

TLC696x1-Q1 16 通道、车用 局部调光背光 LED 驱动器

1 特性

- 符合面向汽车应用的 AEC-Q100 标准：
 - 器件温度等级 1：-40°C 至 +125°C， T_A
 - 器件 HBM ESD 分类等级 2
 - 器件 CDM ESD 分类等级 C4B
- 功能安全型：
 - 可提供用于功能安全系统设计的文档
- 工作电压 V_{CC} 范围：3V 至 5.5V
- 16 个高精度恒定电流阱：
 - 最大输出电流/电压：
 - 30mA/20V：TLC69601-Q1
 - 60mA/20V：TLC69611-Q1
 - 30mA/50V：TLC69651-Q1
 - 60mA/50V：TLC69661-Q1
 - 器件间误差： $\pm 2\%$ (典型值)
 - 通道间误差： $\pm 2\%$ (典型值)
- 灵活的调光控制：
 - 全局 8 位最大电流 (MC) 设置
 - 亮度分辨率：高达 15 位
 - PWM/混合控制模式
- 高速菊花链接口：
 - I/O 电压兼容：1.8 V/3.3 V
 - 数据传输速率：高达 20MHz
- 高系统效率：
 - 自适应余量电压控制 (AHVC)
 - 超低器件功耗：
 - 待机模式： $I_{CC} \leq 200\mu A$
 - 正常模式： $I_{CC} \leq 3.5mA$
- EMI 增强：
 - 可编程接口驱动能力
 - 集成四相相移方案
- 诊断：
 - 每个区域的 LED 开路/短路检测
 - 器件热关断检测

– 报告界面选项：

- UART 和中断引脚 (INT)
- 两线制输出：CLK_O 和 SOUT

2 应用

- LCD 局部调光背光：
 - 汽车中心信息显示屏
 - 汽车仪表组显示屏
 - 汽车抬头显示

3 说明

TLC696x1-Q1 是一款 16 通道恒定电流阱驱动器。每个器件都集成了 16 个具有 SRAM (用于存储亮度) 的恒定电流阱。该器件在菊花链拓扑中通过两线制串行接口相互连接，支持多达 1024 个器件，可用于 16,000 个局部调光区域。

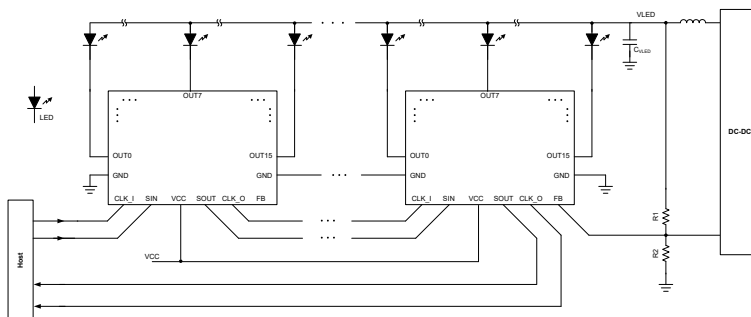
为了优化系统效率，该器件配备了自适应余量电压控制方案，以直接控制直流/直流。为了简化系统布局，只需将串行链中最后一个器件的 FB 引脚连接到直流/直流。该器件还集成了超低亮度更新延迟、插黑和 VRR 特性，以提高显示质量。

TLC696x1-Q1 有三个错误标志：用于诊断的 LED 开路检测 (LOD)、LED 短路检测 (LSD) 和热关断检测 (TSD)。该器件实现了两个回读选项 (包括 UART/INT 和 SOUT/CLK_O)，可通过寄存器进行编程。

器件信息

器件型号	封装 ⁽¹⁾	封装尺寸 (标称值)
TLC696x1-Q1	WQFN (24) 可湿性侧面	4mm x 4mm
	HTSSOP (28)	9.7mm x 4.4mm

(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。



简化原理图



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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

