designs.
8. Solder mask tolerances between and around signal pads can vary based on board fabrication site.
9. This package is designed to be soldered to a thermal pad on the board. Refer to technical brief, PowerPAD Thermally Enhanced Package, Texas Instruments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

EXAMPLE STENCIL DESIGN

PAP0064N

HTQFP - 1.2 mm max height

PLASTIC QUAD FLATPACK



SOLDER PASTE EXAMPLE
EXPOSED PAD
100% PRINTED COVERAGE BY AREA
SCALE: 8X

STENCIL THICKNESS	SOLDER STENCIL OPENING
0.1	5.3X5.3 (SHOWN)
0.127	4.44 X 4.44
0.152	4.06 X 4.06
0.178	3.75 X 3.75

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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 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
DRV3256AEPAPRQ1	ACTIVE	HTQFP	PAP	64	1000	RoHS & Green	NIPDAU	Level-3-260C-168 HR	-40 to 150	DRV3256A Q1	Samples
DRV3256BEPAPRQ1	ACTIVE	HTQFP	PAP	64	1000	RoHS & Green	NIPDAU	Level-3-260C-168 HR	-40 to 150	DRV3256B Q1	Samples
DRV3256EPAPRQ1	ACTIVE	HTQFP	PAP	64	1000	RoHS & Green	NIPDAU	Level-3-260C-168 HR	-40 to 150	DRV3256 Q1	Samples
DRV3256PEPAPRQ1	ACTIVE	HTQFP	PAP	64	1000	RoHS & Green	NIPDAU	Level-3-260C-168 HR	-40 to 150	DRV3256P Q1	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.

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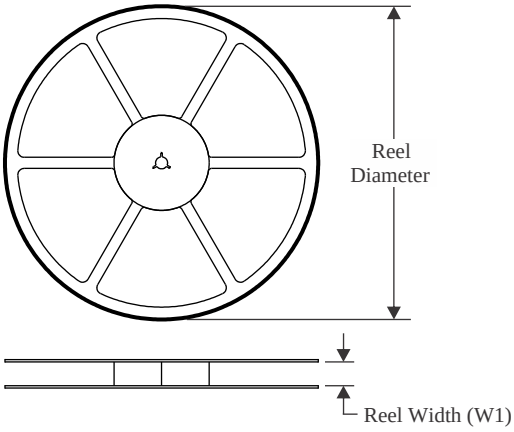
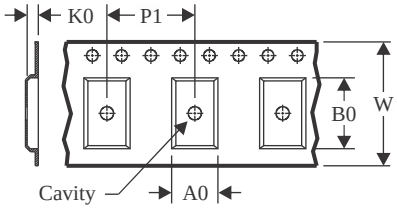
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



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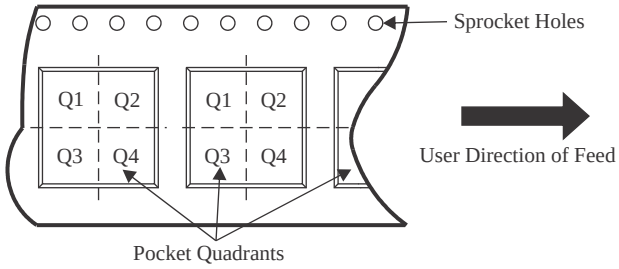
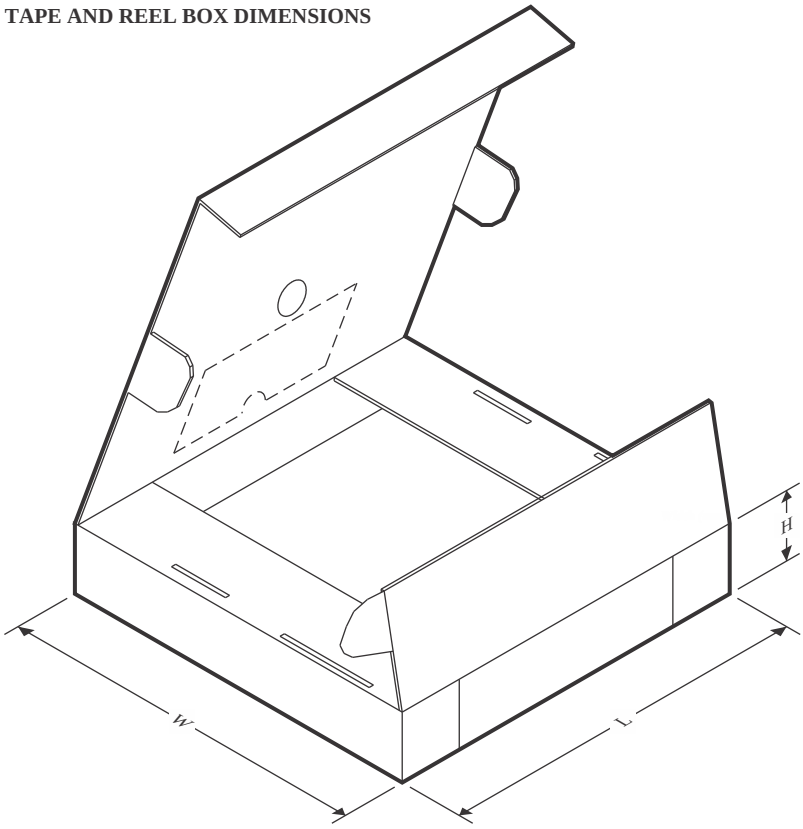
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
DRV3256AEPAPRQ1	HTQFP	PAP	64	1000	330.0	24.4	13.0	13.0	1.5	16.0	24.0	Q2
DRV3256BEPAPRQ1	HTQFP	PAP	64	1000	330.0	24.4	13.0	13.0	1.5	16.0	24.0	Q2
DRV3256EPAPRQ1	HTQFP	PAP	64	1000	330.0	24.4	13.0	13.0	1.5	16.0	24.0	Q2
DRV3256PEPAPRQ1	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

