DRV3233-Q1 具有精确电流检测和增强型诊断功能的汽车类 24/12V 电池三相栅极驱动器单元

1 特性

- 符合面向汽车应用的 AEC-Q100 标准 - 温度选项：
  - DRV3233EPHP：–40°C 至 +150°C，T_A
  - DRV3233QPHP（预发布）：–40°C 至 +125°C，T_A
- 以功能安全合规型为目标
  - 专为功能安全应用开发
  - 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
- 三相半桥栅极驱动器
  - 驱动六个 N 沟道 MOSFET (NMOS)
  - 4.5V 至 60V 宽工作电压范围
  - 适用于高侧栅极驱动器的自举架构
  - 用于 50mA 平均栅极电流的电荷泵
  - 支持 100% PWM 占空比
  - 外部开关的过驱电源
- 智能栅极驱动架构
  - 高达 1000/2000mA（拉电流/灌电流）的 45 级可配置峰值栅极驱动电流
  - 三步动态驱动电流控制
  - 用于保护功率级的软关断
- 低侧电流检测放大器
  - 在整个温度范围内具有低于 1mV 的低输入失调电压
  - 9 级可调增益
- 基于 SPI 的详细配置和诊断
- DRVOFF 引脚可独立禁用驱动器
- 高压唤醒引脚 (nSLEEP)
- 提供多个 PWM 接口选项
  - 6x、3x、1x PWM 模式
  - 通过 SPI 传输 PWM 信号
- 支持 3.3V 和 5V 逻辑输入
- 用于复位设置的可选可编程 OTP
- 高级和可配置保护功能
  - 电池和电源电压监测器
  - 相位反馈比较器
  - MOSFET V_{DS} 和 R_{sense} 过电流监测器
  - 模拟内置自检，时钟监控器
  - 故障状态指示引脚

2 应用

- 12V/24V 汽车电机控制应用
  - 电动助力转向和线控转向
  - 电子机械制动、制动助力辅助和线控制动
  - 变速和线控换档
  - 汽车泵

3 说明

DRV3233 是一款集成式智能栅极驱动器，适用于 12V 和 24V 汽车类三相 BLDC 应用。此器件具有三个半桥栅极驱动器，每个驱动器都能够驱动高侧和低侧 N 沟道功率 MOSFET。DRV3233 使用集成式自举二极管和 GVDD 电荷泵生成合适的栅极驱动电压。此智能栅极驱动架构支持 0.8mA 至 1A（拉电流）和 2A（灌电流）的可配置峰值栅极驱动电流。DRV3233 可以采用单电源运行，并具有 4.5V 至 60V 宽输入电压范围。涓流电荷泵支持 100% PWM 占空比控制，并提供外部开关的过驱栅极驱动电压。

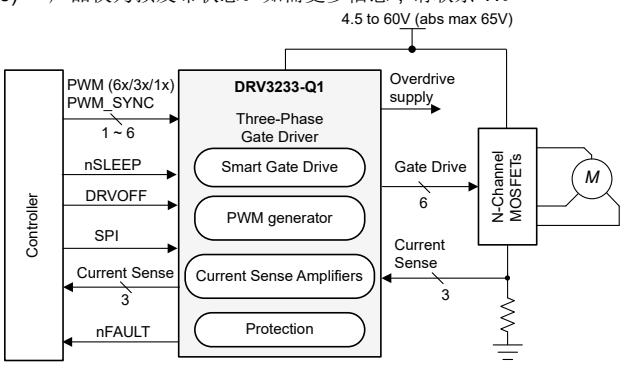
DRV3233 提供低侧电流检测放大器，用于支持基于电阻器的低侧电流检测。放大器的低失调电压使系统能够实现精密的电机电流测量。

DRV3233 集成了各种诊断和保护特性，可实现稳健的电机驱动系统设计，还有助于消除对外部元件的需求。该器件具有高度可配置特性，能够无缝集成到各种系统设计中。

封装信息

器件型号	封装(1)	封装尺寸（标称值）(2)	本体尺寸（标称值）
DRV3233-Q1	HTQFP (48)	9mm x 9mm	7mm × 7mm
	QFN (48)(3)	7mm × 7mm	7mm × 7mm
	QFN (32)(3)	6mm × 4mm	6mm × 4mm

