

TLC696x2/4/8-Q1 16 通道、2/4/8 时分多路复用 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：TLC69602/4/8-Q1
 - 60mA/20V：TLC69612/4/8-Q1
 - 30mA/50V：TLC69652/4/8-Q1
 - 60mA/50V：TLC69662/4/8-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

TLC696x8-Q1 是与 TLC696x0-Q1 (一款扫描 MOSFET 控制器, 可实现 2/4/8 时分多路复用控制) 兼容的 LCD 局部调光背光驱动器系列。每个器件都集成了 16 个具有相应大小 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, 可用于超过 32,000 个局部调光区域。

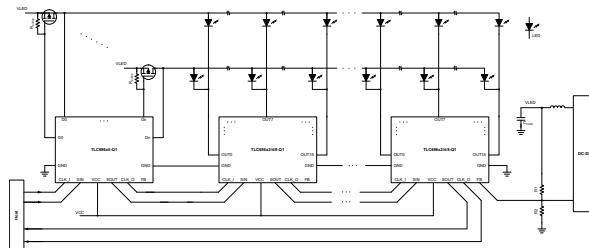
为了优化系统效率, 该器件配备了自适应余量电压控制方案, 以直接控制直流/直流。为了简化系统布局, 只需将串行链中最后一个器件的 FB 引脚连接到直流/直流。该器件还集成了超低亮度更新延迟、插黑和 VRR 特性, 以提高显示质量。

TLC696x2/4/8-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)
TLC696x2/4/8-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 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	说明
2023 年 6 月	*	初始发行版

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 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)
TLC69602QPWPRQ1	Active	Production	HTSSOP (PWP) 28	2000 LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 125	69602Q
TLC69602QPWPRQ1.A	Active	Production	HTSSOP (PWP) 28	2000 LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 125	69602Q
TLC69602QRTWRQ1	Active	Production	WQFN (RTW) 24	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	69602Q
TLC69602QRTWRQ1.A	Active	Production	WQFN (RTW) 24	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	69602Q
TLC69604QPWPRQ1	Active	Production	HTSSOP (PWP) 28	2000 LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 125	69604Q
TLC69604QPWPRQ1.A	Active	Production	HTSSOP (PWP) 28	2000 LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 125	69604Q
TLC69604QRTWRQ1	Active	Production	WQFN (RTW) 24	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	69604Q
TLC69604QRTWRQ1.A	Active	Production	WQFN (RTW) 24	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	69604Q
TLC69608QPWPRQ1	Active	Production	HTSSOP (PWP) 28	2000 LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 125	69608Q
TLC69608QPWPRQ1.A	Active	Production	HTSSOP (PWP) 28	2000 LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 125	69608Q
TLC69608QRTWRQ1	Active	Production	WQFN (RTW) 24	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	69608Q
TLC69608QRTWRQ1.A	Active	Production	WQFN (RTW) 24	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	69608Q
TLC69612QPWPRQ1	Active	Production	HTSSOP (PWP) 28	2000 LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 125	69612Q
TLC69612QPWPRQ1.A	Active	Production	HTSSOP (PWP) 28	2000 LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 125	69612Q
TLC69612QRTWRQ1	Active	Production	WQFN (RTW) 24	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	69612Q
TLC69612QRTWRQ1.A	Active	Production	WQFN (RTW) 24	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	69612Q
TLC69614QPWPRQ1	Active	Production	HTSSOP (PWP) 28	2000 LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 125	69614Q
TLC69614QPWPRQ1.A	Active	Production	HTSSOP (PWP) 28	2000 LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 125	69614Q
TLC69614QRTWRQ1	Active	Production	WQFN (RTW) 24	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	69614Q
TLC69614QRTWRQ1.A	Active	Production	WQFN (RTW) 24	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	69614Q
TLC69618QPWPRQ1	Active	Production	HTSSOP (PWP) 28	2000 LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 125	69618Q
TLC69618QPWPRQ1.A	Active	Production	HTSSOP (PWP) 28	2000 LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 125	69618Q
TLC69618QRTWRQ1	Active	Production	WQFN (RTW) 24	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	69618Q
TLC69618QRTWRQ1.A	Active	Production	WQFN (RTW) 24	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	69618Q
TLC69652QPWPRQ1	Active	Production	HTSSOP (PWP) 28	2000 LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 125	69652Q
TLC69652QPWPRQ1.A	Active	Production	HTSSOP (PWP) 28	2000 LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 125	69652Q
TLC69652QRTWRQ1	Active	Production	WQFN (RTW) 24	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	69652Q
TLC69652QRTWRQ1.A	Active	Production	WQFN (RTW) 24	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	69652Q
TLC69654QPWPRQ1	Active	Production	HTSSOP (PWP) 28	2000 LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 125	69654Q