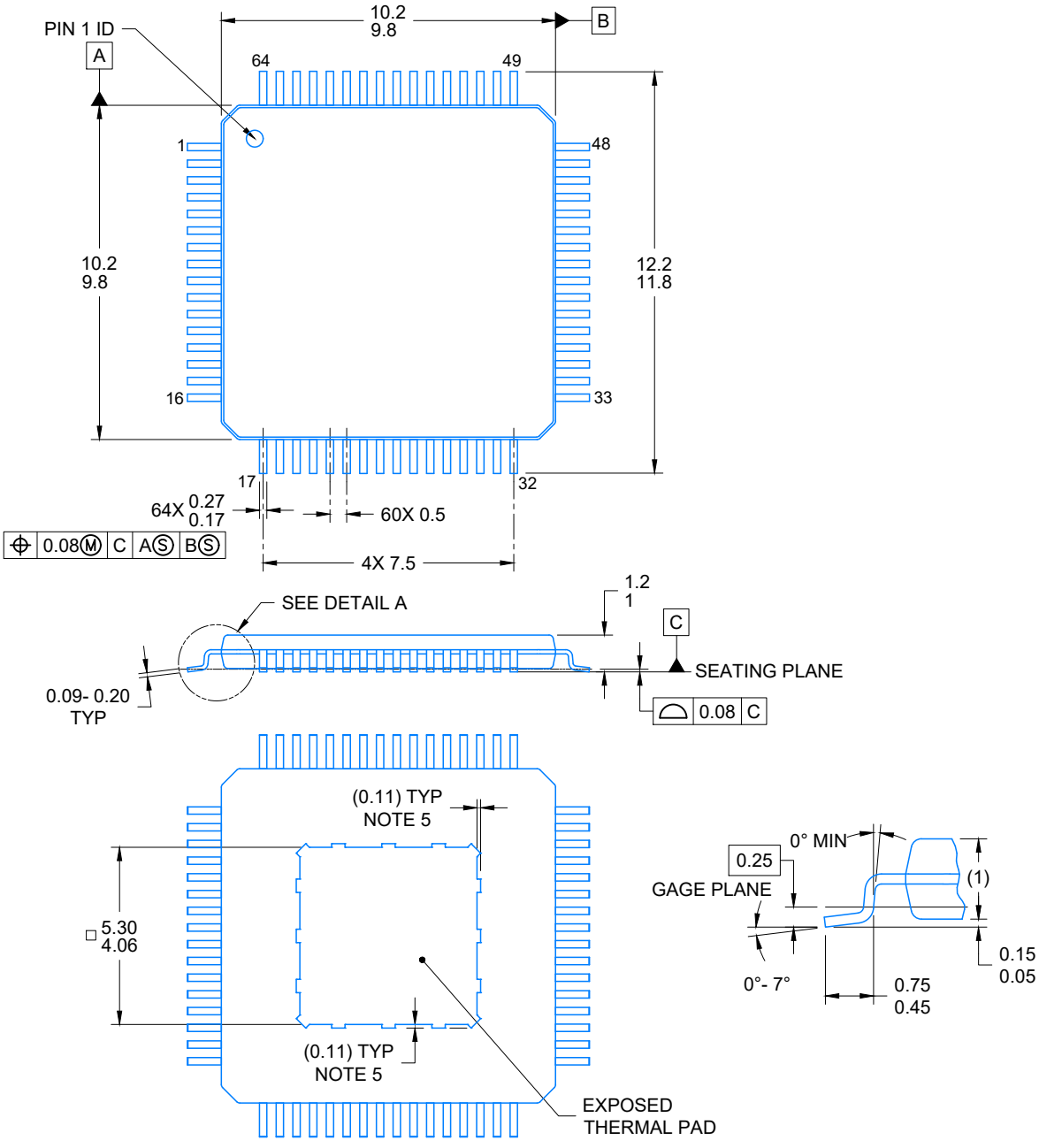
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
DRV3256AEPAPRQ1	HTQFP	PAP	64	1000	367.0	367.0	55.0
DRV3256BEPAPRQ1	HTQFP	PAP	64	1000	367.0	367.0	55.0
DRV3256EPAPRQ1	HTQFP	PAP	64	1000	367.0	367.0	55.0
DRV3256PEPAPRQ1	HTQFP	PAP	64	1000	367.0	367.0	55.0

