

# 具有超低功耗的 TLC6983 48x16 共阴极矩阵 LED 显示驱动器

## 1 特性

- 支持分立式  $V_{CC}$  和  $V_{R/G/B}$  电源
  - $V_{CC}$  电压范围：2.5V - 5.5V
  - $V_{R/G/B}$  电压范围：2.5V - 5.5V
- 48 个电流源通道，范围从 0.2mA 到 20mA
  - 通道间精度：±0.5% (典型值)，±2% (最大值)；器件间一致性：±0.5% (典型值)，±2% (最大值)
  - 低拐点电压：当  $I_{OUT} = 5mA$  时为 0.26V (最大值)
  - 3 位 (8 级) 全局亮度控制
  - 8 位 (256 级) 色彩亮度控制
  - 最大 16 位 (65536 级) PWM 灰度控制
- 带  $190m\Omega$   $R_{DS(ON)}$  的 16 个线路扫描开关
- 超低功耗
  - 低至 2.5V 的独立  $V_{CC}$
  - 超低  $I_{CC}$  (低至 3.9mA)，具有 50MHz GCLK
  - 智能省电模式
- 内置 SRAM 支持 1 至 32 路复用
  - 支持 16 路复用的单个器件可驱动  $32 \times 16$  LED 或  $16 \times 16$  RGB 像素
  - 支持 32 路复用的两个器件堆叠后可驱动  $96 \times 32$  LED 或  $32 \times 32$  RGB 像素
- 高速和低 EMI 连续时钟串行接口 (CCSI)
  - 仅三条总线：SCLK/SIN/SOUT
  - 具有双沿传输机制的外部 25MHz (最大值) SCLK (内部 50MHz)
  - 支持 40MHz 至 160MHz 范围 GCLK 的内部倍频器
- 经优化的显示性能

- 去除上下重影
- 低灰度增强
- LED 开/短路/弱短路检测和消除

## 2 应用

- 窄像素间距 (NPP) LED 显示屏
- Mini/Micro-LED 产品

## 3 说明

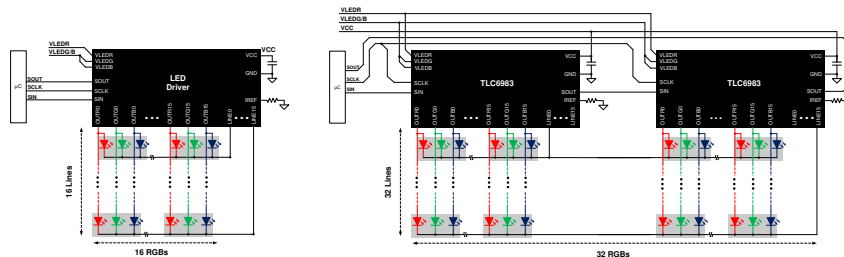
随着窄像素间距 LED 显示或 Mini/Micro-LED 产品的像素密度不断提高，我们迫切需要使用 LED 驱动器来应对各种关键挑战，即通过超高集成度满足严格的布板空间限制，通过超低功耗更大程度地降低系统级功耗，通过全新的接口实现高数据刷新率并减少 EMI 的影响，通过出色的显示性能满足不断增长的高显示质量的需求。

TLC6983 是高度集成的共阴极矩阵 LED 显示驱动器，有 48 个恒流源和 16 个扫描 FET。单个 TLC6983 能驱动  $16 \times 16$  RGB LED 像素，两个 TLC6983 堆叠后可驱动  $32 \times 32$  RGB LED 像素。为实现低功耗，该器件可通过其共阴极结构为红色、绿色和蓝色 LED 提供分立式电源。此外，通过超低的工作电压范围 ( $V_{CC}$  低至 2.5V) 和超低的工作电流 ( $I_{CC}$  低至 3.9mA)，TLC6983 可显著降低运行功率。

### 器件信息

| 器件型号    | 封装 <sup>(1)</sup> | 封装尺寸 (标称值) |
|---------|-------------------|------------|
| TLC6983 | VQFN (76)         | 9mm x 9mm  |
|         | BGA (96)          | 6mm x 6mm  |

