

具有两个 MIPI CSI-2 端口且适用于 2MP/60fps 摄像头、雷达和其他传感器的 DS90UB960-Q1 四路 FPD-Link III 解串器集线器

1 特性

- 符合 AEC-Q100 的汽车应用 标准：
 - 器件温度等级 2 级：环境工作温度范围为 -40°C 至 $+115^{\circ}\text{C}$
 - 器件 HBM ESD 分类等级 $\pm 4\text{kV}$
 - 器件 CDM ESD 分类等级 C5
- 四路解串器集线器同时从最多 4 个传感器聚合数据
- 支持 200 万像素传感器，可在 60Hz 帧速率下支持全高清 1080p 分辨率
- 多摄像头同步
- 符合 MIPI DPHY 版本 1.2/CSI-2 版本 1.3 标准
 - 2 个 CSI-2 输出端口
 - 每个 CSI-2 端口支持 1、2、3、4 个数据通道
 - CSI-2 数据速率可扩展：每个数据通道支持 400Mbps/800Mbps/1.2Gbps/1.5Gbps/1.6Gbps
 - 端口复制模式
- 超低数据和控制路径延迟
- 支持单端同轴或屏蔽双绞线 (STP) 电缆
- 自适应接收均衡
- 具有快速模式增强版（高达 1Mbps）的 I2C
- 用于传感器同步和诊断的灵活 GPIO
- 可与 DS90UB953-Q1、DS90UB913A-Q1、DS90UB933-Q1 串行器兼容
- 内部可编程帧同步发生器
- 线路故障检测和高级诊断

2 应用

- 汽车 ADAS
 - 后视摄像头 (RVC)
 - 环视系统 (SVS)
 - 摄像头监控系统 (CMS)
 - 前视摄像头 (FC)
 - 驾驶员监控系统 (DMS)
 - 卫星雷达、飞行时间 (ToF) 和激光雷达传感器模块
 - 传感器融合
- 安全和监控

3 说明

DS90UB960-Q1 是一款多功能摄像头集线器，可通过 FPD-Link III 接口收集从 4 个独立视频数据流接收到的串行摄像头数据。与 DS90UB953-Q1 串行器配对时，DS90UB960-Q1 可接收来自成像器的数据，可在 60Hz 帧速率下支持全高清 1080p/2MP 分辨率。接收的数据将聚合至符合 MIPI CSI-2 标准并与下游处理器互连的输出端。该器件还配有第二个 MIPI CSI-2 输出端口，可提供额外带宽或提供第二个复制输出以便进行数据记录和并行处理。

DS90UB960-Q1 包括 4 个 FPD-Link III 解串器，每个均支持通过具有成本效益的 50Ω 单端同轴或 100Ω 差分 STP 电缆进行连接。接收均衡器会自动适应以补偿电缆损耗特性，包括随时间推移而出现的劣化。

每个 FPD-Link III 接口还包括一个单独的低延迟双向控制通道，该通道可连续传送 I2C、GPIO 和其他控制信息。通用 I/O 信号（如摄像头同步和诊断 特性 所需的信号）也会利用此双向控制通道。

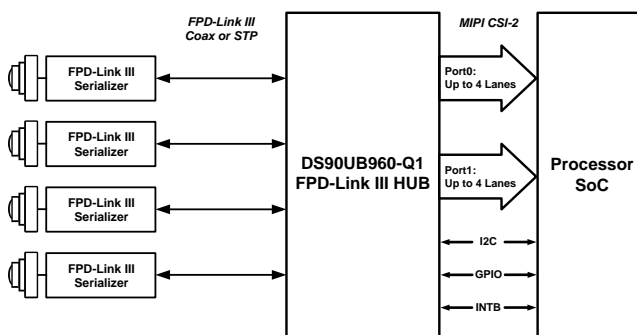
DS90UB960-Q1 符合 AEC-Q100 的汽车应用 要求，并采用具有成本效益且节省空间的 VQFN-64 封装。

器件信息⁽¹⁾

| 器件型号 | 封装 | 封装尺寸 (标称值) |
|--------------|-----------|-----------------|
| DS90UB960-Q1 | VQFN (64) | 9.00mm x 9.00mm |

(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。

典型应用原理图



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4 修订历史记录

注：之前版本的页码可能与当前版本有所不同。

| Changes from Original (September 2016) to Revision A | Page |
|---|-------------|
| • 已更改 将“产品预览”更改为“生产数据” | 1 |

5 器件和文档支持

5.1 文档支持

5.1.1 相关文档

请参阅如下相关文档：

- 《在 [DS90UB913A](#) 设计中进行同轴电缆供电》
- 《通过具有双向控制通道的 [DS90UB913/4 FPD-Link III](#) 进行 I2C 通信》
- 《通过具有双向控制通道的 [FPD-Link III](#) 进行 I2C 通信》
- 《[I2C](#) 总线上拉电阻器计算》