DATE	REVISION	NOTES
June 2023	*	Initial Release

5 器件和文档支持

TI 提供大量的开发工具。下面列出了用于评估器件性能、生成代码和开发解决方案的工具和软件。

5.1 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。

5.2 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》](#)。

5.3 商标

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

5.4 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。

5.5 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。

6 机械、封装和可订购信息

下述页面包含机械、封装和订购信息。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。

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
TLC69601QPWPRQ1	ACTIVE	HTSSOP	PWP	28	2000	RoHS & Green	NIPDAU	Level-3-260C-168 HR	-40 to 125	69601Q	Samples
TLC69601QRTWRQ1	ACTIVE	WQFN	RTW	24	3000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	69601Q	Samples
TLC69611QPWPRQ1	ACTIVE	HTSSOP	PWP	28	2000	RoHS & Green	NIPDAU	Level-3-260C-168 HR	-40 to 125	69611Q	Samples
TLC69611QRTWRQ1	ACTIVE	WQFN	RTW	24	3000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	69611Q	Samples
TLC69651QPWPRQ1	ACTIVE	HTSSOP	PWP	28	2000	RoHS & Green	NIPDAU	Level-3-260C-168 HR	-40 to 125	69651Q	Samples
TLC69651QRTWRQ1	ACTIVE	WQFN	RTW	24	3000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	69651Q	Samples
TLC69661QPWPRQ1	ACTIVE	HTSSOP	PWP	28	2000	RoHS & Green	NIPDAU	Level-3-260C-168 HR	-40 to 125	69661Q	Samples
TLC69661QRTWRQ1	ACTIVE	WQFN	RTW	24	3000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	69661Q	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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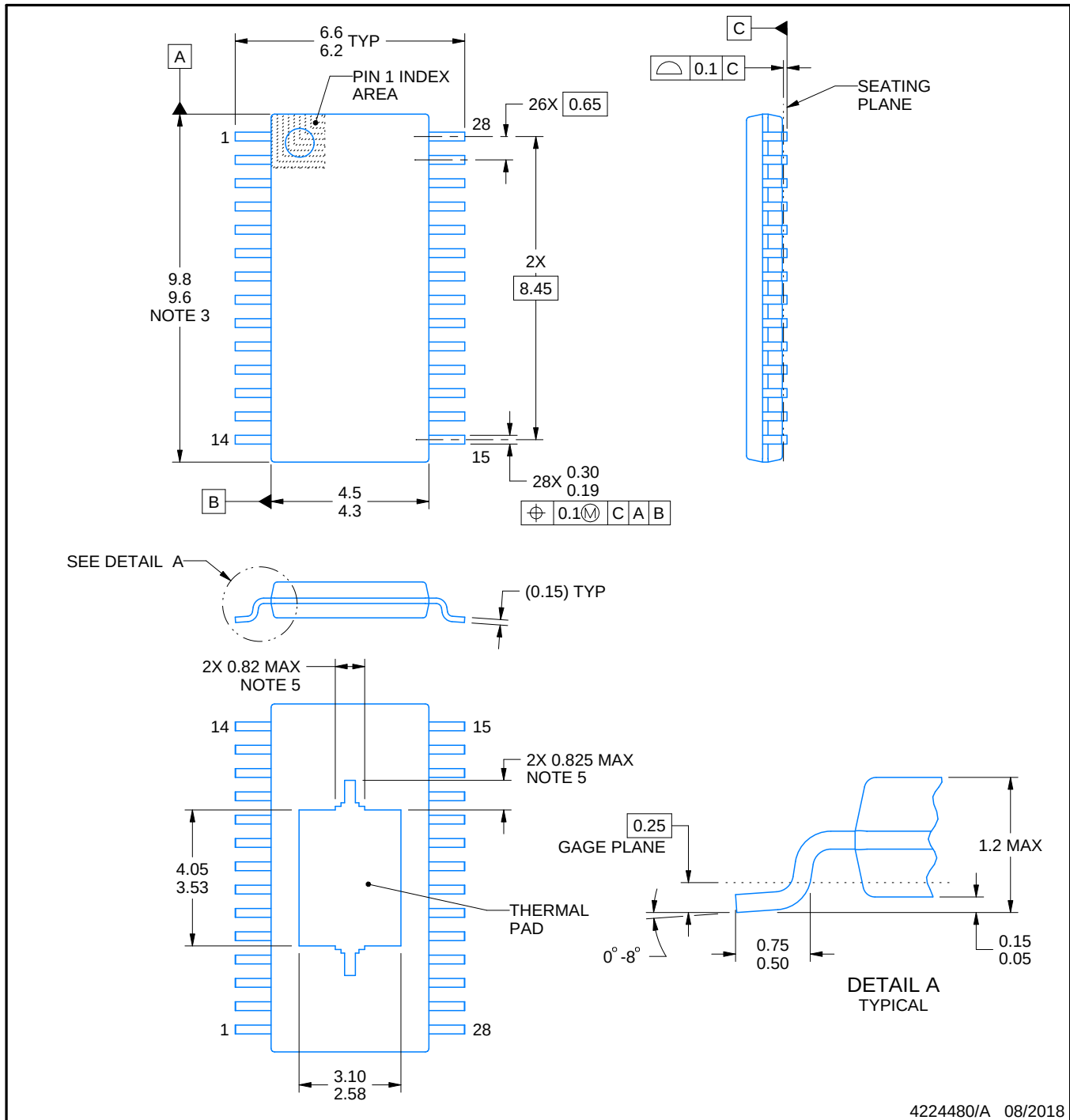
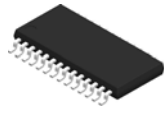
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