(1) 如需了解所有可用封装，请参阅产品说明书末尾的可订购产品附录。



单器件或双器件可堆叠连接的 TLC6983



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## 4 Revision History

| DATE          | REVISION | NOTES            |
|---------------|----------|------------------|
| December 2020 | *        | Initial release. |

## 5 Description (continued)

The TLC6983 implements a high speed dual-edge transmission interface to support high device count daisy-chained and high refresh rate while minimizing electrical-magnetic interference (EMI). The device supports up to 25-MHz SCLK (external) and up to 160-MHz GCLK (internal). Meanwhile, the device integrates enhanced circuits and intelligent algorithms to solve the various display challenges in Narrow Pixel Pitch (NPP) LED display applications and Mini / Micro-LED products: Dim at the first scan line, Upper and downside ghosting, Non-uniformity in low grayscale, Coupling, and Caterpillar caused by open or short LEDs, which make the TLC6983 a perfect choice in such applications.

The TLC6983 also implements LED open/weak short/short detections and removals during operations and can also report this information to the accompanying digital processor.

## 6 Device and Documentation Support

### 6.1 接收文档更新通知

要接收文档更新通知，请导航至 [ti.com](http://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。

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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。

### 6.5 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。

## 7 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.

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## PACKAGING INFORMATION

| Orderable part number       | Status<br>(1) | Material type<br>(2) | Package   Pins   | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C) | Part marking<br>(6) |
|-----------------------------|---------------|----------------------|------------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| <a href="#">TLC6983RRFR</a> | Active        | Production           | VQFN (RRF)   76  | 2000   LARGE T&R      | Yes         | NIPDAU                               | Level-3-260C-168 HR               | -40 to 85    | TLC6983             |
| TLC6983RRFR.A               | Active        | Production           | VQFN (RRF)   76  | 2000   LARGE T&R      | Yes         | NIPDAU                               | Level-3-260C-168 HR               | -40 to 85    | TLC6983             |
| <a href="#">TLC6983ZXLR</a> | Active        | Production           | NFBGA (ZXL)   96 | 2500   LARGE T&R      | Yes         | SNAGCU                               | Level-3-260C-168 HR               | -40 to 85    | TLC6983             |
| TLC6983ZXLR.A               | Active        | Production           | NFBGA (ZXL)   96 | 2500   LARGE T&R      | Yes         | SNAGCU                               | Level-3-260C-168 HR               | -40 to 85    | TLC6983             |

<sup>(1)</sup> **Status:** For more details on status, see our [product life cycle](#).

<sup>(2)</sup> **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.

<sup>(3)</sup> **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

<sup>(4)</sup> **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.

<sup>(5)</sup> **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.

<sup>(6)</sup> **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.