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)
TLC69654QPWPRQ1.A	Active	Production	HTSSOP (PWP) 28	2000 LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 125	69654Q
TLC69654QRTWRQ1	Active	Production	WQFN (RTW) 24	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	69654Q
TLC69654QRTWRQ1.A	Active	Production	WQFN (RTW) 24	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	69654Q
TLC69658QPWPRQ1	Active	Production	HTSSOP (PWP) 28	2000 LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 125	69658Q
TLC69658QPWPRQ1.A	Active	Production	HTSSOP (PWP) 28	2000 LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 125	69658Q
TLC69658QRTWRQ1	Active	Production	WQFN (RTW) 24	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	69658Q
TLC69658QRTWRQ1.A	Active	Production	WQFN (RTW) 24	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	69658Q
TLC69662QPWPRQ1	Active	Production	HTSSOP (PWP) 28	2000 LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 125	69662Q
TLC69662QPWPRQ1.A	Active	Production	HTSSOP (PWP) 28	2000 LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 125	69662Q
TLC69662QRTWRQ1	Active	Production	WQFN (RTW) 24	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	69662Q
TLC69662QRTWRQ1.A	Active	Production	WQFN (RTW) 24	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	69662Q
TLC69664QPWPRQ1	Active	Production	HTSSOP (PWP) 28	2000 LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 125	69664Q
TLC69664QPWPRQ1.A	Active	Production	HTSSOP (PWP) 28	2000 LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 125	69664Q
TLC69664QRTWRQ1	Active	Production	WQFN (RTW) 24	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	69664Q
TLC69664QRTWRQ1.A	Active	Production	WQFN (RTW) 24	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	69664Q
TLC69668QPWPRQ1	Active	Production	HTSSOP (PWP) 28	2000 LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 125	69668Q
TLC69668QPWPRQ1.A	Active	Production	HTSSOP (PWP) 28	2000 LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 125	69668Q
TLC69668QRTWRQ1	Active	Production	WQFN (RTW) 24	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	69668Q
TLC69668QRTWRQ1.A	Active	Production	WQFN (RTW) 24	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	69668Q

⁽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.