OTHER QUALIFIED VERSIONS OF TLC69601-Q1, TLC69611-Q1, TLC69651-Q1, TLC69661-Q1 :

- Catalog : [TLC69601](#), [TLC69611](#), [TLC69651](#), [TLC69661](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product



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NOTES:

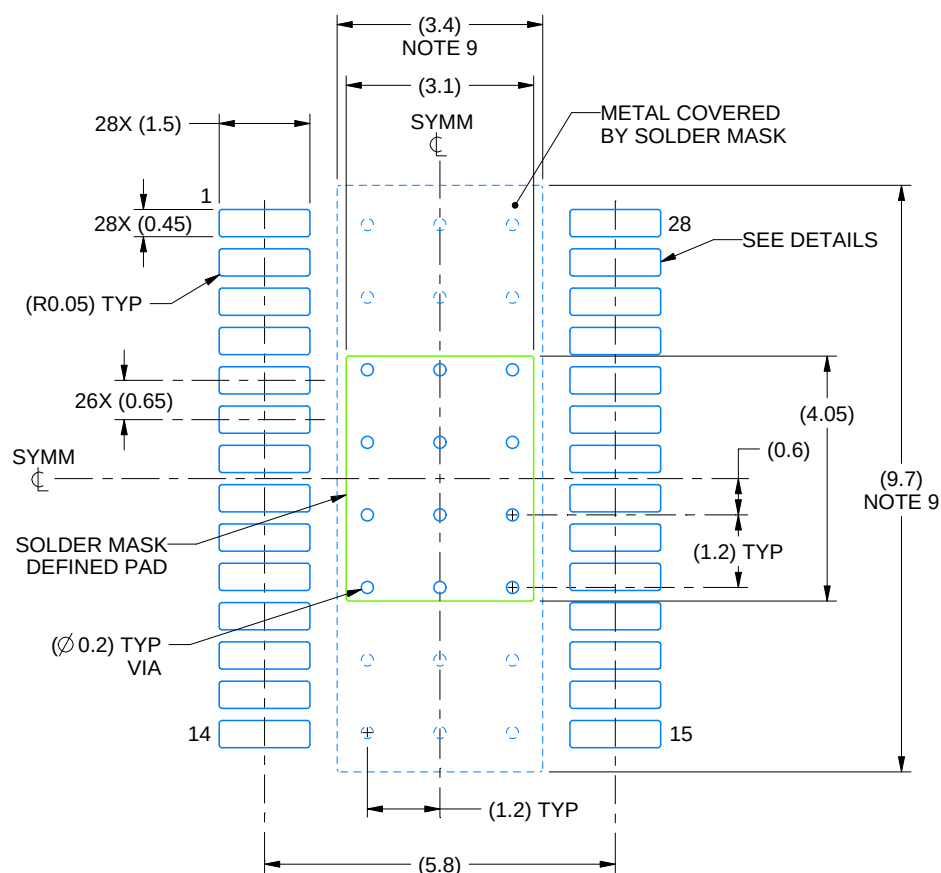
PowerPAD is a trademark of Texas Instruments.