5.2 接收文档更新通知

要接收文档更新通知，请导航至德州仪器 TI.com.cn 上的器件产品文件夹。单击右上角的通知我进行注册，即可每周接收产品信息更改摘要。有关更改的详细信息，请查看任意已修订文档中包含的修订历史记录。

5.3 社区资源

下列链接提供到 TI 社区资源的连接。链接的内容由各个分销商“按照原样”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》。

TI E2E™ 在线社区 [TI 的工程师对工程师 \(E2E\) 社区](#)。此社区的创建目的在于促进工程师之间的协作。在 e2e.ti.com 中，您可以咨询问题、分享知识、拓展思路并与同行工程师一道帮助解决问题。

设计支持 [TI 参考设计支持](#) 可帮助您快速查找有帮助的 E2E 论坛、设计支持工具以及技术支持的联系信息。

5.4 商标

E2E is a trademark of Texas Instruments.

5.5 静电放电警告



ESD 可能会损坏该集成电路。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措施和安装程序，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。

5.6 Glossary

[SLYZ022](#) — *TI Glossary*.

This glossary lists and explains terms, acronyms, and definitions.

6 机械、封装和可订购信息

以下页面包括机械、封装和可订购信息。这些信息是指定器件的最新可用数据。这些数据发生变化时，我们可能不会另行通知或修订此文档。如欲获取此产品说明书的浏览器版本，请参阅左侧的导航栏。

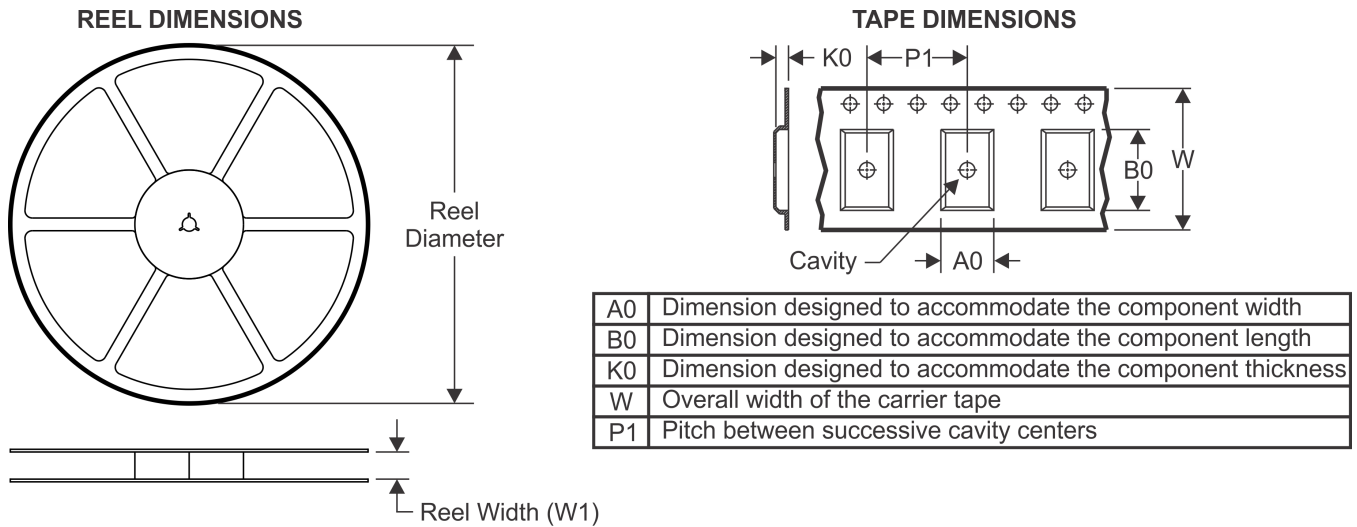
DS90UB960-Q1

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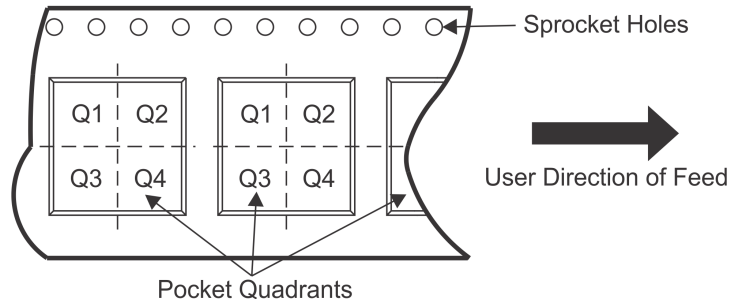
www.ti.com.cn
6.1 Package Option Addendum
6.1.1 Packaging Information

| Orderable Device | Status | Package Type | Package Drawing | Pins | Package Qty | Eco Plan | Lead/Ball Finish | MSL Peak Temp | Op Temp (°C) | Device Marking |
|------------------|---------|--------------|-----------------|------|-------------|----------|------------------|---------------|--------------|----------------|
| DS90UB960WRTDRQ1 | PREVIEW | VQFN | RTD | 64 | 2500 | TBD | Call TI | Call TI | -40 to 115 | |
| DS90UB960WRTDTQ1 | PREVIEW | VQFN | RTD | 64 | 250 | TBD | Call TI | Call TI | -40 to 115 | |

