TAS6511-Q1 具有电流检测和实时负载诊断功能的 50W、2MHz 数字输入单通道汽车级无散热器 D 类音频放大器

1 特性

- 符合面向汽车应用的 AEC-Q100 标准
  - 温度等级 1：–40°C 至 +125°C，T_A
- 常规运行
  - 4.5V 至 19V 电源电压，40V 负载突降
  - 支持 1.8V 和 3.3V I/O
  - I^2C 控制，具有 8 个地址选项
  - 14.4V 下的空闲功率损耗低于 0.5W，最大 PVDD 关断损耗低于 5uA
- 通过 I^2S 或 TDM 进行输出电流检测
  - 无需外部电路
- 实时负载诊断
  - 播放音频时监控输出条件
  - 开路负载、短路负载、电源短路、接地短路检测
- 集成 DSP 处理
  - 热监控和折返
  - PVDD 监控和折返
  - 削波检测
  - 低延迟路径，在 48kHz 时信号延迟减少 70% 以上
- 直流和交流备用负载诊断
- 音频输入
  - I^2S 和 TDM 支持高达 TDM16
  - 输入采样率：16、32、44.1、48、96、192kHz
- 音频输出
  - 384kHz 至 2MHz 可配置输出开关频率
  - 高达 7A 的通道输出电流
  - 30W（14.4V，4Ω，10% THD+N）
  - 50W（14.4V，2Ω，10% THD+N）
- 音频性能
  - THD+N <0.02%（4Ω，1W，1kHz）
  - 108dB 的信噪比 (SNR)
  - 输出噪声：14.4V 时为 41 μ V_{RMS}，A 加权
- 保护
  - 输出短路保护
  - Speaker Guard™ Pro 功率限制器
  - 可配置的过热警告和关断
  - I^2C 温度和电源电压读数
  - 直流失调电压，欠压和过压
- 可轻松满足 CISPR25-L5 EMC 规范要求
  - 高级展频

2 应用

- 声学车辆警报系统 (AVAS)
- 紧急呼叫 (eCall)
- 汽车音响主机
- 远程信息处理控制单元
- 汽车仪表组显示器

3 说明

TAS6511-Q1 是一款单通道、数字输入、D 类音频放大器，支持 2MHz 开关频率，可实现成本和尺寸优化的单通道音频放大器设计。该器件的工作电压为 4.5V 至 19V，可提供高达 30W（14.4V，4Ω，10% THD+N）和高达 50W（14.4V，2Ω，10% THD+N）的功率。该器件集成了直流和交流负载诊断功能，可在启用输出级之前确定所连接负载的状态。此外，该器件还可以在 PLAY 模式下使用实时负载诊断（无论是否有音频）来监控输出负载状况，该诊断独立于主机和音频输入运行。

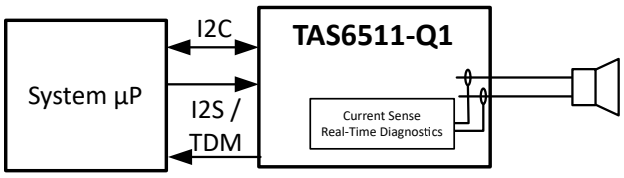
TAS6511-Q1 可以监测器件的输出电流、PVDD 电压和温度，并可以通过 TDM 或 I2S 报告这些数据。TAS6511-Q1 的集成 DSP 可实现高级保护功能，例如 PVDD 折返、热折返和 Speaker Guard™ Pro 功率限制器。该 DSP 还支持一个额外的低延迟信号路径，在 48kHz 条件下为时间敏感型有源噪声消除 (ANC) 和道路噪声消除 (RNC) 应用提供最高快 70% 的信号处理速度。

该器件采用焊盘朝下的小型 TSSOP 和 QFN（具有可湿性侧面）封装，可实现无散热器的音频放大器设计。

封装信息

器件型号	封装(1)	封装尺寸(2)
TAS6511-Q1	PWP (HTSSOP，28)	6.4mm × 9.7mm
	RGE（VQFN，24）	4mm × 4mm

(1) 有关更多信息，请参阅 节 7。
(2) 封装尺寸（长 × 宽）为标称值，并包括引脚（如适用）。



简图

内容

4 相关产品

表 4-1. 相关的 D 类音频放大器

器件	通道电流限制（典型值）	输出功率/10% THD+N
		4Ω / 14.4V
TAS6501-Q1	3.7A	15W
TAS6511-Q1	7.3A	30W

5 器件和文档支持

TI 提供广泛的开发工具。下面列出了用于评估器件性能、生成代码和开发设计的工具和软件。

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*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。

