

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

- 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。

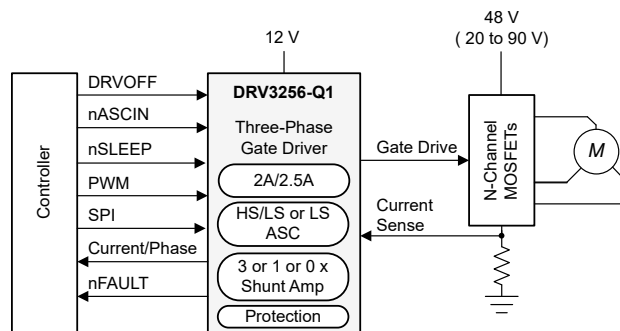
可选择提供三个或单个低侧电流分流放大器，以支持基于电阻器的低侧电流检测。

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

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



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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](https://www.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

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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

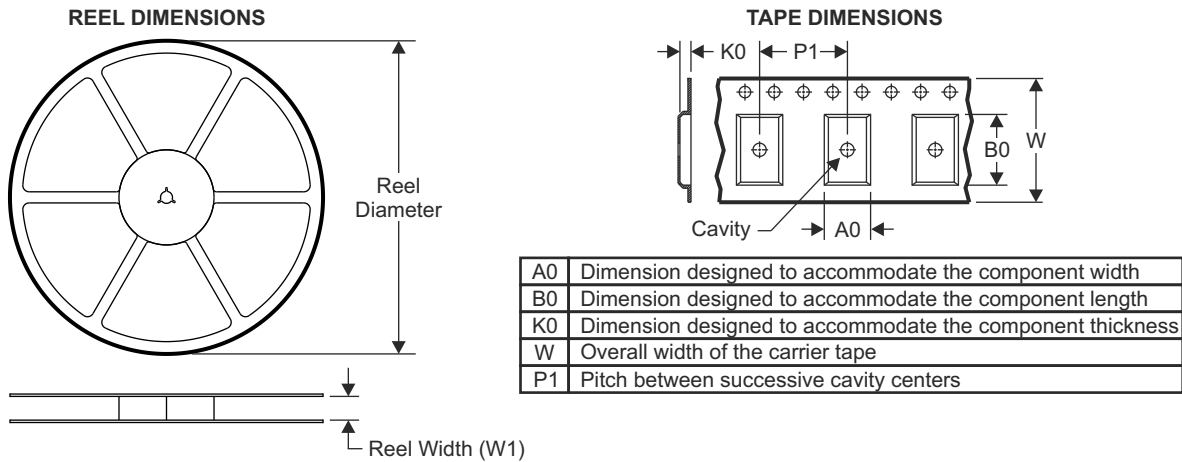
Packaging Information

Orderable Device	Status	Package Type	Package Drawing	Pins	Package Qty	Eco Plan	Lead/Ball Finish	MSL Peak Temp	Op Temp (°C)	Device Marking
DRV3256AEPA PRQ1	ACTIVE	HTQFP	PAP	64	1000	RoHS & Green	NIPDAU	Level-3-260C-1 68 HR	-40 to 150	DRV3256A
DRV3256EPAP RQ1	ACTIVE	HTQFP	PAP	64	1000	RoHS & Green	NIPDAU	Level-3-260C-1 68 HR	-40 to 150	DRV3256
DRV3256BEPA PRQ1	ACTIVE	HTQFP	PAP	64	1000	RoHS & Green	NIPDAU	Level-3-260C-1 68 HR	-40 to 150	DRV3256B
DRV3256PEPA PRQ1	ACTIVE	HTQFP	PAP	64	1000	RoHS & Green	NIPDAU	Level-3-260C-1 68 HR	-40 to 150	DRV3256P

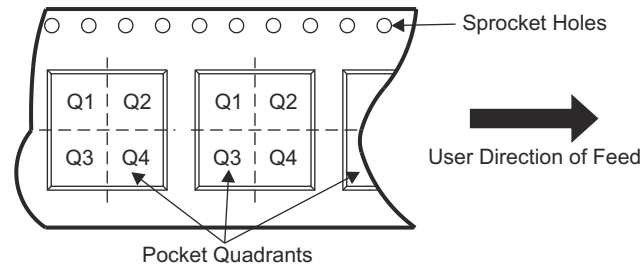
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6.2 Tape and Reel Information