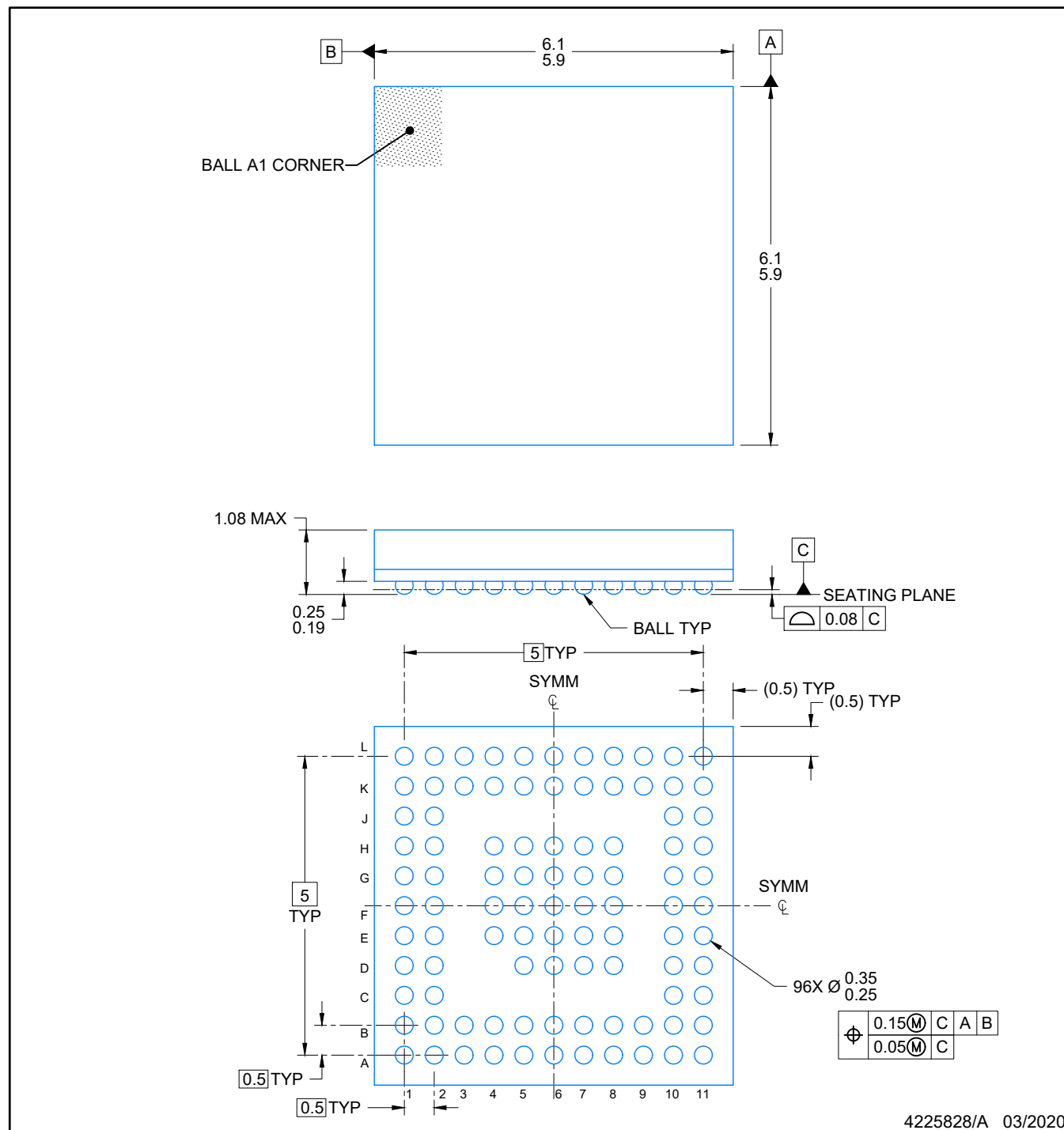
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## PACKAGE OUTLINE