6.1.2 Tape and Reel Information



QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



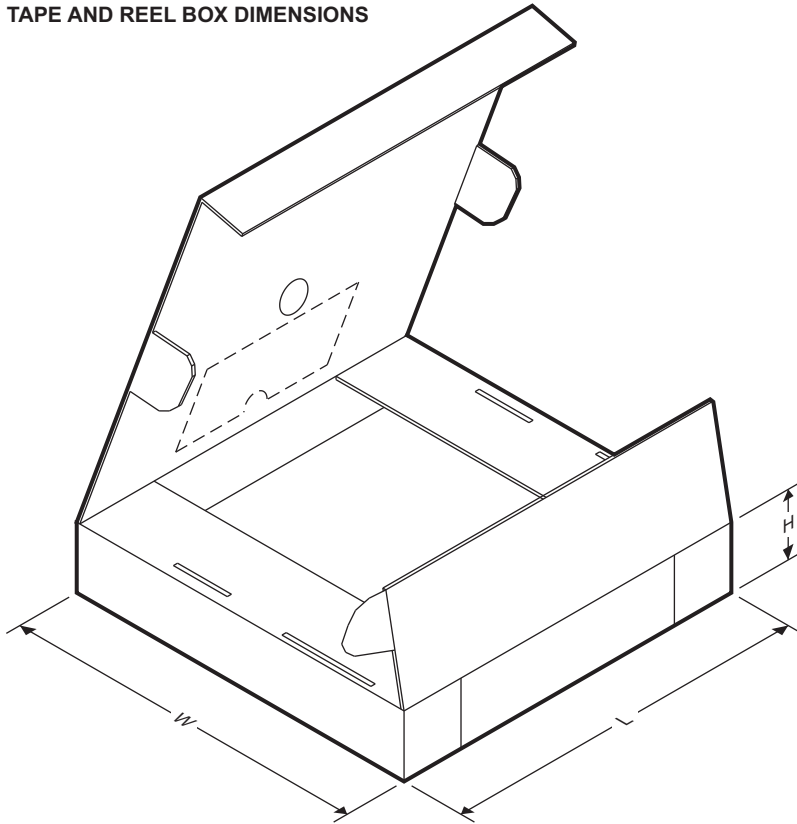
| Device | Package Type | Package Drawing | Pins | SPQ | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|--------|--------------|-----------------|------|-----|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| | | | | | | | | | | | | |

DS90UB960-Q1

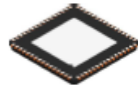
ZHCSBM2A – SEPTEMBER 2016 – REVISED JUNE 2017

www.ti.com.cn

TAPE AND REEL BOX DIMENSIONS



| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|--------|--------------|-----------------|------|-----|-------------|------------|-------------|
| | | | | | | | |