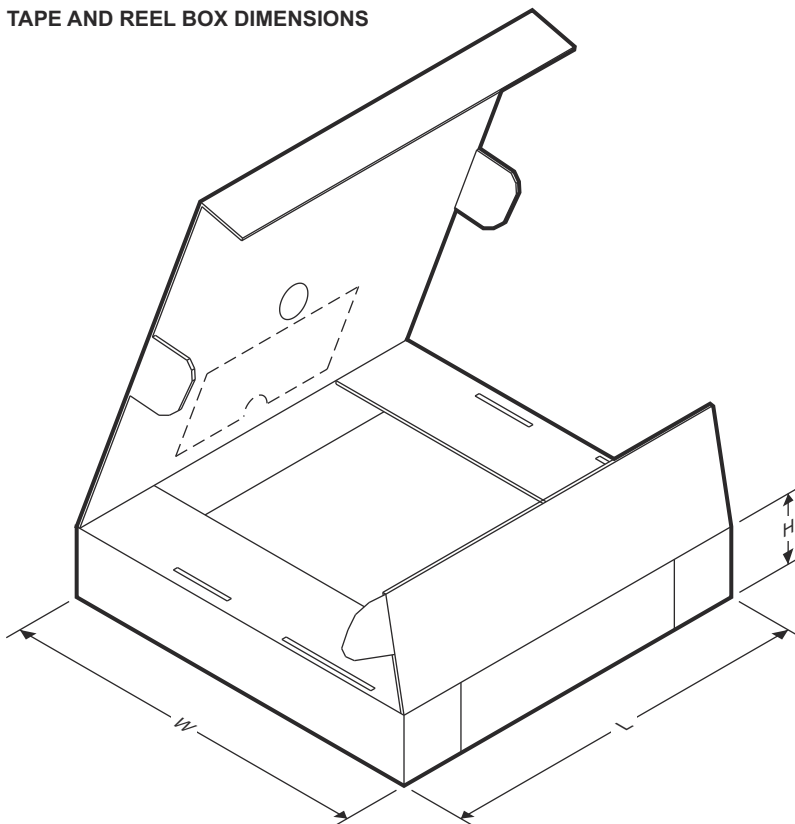


QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



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
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