## NFBGA - 1.08 mm max height

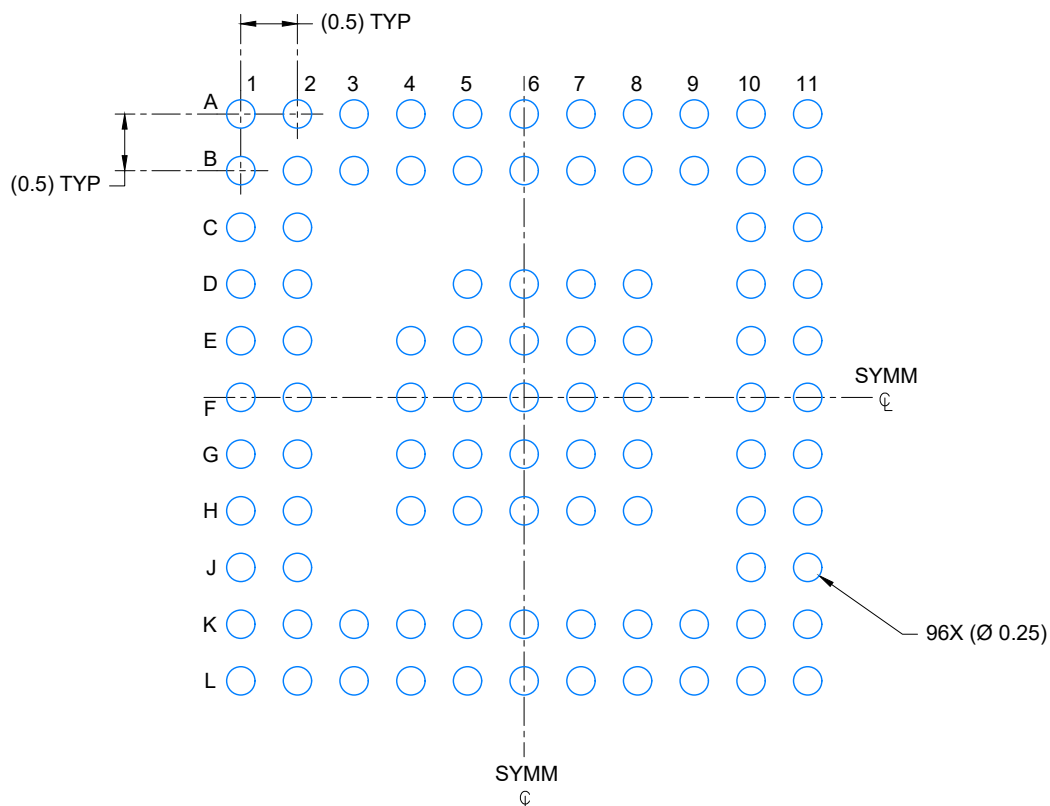
## PLASTIC BALL GRID ARRAY



NOTES:

NanoFree is a trademark of Texas Instruments.

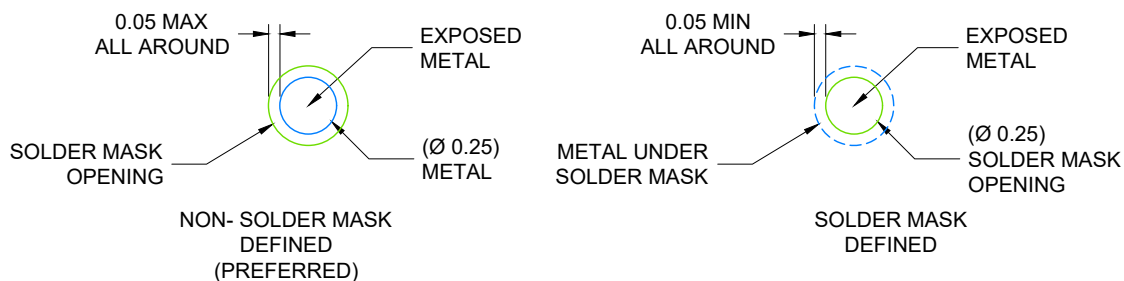
