TPS92402 具有集成 PWM 分流 FET、SPI 接口和自适应配置的 8 通道 2.5A LED 点控制器

1 特性

- 4.5V 至 65V 宽输入范围
- LED 共阳极或共阴极连接
- 8 个集成 PWM 分流 FET
  - 2.5A FET 最大持续电流
  - 内部 32MHz 振荡器，支持 PWM 发生器
  - 可编程 16 位 >20kHz PWM 调光
- SPI 接口和自适应配置
  - 用于数据传输的最高 5MHz SPI 时钟
  - 星形和菊花链连接
  - 一个器件控制 8 LED 或 2x4 LED 灯串
  - 可堆叠多达 4 个器件来控制 32 LED 灯串
- 增强的 EMI 性能
  - 可编程 PWM 压摆率
  - 可编程 PWM 边沿偏移
  - 具有展频功能的内部电荷泵
- 全面保护特性
  - LED 开路检测和保护
  - LED 短路检测
  - 分流 FET 开路检测
  - 可编程 LED 开路电压
  - 热警告
- 可选省电模式
  - 通过 PWM 输出控制 LED 驱动器
  - 低功耗待机模式
- 封装：VQFN-36

2 应用

- 舞台和摄影灯光
- 手术照明
- 机器视觉和 IP 摄像机 LED 阵列
- 冷/暖 WLED 照明
- 3D 打印
- 工业运输

3 说明

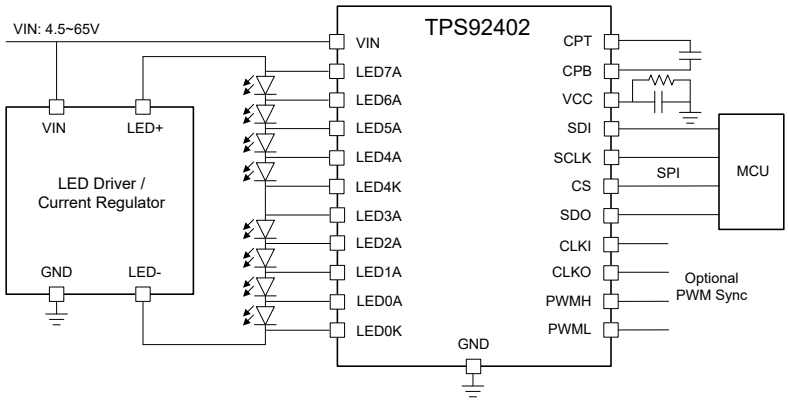
TPS92402 LED 点控制器器件可在 4.5V 至 65V 的宽输入范围内提供高达 2.5A 的像素级 LED 调光控制，从而实现 8 通道独立照明解决方案。该器件包括一串（8 个串联）集成分流 FET，每个 FET 均可为单个 LED 提供 PWM 调光。借助分流 FET 串，该器件可支持恒流稳压器，适用于通过共阳极或共阴极连接的 LED。

TPS92402 具有可产生系统时钟信号的内部振荡器，从而支持高达 16 位的集成 PWM 发生器，且可编程 PWM 频率高达 60kHz。串行外设接口 (SPI) 可实现高速数据传输，并且支持菊花链和星型连接。SPI 和经过优化的引脚排列支持多个器件以堆叠配置连接在一起，从而实现单层 PCB。

TPS92402 包含寄存器，可用于对灯串中单个 LED 的 PWM 脉宽、压摆率、边沿偏移和开路电压进行编程，还可用于报告 LED 开路、LED 短路、分流 FET 开路和热警告。内部电荷泵整合了展频功能，可增强 EMI 性能。TPS92402 还提供恒流稳压器的 PWM 调光控制，并可实现多通道省电功能，从而显著提高调光效率，尤其是在低亮度条件下。

封装信息

器件型号	封装	本体尺寸（标称值）
TPS92402	VQFN (36)	6.00mm × 5.00mm



简化版应用

内容

4 器件和文档支持

4.1 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*通知* 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。

4.2 支持资源

TI E2E™ 中文支持论坛是工程师的重要参考资料，可直接从专家处获得快速、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，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。

4.3 商标

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4.4 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。

4.5 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。

5 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

日期	修订版本	注释
2024 年 9 月	*	初始发行版

6 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。

6.1 Package Option Addendum

Packaging Information

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish(4)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking(5) (6)
TPS92402RRVR	ACTIVE	VQFN	RRV	36	3000	Green (RoHS and no Sb/Br)	Cu NiPdAu	LEVEL1-260C-UNLIM	-40 to 85	92402
TPS92402MRRVR	ACTIVE	VQFN	RRV	36	3000	Green (RoHS and no Sb/Br)	Cu NiPdAu	LEVEL1-260C-UNLIM	-55 to 125	92402M