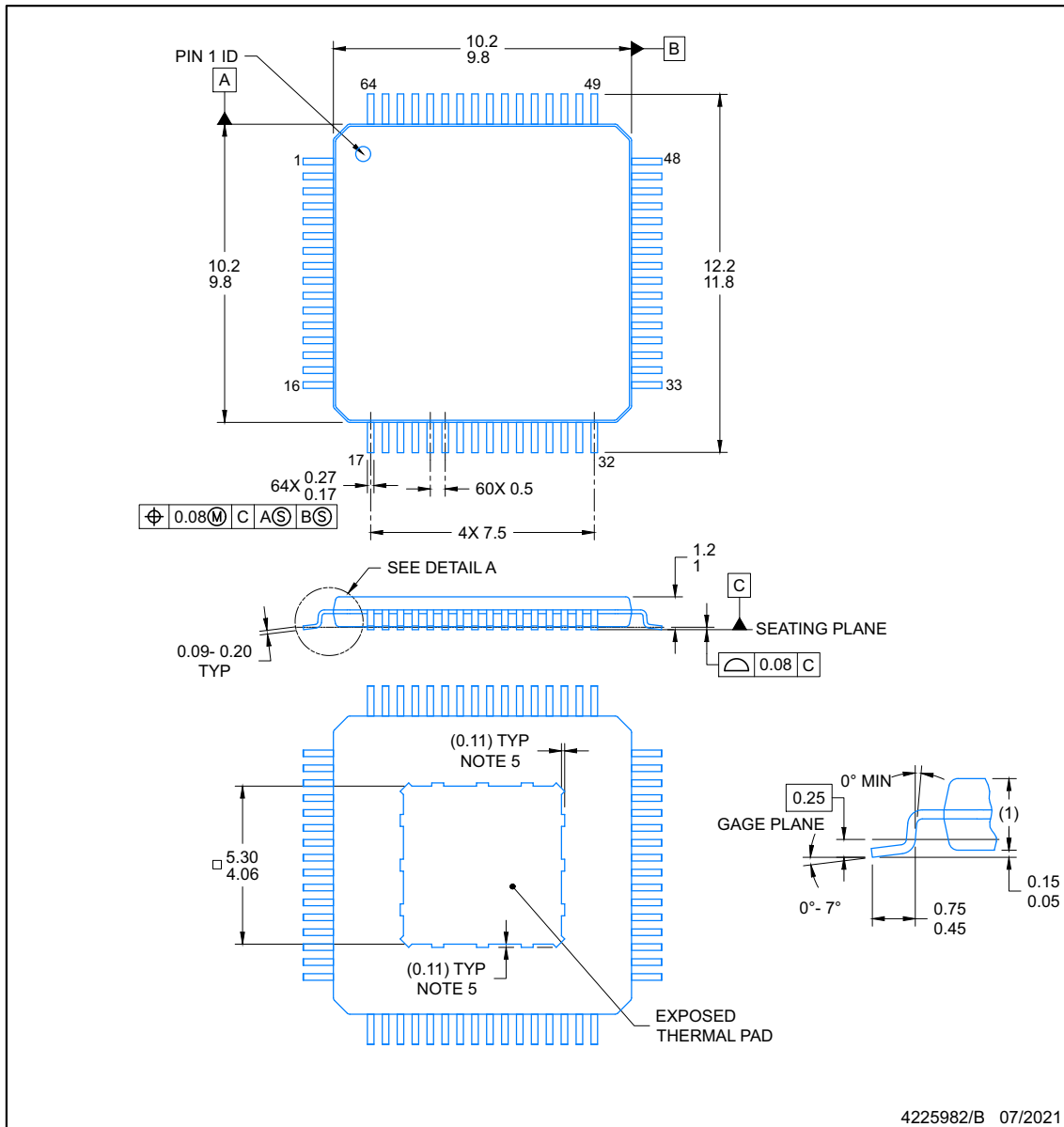
TAPE AND REEL BOX DIMENSIONS



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

PAP0064N
PACKAGE OUTLINE
HTQFP - 1.2 mm max height

PLASTIC QUAD FLATPACK



NOTES:

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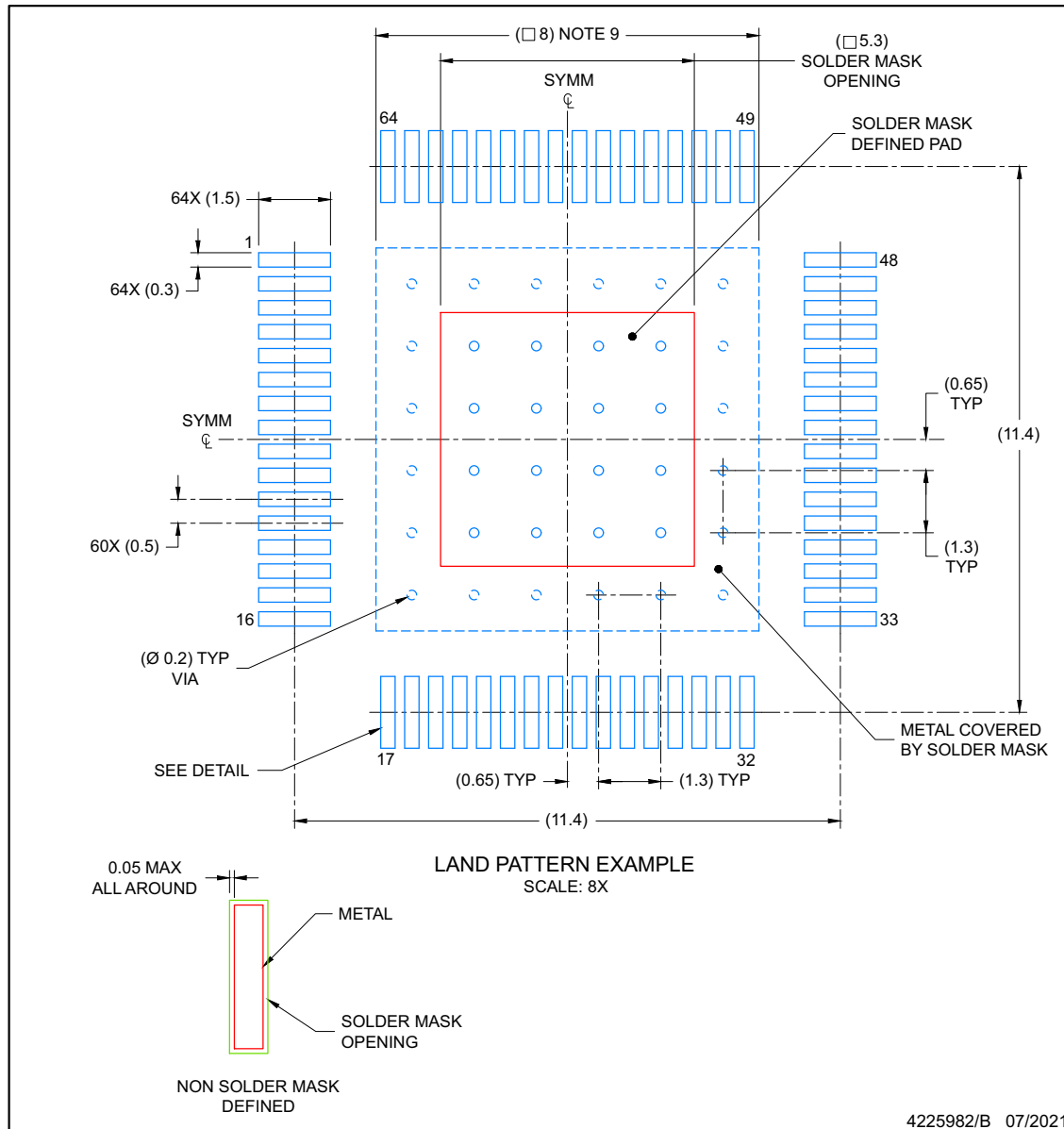
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate 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.