(1) 如需了解所有可用封装，请参阅数据表末尾的可订购产品附录。
(2) 封装尺寸包括引脚（如适用）。
(3) 产品仅为预发布状态。如需更多信息，请联系 TI。



简化版原理图

内容

4 修订历史记录

注：以前版本的页码可能与当前版本的页码不同

Changes from Revision * (September 2023) to Revision A (August 2024)	Page
• 将 DRV3233EPHP 的器件状态更新为量产数据。	1

5 机械、封装和可订购信息

以下页面包含机械、封装和可订购信息。这些信息是指定器件可用的最新数据。数据如有变更，恕不另行通知，且不会对此文档进行修订。有关此数据表的浏览器版本，请查阅左侧的导航栏。

5.1 封装选项附录

封装信息

可订购器件	状态(1)	封装类型	封装图	引脚	包装数量	环保计划	铅/焊球镀层(5)	MSL 峰值温度 (2)	工作温度 (°C)	器件标识(3) (4)
DRV3233EPHPRQ1	运行	HTQFP	PHP	48	1000	RoHS 和绿色环保	NiPdAu	Level-3-260C-168 HR)	-40 至 150	PDRV3233

(1) 销售状态值定义如下：
正在供货：建议用于新设计的产品器件。
限期购买：TI 已宣布器件即将停产，但仍在购买期限内。
NRND：不推荐用于新设计。为支持现有客户，器件仍在生产，但 TI 不建议在新设计中使用此器件。
预发布：器件已发布，但未量产。可能提供样片，也可能无法提供样片。
已停产：TI 已停止生产该器件。

(2) MSL，峰值温度-- 湿敏等级额定值（符合 JEDEC 工业标准分级）和峰值焊接温度。

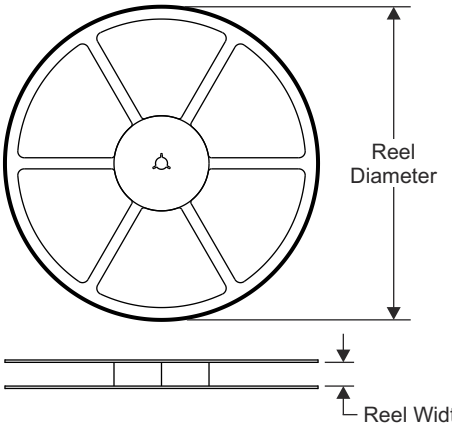
(3) 器件上可能还有与标识、批次跟踪代码信息或环境分类相关的其他标志。

(4) 如有多个器件标识，将用括号括起来。不过，器件上仅显示括号中以“~”隔开的其中一个器件标识。如果某一行缩进，说明该行续接上一行，这两行合在一起表示该器件的完整器件标识。

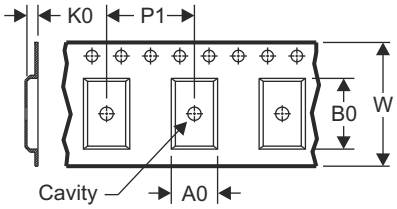
(5) 铅/焊球镀层 - 可订购器件可能有多种镀层材料选项。各镀层选项用垂直线隔开。如果铅/焊球镀层值超出最大列宽，则会折为两行。

