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：
  - DRV3233E：–40°C 至 +150°C，T_A
  - DRV3233Q：–40°C 至 +125°C，T_A
- 符合功能安全标准
  - 专为功能安全应用开发
  - 现已提供可帮助进行 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 通道 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-Q1 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-Q1 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-Q1 ，可由具有 4.5V 至 60V 宽输入范围的单个电源供电。涓流电荷泵可实现 100% PWM 占空比控制，并可为外部开关提供过驱电源电压。

DRV3233-Q1 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。

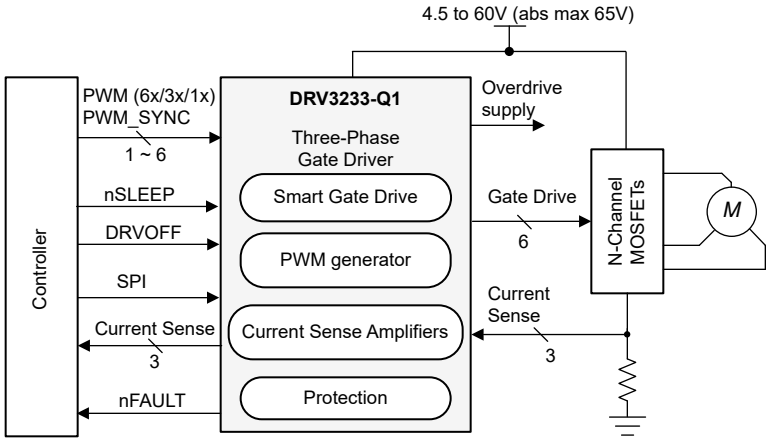
DRV3233-Q1 集成了各种诊断和保护特性，可实现稳健的电机驱动系统设计，还有助于消除对外部元件的需求。该器件具有高度可配置特性，能够无缝集成到各种系统设计中。

封装信息

器件型号	封装(1)	封装尺寸（标称值）(2)	封装尺寸（标称值）
DRV3233-Q1	HTQFP (48)	9mm x 9mm	7mm × 7mm
	QFN (48)	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（长 × 宽）为标称值，并包括引脚（如适用）。
(3) 产品仅为预发布状态。如需更多信息，请联系 TI。

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简化版原理图

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内容

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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 E (January 2026) to Revision F (May 2026) **Page**

- 将 DRV3233ERRY 的器件状态更新为预览数据 4

Changes from Revision D (January 2026) to Revision E (May 2026) **Page**

- 将 DRV3233ERGZ 的器件状态更新为量产数据 4

Changes from Revision C (July 2025) to Revision D (December 2025) **Page**

- 更新了功能安全合规型状态以反映功能安全评估完成情况 1
- 已新增 DRV3233QRGZ 的可订购器件型号 1

Changes from Revision B (March 2025) to Revision C (July 2025) **Page**

- 将 DRV3233ERGZ 的器件状态更新为预览数据 4

Changes from Revision A (August 2024) to Revision B (July 2025) **Page**

- 将 DRV3233QPHP 的器件状态更新为量产数据 4

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

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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。

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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)
DRV3233EPHPRQ1	Active	Production	HTQFP (PHP) | 48	1000 | LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 150	DRV3233E
DRV3233EPHPRQ1.A	Active	Production	HTQFP (PHP) | 48	1000 | LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 150	DRV3233E
DRV3233ERGZRQ1	Active	Production	VQFN (RGZ) | 48	4000 | LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 150	DRV3233 ERGZ Q1
DRV3233ERRYRQ1	Active	Production	WQFN (RRY) | 32	3000 | LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 150	DRV3233E Q1
DRV3233QPHPRQ1	Active	Production	HTQFP (PHP) | 48	1000 | LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 125	DRV3233Q
DRV3233QPHPRQ1.A	Active	Production	HTQFP (PHP) | 48	1000 | LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 125	DRV3233Q
DRV3233QRGZRQ1	Active	Production	VQFN (RGZ) | 48	4000 | LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 150	DRV3233 QRGZ Q1
DRV3233QRRYRQ1	Active	Production	WQFN (RRY) | 32	3000 | LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 150	DRV3233Q 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.