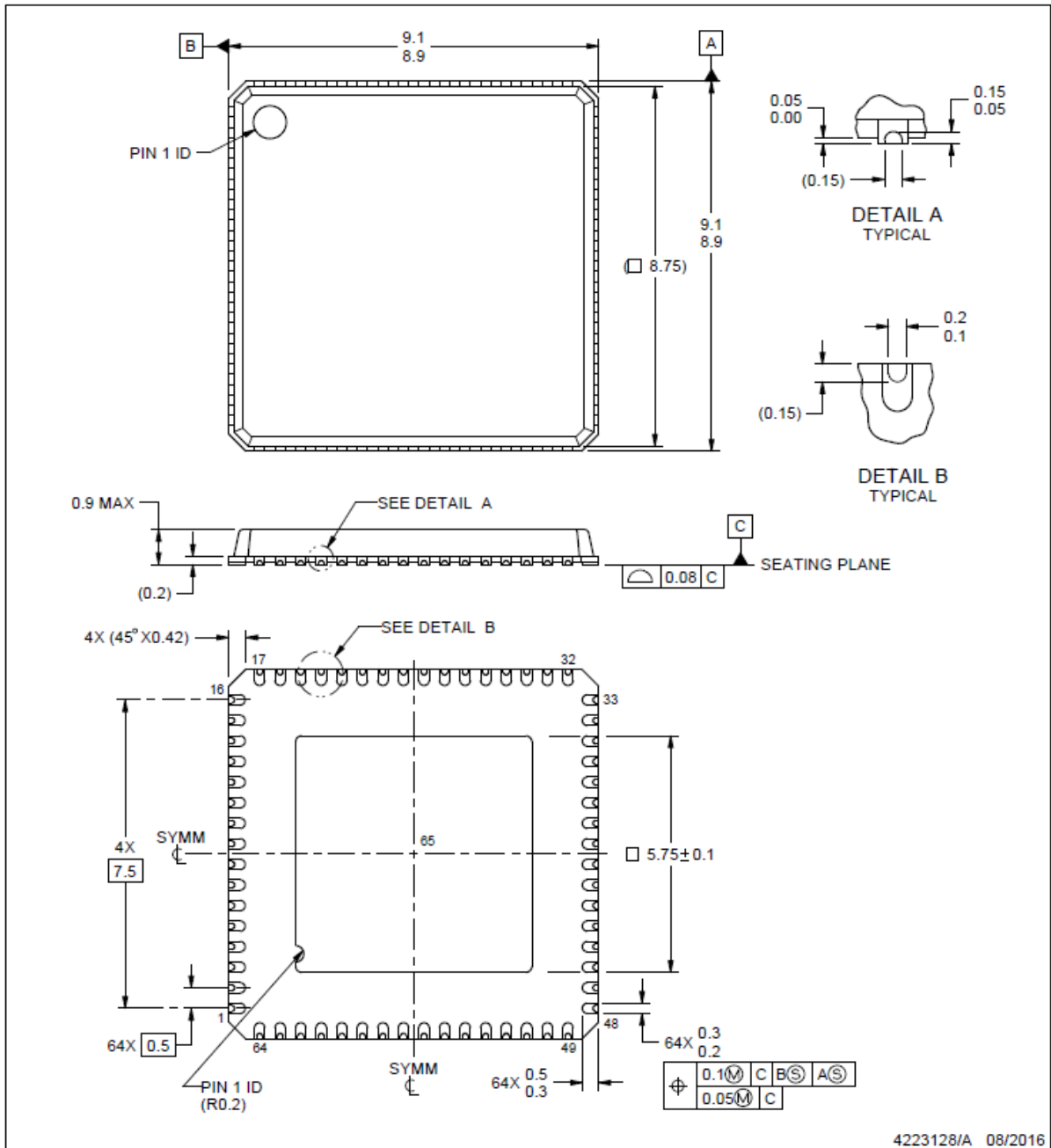


RTD0064F

PACKAGE OUTLINE

VQFN - 0.9 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



4223128/A 08/2016

NOTES:

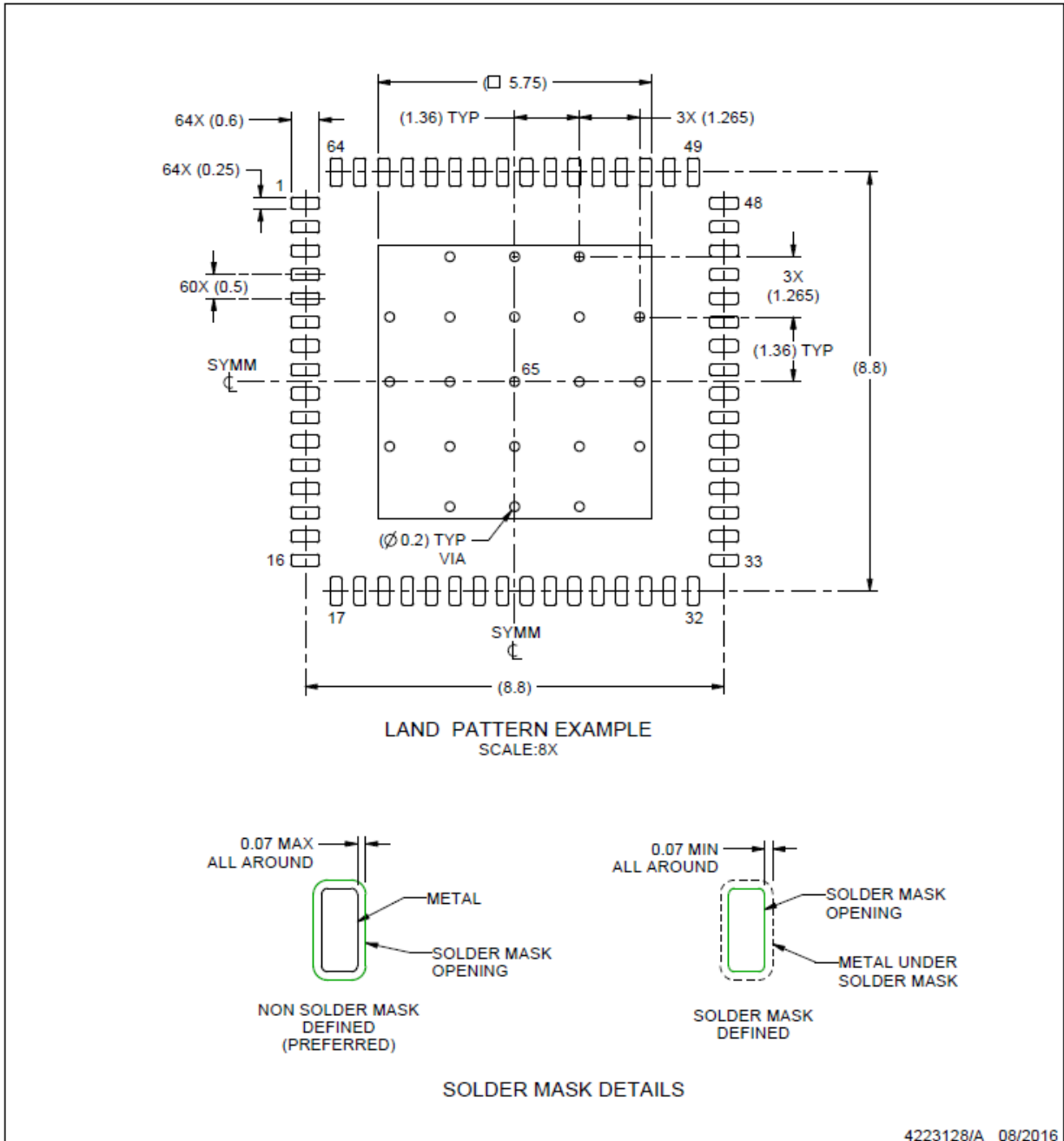
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.