PAP0064N

EXAMPLE BOARD LAYOUT

HTQFP - 1.2 mm max height

PLASTIC QUAD FLATPACK

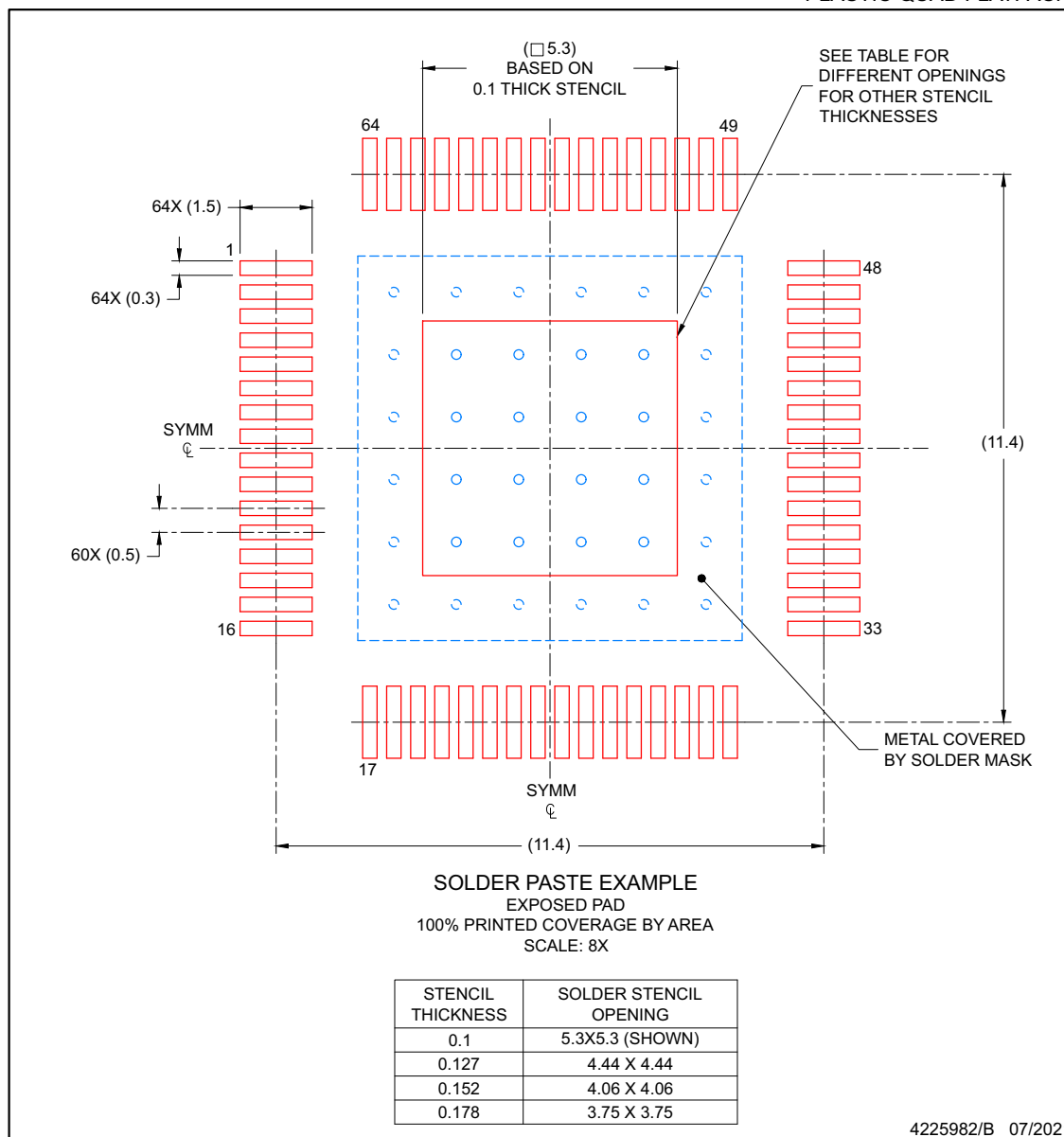


NOTES: (continued)

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**HTQFP - 1.2 mm max height****PAP0064N**