(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.
PRE_PROD Unannounced device, not in production, not available for mass market, nor on the web, samples not available.
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) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

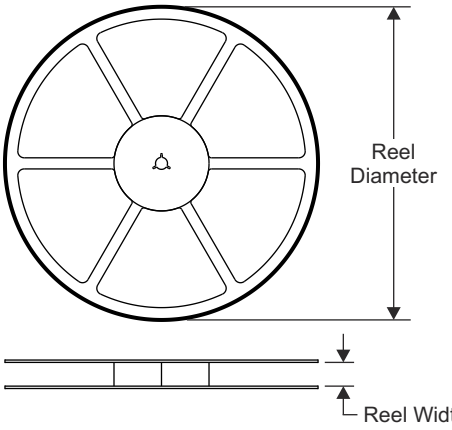
(4) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

(5) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device

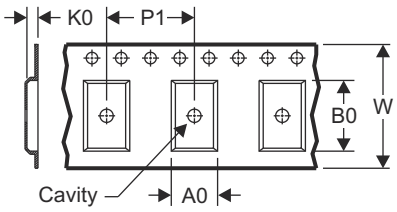
(6) Multiple Device markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

6.2 Tape and Reel Information

REEL DIMENSIONS

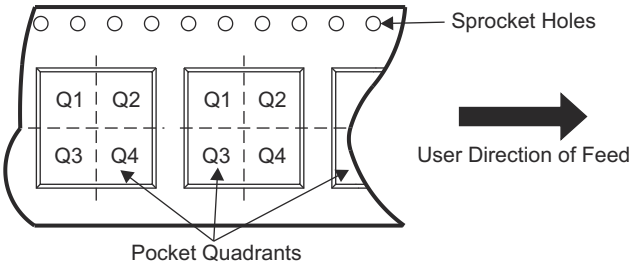


TAPE DIMENSIONS



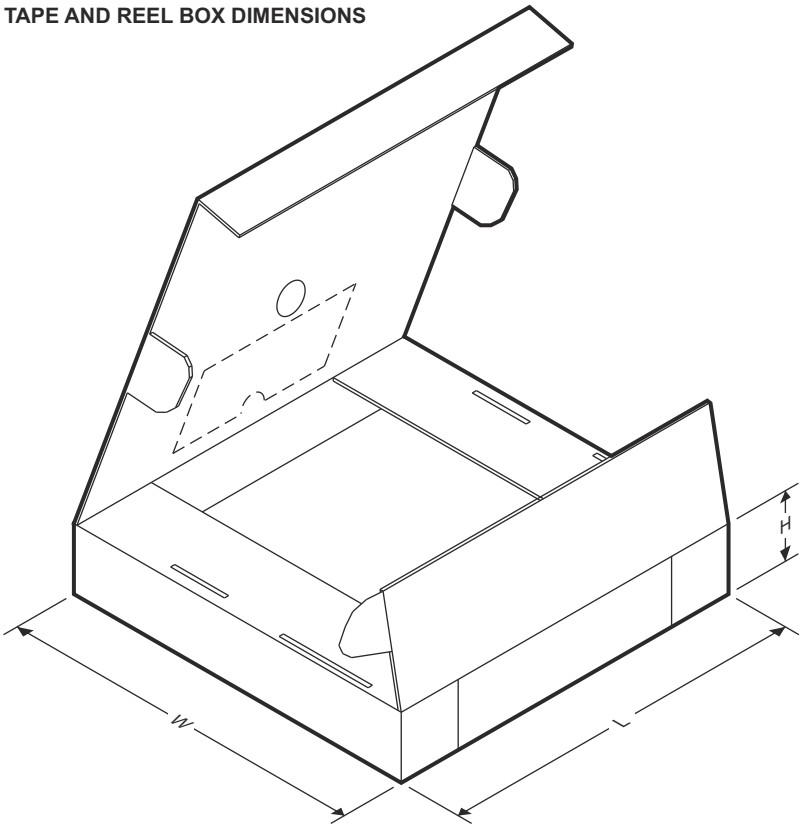
A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

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
TPS92402RRVR	VQFN	RRV	36	3000	330.0	12.4	5.3	6.3	1.15	8.0	12.0	Q1
TPS92402MRRVR	VQFN	RRV	36	3000	330.0	12.4	5.3	6.3	1.15	8.0	12.0	Q1

TAPE AND REEL BOX DIMENSIONS



Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TPS92402RRVR	VQFN	RRV	36	3000	360.0	360.0	36.0
TPS92402MRRVR	VQFN	RRV	36	3000	360.0	360.0	36.0

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)
TPS92402MRRVR	Active	Production	VQFN (RRV) | 36	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	92402M
TPS92402MRRVR.A	Active	Production	VQFN (RRV) | 36	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	92402M
TPS92402RRVR	Active	Production	VQFN (RRV) | 36	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	92402
TPS92402RRVR.A	Active	Production	VQFN (RRV) | 36	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	92402

(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.