EXAMPLE BOARD LAYOUT

RTD0064F

VQFN - 0.9 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



NOTES: (continued)

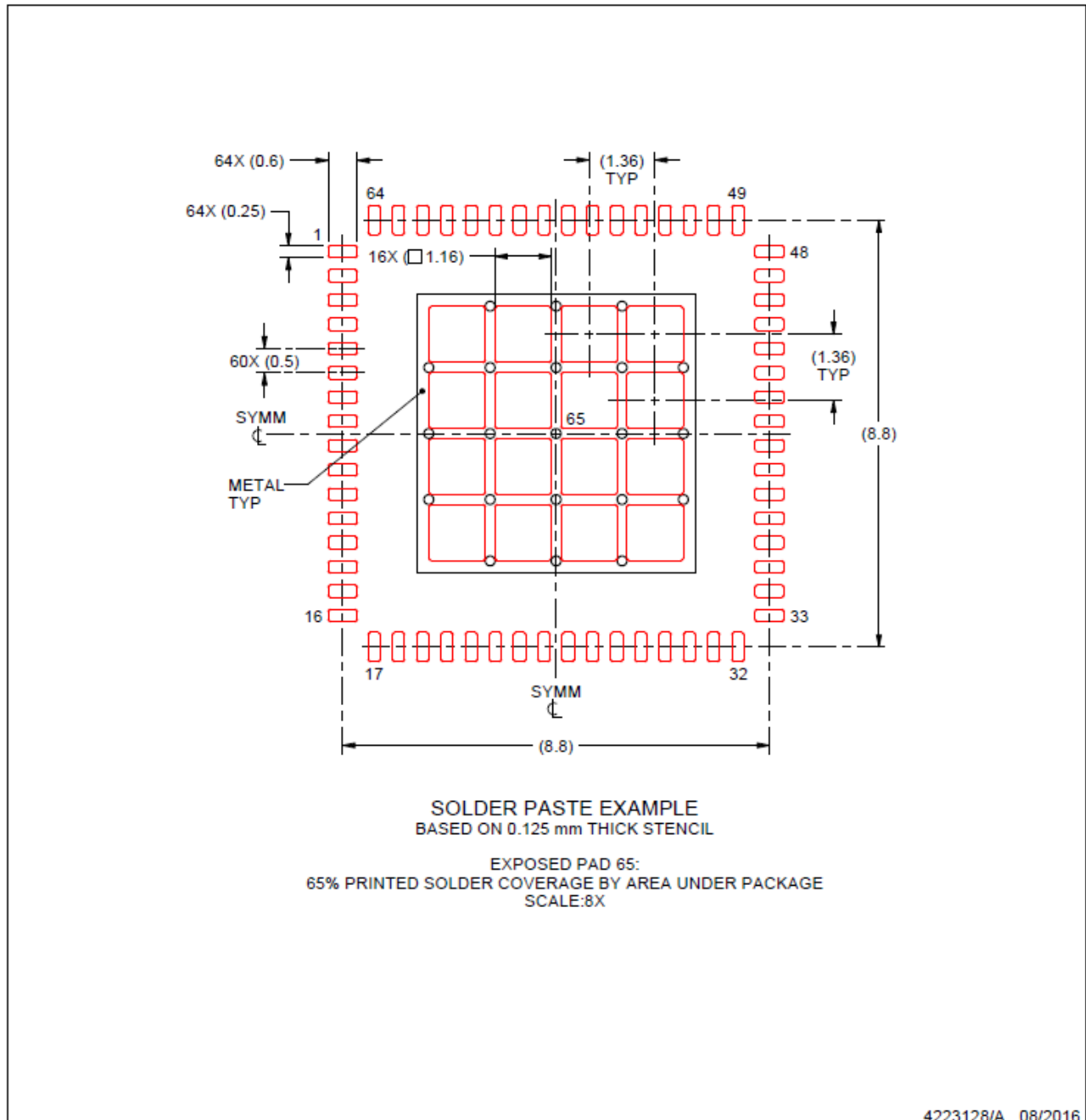
4. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/slua271).
5. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.