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 MO-153.
5. Features may differ or may not be present.

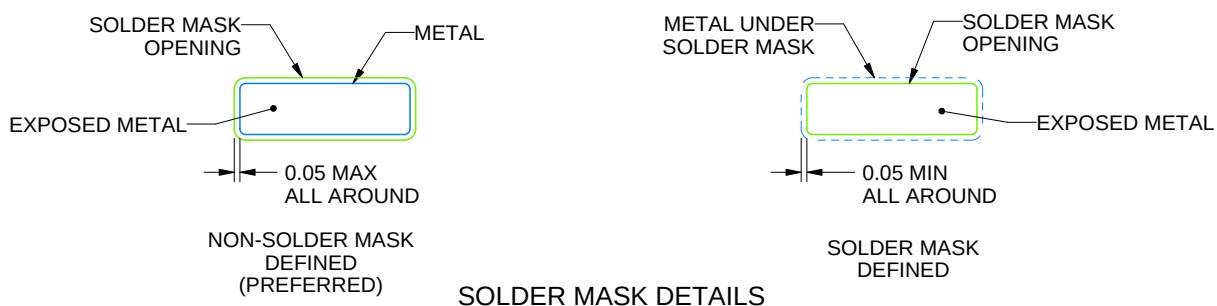
PWP0028M

PowerPAD™ TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 8X



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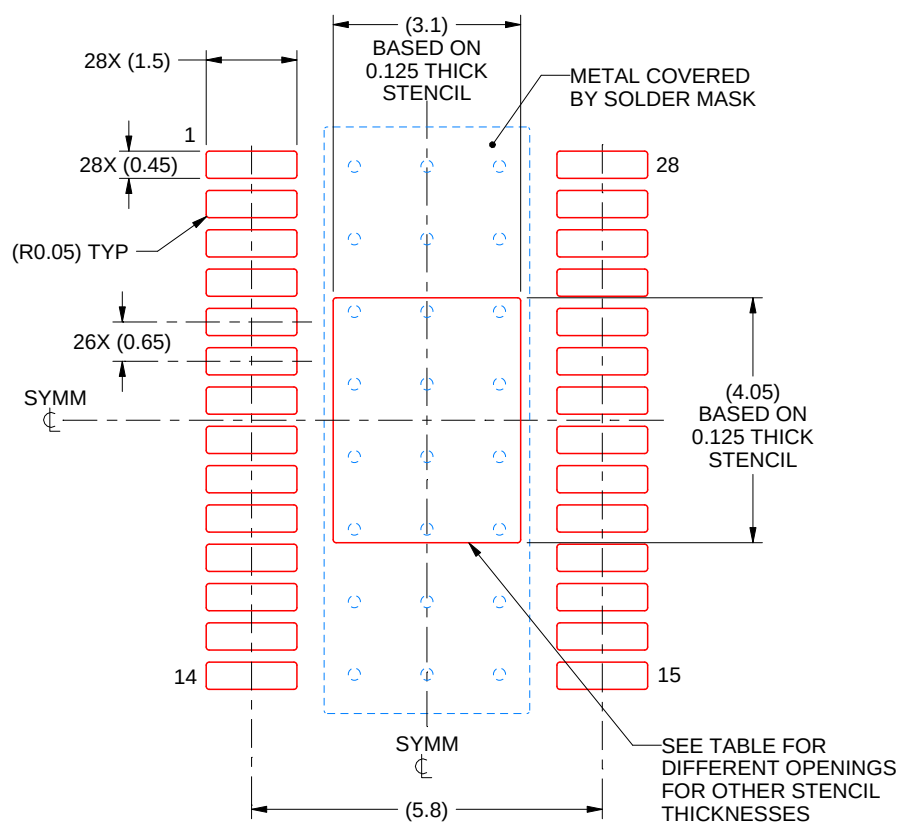
NOTES: (continued)

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. For more information, see Texas Instruments literature numbers SLMA002 (www.ti.com/lit/slma002) and SLMA004 (www.ti.com/lit/slma004).
9. Size of metal pad may vary due to creepage requirement.
10. Vias are optional depending on application, refer to device data sheet. It is recommended that vias under paste be filled, plugged or tented.