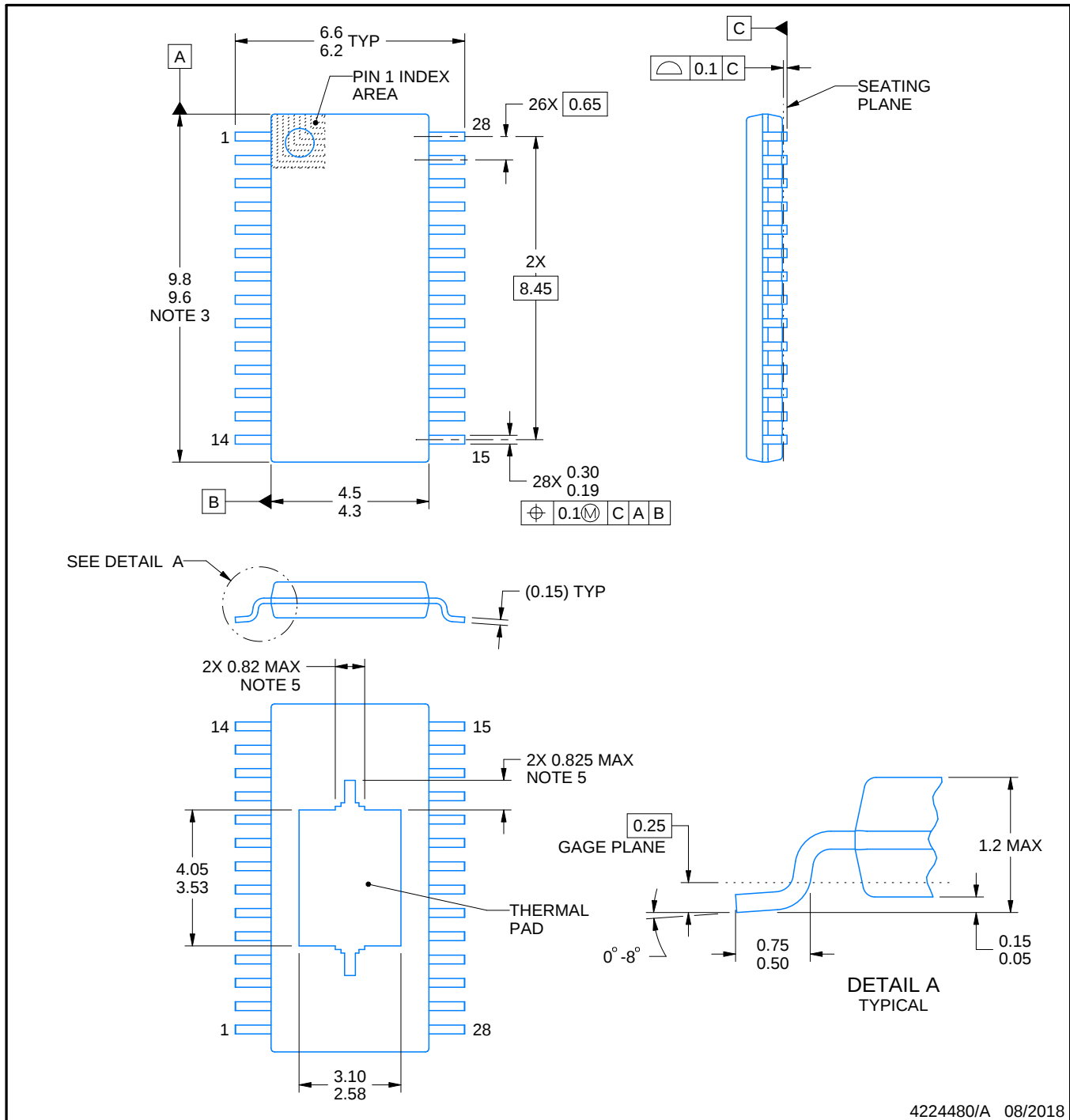
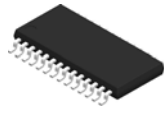
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

OTHER QUALIFIED VERSIONS OF TLC69602-Q1, TLC69604-Q1, TLC69608-Q1, TLC69612-Q1, TLC69614-Q1, TLC69618-Q1, TLC69652-Q1, TLC69654-Q1, TLC69658-Q1, TLC69662-Q1, TLC69664-Q1, TLC69668-Q1 :

- Catalog : [TLC69602](#), [TLC69604](#), [TLC69608](#), [TLC69612](#), [TLC69614](#), [TLC69618](#), [TLC69652](#), [TLC69654](#), [TLC69658](#), [TLC69662](#), [TLC69664](#), [TLC69668](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product



4224480/A 08/2018

NOTES:

PowerPAD is a trademark of Texas Instruments.