PACKAGE OUTLINE

PAP0064N

HTQFP - 1.2 mm max height

PLASTIC QUAD FLATPACK



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NOTES:

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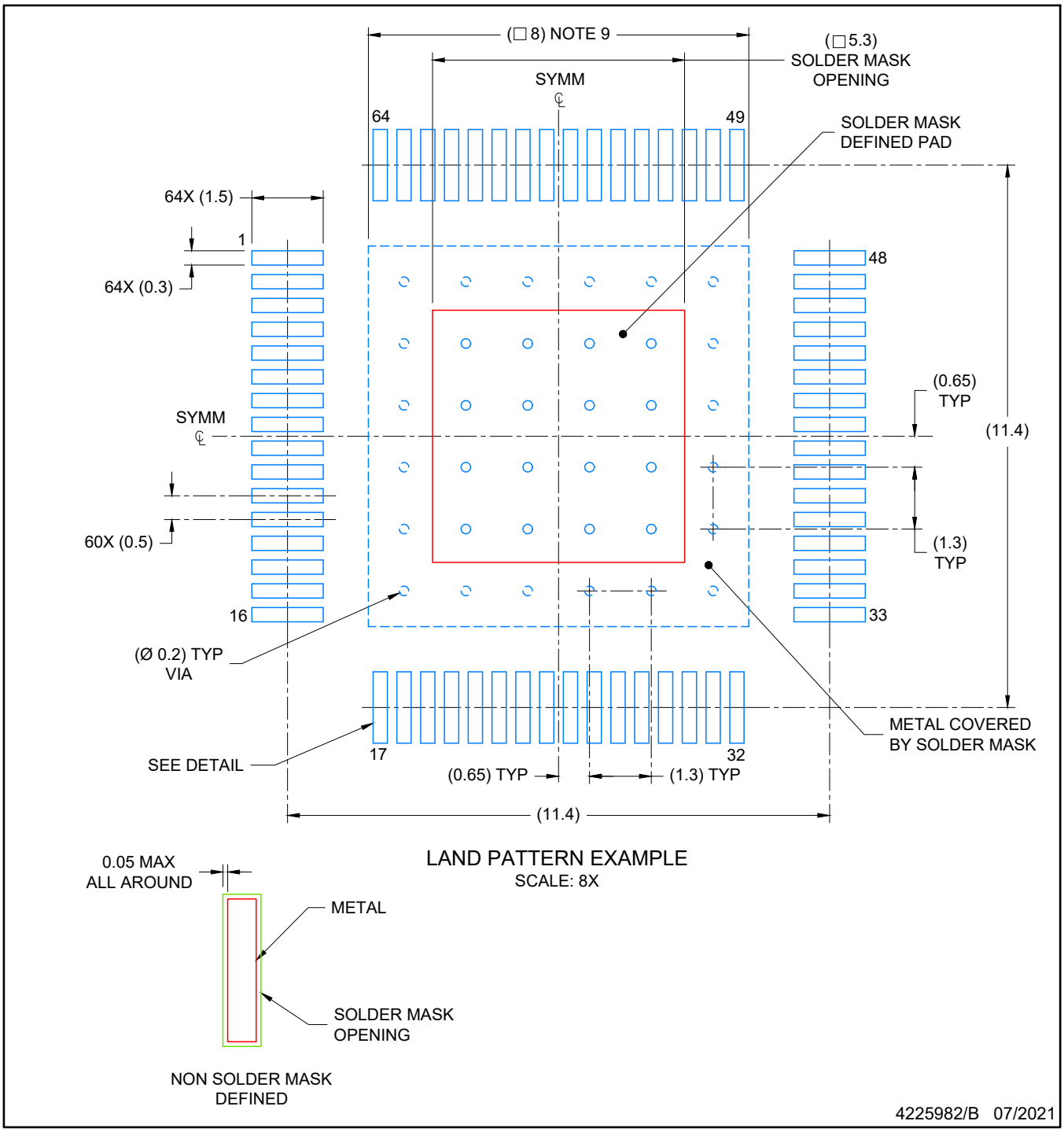
6. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.