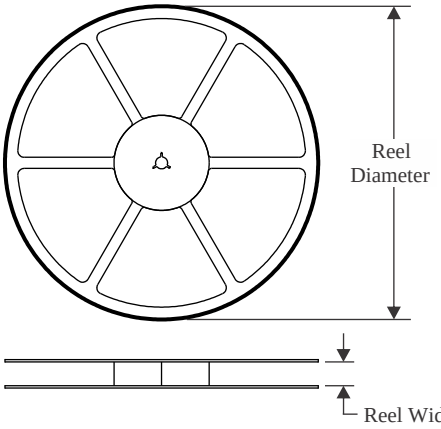
Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

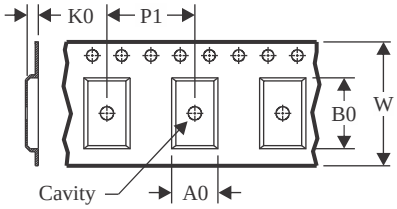
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

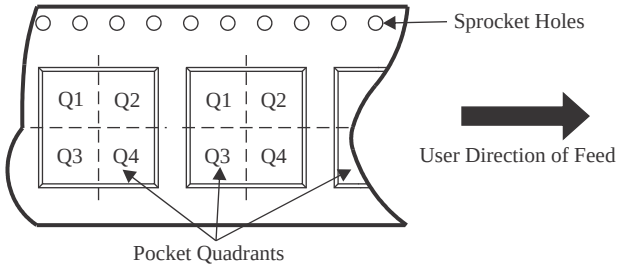


TAPE DIMENSIONS



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

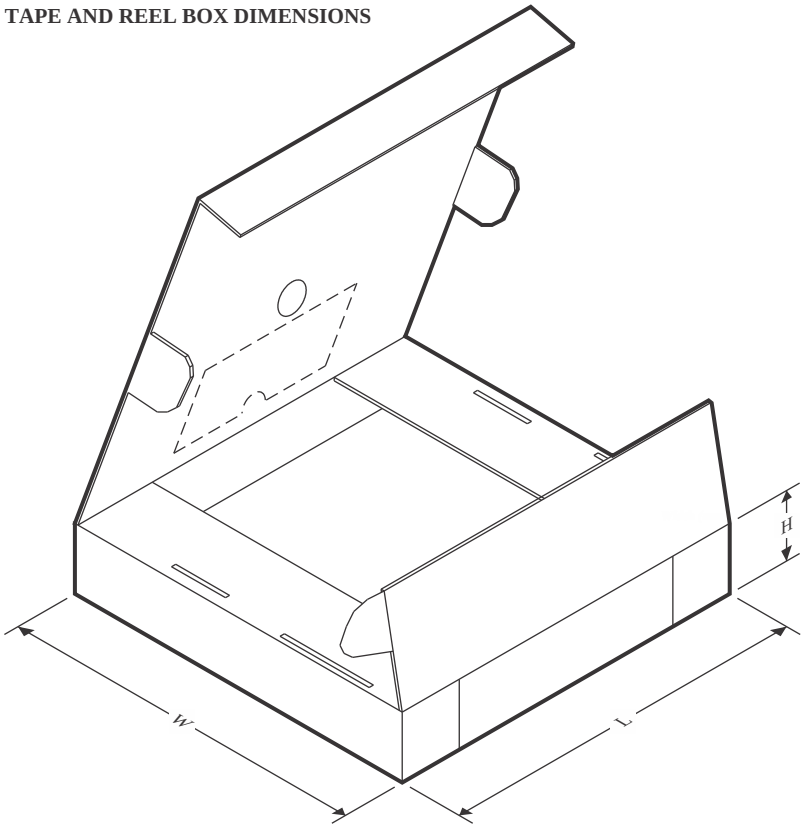
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
DRV3233EPHPRQ1	HTQFP	PHP	48	1000	330.0	16.4	9.6	9.6	1.5	12.0	16.0	Q2
DRV3233ERGZRQ1	VQFN	RGZ	48	4000	330.0	16.4	7.3	7.3	1.1	12.0	16.0	Q2
DRV3233ERRYRQ1	WQFN	RRY	32	3000	330.0	16.4	4.3	6.3	0.9	8.0	16.0	Q1
DRV3233QPHPRQ1	HTQFP	PHP	48	1000	330.0	16.4	9.6	9.6	1.5	12.0	16.0	Q2
DRV3233QRGZRQ1	VQFN	RGZ	48	4000	330.0	16.4	7.3	7.3	1.1	12.0	16.0	Q2
DRV3233QRRYRQ1	WQFN	RRY	32	3000	330.0	16.4	4.3	6.3	0.9	8.0	16.0	Q1

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
DRV3233EPHPRQ1	HTQFP	PHP	48	1000	336.6	336.6	31.8
DRV3233ERGZRQ1	VQFN	RGZ	48	4000	367.0	367.0	38.0
DRV3233ERRYRQ1	WQFN	RRY	32	3000	367.0	367.0	38.0
DRV3233QPHPRQ1	HTQFP	PHP	48	1000	336.6	336.6	31.8
DRV3233QRGZRQ1	VQFN	RGZ	48	4000	367.0	367.0	38.0
DRV3233QRRYRQ1	WQFN	RRY	32	3000	367.0	367.0	38.0