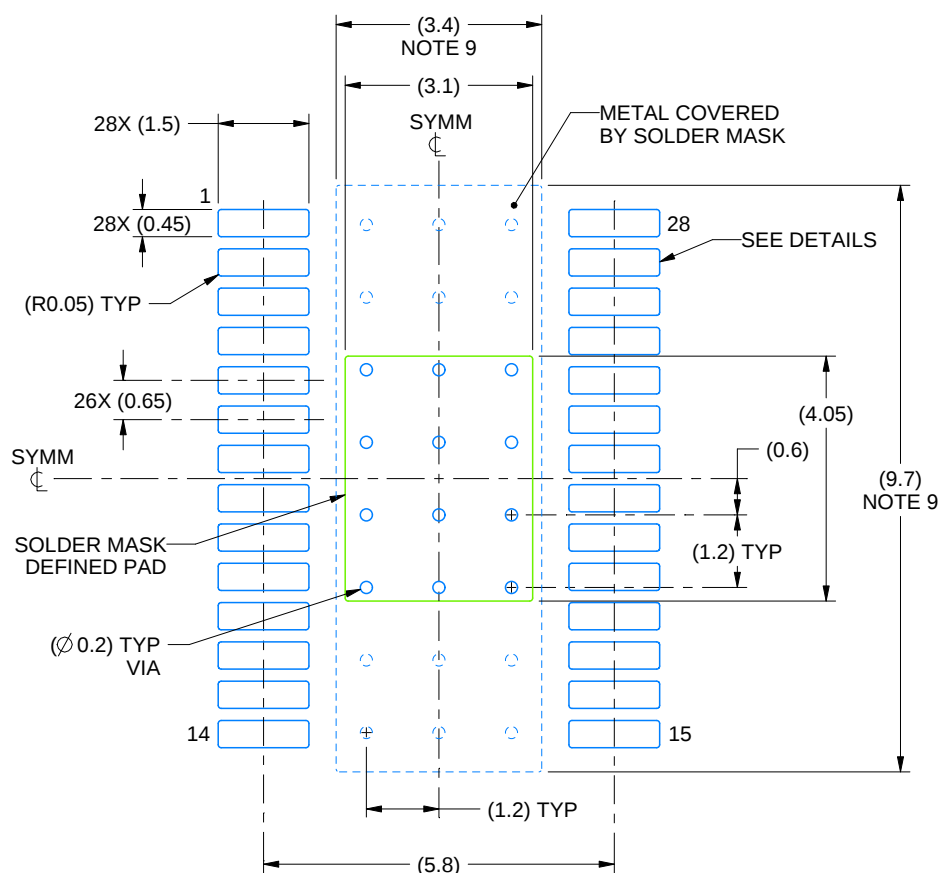
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or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

EXAMPLE BOARD LAYOUT

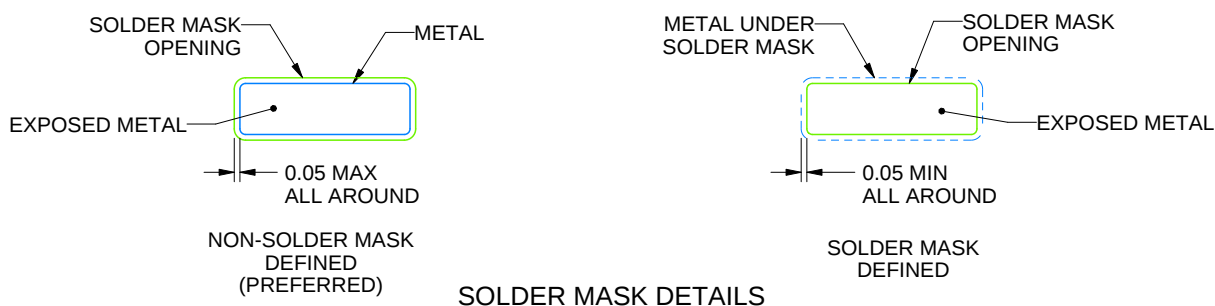
PWP0028M

PowerPAD™ TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 8X



4224480/A 08/2018

NOTES: (continued)

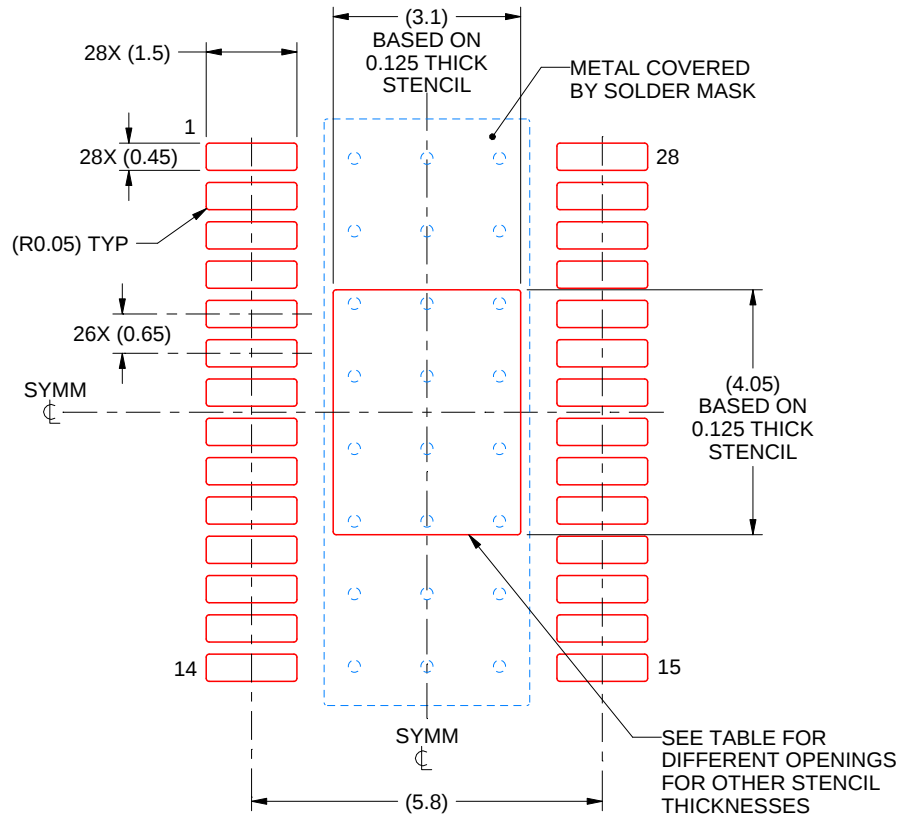
6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.
8. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature numbers SLMA002 (www.ti.com/lit/slma002) 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.