5.2 卷带包装信息

REEL DIMENSIONS

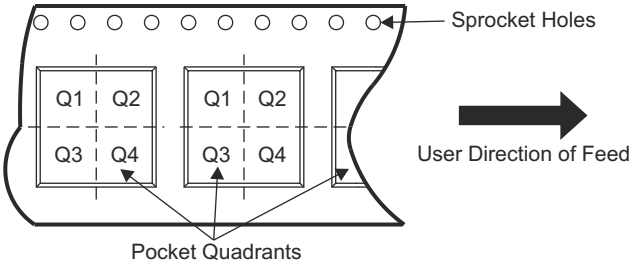


TAPE DIMENSIONS



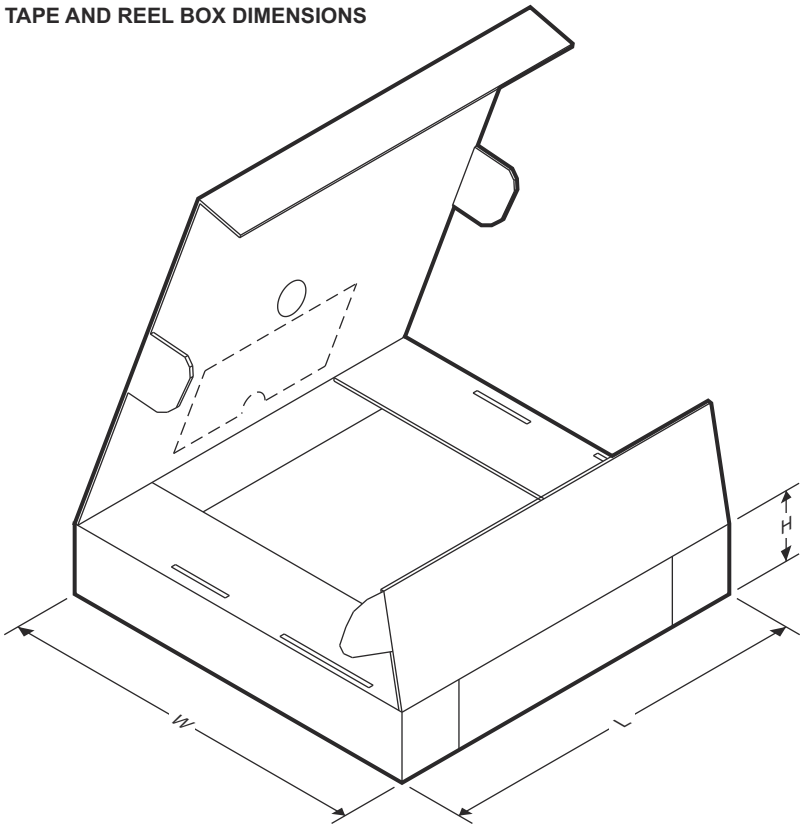
A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



器件	封装类型	封装图	引脚	SPQ	卷带直径 (mm)	卷带宽度 W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1象限
DRV3233EPHPRQ1	HTQFP	PHP	48	1000	330.0	16.4	9.6	9.6	1.5	12.0	16.0	2

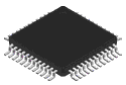
TAPE AND REEL BOX DIMENSIONS



器件	封装类型	封装图	引脚	SPQ	长度 (mm)	宽度 (mm)	高度 (mm)
DRV3233EPHPRQ1	HTQFP	PHP	48	1000	336.6	336.6	31.8