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 (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)
DRV3256AEPAPRQ1	Active	Production	HTQFP (PAP) 64	1000 LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 150	DRV3256A Q1
DRV3256AEPAPRQ1.A	Active	Production	HTQFP (PAP) 64	1000 LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 150	DRV3256A Q1
DRV3256BEPAPRQ1	Active	Production	HTQFP (PAP) 64	1000 LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 150	DRV3256B Q1
DRV3256BEPAPRQ1.A	Active	Production	HTQFP (PAP) 64	1000 LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 150	DRV3256B Q1
DRV3256EPAPRQ1	Active	Production	HTQFP (PAP) 64	1000 LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 150	DRV3256 Q1
DRV3256EPAPRQ1.A	Active	Production	HTQFP (PAP) 64	1000 LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 150	DRV3256 Q1
DRV3256PEPAPRQ1	Active	Production	HTQFP (PAP) 64	1000 LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 150	DRV3256P Q1
DRV3256PEPAPRQ1.A	Active	Production	HTQFP (PAP) 64	1000 LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 150	DRV3256P 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.

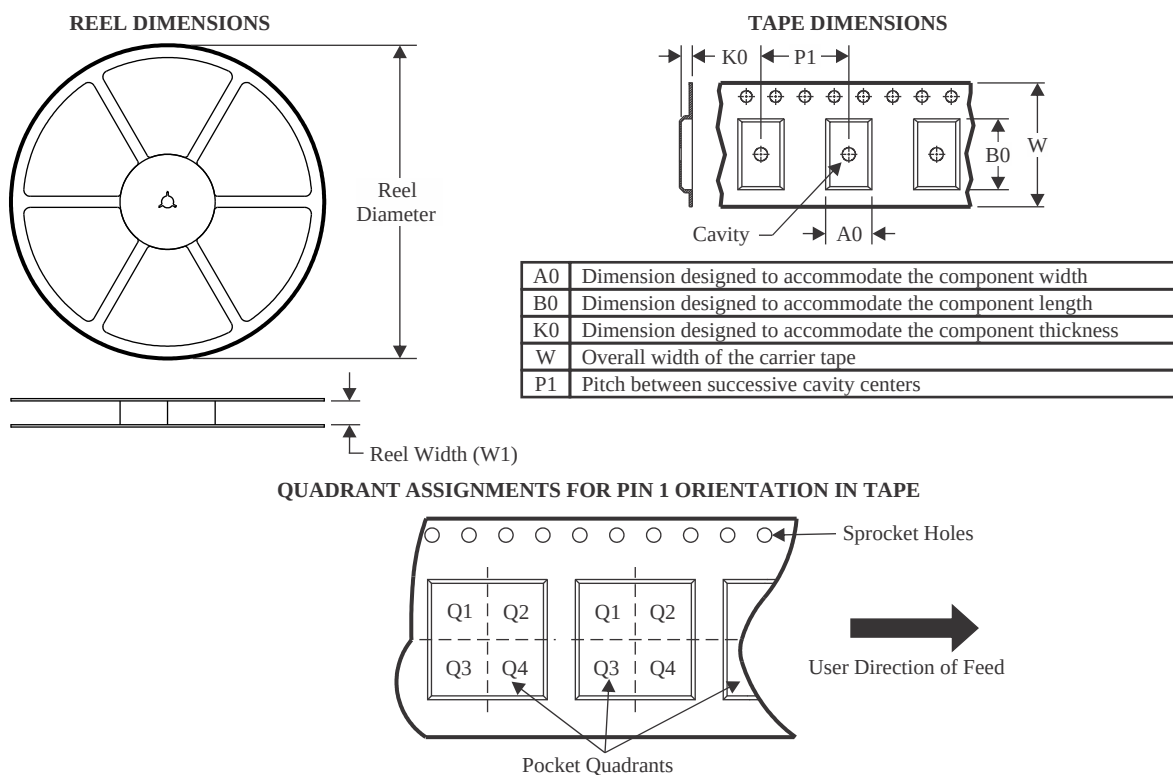
⁽⁶⁾ **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