EXAMPLE STENCIL DESIGN

PWP0028M

PowerPAD™ TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



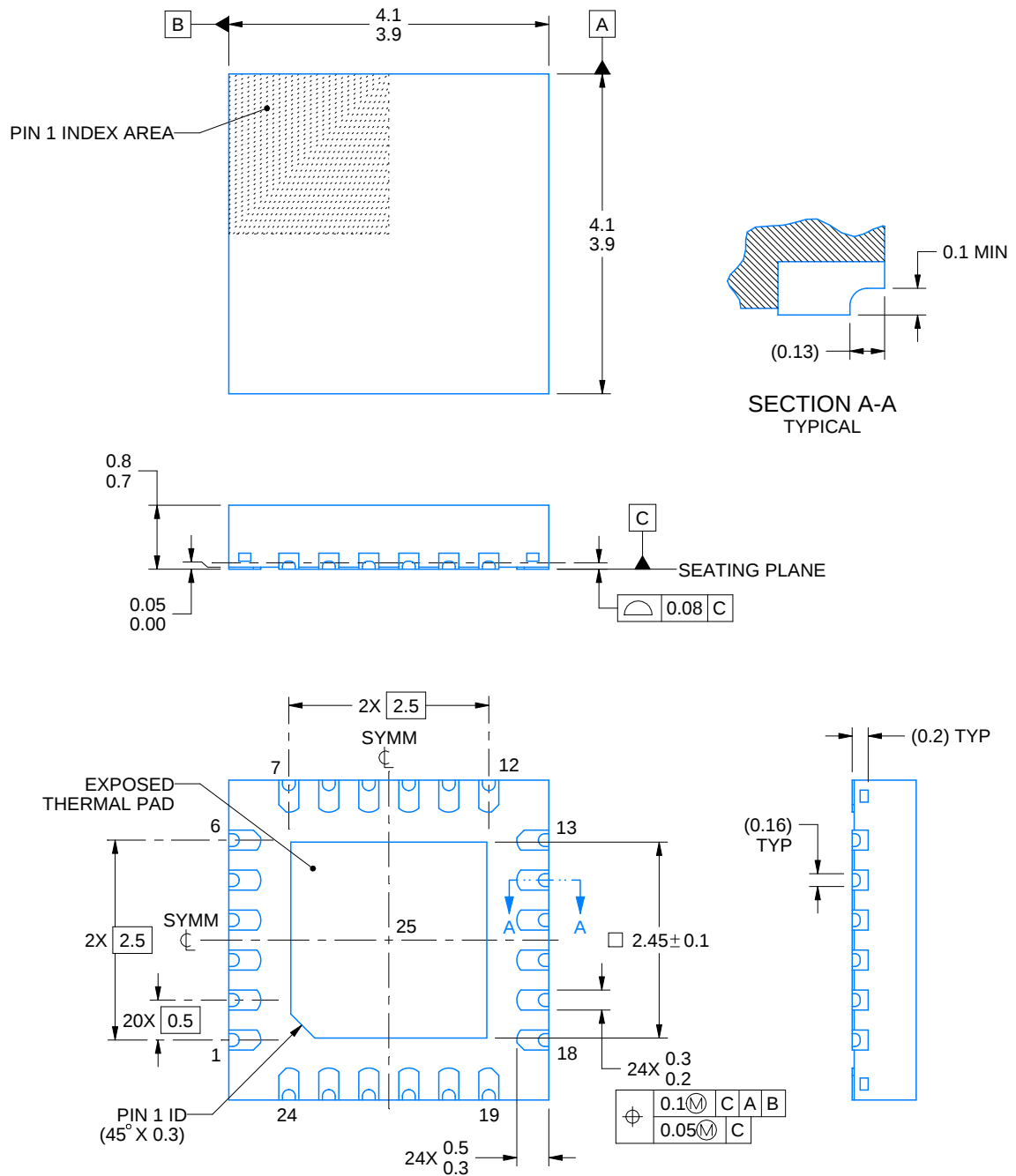
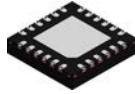
SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE: 8X