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.



## LAND PATTERN EXAMPLE

EXPOSED METAL SHOWN

SCALE: 15X



## SOLDER MASK DETAILS

NOT TO SCALE

4225828/A 03/2020

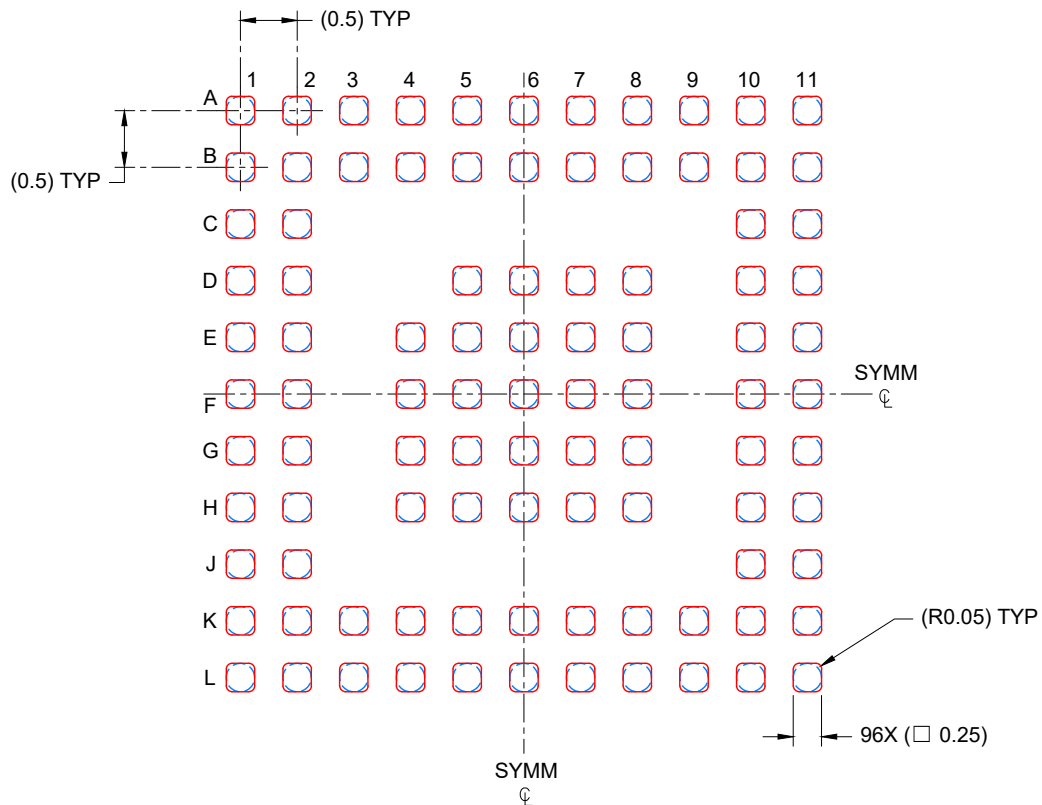
NOTES: (continued)