EXAMPLE STENCIL DESIGN

RTD0064F

VQFN - 0.9 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



NOTES: (continued)

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

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 |
|------------------|---------------|--------------|-----------------|------|-------------|-----------------|--------------------------------------|----------------------|--------------|-------------------------|---------|
| TPS65233RTER | ACTIVE | WQFN | RTE | 16 | 3000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | 65233 | Samples |
| TPS65233RTET | ACTIVE | WQFN | RTE | 16 | 250 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | 65233 | 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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TAPE AND REEL INFORMATION

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 |
|--------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TPS65233RTER | WQFN | RTE | 16 | 3000 | 330.0 | 12.4 | 3.3 | 3.3 | 1.1 | 8.0 | 12.0 | Q2 |
| TPS65233RTER | WQFN | RTE | 16 | 3000 | 330.0 | 12.4 | 3.3 | 3.3 | 1.1 | 8.0 | 12.0 | Q2 |
| TPS65233RTET | WQFN | RTE | 16 | 250 | 180.0 | 12.4 | 3.3 | 3.3 | 1.1 | 8.0 | 12.0 | Q2 |
| TPS65233RTET | WQFN | RTE | 16 | 250 | 180.0 | 12.4 | 3.3 | 3.3 | 1.1 | 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) |
|--------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TPS65233RTER | WQFN | RTE | 16 | 3000 | 335.0 | 335.0 | 25.0 |
| TPS65233RTER | WQFN | RTE | 16 | 3000 | 367.0 | 367.0 | 35.0 |
| TPS65233RTET | WQFN | RTE | 16 | 250 | 182.0 | 182.0 | 20.0 |
| TPS65233RTET | WQFN | RTE | 16 | 250 | 210.0 | 185.0 | 35.0 |