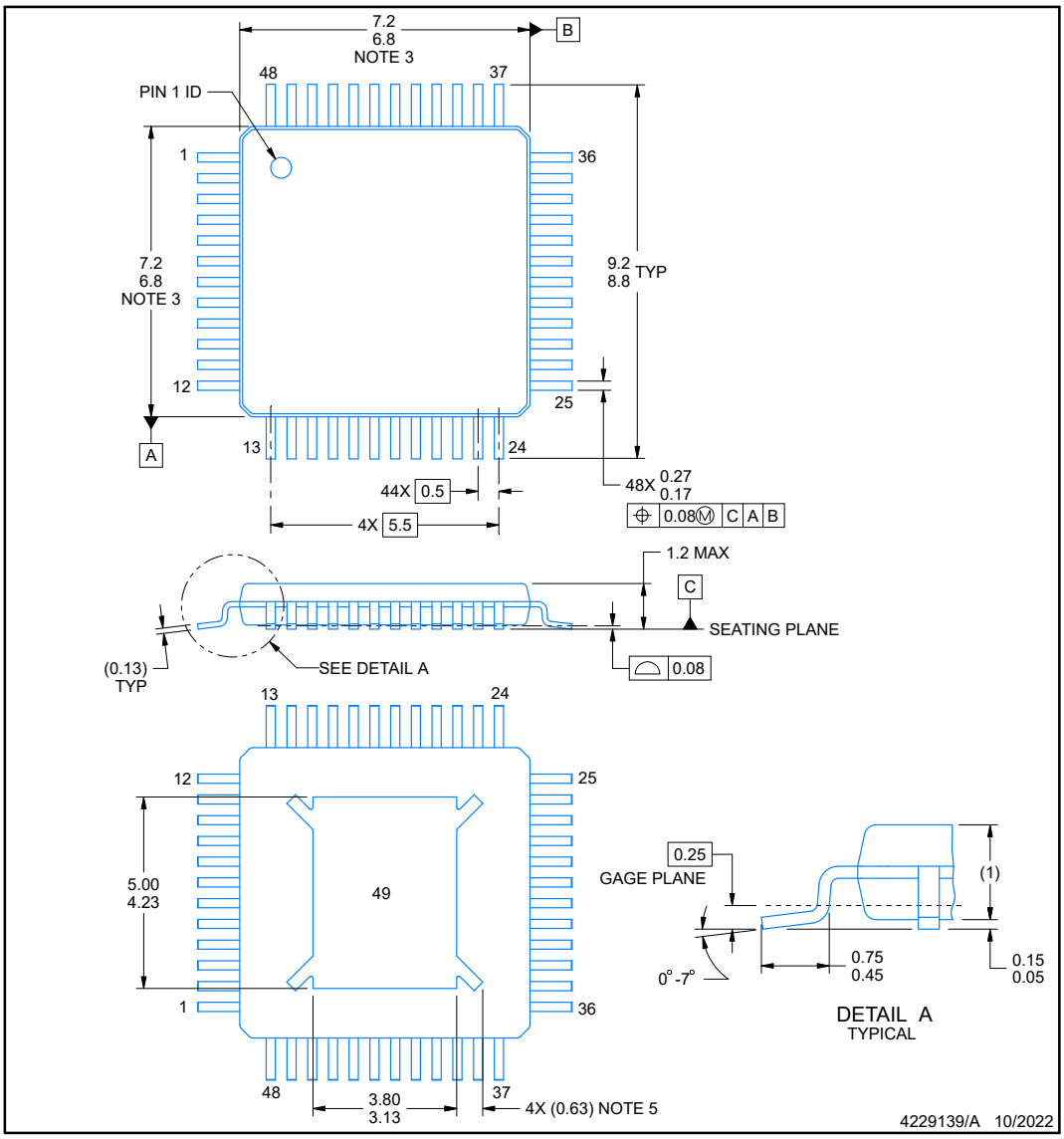
PACKAGE OUTLINE

PHP0048P



PowerPAD™ HTQFP - 1.2 mm max height

PLASTIC QUAD FLATPACK



PowerPAD is a trademark of Texas Instruments.

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. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. Reference JEDEC registration MS-026.
5. Feature may not be present.