GENERIC PACKAGE VIEW

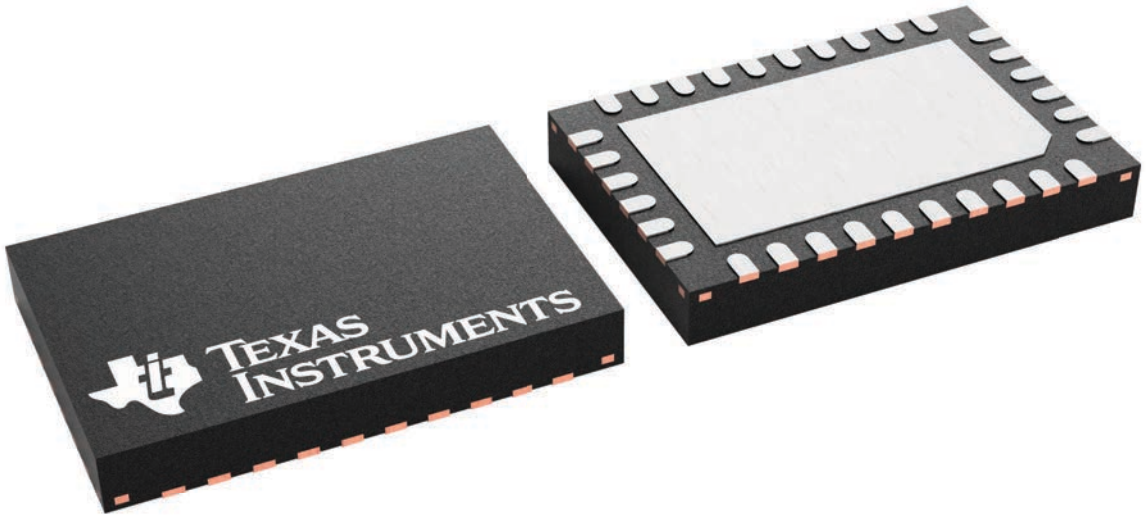
RRY 32

WQFN - 0.8 mm max height

4 x 6, 0.5 mm pitch

PLASTIC QUAD FLATPACK - NO LEAD

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



4229624/A

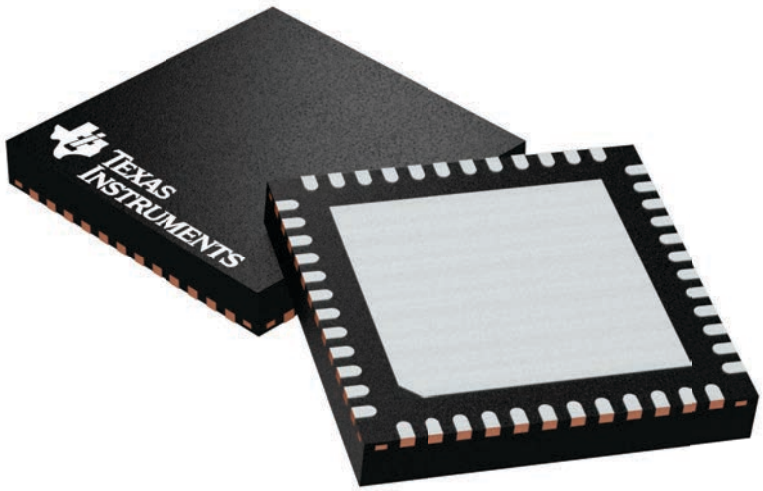
GENERIC PACKAGE VIEW

RGZ 48

VQFN - 1 mm max height

7 x 7, 0.5 mm pitch

PLASTIC QUADFLAT PACK- 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.