PWP0028M

PowerPAD™ TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



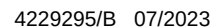
SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE: 8X

STENCIL THICKNESS	SOLDER STENCIL OPENING
0.1	3.47 X 4.53
0.125	3.10 X 4.05 (SHOWN)
0.15	2.83 X 3.70
0.175	2.62 X 3.42

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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.



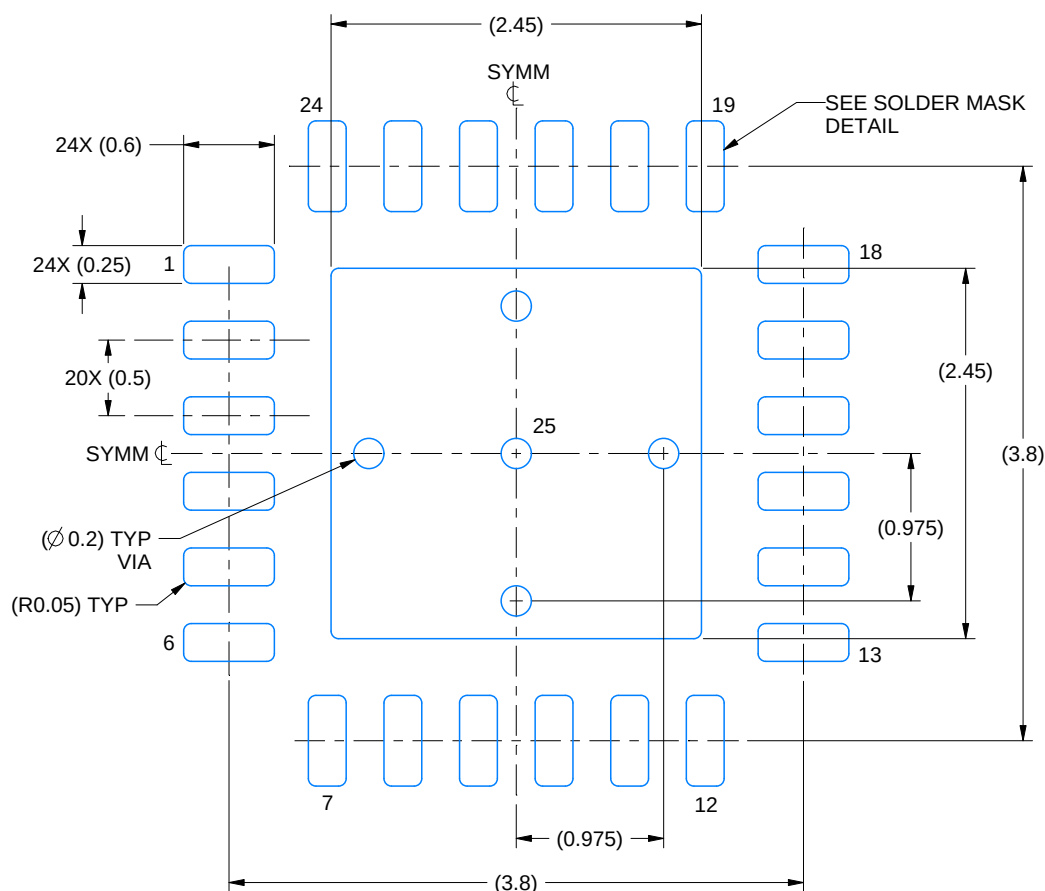
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.
4. Reference JEDEC registration MO-220. For wettable flank, reference IPC document IPC-7093.