NOTES: (continued)

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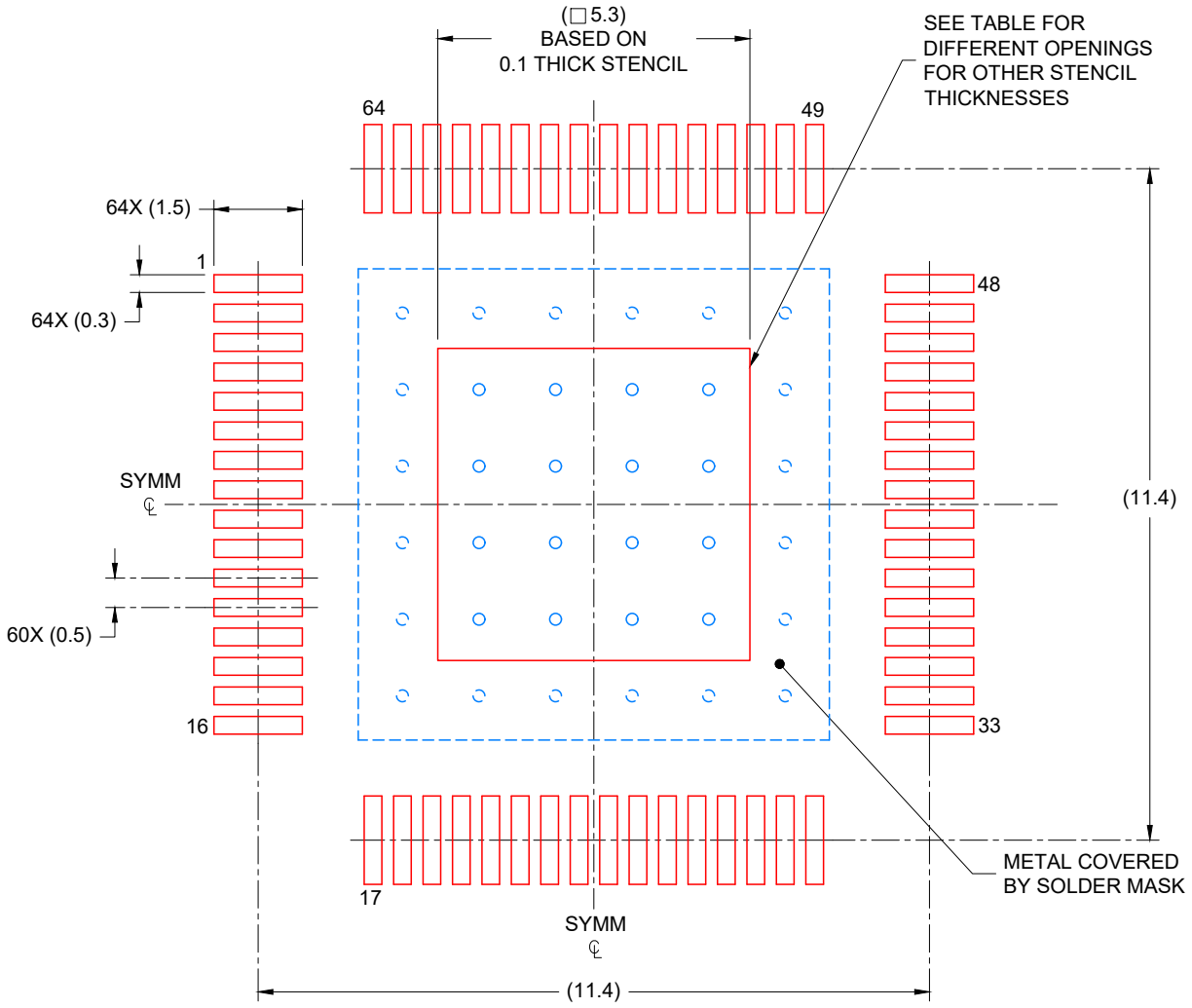

SOLDER PASTE EXAMPLE
EXPOSED PAD
100% PRINTED COVERAGE BY AREA
SCALE: 8X

STENCIL THICKNESS	SOLDER STENCIL OPENING
0.1	5.3X5.3 (SHOWN)
0.127	4.44 X 4.44
0.152	4.06 X 4.06
0.178	3.75 X 3.75

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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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