- Final dimensions may vary due to manufacturing tolerance considerations and also routing constraints. Refer to Texas Instruments Literature number SNVA009 ([www.ti.com/lit/snva009](http://www.ti.com/lit/snva009)).

**ZXL0096A**

**NFBGA - 1.08 mm max height**

## PLASTIC BALL GRID ARRAY



SOLDER PASTE EXAMPLE  
BASED ON 0.1 mm THICK STENCIL  
SCALE: 15X

4225828/A 03/2020

NOTES: (continued)

4. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release.

## GENERIC PACKAGE VIEW

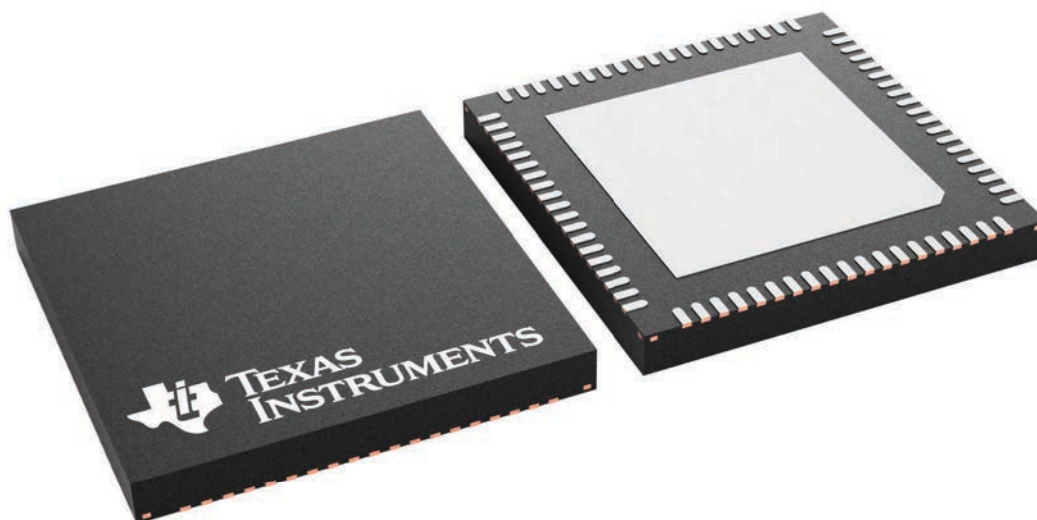
**RRF 76**

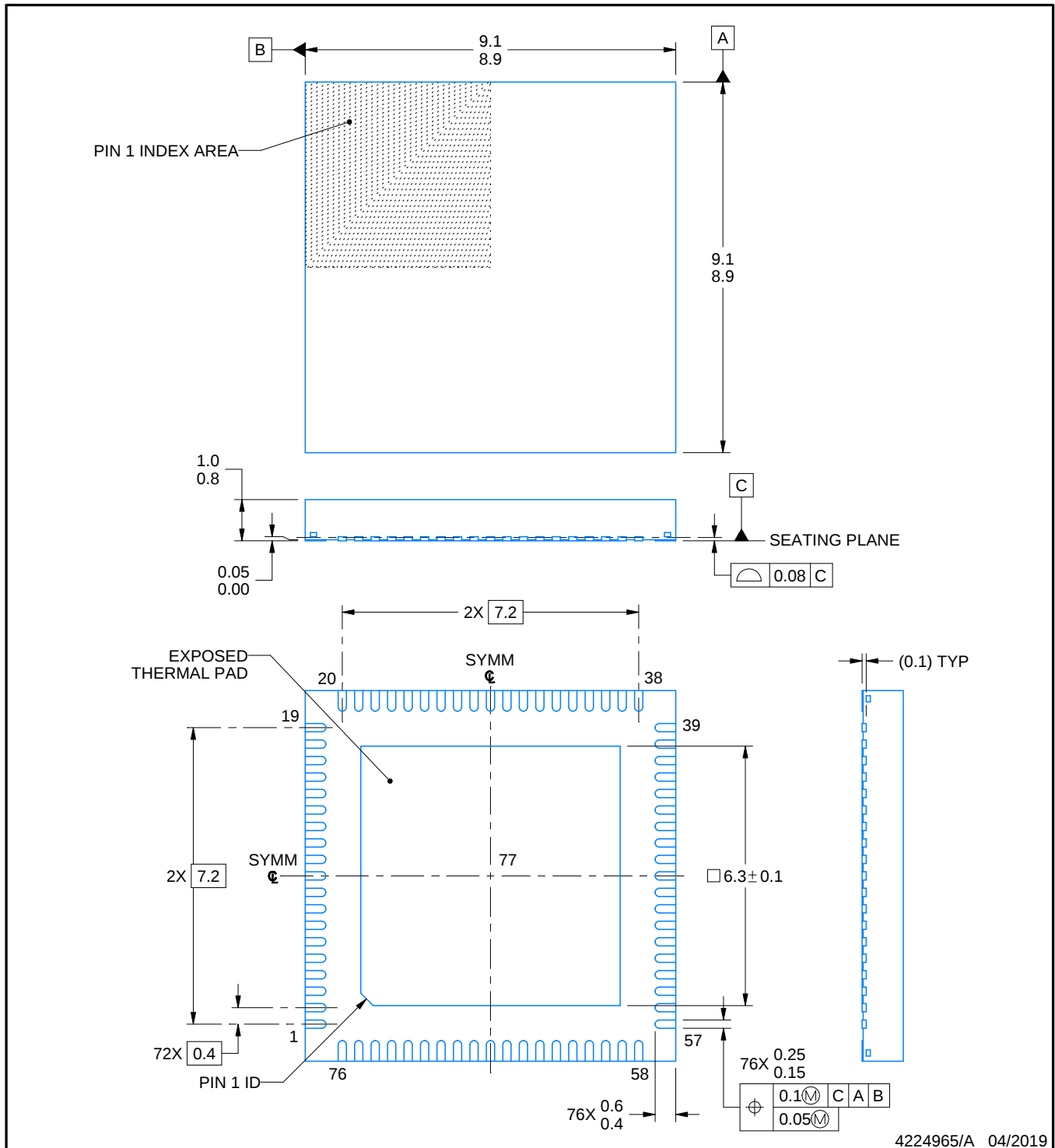
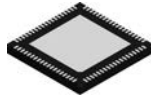
**VQFN - 1 mm max height**

9 x 9, 0.4 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.





