

TLC696x1 16 通道、局部调光背光 LED 驱动器

1 特性

- 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
 - 60mA/20V：TLC69611
 - 30mA/50V：TLC69651
 - 60mA/50V：TLC69661
 - 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
- 显示质量改进：
 - 超低亮度更新延迟
 - 可编程插黑
 - 无闪烁的可变刷新率 (VRR)
- 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：
 - 电视
 - 监视器
 - 笔记本电脑
 - 平板电脑

3 说明

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。

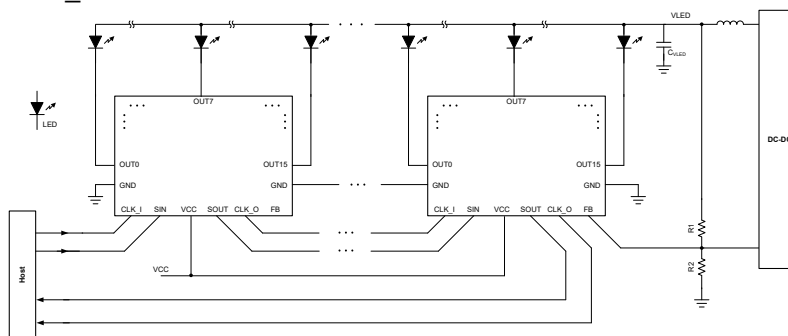
为了优化系统效率，该器件配备了自适应余量电压控制方案，以直接控制直流/直流。为了简化系统布局，只需将串行链中最后一个器件的 FB 引脚连接到直流/直流。该器件还集成了超低亮度更新延迟、插黑和 VRR 特性，以提高显示质量。

TLC696x1 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	DSBGA (24)	1.58 mm × 2.43 mm
	WQFN (24)	4mm x 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
April 2023	*	Initial Release

5 Device and Documentation Support

TI offers an extensive line of development tools. Tools and software to evaluate the performance of the device, generate code, and develop solutions are listed below.

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 Trademarks

TI E2E™ is a trademark of Texas Instruments.

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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 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

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)
TLC69601RTWR	Active	Production	WQFN (RTW) 24	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	69601
TLC69601RTWR.A	Active	Production	WQFN (RTW) 24	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	69601
TLC69601YBHR	Active	Production	DSBGA (YBH) 24	3000 LARGE T&R	Yes	SNAGCU	Level-1-260C-UNLIM	-40 to 85	TLC69601
TLC69601YBHR.A	Active	Production	DSBGA (YBH) 24	3000 LARGE T&R	Yes	SNAGCU	Level-1-260C-UNLIM	-40 to 85	TLC69601
TLC69611RTWR	Active	Production	WQFN (RTW) 24	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	69611
TLC69611RTWR.A	Active	Production	WQFN (RTW) 24	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	69611
TLC69611YBHR	Active	Production	DSBGA (YBH) 24	3000 LARGE T&R	Yes	SNAGCU	Level-1-260C-UNLIM	-40 to 85	TLC69611
TLC69611YBHR.A	Active	Production	DSBGA (YBH) 24	3000 LARGE T&R	Yes	SNAGCU	Level-1-260C-UNLIM	-40 to 85	TLC69611
TLC69651RTWR	Active	Production	WQFN (RTW) 24	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	69651
TLC69651RTWR.A	Active	Production	WQFN (RTW) 24	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	69651
TLC69651YBHR	Active	Production	DSBGA (YBH) 24	3000 LARGE T&R	Yes	SNAGCU	Level-1-260C-UNLIM	-40 to 85	TLC69651
TLC69651YBHR.A	Active	Production	DSBGA (YBH) 24	3000 LARGE T&R	Yes	SNAGCU	Level-1-260C-UNLIM	-40 to 85	TLC69651
TLC69661RTWR	Active	Production	WQFN (RTW) 24	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	69661
TLC69661RTWR.A	Active	Production	WQFN (RTW) 24	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	69661
TLC69661YBHR	Active	Production	DSBGA (YBH) 24	3000 LARGE T&R	Yes	SNAGCU	Level-1-260C-UNLIM	-40 to 85	TLC69661
TLC69661YBHR.A	Active	Production	DSBGA (YBH) 24	3000 LARGE T&R	Yes	SNAGCU	Level-1-260C-UNLIM	-40 to 85	TLC69661

⁽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.