GENERIC PACKAGE VIEW

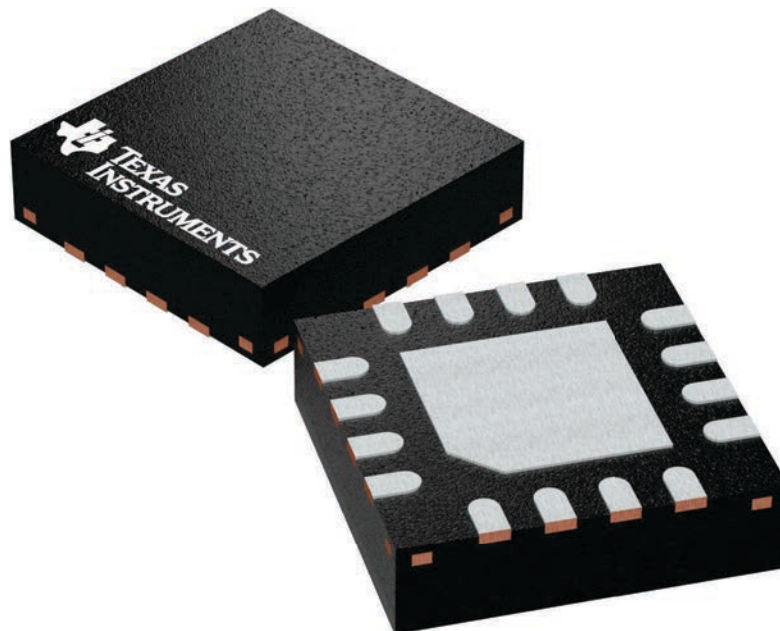
RTE 16

WQFN - 0.8 mm max height

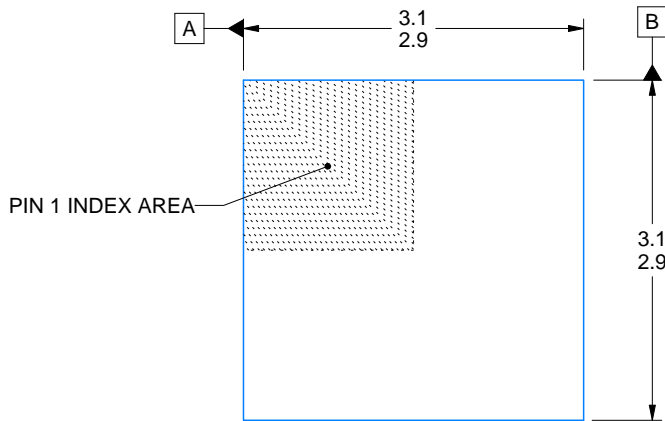
3 x 3, 0.5 mm pitch

PLASTIC QUAD FLATPACK - NO LEAD

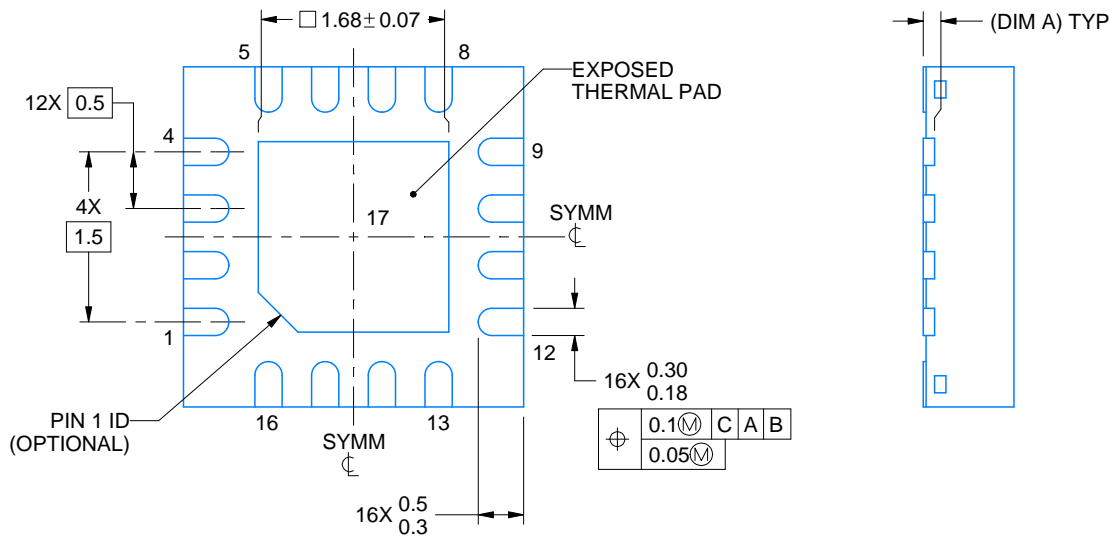
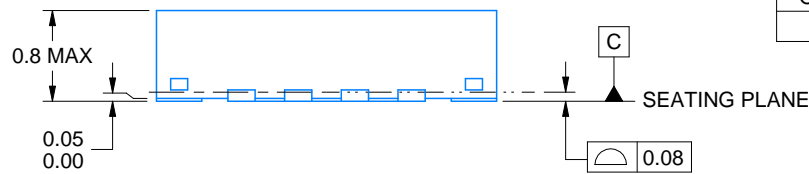
This image is a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.



4225944/A



| SIDE WALL METAL THICKNESS DIM A | |
|---------------------------------|----------|
| OPTION 1 | OPTION 2 |
| 0.1 | 0.2 |



4219117/B 04/2022

NOTES:

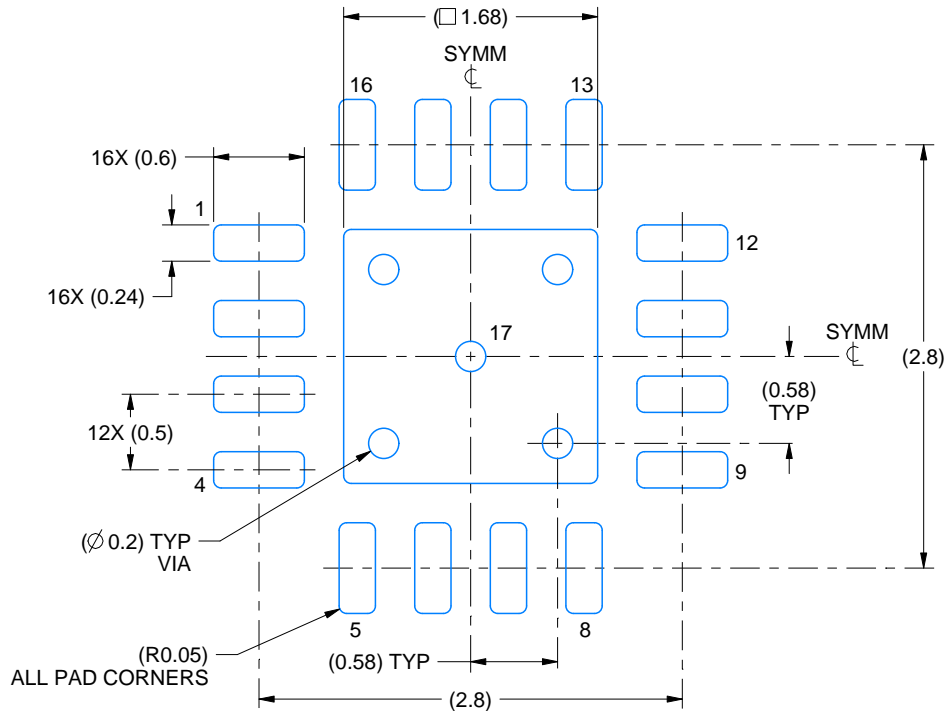
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.