GENERIC PACKAGE VIEW

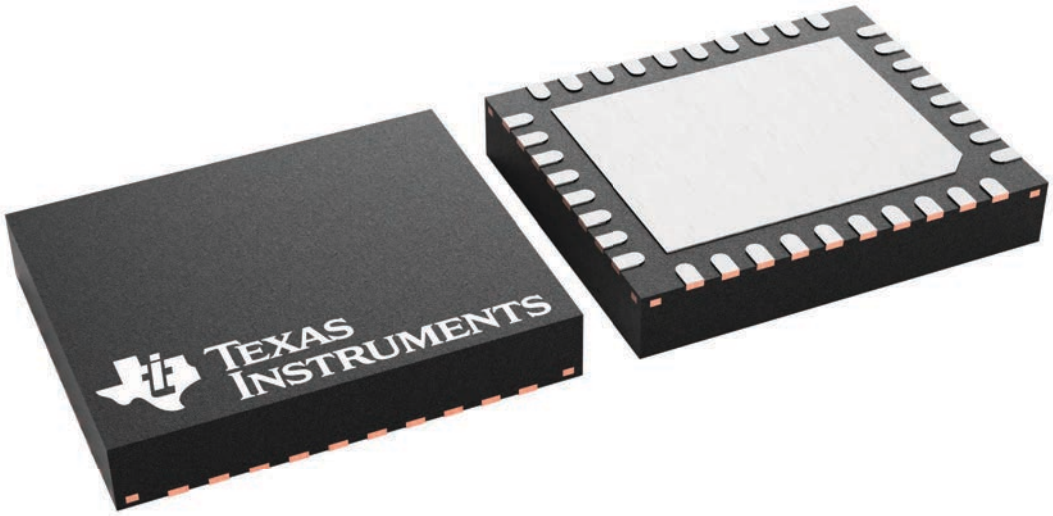
RRV 36

VQFN - 1 mm max height

5 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.



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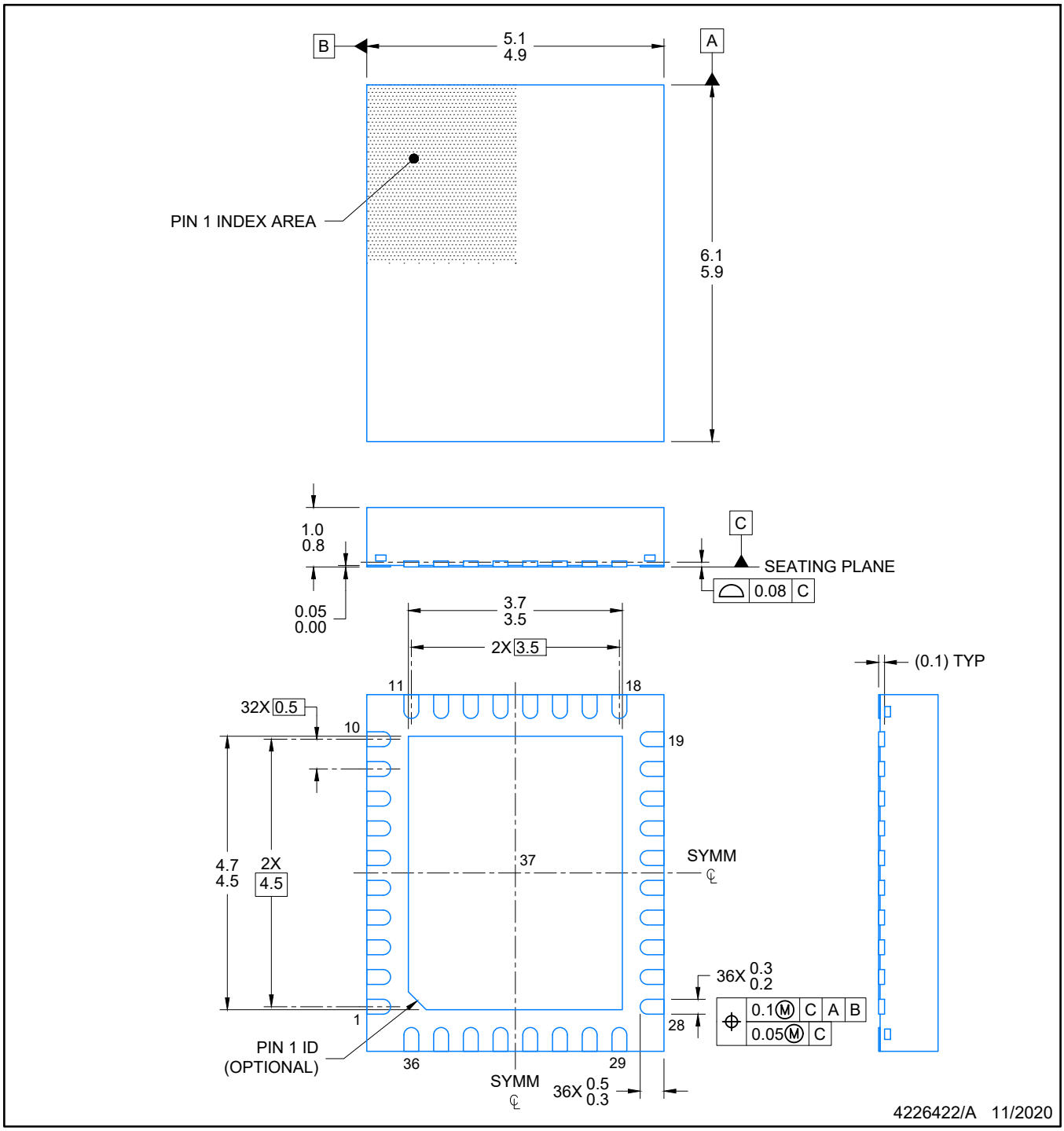
PACKAGE OUTLINE