5.2 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。

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 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 B (April 2025) to Revision C (January 2026)	Page
• 通篇添加了 RGE (VQFN) 封装信息	1
• 添加了*相关产品* 部分	3

Changes from Revision A (December 2024) to Revision B (April 2025)	Page
• 将 14.4V，4Ω，10% THD + N 条件下的输出功率更新为 30W	1
• 添加了机械、封装和可订购信息部分	4

Changes from Revision * (December 2023) to Revision A (December 2024)	Page
• 将器件状态更新为量产数据	1

7 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。

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)
TAS6511QPWPRQ1	Active	Production	HTSSOP (PWP) | 28	2000 | LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 125	TAS6511
TAS6511QPWPRQ1.A	Active	Production	HTSSOP (PWP) | 28	2000 | LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 125	TAS6511
TAS6511QRGERQ1	Active	Production	VQFN (RGE) | 24	3000 | LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 125	TAS6511

(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.

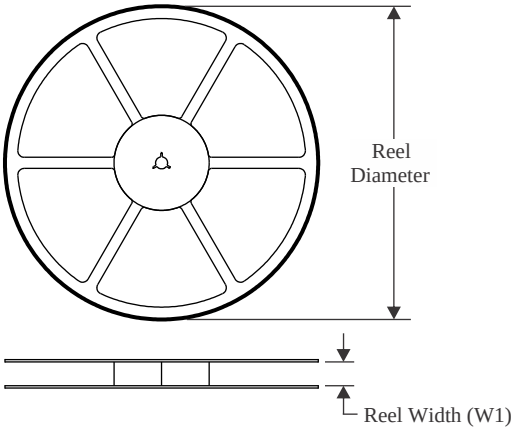
(5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will 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.

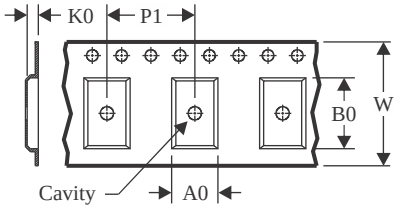
Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

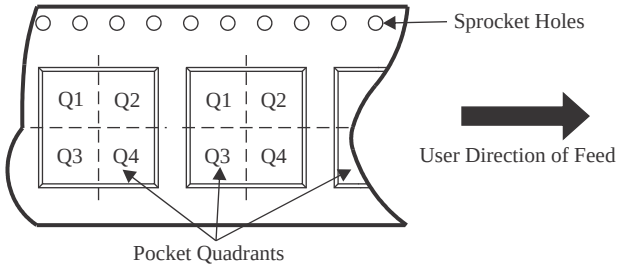


TAPE DIMENSIONS



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

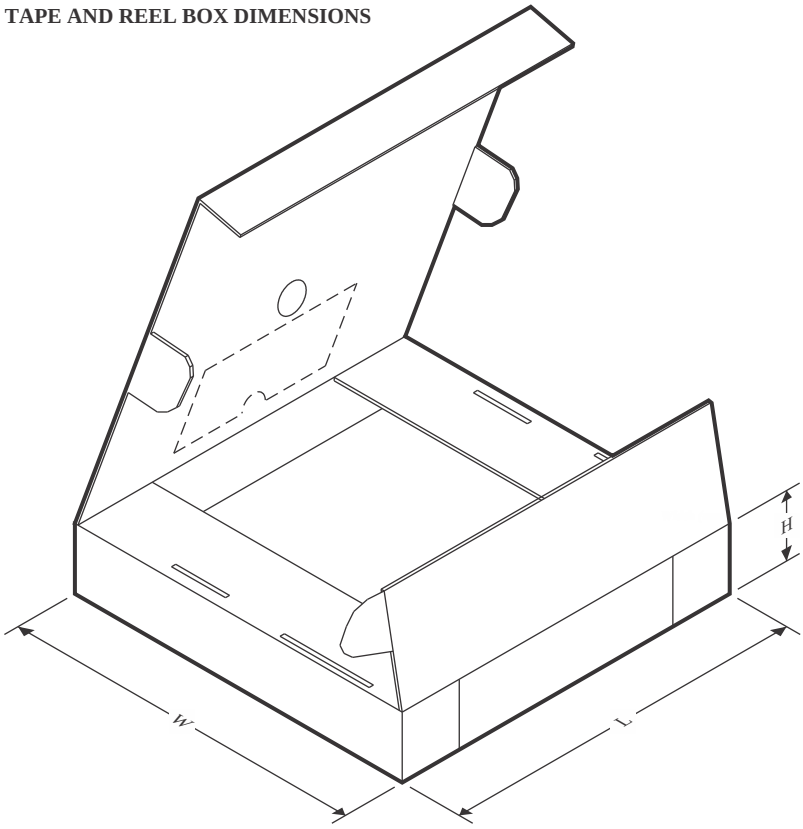
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
TAS6511QPWPRQ1	HTSSOP	PWP	28	2000	330.0	16.4	6.75	10.1	1.8	12.0	16.0	Q1
TAS6511QRGERQ1	VQFN	RGE	24	3000	330.0	12.4	4.25	4.25	1.15	8.0	12.0	Q2