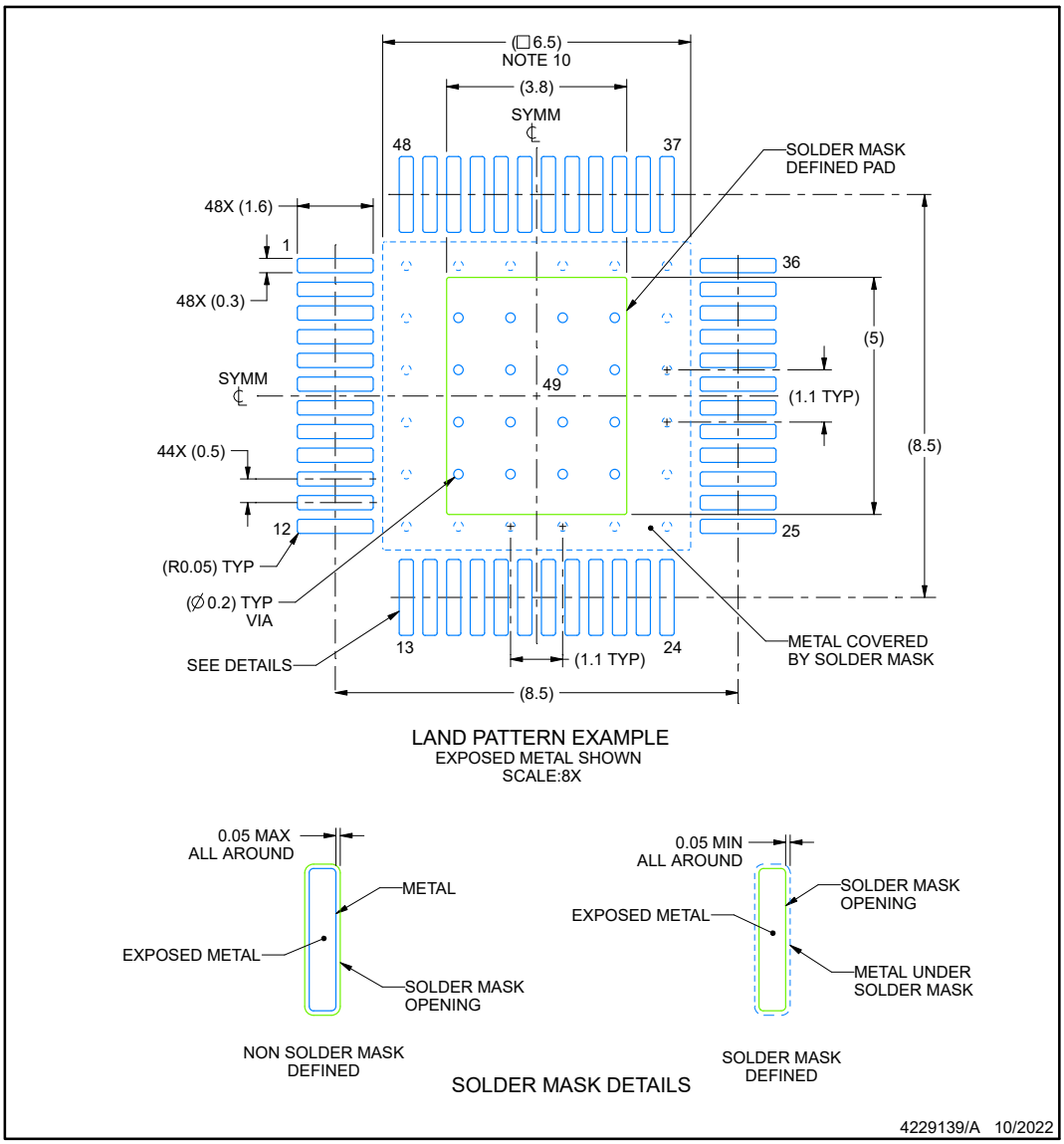
TEXAS INSTRUMENTS
www.ti.com

EXAMPLE BOARD LAYOUT

PHP0048P

PowerPAD™ HTQFP - 1.2 mm max height

PLASTIC QUAD FLATPACK



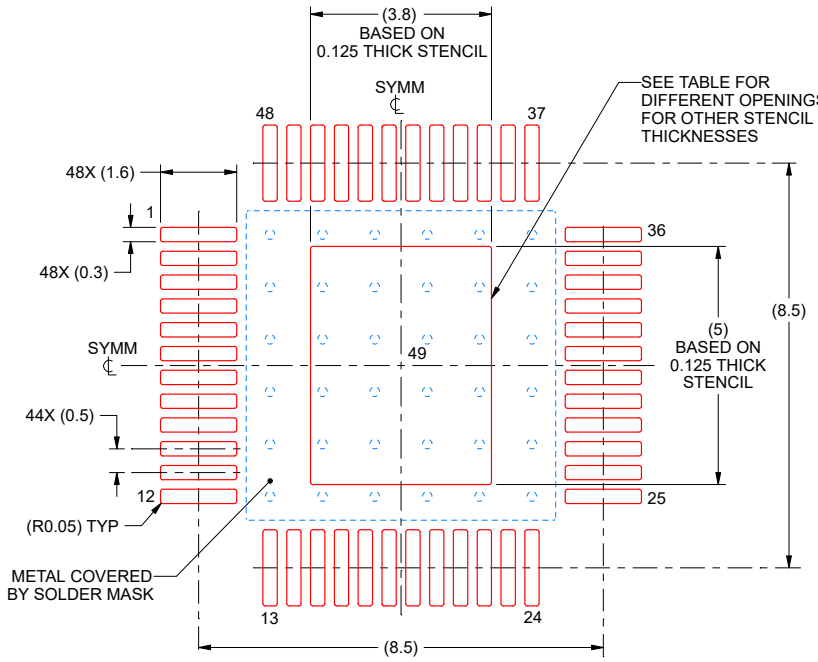
NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.
8. This package is designed to be soldered to a thermal pad on the board. See technical brief, Powerpad thermally enhanced package, Texas Instruments Literature No. SLMA002 (www.ti.com/lit/slma002) and SLMA004 (www.ti.com/lit/slma004).
9. Vias are optional depending on application, refer to device data sheet. It is recommended that vias under paste be filled, plugged or tented.
10. Size of metal pad may vary due to creepage requirement.

EXAMPLE STENCIL DESIGN

PHP0048P — **PowerPAD™ HTQFP - 1.2 mm max height**

PLASTIC QUAD FLATPACK



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

STENCIL THICKNESS	SOLDER STENCIL OPENING
0.1	4.25 X 5.59
0.125	3.80 X 5.00 (SHOWN)
0.150	3.47 X 4.56
0.175	3.21 X 4.23

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NOTES: (continued)

11. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
12. 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
DRV3233EPHPRQ1	ACTIVE	HTQFP	PHP	48	1000	RoHS & Green	NIPDAU	Level-3-260C-168 HR	-40 to 150	DRV3233E	Samples
PDRV3233EPHPRQ1	ACTIVE	HTQFP	PHP	48	1000	TBD	Call TI	Call TI	-40 to 150		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.