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

4224480/A 08/2018

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.



4229295/B 07/2023

NOTES:

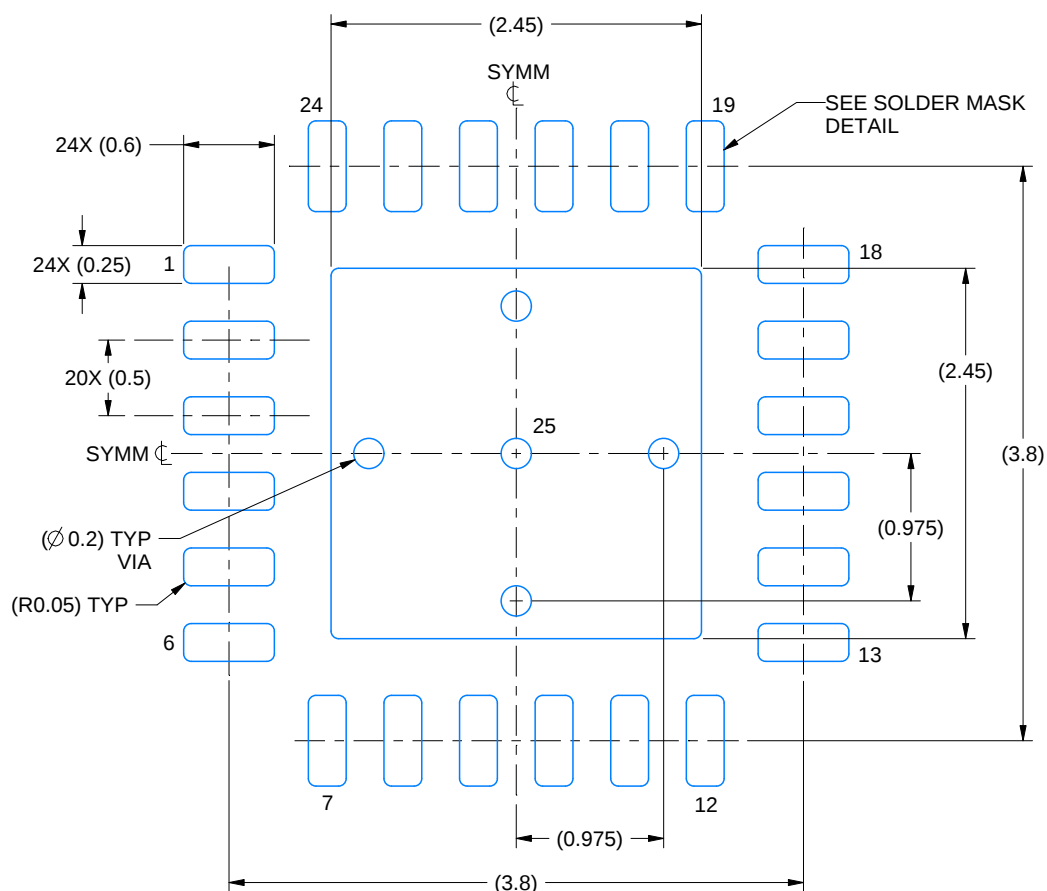
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.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