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TAS6511QPWPRQ1	HTSSOP	PWP	28	2000	353.0	353.0	32.0
TAS6511QRGERQ1	VQFN	RGE	24	3000	367.0	367.0	35.0

GENERIC PACKAGE VIEW

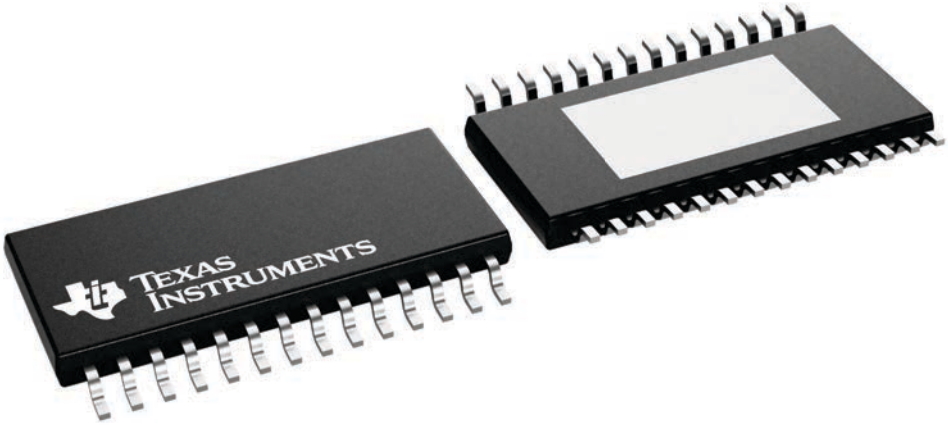
PWP 28

PowerPAD™ TSSOP - 1.2 mm max height

4.4 x 9.7, 0.65 mm pitch

SMALL OUTLINE PACKAGE

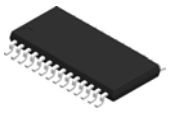
This image is a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.