GENERIC PACKAGE VIEW

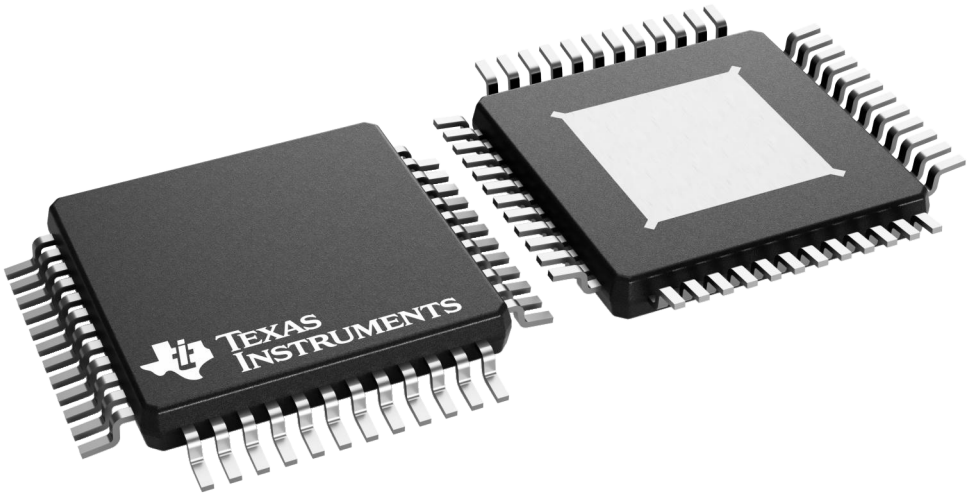
PHP 48

TQFP - 1.2 mm max height

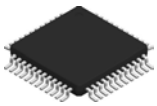
7 x 7, 0.5 mm pitch

QUAD FLATPACK

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



4226443/A

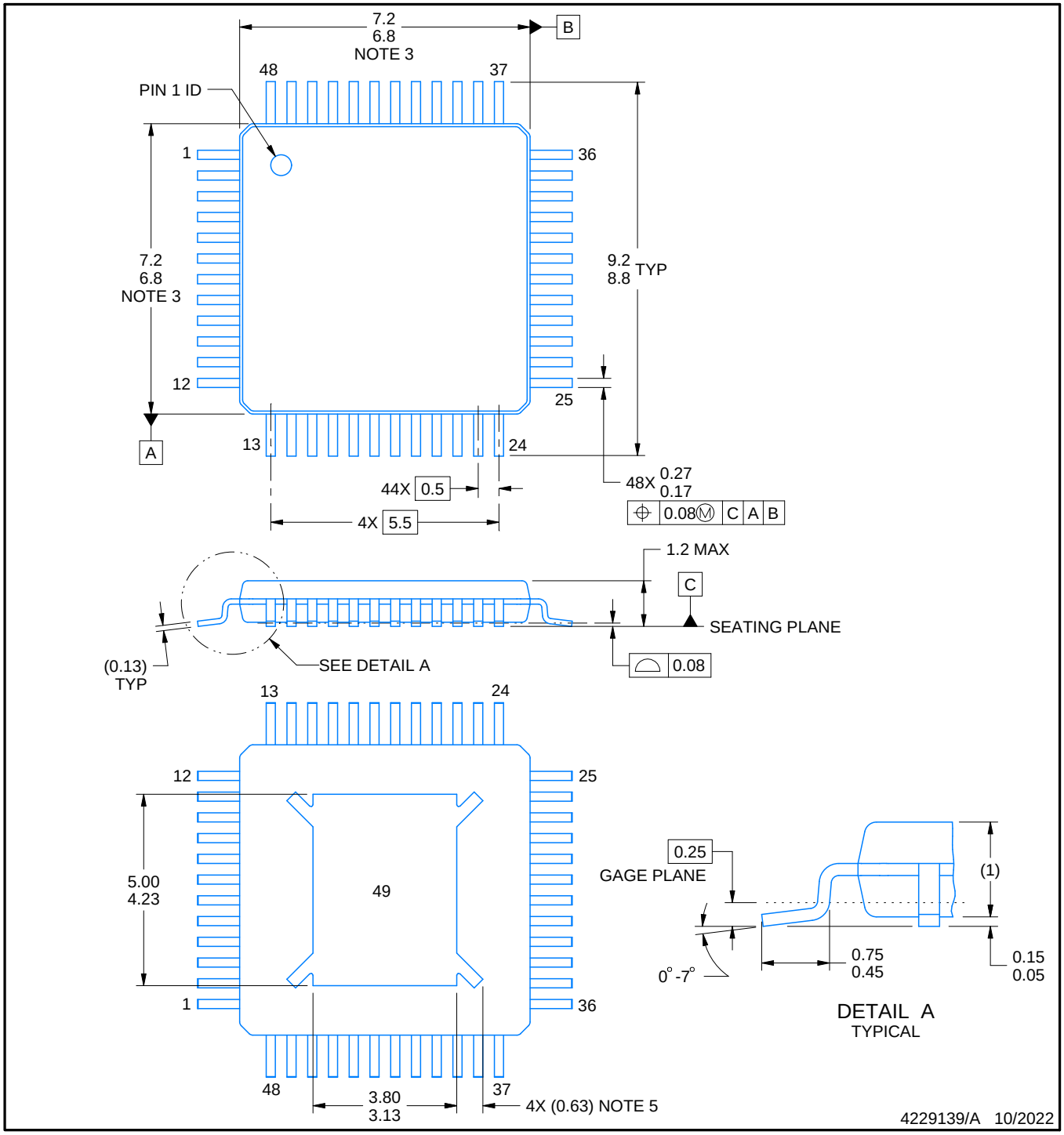


PACKAGE OUTLINE

PHP0048P