EXAMPLE BOARD LAYOUT

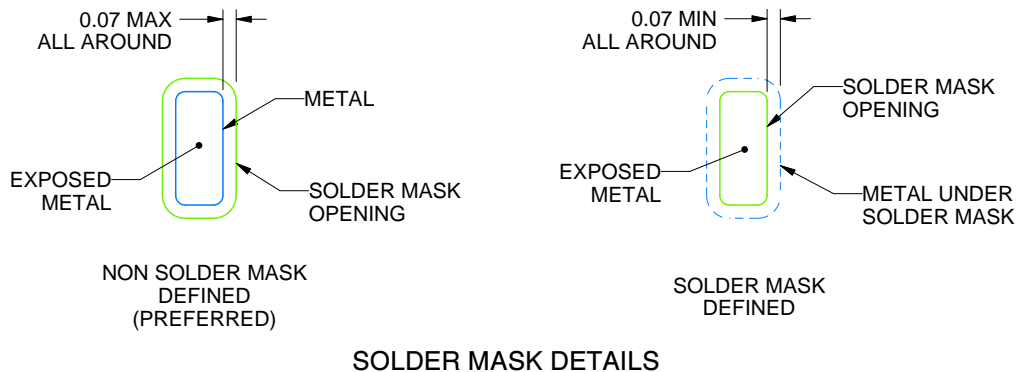
RTE0016C

WQFN - 0.8 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:20X



SOLDER MASK DETAILS

4219117/B 04/2022

NOTES: (continued)

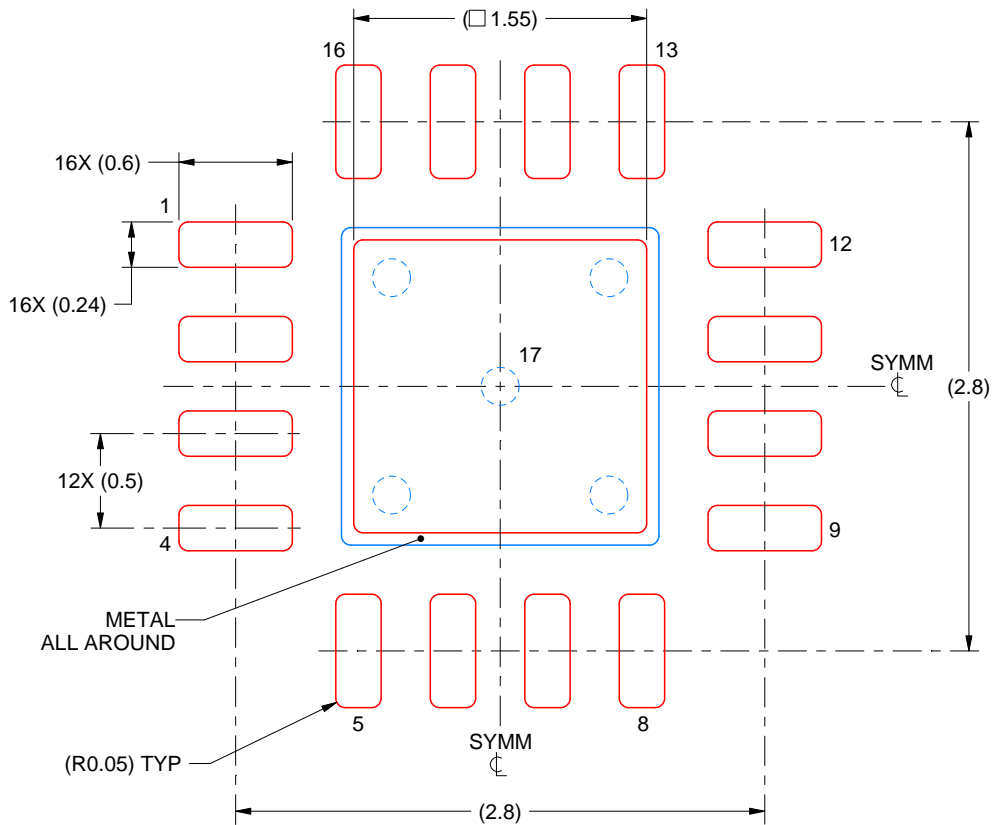
- This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/slua271).
- Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.

EXAMPLE STENCIL DESIGN

RTE0016C

WQFN - 0.8 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL

EXPOSED PAD 17:
85% PRINTED SOLDER COVERAGE BY AREA UNDER PACKAGE
SCALE:25X

4219117/B 04/2022

NOTES: (continued)

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

重要声明和免责声明

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