4224765/B

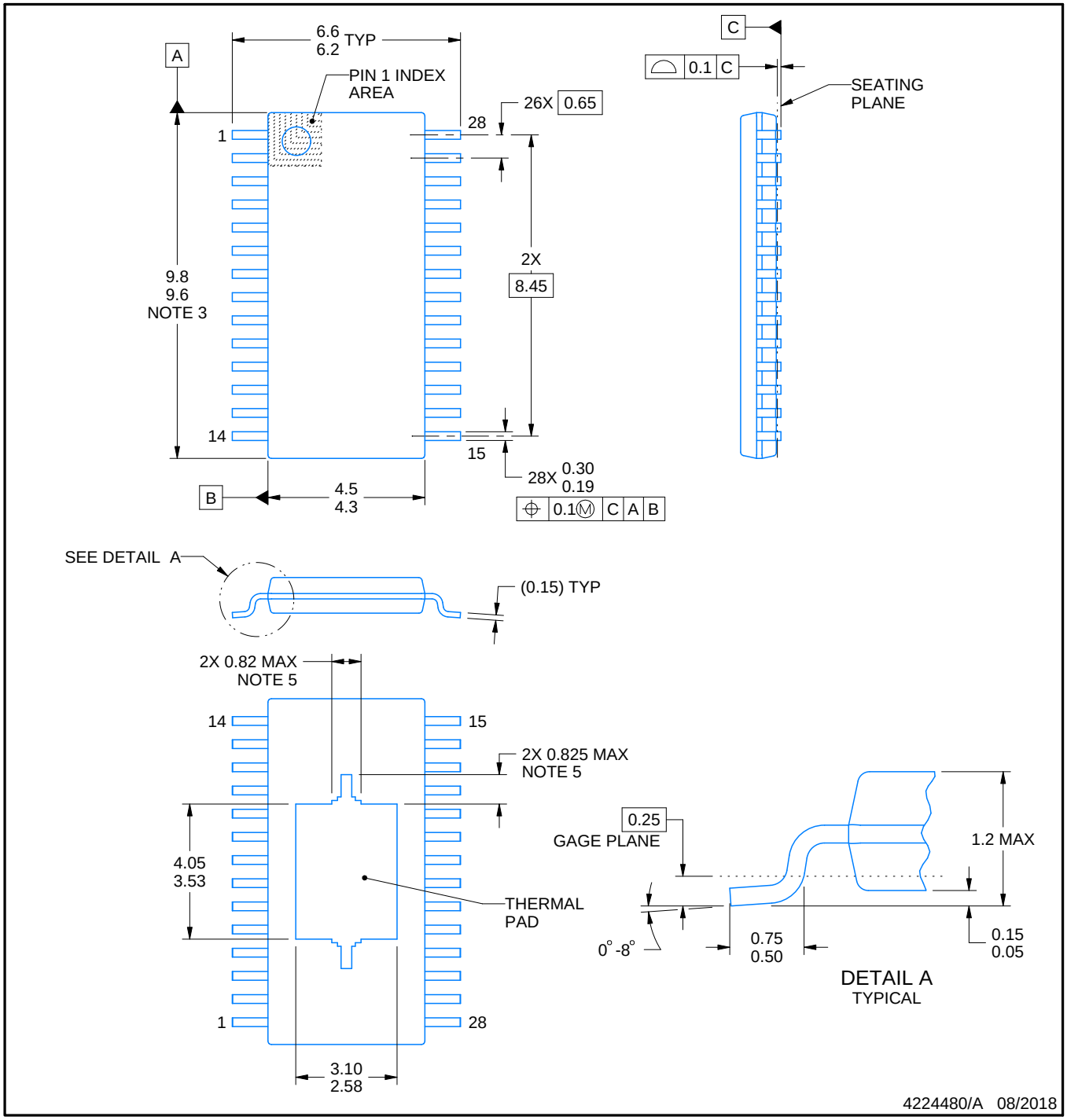
PACKAGE OUTLINE

PWP0028M



PowerPAD™ TSSOP - 1.2 mm max height

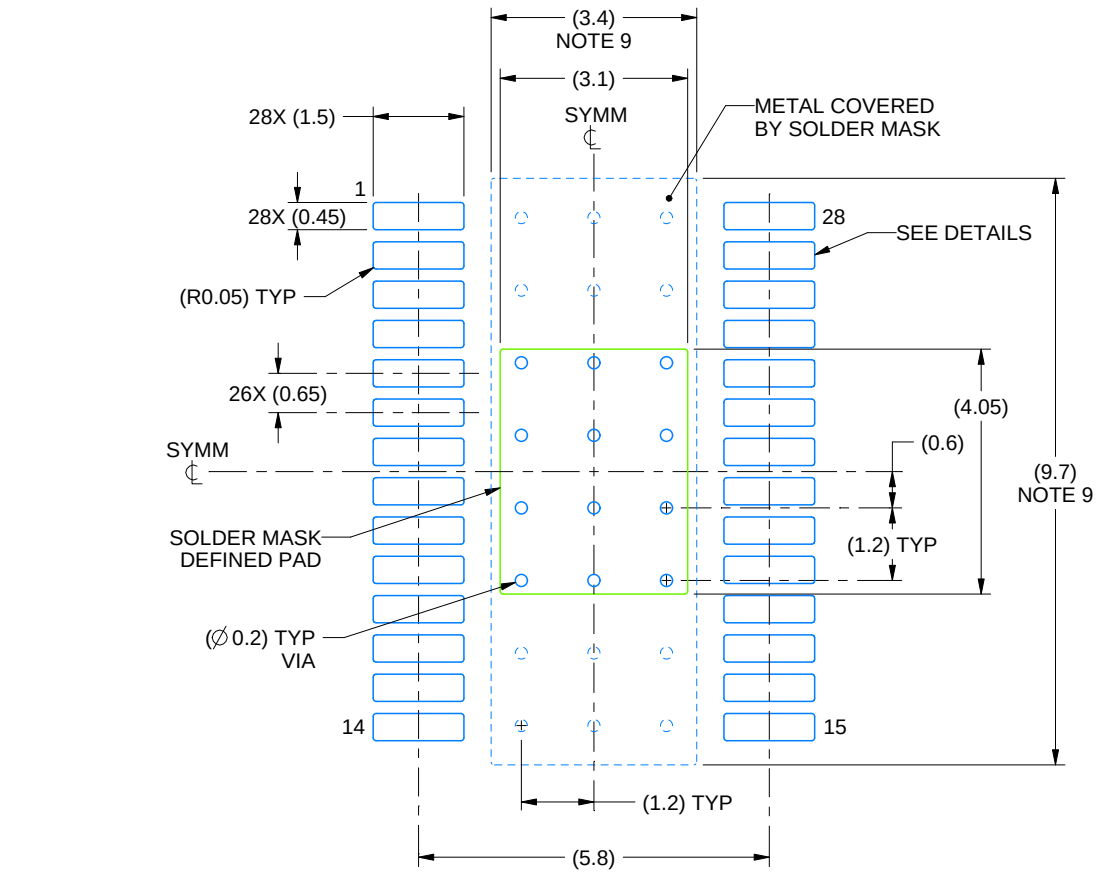
SMALL OUTLINE PACKAGE



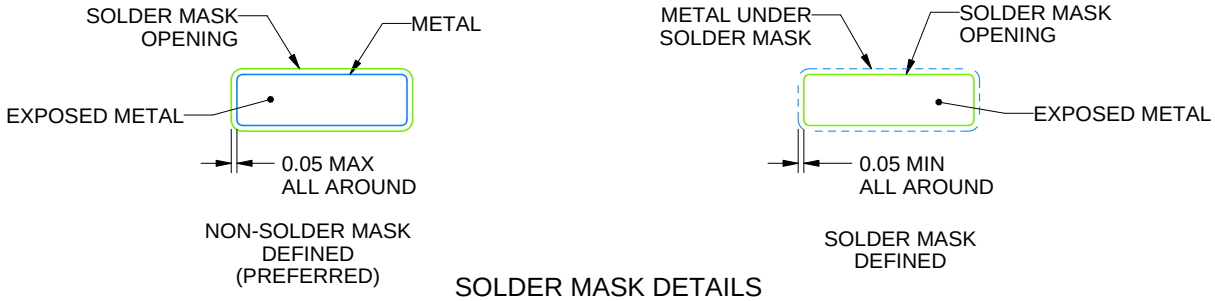
PowerPAD is a trademark of Texas Instruments.