PowerPAD™ HTQFP - 1.2 mm max height

PLASTIC QUAD FLATPACK



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NOTES:

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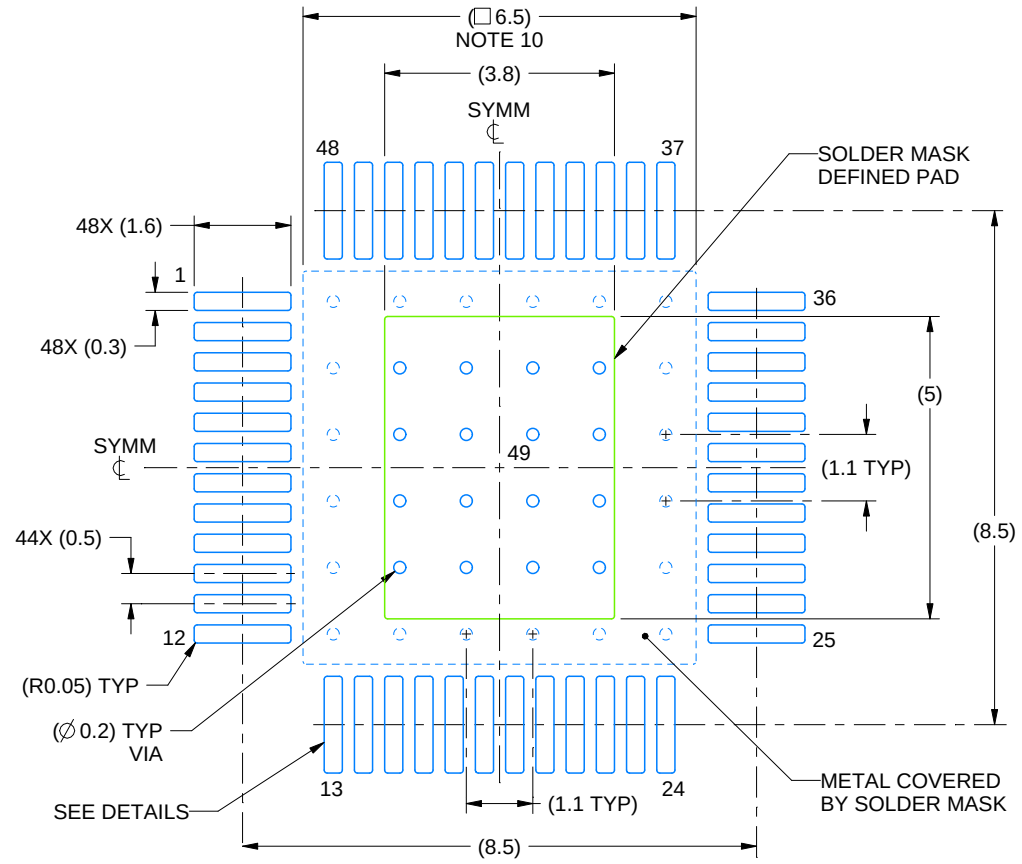
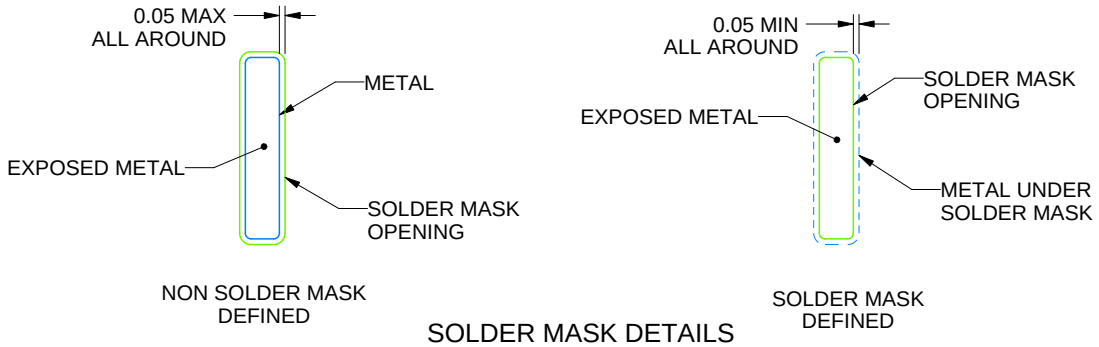
4. Reference JEDEC registration MS-026.
5. Feature may not be present.