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

- Automotive : [TLC69601-Q1](#), [TLC69611-Q1](#), [TLC69651-Q1](#), [TLC69661-Q1](#)

NOTE: Qualified Version Definitions:

- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects

GENERIC PACKAGE VIEW

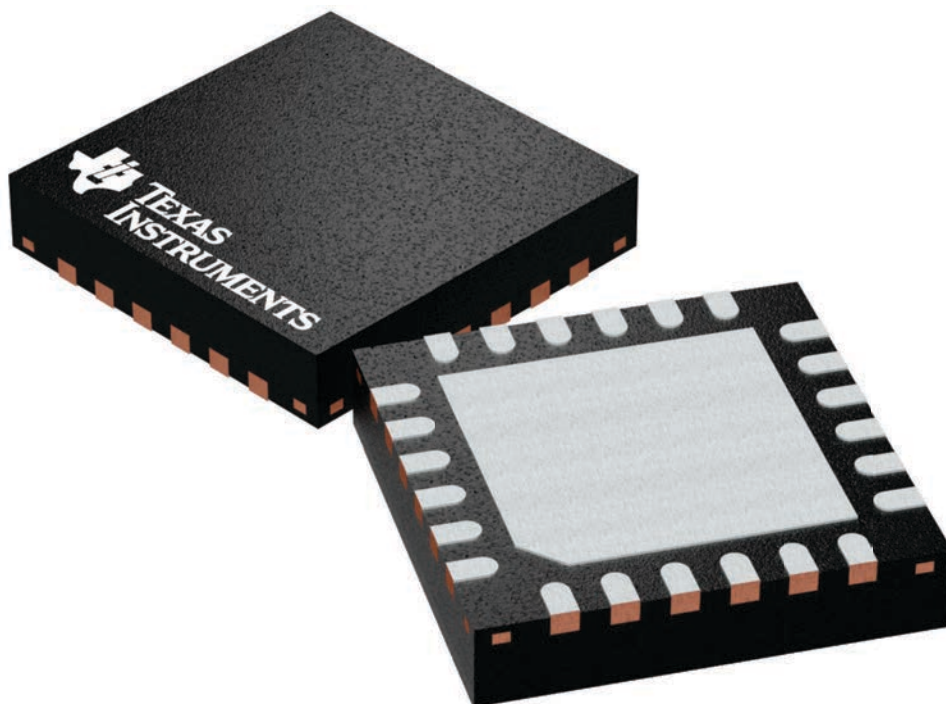
RTW 24

WQFN - 0.8 mm max height

4 x 4, 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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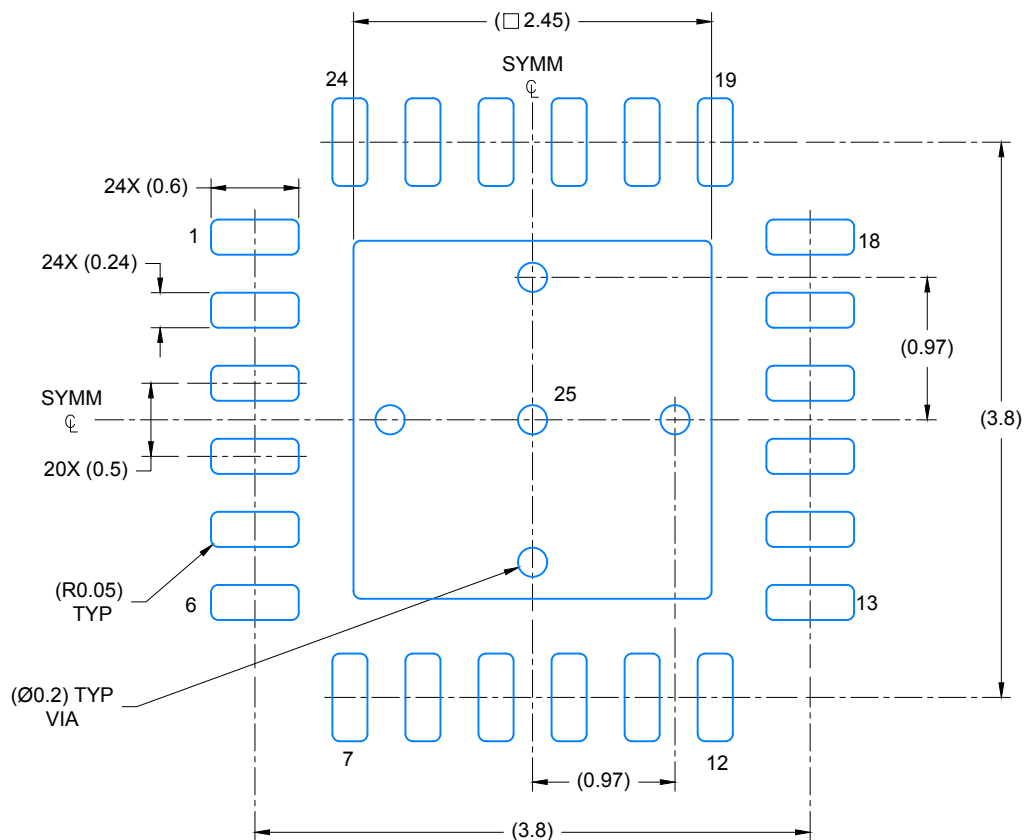
PACKAGE OUTLINE