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



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 8X

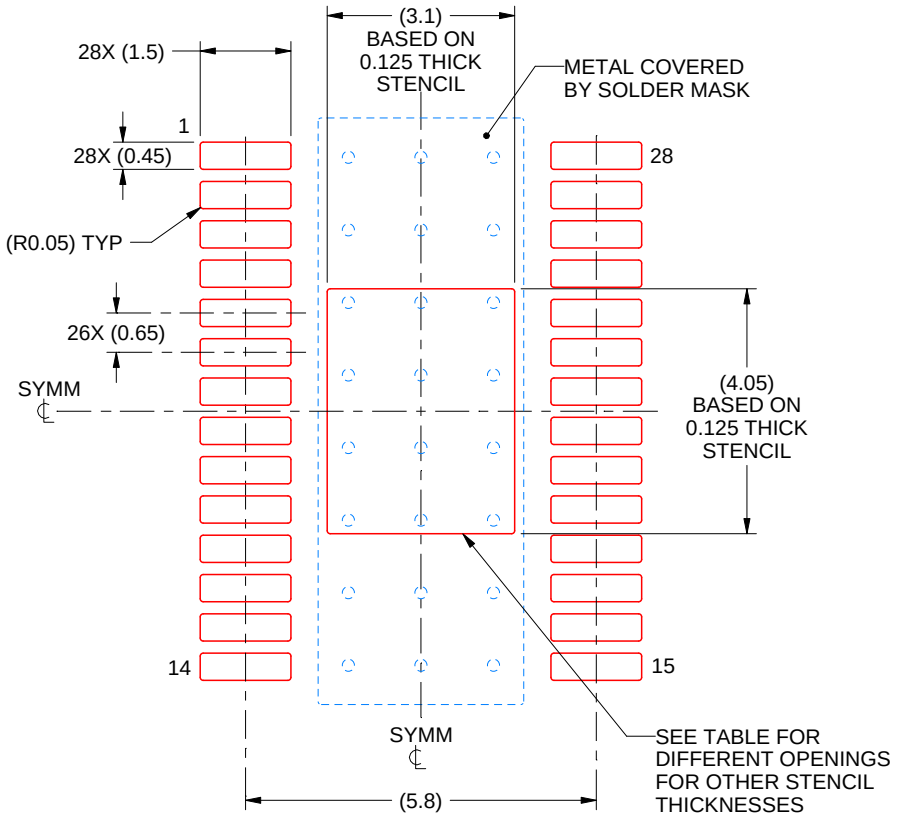


SOLDER MASK DETAILS

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.