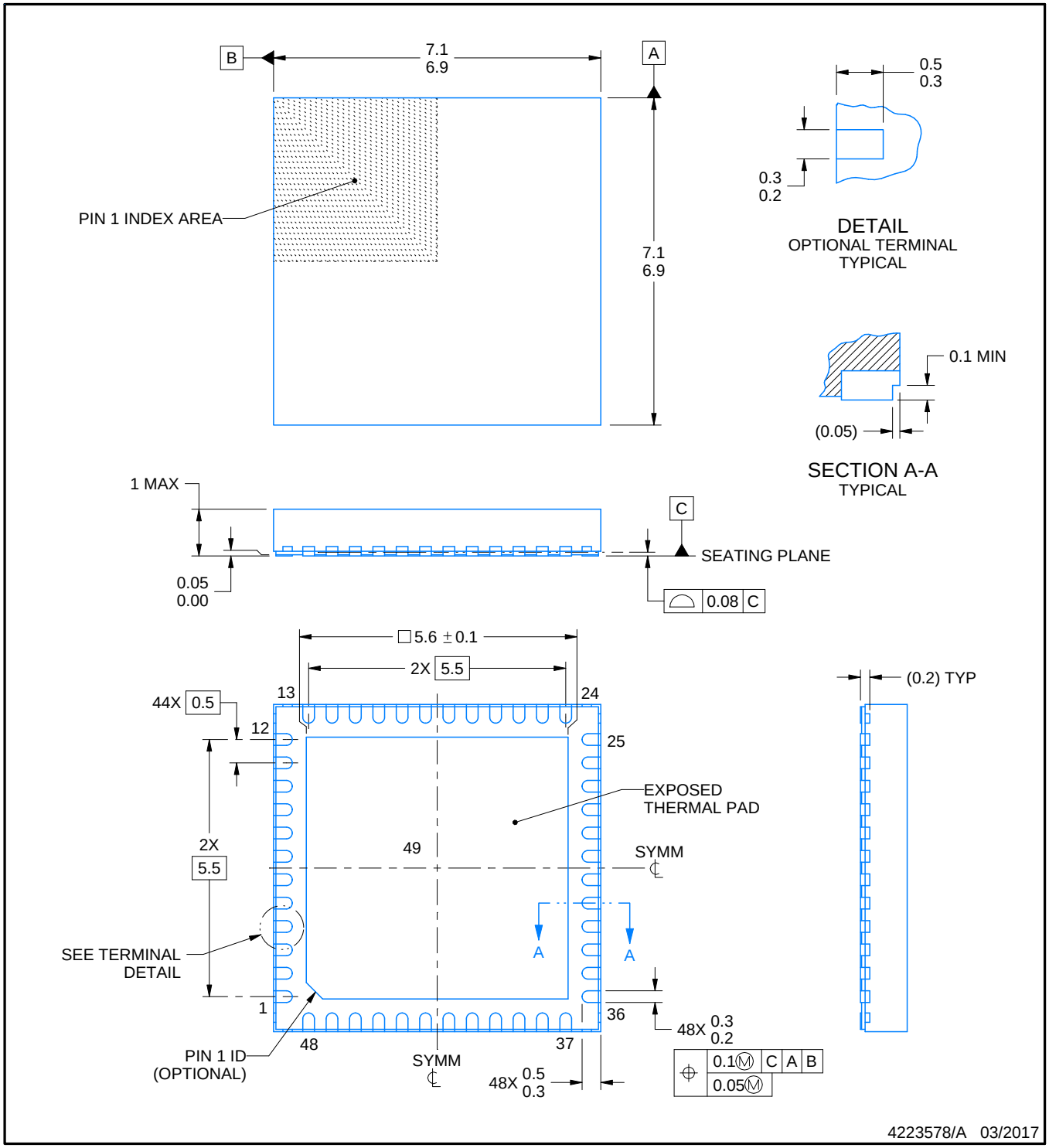
4224671/A

PACKAGE OUTLINE

RGZ0048M

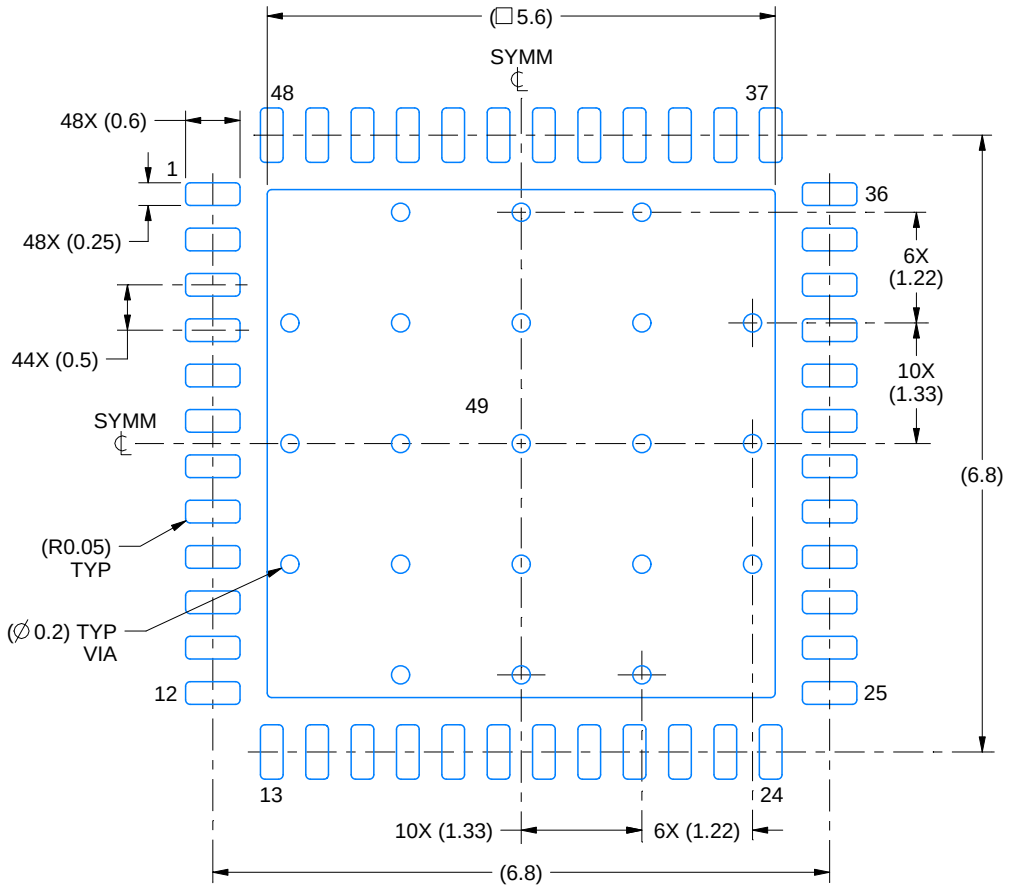