WQFN - 0.8 mm max height

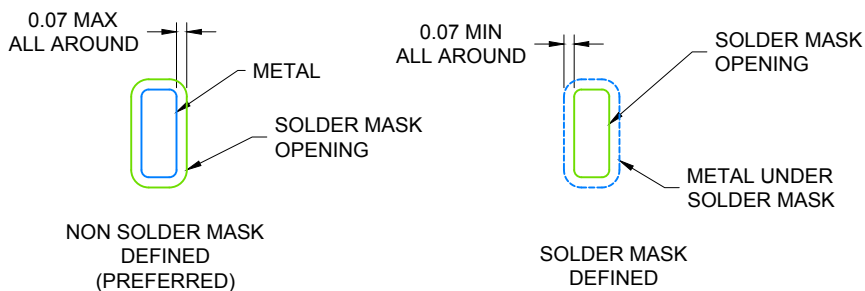
[illegible]

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.



LAND PATTERN EXAMPLE
SCALE: 20X

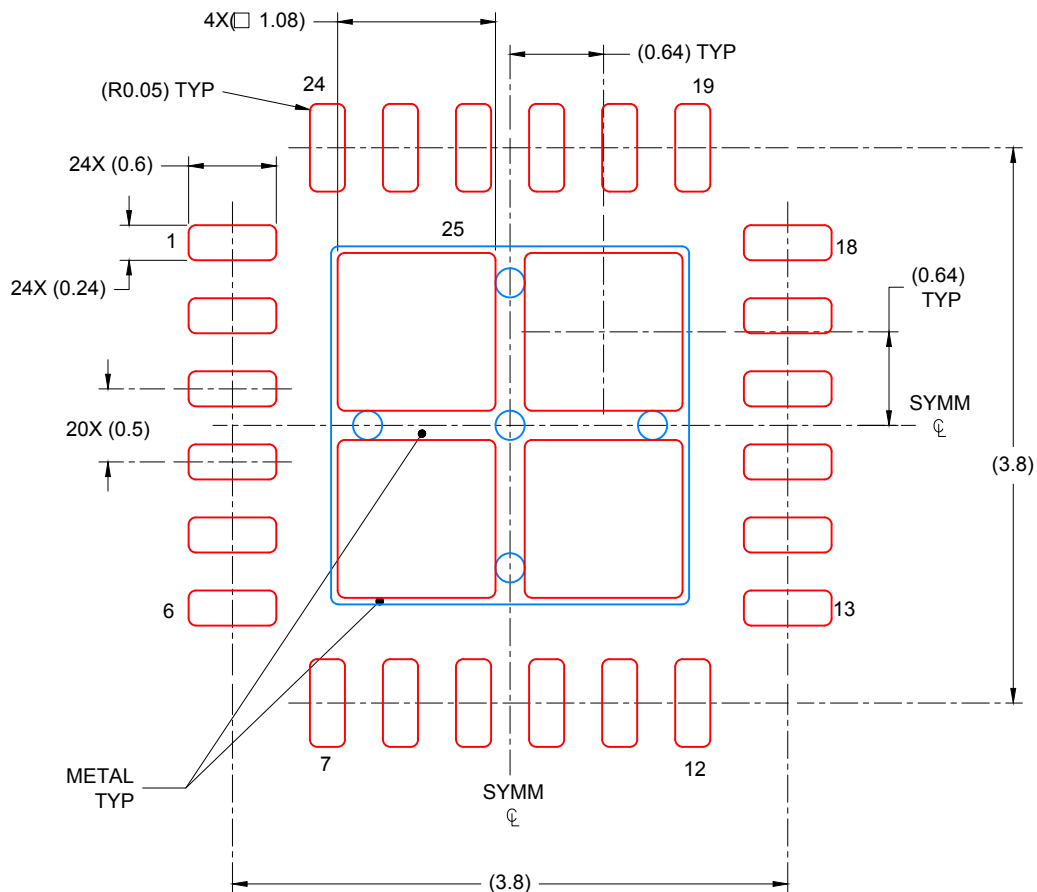


SOLDER MASK DETAILS

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NOTES: (continued)

- For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/sluea271).



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL

EXPOSED PAD 25:
78% PRINTED COVERAGE BY AREA UNDER PACKAGE
SCALE: 20X

4219135/B 11/2016

NOTES: (continued)

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

重要通知和免责声明

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