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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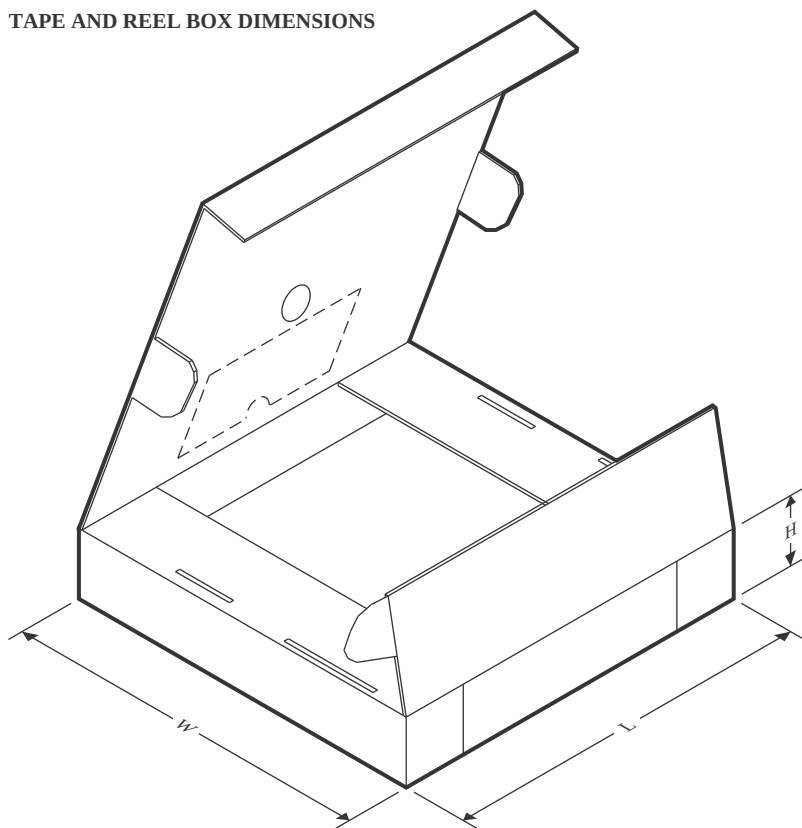
TAPE AND REEL INFORMATION



*All dimensions are nominal

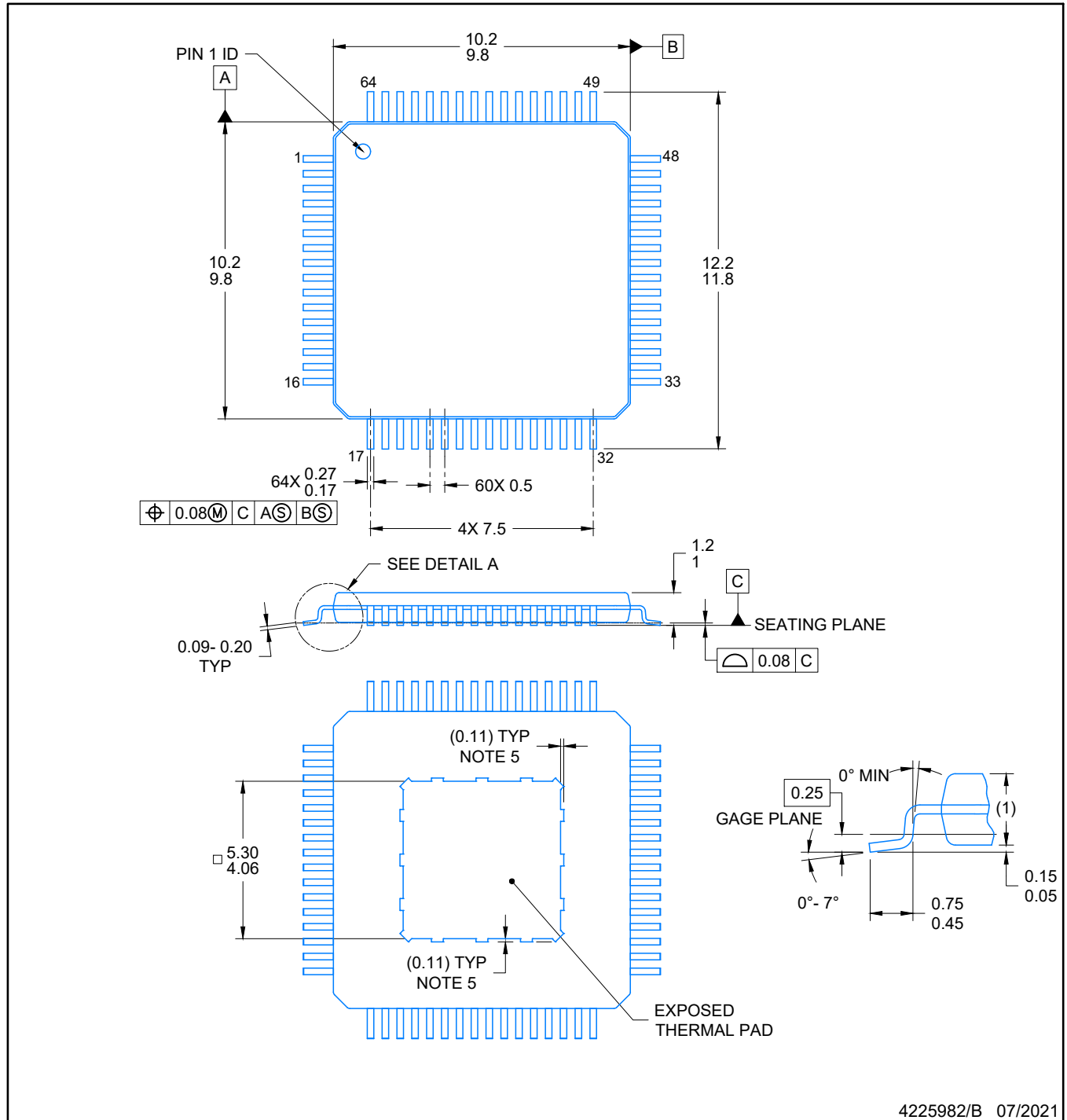
Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
DRV3256AEPAPRQ1	HTQFP	PAP	64	1000	330.0	24.4	13.0	13.0	1.5	16.0	24.0	Q2
DRV3256BEPAPRQ1	HTQFP	PAP	64	1000	330.0	24.4	13.0	13.0	1.5	16.0	24.0	Q2
DRV3256EPAPRQ1	HTQFP	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