VQFN - 1 mm max height

PLASTIC QUAD FLATPACK - NO LEAD

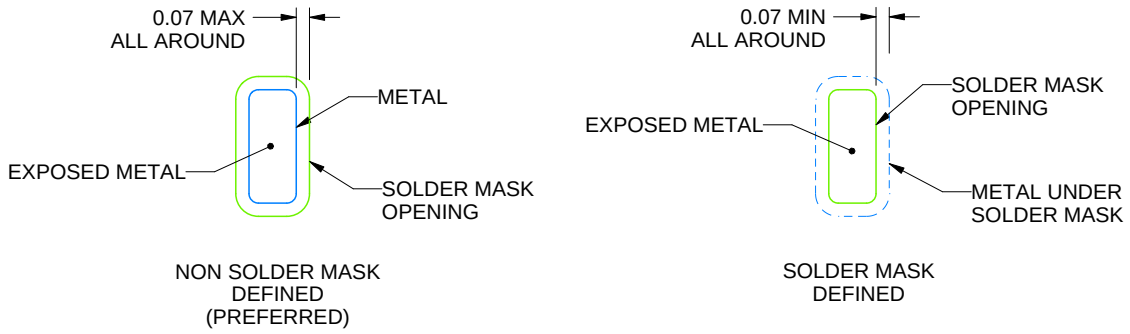


NOTES:

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:12X

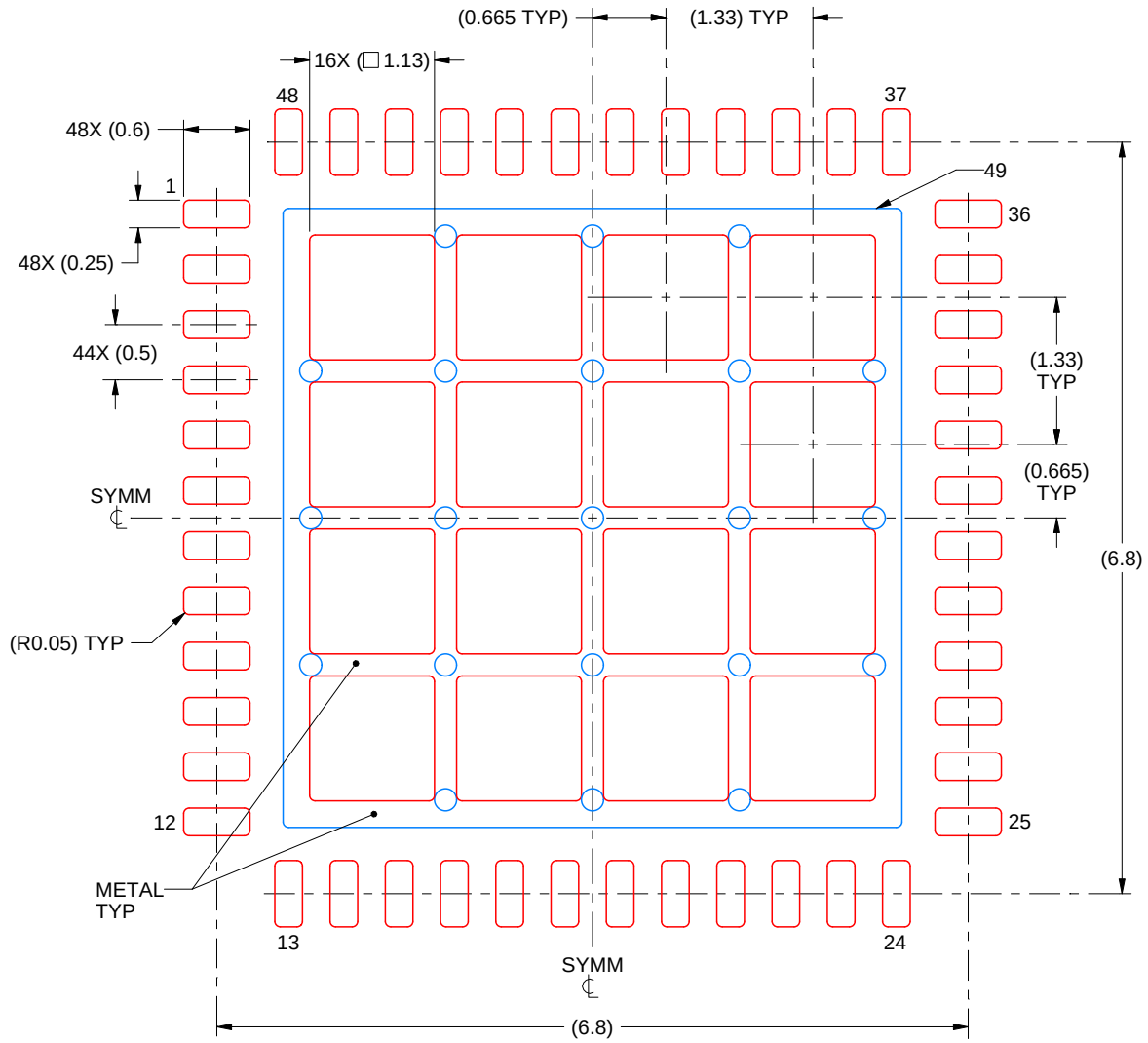


SOLDER MASK DETAILS

4223578/A 03/2017

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 49
66% PRINTED SOLDER COVERAGE BY AREA UNDER PACKAGE
SCALE:15X

4223578/A 03/2017

NOTES: (continued)

6. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.