RRV0036A

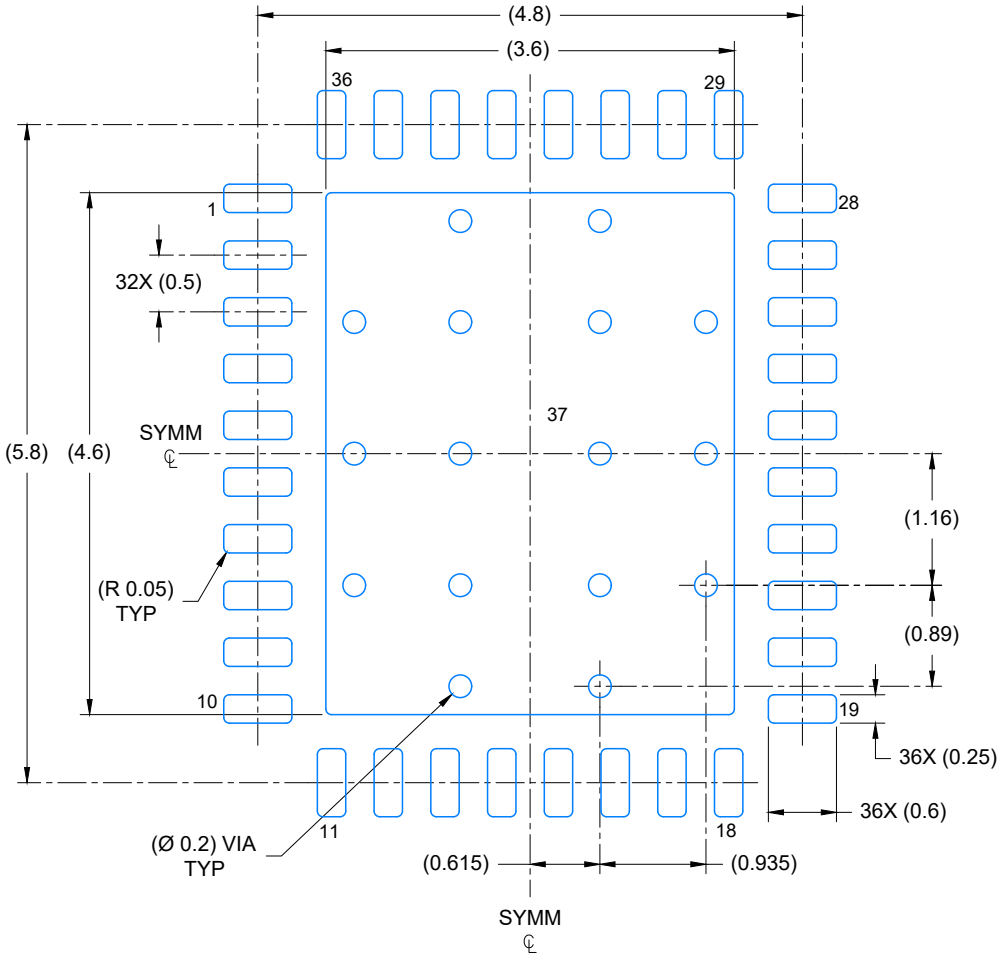
VQFN - 1 mm max height

PLASTIC QUAD FLATPACK-NO LEAD

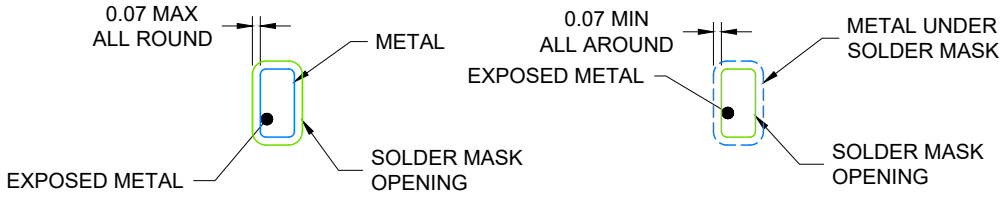


NOTES:

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 optimal thermal and mechanical performance.



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 15X



NON- SOLDER MASK DEFINED (PREFERRED)