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:8X



SOLDER MASK DETAILS

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NOTES: (continued)

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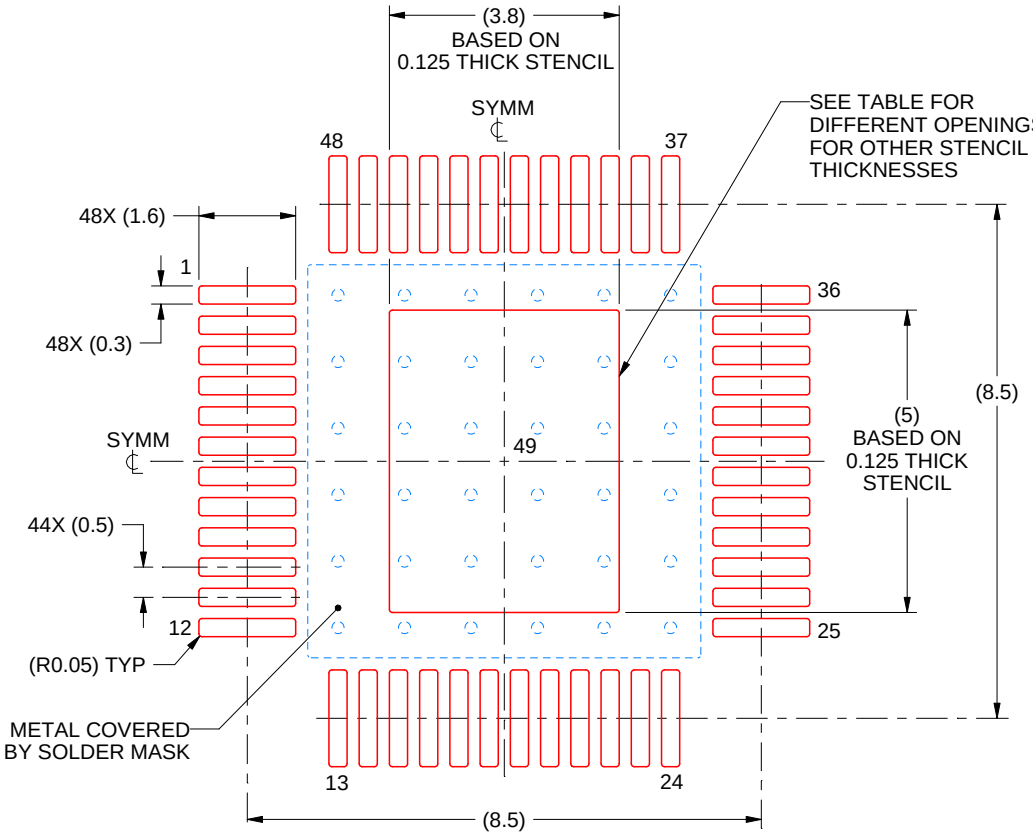
10. Size of metal pad may vary due to creepage requirement.



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

STENCIL THICKNESS	SOLDER STENCIL OPENING
0.1	4.25 X 5.59
0.125	3.80 X 5.00 (SHOWN)
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4229139/A 10/2022

NOTES: (continued)

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12. Board assembly site may have different recommendations for stencil design.

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