GENERIC PACKAGE VIEW

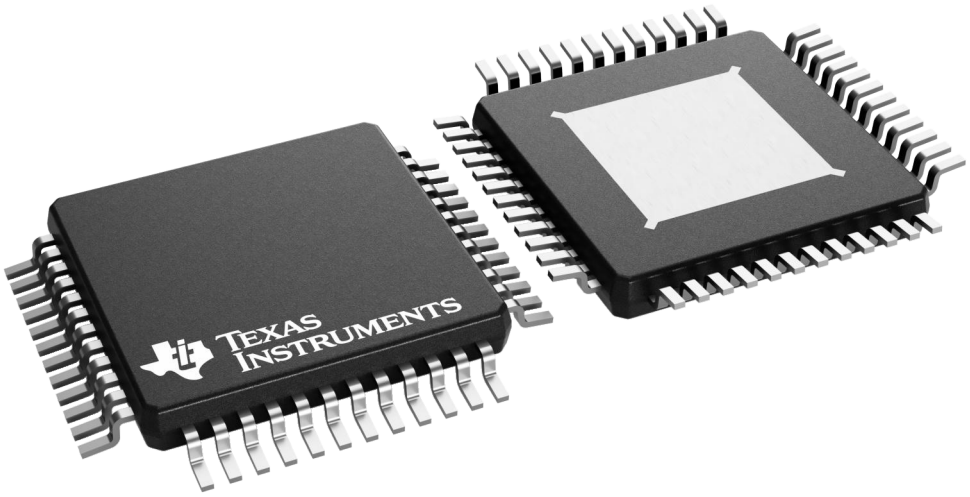
PHP 48

TQFP - 1.2 mm max height

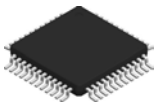
7 x 7, 0.5 mm pitch

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

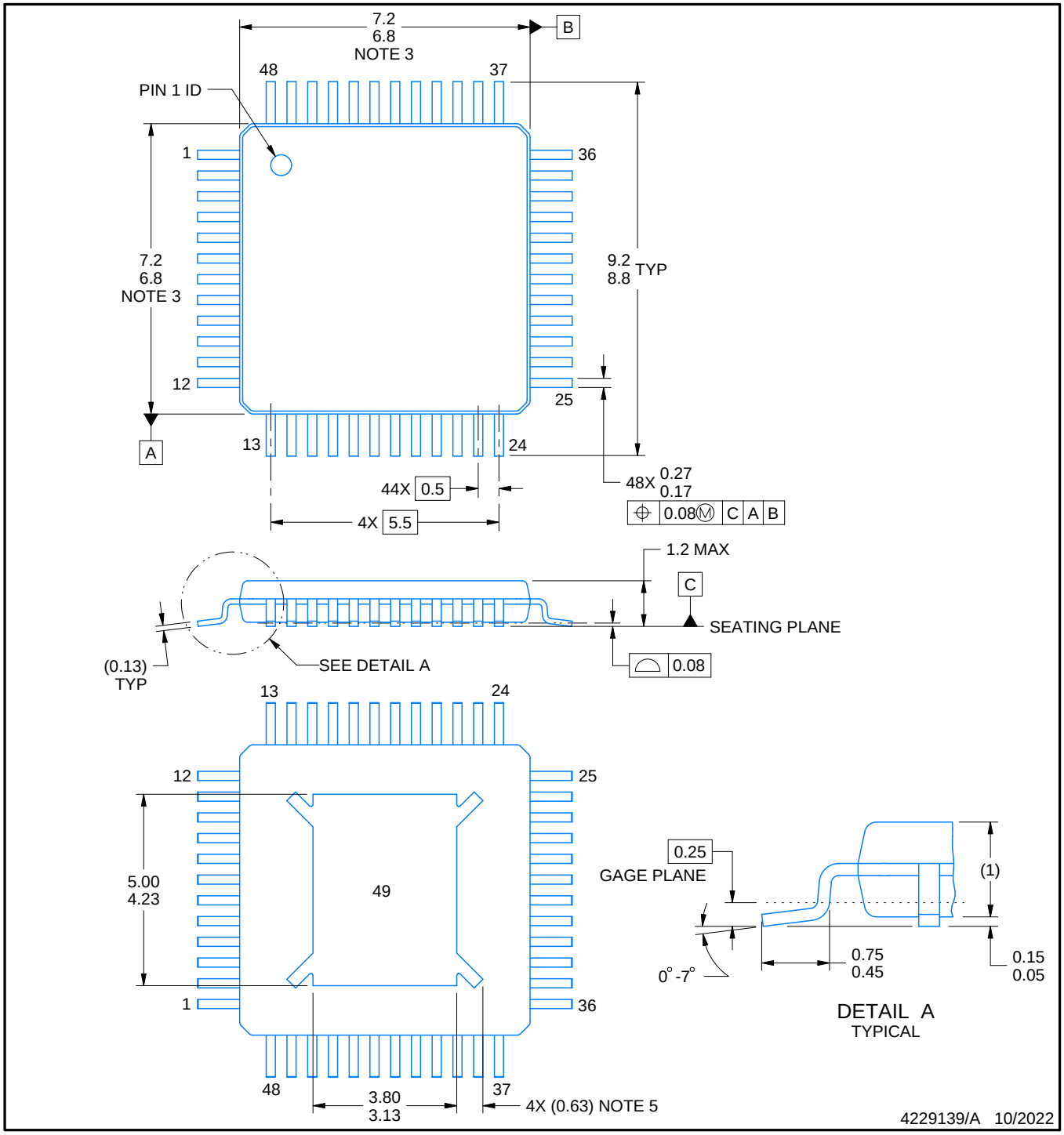


PACKAGE OUTLINE

PHP0048P

PowerPAD™ HTQFP - 1.2 mm max height

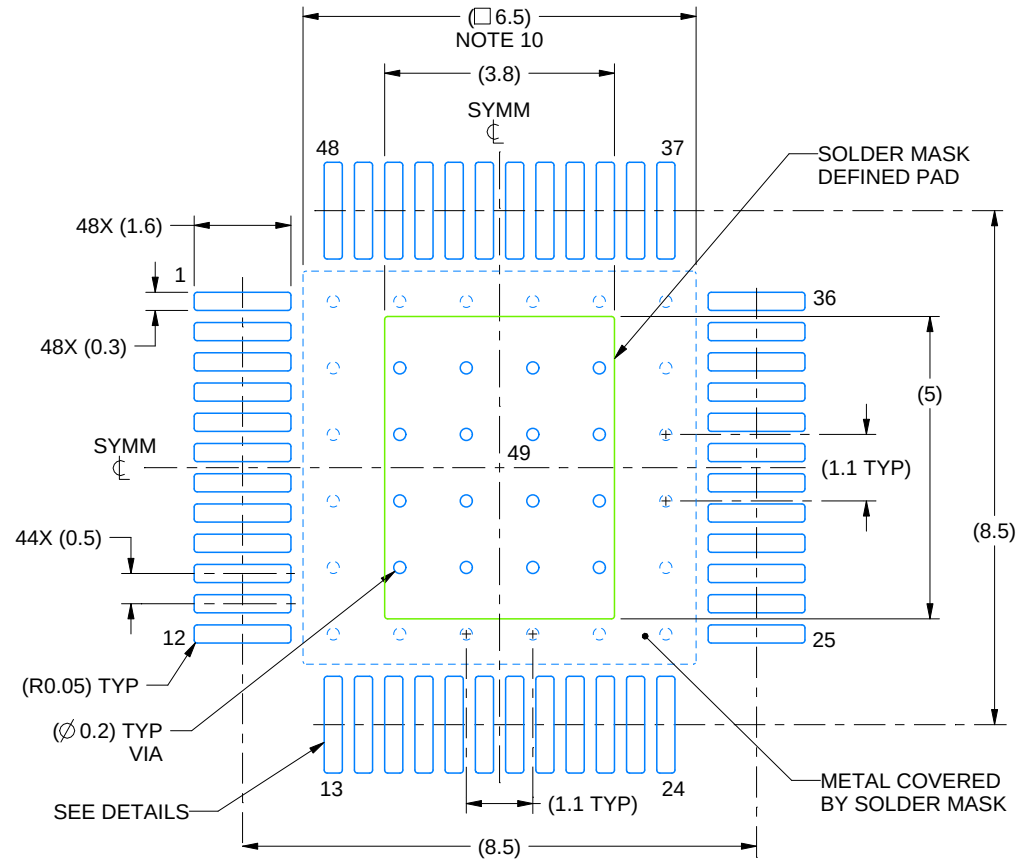
PLASTIC QUAD FLATPACK



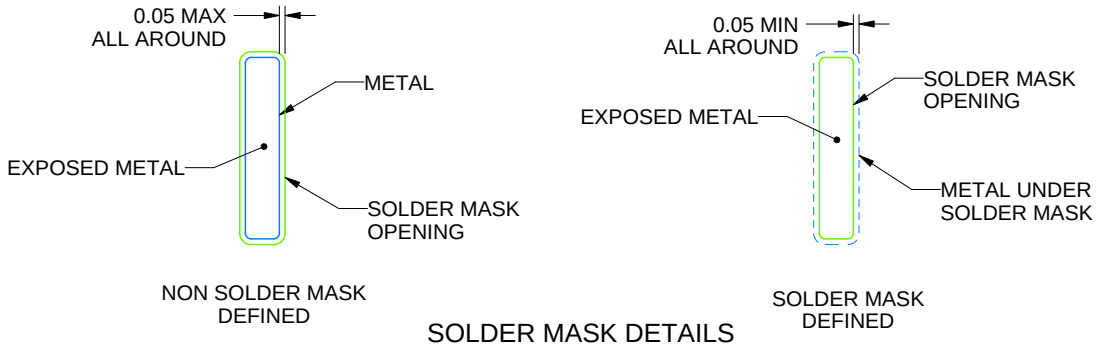
PowerPAD is a trademark of Texas Instruments.