EXAMPLE BOARD LAYOUT

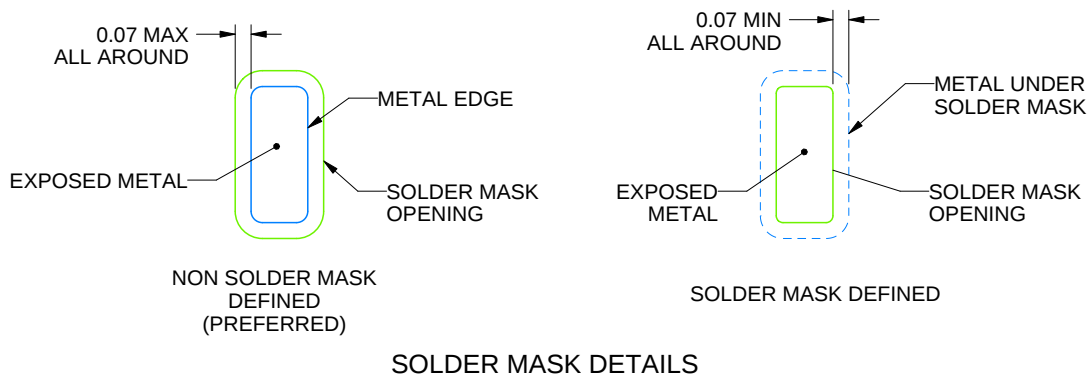
RTW0024N

WQFN - 0.8 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 20X



SOLDER MASK DETAILS

4229295/B 07/2023

NOTES: (continued)

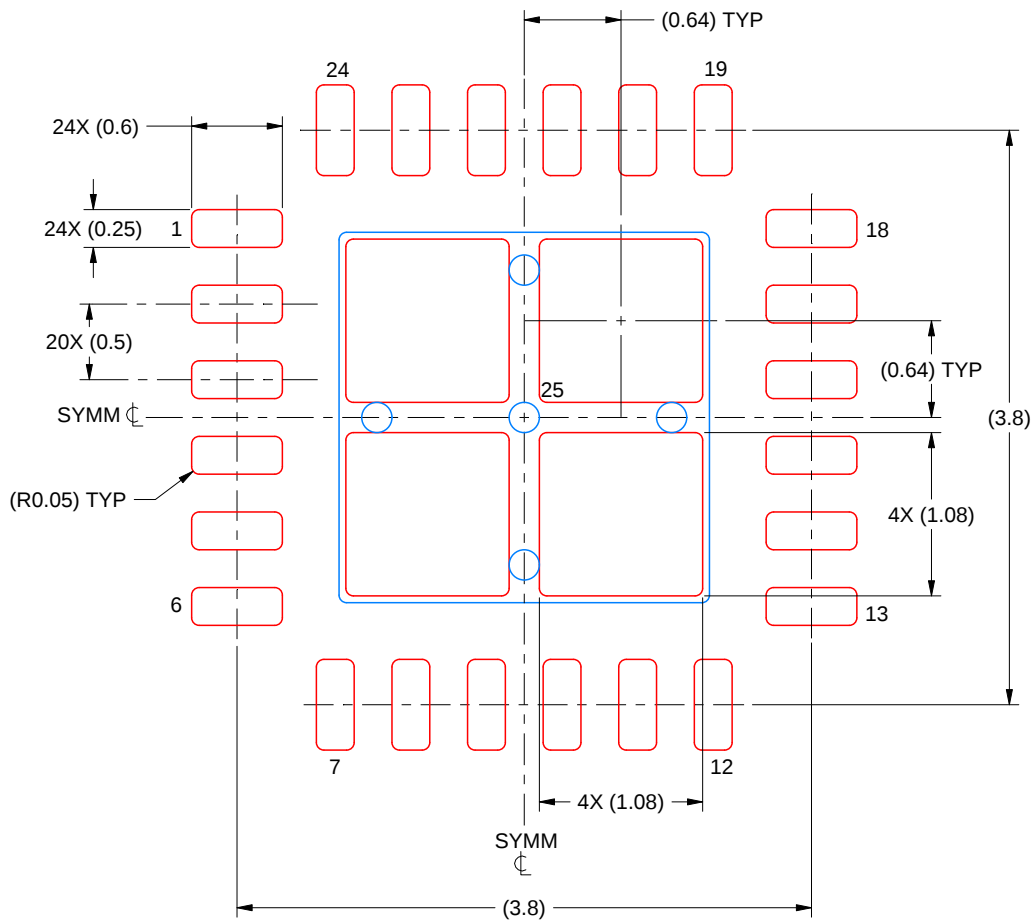
5. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/sluea271).
6. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.

EXAMPLE STENCIL DESIGN

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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