EXAMPLE BOARD LAYOUT

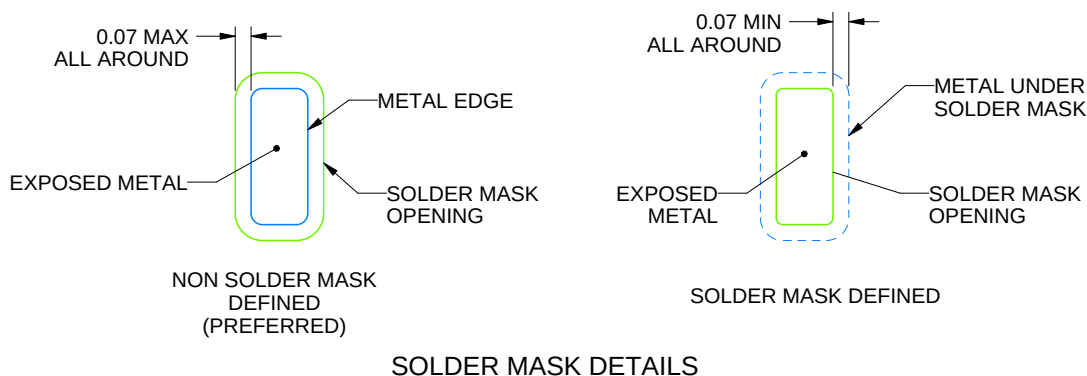
RTW0024N

WQFN - 0.8 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 20X



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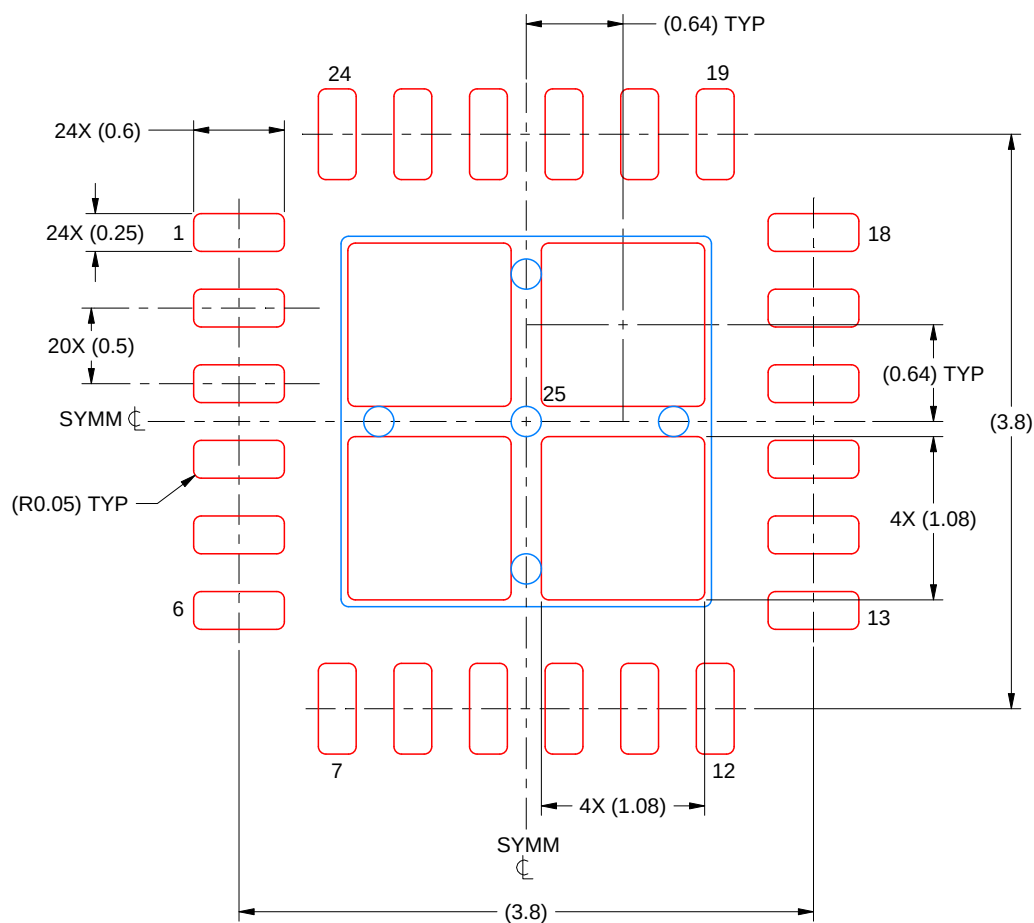
NOTES: (continued)

5. 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/sluea271).
6. 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.

RTW0024N

WQFN - 0.8 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



SOLDER PASTE EXAMPLE
BASED ON 0.125 MM THICK STENCIL
SCALE: 20X

EXPOSED PAD 25
78% PRINTED SOLDER COVERAGE BY AREA UNDER PACKAGE

4229295/B 07/2023

NOTES: (continued)

7. 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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