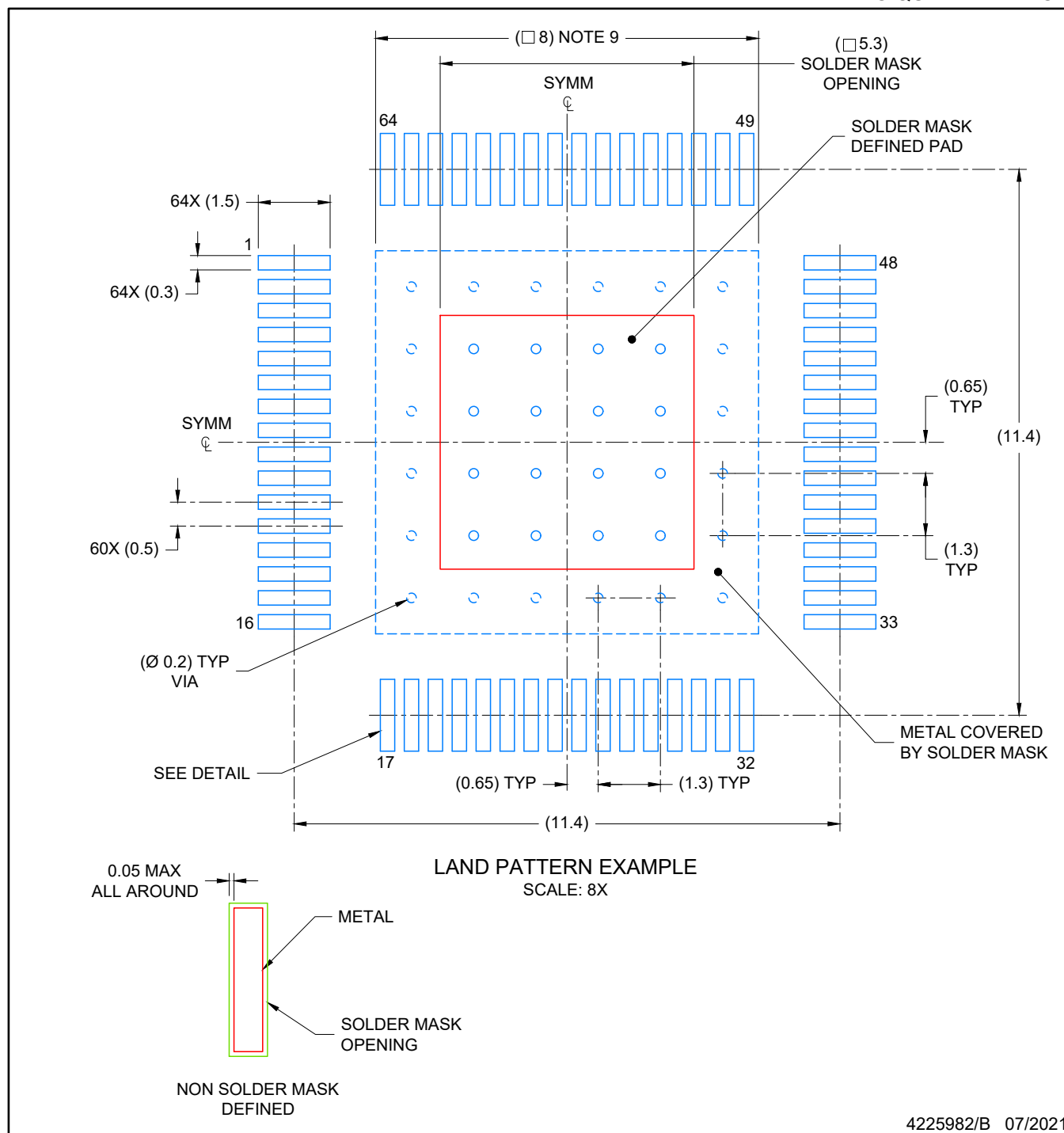
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
DRV3256AEPAPRQ1	HTQFP	PAP	64	1000	367.0	367.0	55.0
DRV3256BEPAPRQ1	HTQFP	PAP	64	1000	367.0	367.0	55.0
DRV3256EPAPRQ1	HTQFP	PAP	64	1000	367.0	367.0	55.0
DRV3256PEPAPRQ1	HTQFP	PAP	64	1000	367.0	367.0	55.0