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.



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:8X

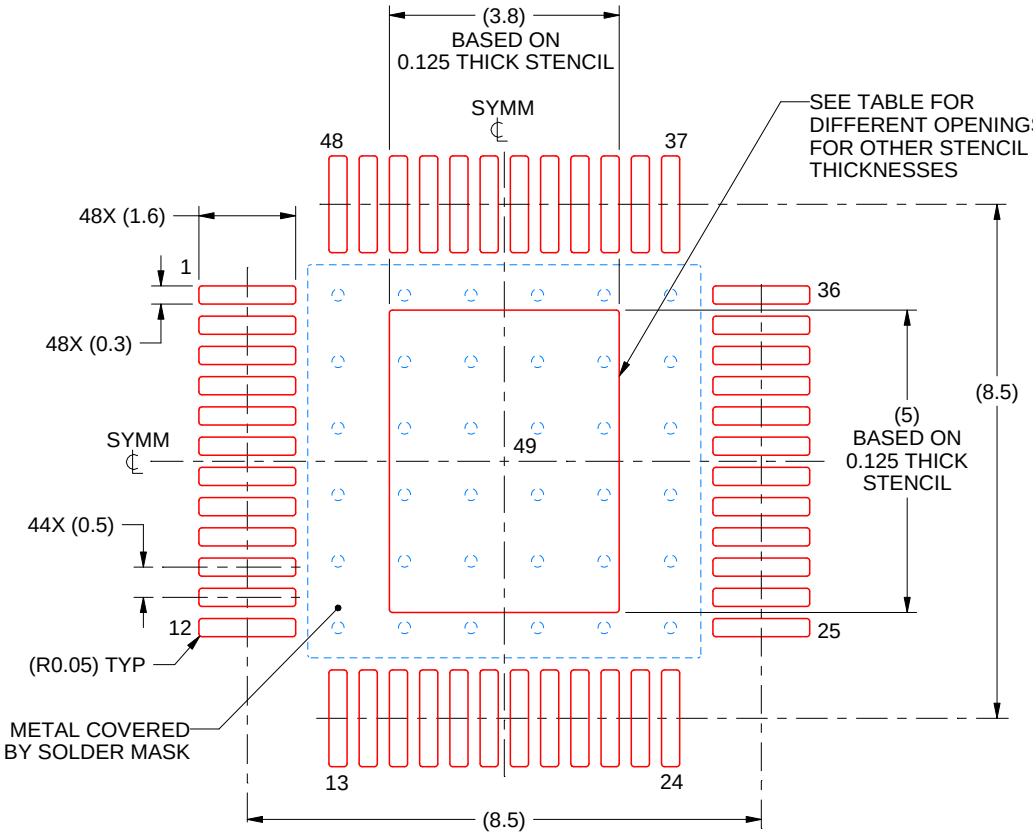


SOLDER MASK DETAILS

4229139/A 10/2022

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.



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

4229139/A 10/2022

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.

重要通知和免责声明

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