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

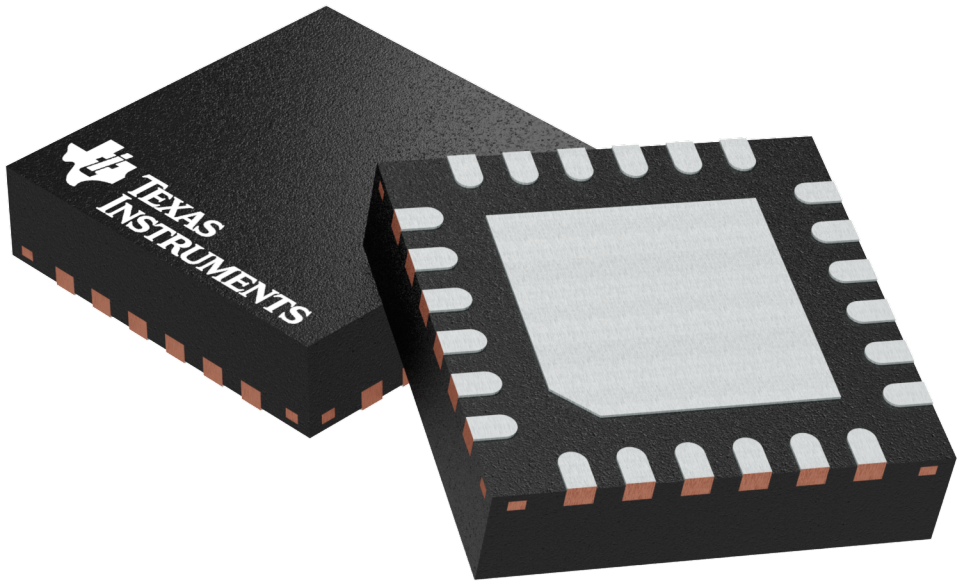
NOTES: (continued)

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.

GENERIC PACKAGE VIEW

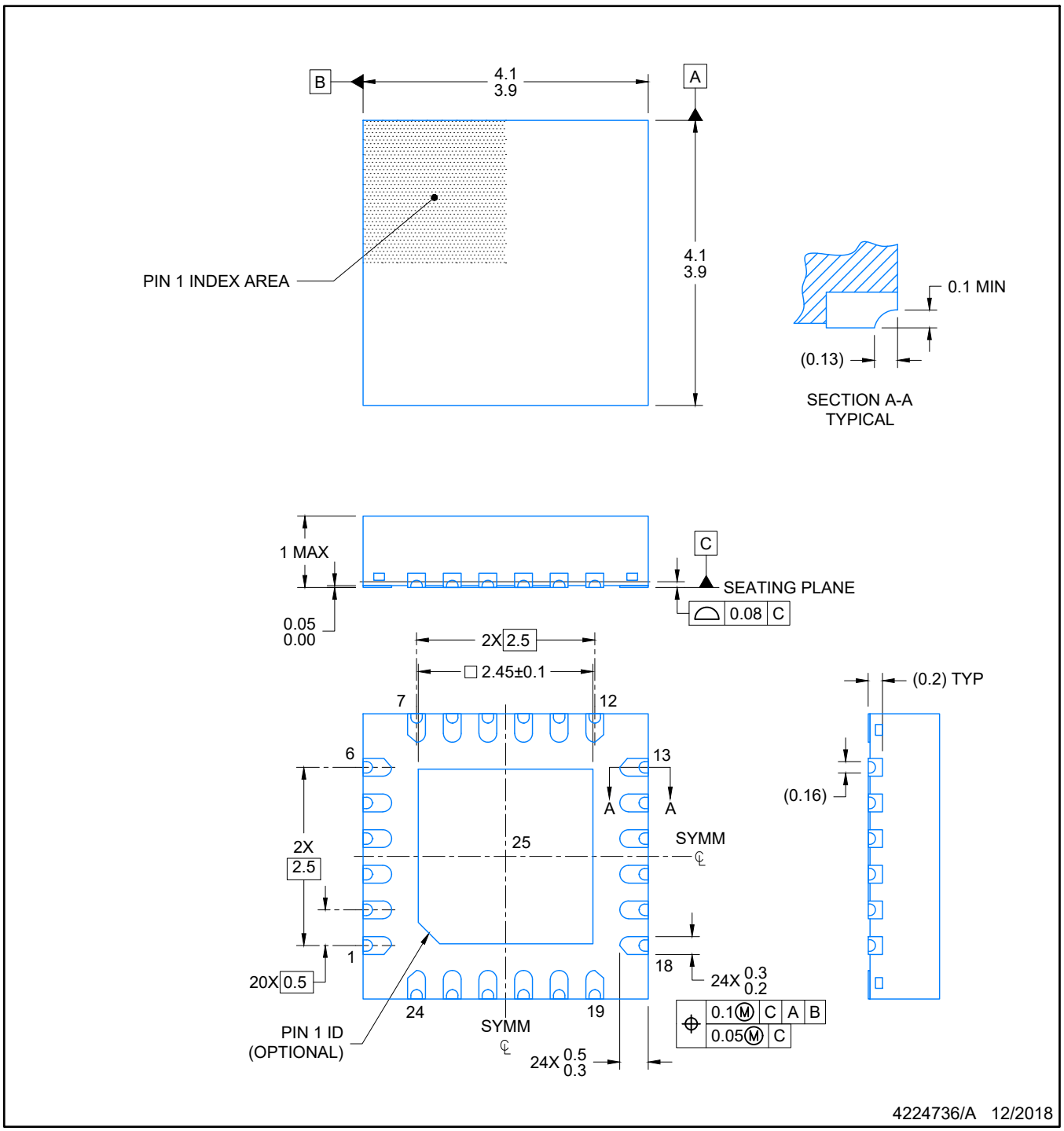
RGE 24 VQFN - 1 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