NOTES:

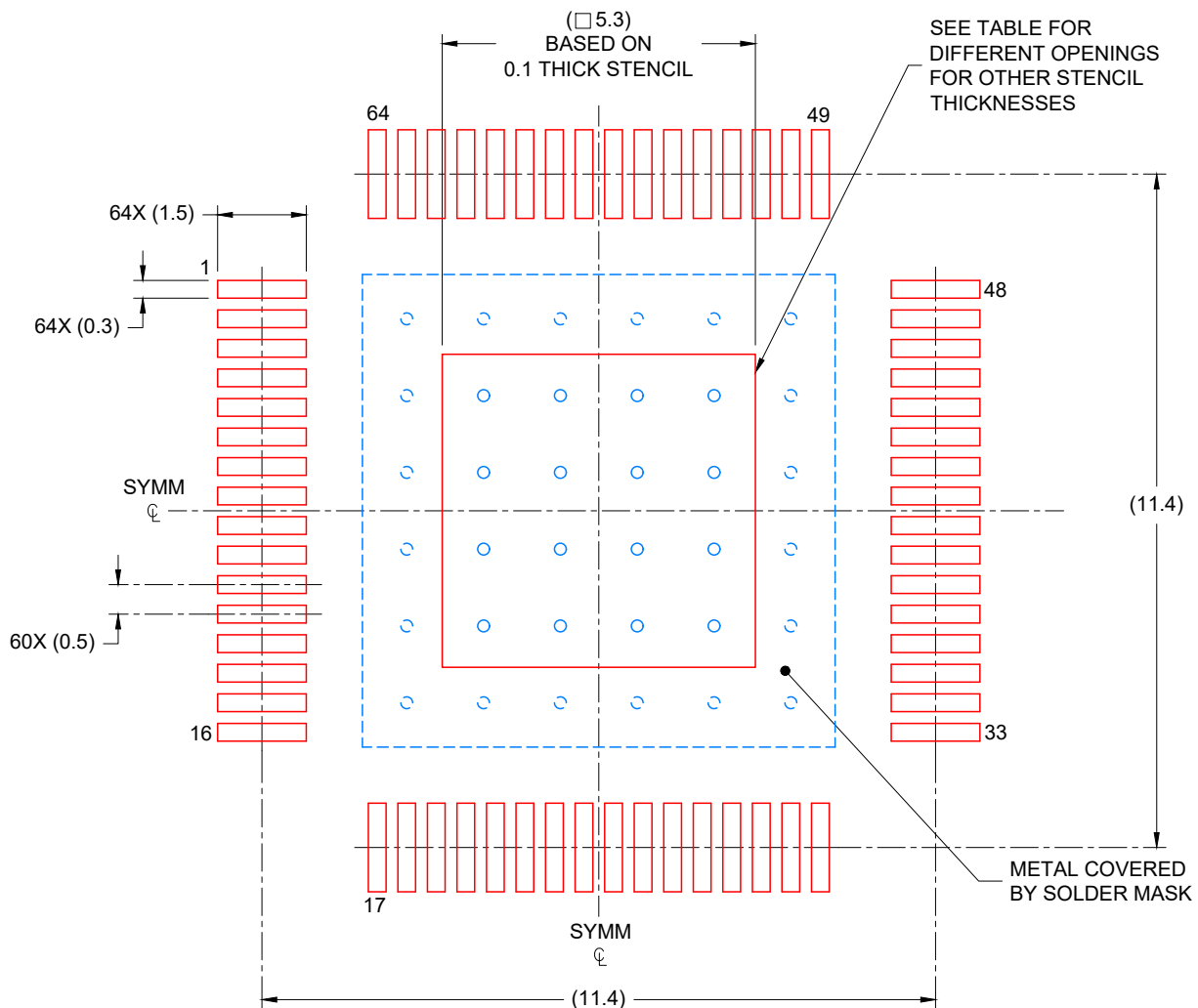
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1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
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4. Body width does not include interlead flash. Interlead 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.



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).



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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