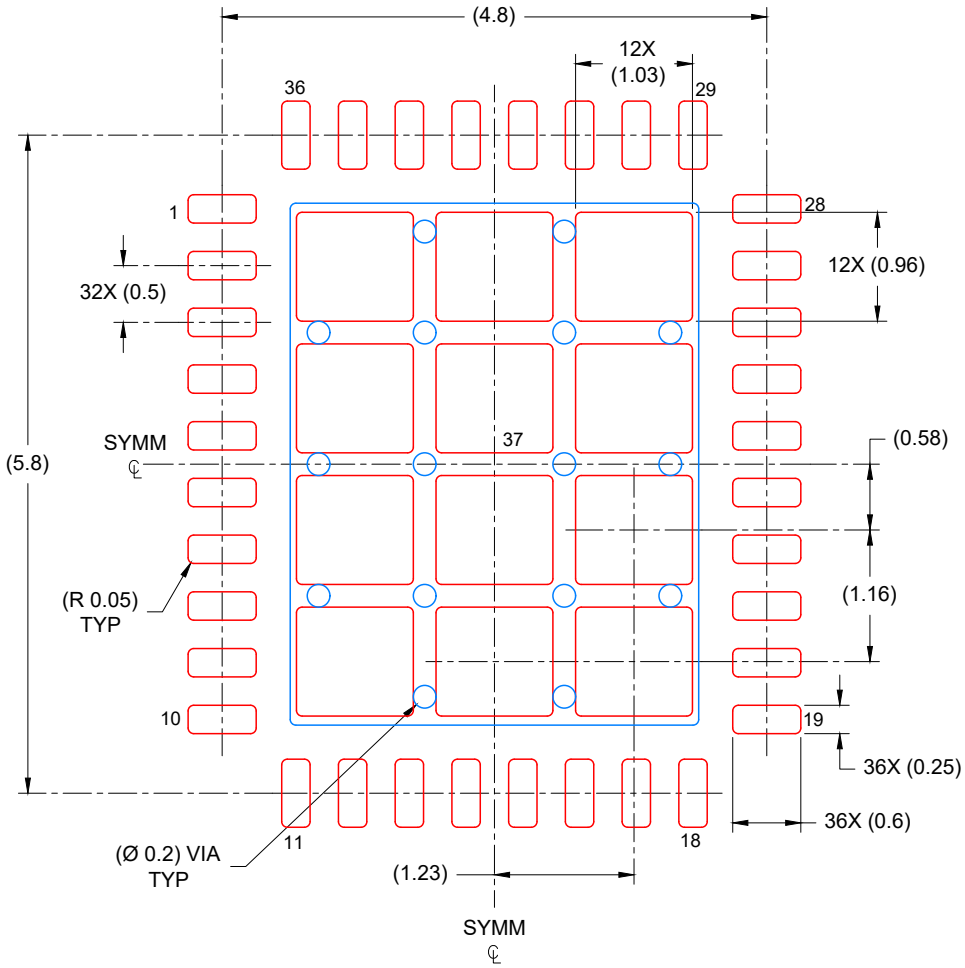
SOLDER MASK DEFINED

SOLDER MASK DETAILS

4226422/A 11/2020

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
72% PRINTED COVERAGE BY AREA
SCALE: 15X

4226422/A 11/2020

NOTES: (continued)

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

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