4224965/A 04/2019

## NOTES:

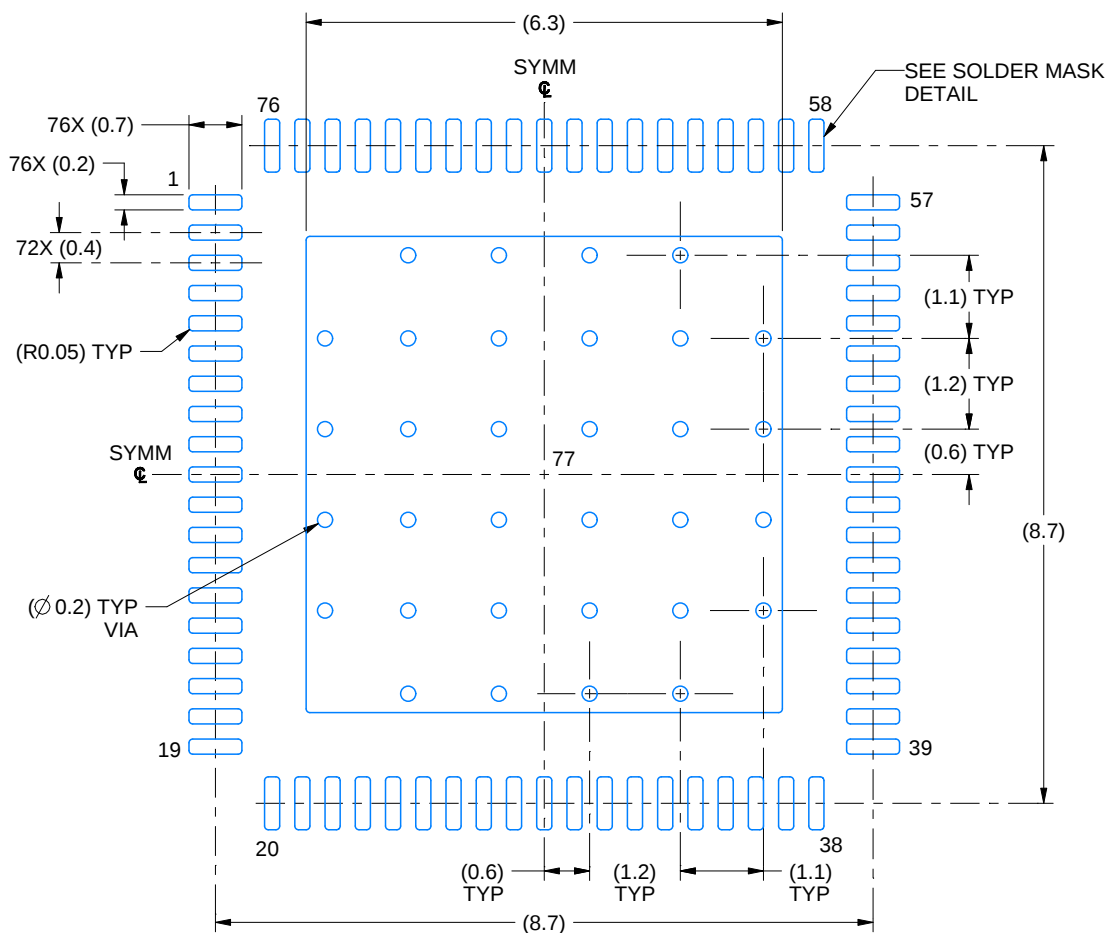
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.

# EXAMPLE BOARD LAYOUT

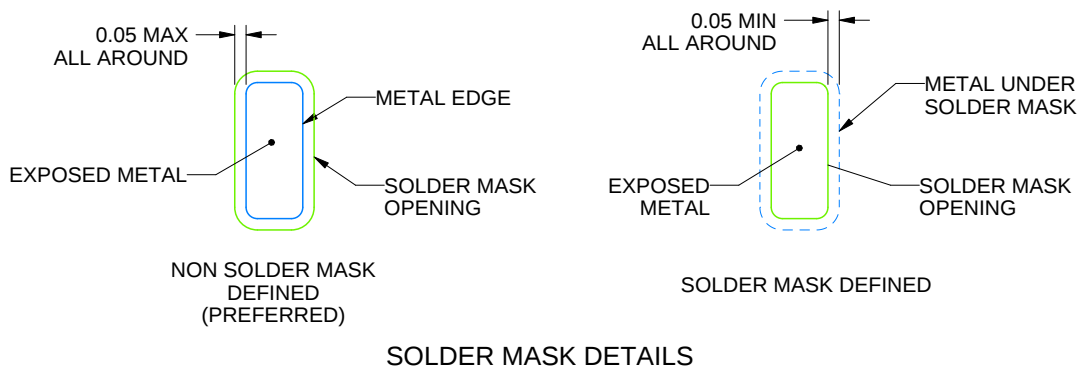
RRF0076A

VQFN - 1 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE: 10X



4224965/A 04/2019

NOTES: (continued)