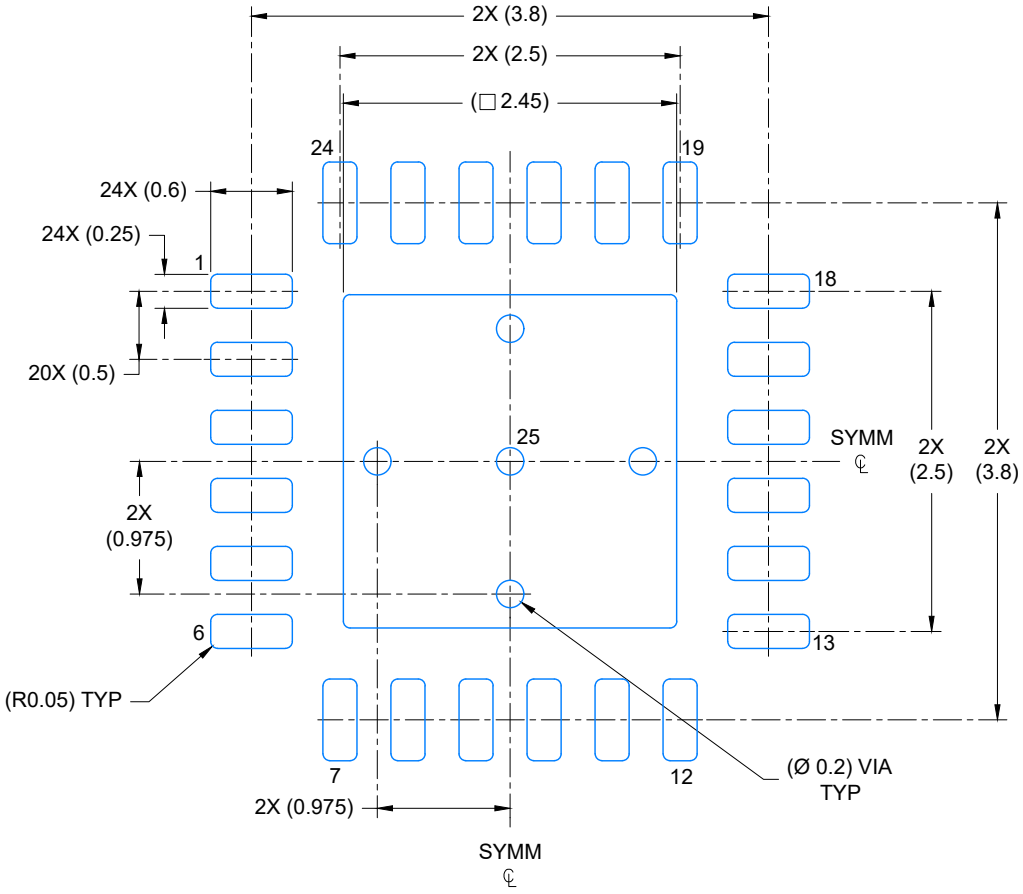
Images above are just a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.

4204104/H

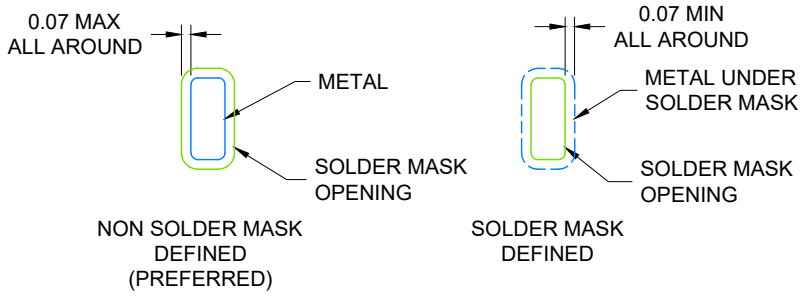


NOTES:

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: 18X

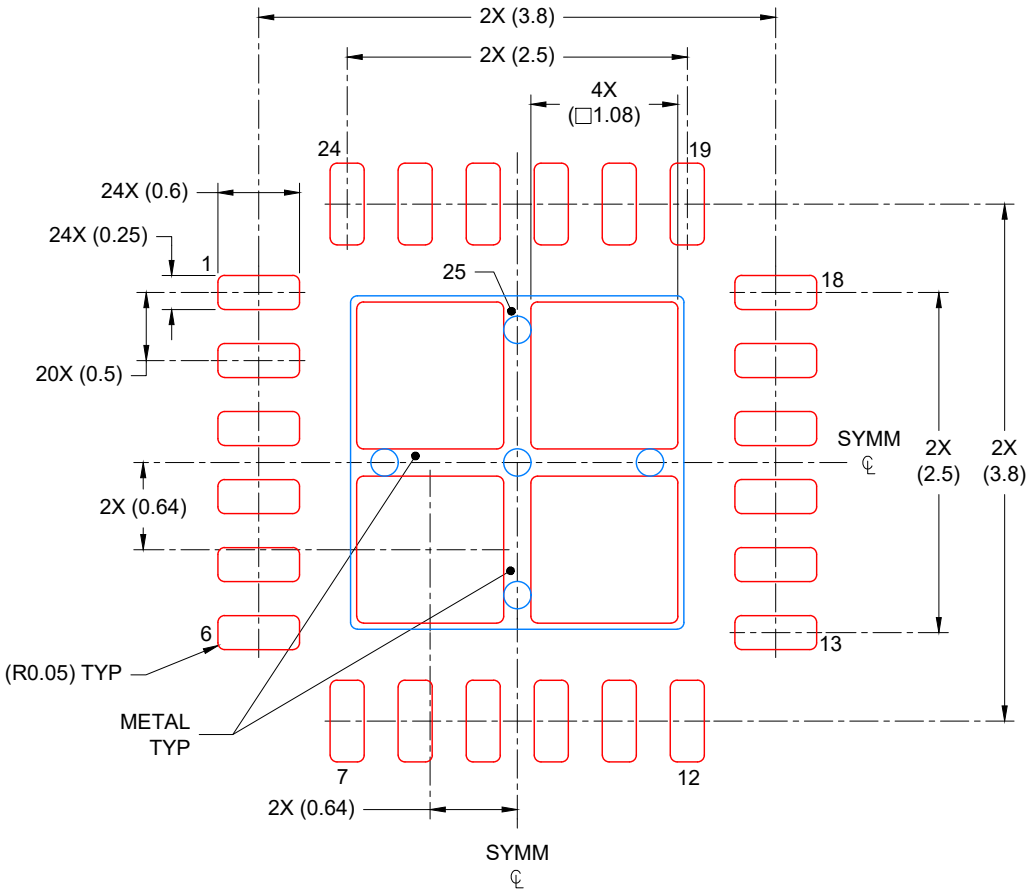


SOLDER MASK DETAILS

4224736/A 12/2018

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
78% PRINTED COVERAGE BY AREA
SCALE: 18X

4224736/A 12/2018

NOTES: (continued)

6. 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

TI“按原样”提供技术和可靠性数据（包括数据表）、设计资源（包括参考设计）、应用或其他设计建议、网络工具、安全信息和其他资源，不保证没有瑕疵且不做出任何明示或暗示的担保，包括但不限于对适销性、与某特定用途的适用性或不侵犯任何第三方知识产权的暗示担保。

这些资源可供使用 TI 产品进行设计的熟练开发人员使用。您将自行承担以下全部责任：(1) 针对您的应用选择合适的 TI 产品，(2) 设计、验证并测试您的应用，(3) 确保您的应用满足相应标准以及任何其他安全、安保法规或其他要求。

这些资源如有变更，恕不另行通知。TI 授权您仅可将这些资源用于研发本资源所述的 TI 产品的相关应用。严禁以其他方式对这些资源进行复制或展示。您无权使用任何其他 TI 知识产权或任何第三方知识产权。对于因您对这些资源的使用而对 TI 及其代表造成的任何索赔、损害、成本、损失和债务，您将全额赔偿，TI 对此概不负责。

TI 提供的产品受 TI 销售条款)、TI 通用质量指南 或 ti.com 上其他适用条款或 TI 产品随附的其他适用条款的约束。TI 提供这些资源并不会扩展或以其他方式更改 TI 针对 TI 产品发布的适用的担保或担保免责声明。 除非德州仪器 (TI) 明确将某产品指定为定制产品或客户特定产品，否则其产品均为按确定价格收入目录的标准通用器件。

TI 反对并拒绝您可能提出的任何其他或不同的条款。

最后更新日期：2025 年 10 月