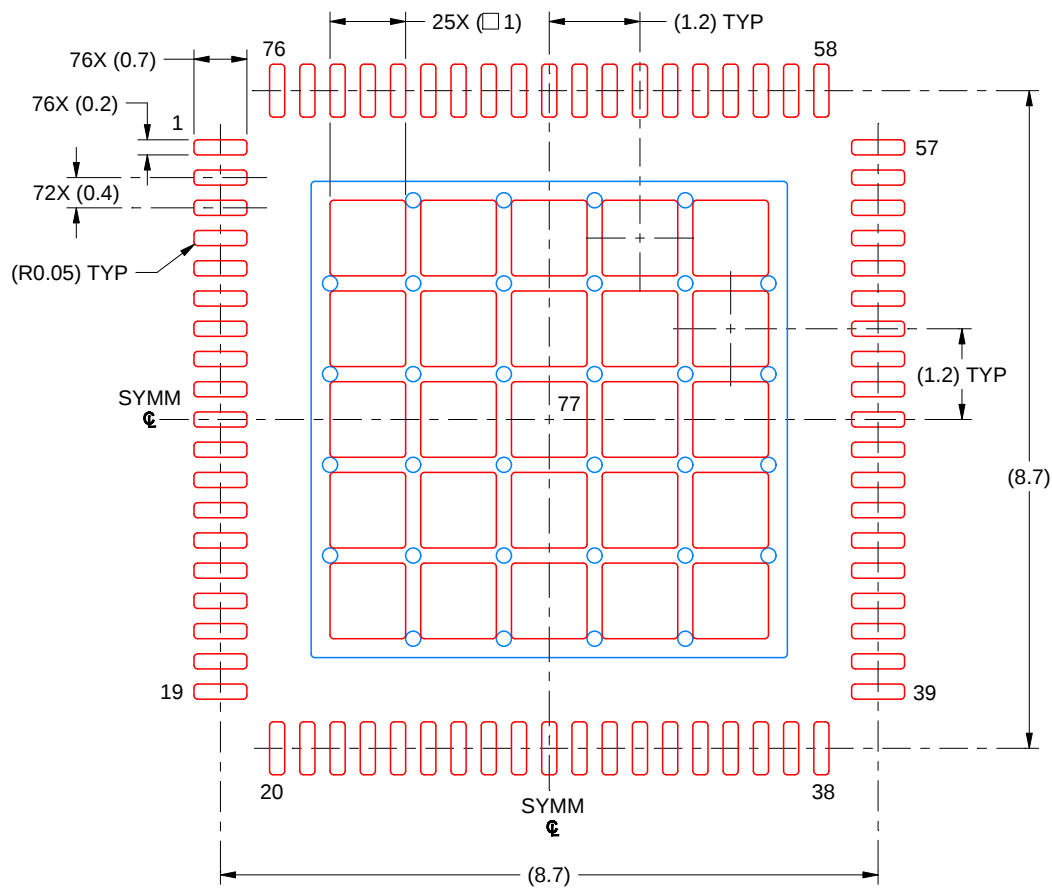
4. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 ([www.ti.com/lit/sluea271](http://www.ti.com/lit/sluea271)).
5. Vias are optional depending on application, refer to device data sheet. If any vias are implemented,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

# EXAMPLE STENCIL DESIGN

RRF0076A

VQFN - 1 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



SOLDER PASTE EXAMPLE  
BASED ON 0.125 MM THICK STENCIL  
SCALE: 10X

EXPOSED PAD 77  
63% PRINTED SOLDER COVERAGE BY AREA UNDER PACKAGE

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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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