TEXAS INSTRUMENTS
BQ79656-Q1, BQ79654-Q1, BQ79652-Q1
ZHCSND5A – MAY 2021 – REVISED JUNE 2022

BQ79656-Q1、BQ79654-Q1、BQ79652-Q1 符合功能安全标准的汽车 16S/14S/12S 电池监控器、平衡器和具有集成电流检测功能的集成硬件保护器

1 特性

- 符合汽车应用要求
- 具有符合 AEC-Q100 标准的下列特性：
  - 器件温度等级 1：–40°C 至 +125°C 环境工作温度范围
  - 器件 HBM ESD 分类等级 2
  - 器件 CDM ESD 分类等级 C4B
- 符合功能安全标准
  - 专为功能安全应用开发
  - 可帮助进行 ISO 26262 系统设计的文档
  - 系统可满足 ASIL D 级要求
  - 硬件可满足 ASIL D 要求
- +/- 1.5mV ADC 精度
- 兼容引脚/封装和软件的器件系列：
  - 可堆叠监控器 16S（BQ79616-Q1、BQ79656-Q1）、14S（BQ79614-Q1、BQ79654-Q1）和 12S（BQ79612-Q1、BQ79652-Q1）
  - 独立式监控器 48V 系统 (BQ75614-Q1)
- 支持电流检测测量
- 用于电压、温度和电流诊断的内置冗余路径
- 可以在 128µs 内对所有电池通道执行高度精确的电池电压测量
- 集成式后 ADC 可配置数字低通滤波器
- 支持汇流条连接和测量
- 主机控制的内置硬件复位功能，可模拟类似于 POR 的器件复位
- 支持内部电池平衡
  - 240mA 的平衡电流
  - 内置平衡热管理，具有自动暂停和恢复控制功能
- 隔离式差分菊花链通信，采用可选的环形架构
- 通过通信线路传输的嵌入式故障信号和检测信号
- 5V LDO 输出为外部数字隔离器供电
- UART/SPI 主机接口/通信桥接器件 BQ79600-Q1
- 内置 SPI 主器件

2 应用

- 混合动力和电动动力总成系统中的电池管理系统 (BMS)
- 带有电池管理系统的储能电池组
- 电动自行车、电动踏板车

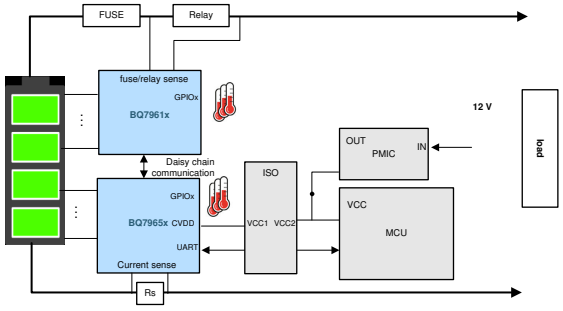
3 说明

BQ7965x-Q1 系列器件可在不到 200µs 的时间内提供 6S 至 12S (BQ79652-Q1)、14S (BQ79654-Q1) 或 16S (BQ79656-Q1) 电池模块的高精度电池电压测量，同时这些器件还支持分流电阻器电流检测测量。借助集成式前端滤波器，可以在电池输入通道上使用简单、低额定电压的差分 RC 滤波器来实施系统。集成式后 ADC 低通滤波器可以执行经过滤波、类似于直流电的电压测量。该系列器件还支持集成电流检测功能，可选择与电池电压测量同步，以更好地计算荷电状态 (SOC)。此器件支持自主内部电池平衡，并通过监测温度来自动暂停和恢复平衡，以免出现过热条件。

器件信息

器件型号 (1)	封装	封装尺寸（标称值）
BQ79652-Q1	HTQFP（64 引脚）	10.00mm x 10.00mm
BQ79654-Q1		
BQ79656-Q1		

(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。



简化版系统图

4 Revision History

注：以前版本的页码可能与当前版本的页码不同

Changes from Revision * (May 2021) to Revision A (June 2022)	Page
• 将 BQ79654-Q1 和 BQ79652-Q1 从“产品预发布”更改为“量产数据”	1

5 说明（续）

包含的隔离式双向菊花链端口支持通过电容器和变压器进行隔离，并允许使用最有效的组件实现 xEV 动力总成系统中常见的集中式或分布式架构。此器件还包含八个 GPIO 或辅助输入，可执行外部热敏电阻测量。

与 BQ7965x-Q1 系列器件的主机通信可通过以下方式进行连接：器件的专用 UART 接口或通信桥接器件 BQ79600。此外，隔离的差分菊花链通信接口允许主机通过单个接口与整个电池组进行通信。在通信线路中断的情况下，菊花链通信接口可配置为环形架构，允许主机与堆栈两端的设备通信。

6 Device and Documentation Support

6.1 Device Support

6.1.1 第三方产品免责声明

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6.2 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。

6.3 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》。

6.4 Trademarks

TI E2E™ is a trademark of Texas Instruments.
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6.5 Electrostatic Discharge Caution

This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

6.6 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。

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 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
BQ79652PAPRQ1	ACTIVE	HTQFP	PAP	64	1000	RoHS & Green	NIPDAU	Level-3-260C-168 HR	-40 to 125	BQ79652	Samples
BQ79654PAPRQ1	ACTIVE	HTQFP	PAP	64	1000	RoHS & Green	NIPDAU	Level-3-260C-168 HR	-40 to 125	BQ79654	Samples
BQ79656PAPRQ1	ACTIVE	HTQFP	PAP	64	1000	RoHS & Green	NIPDAU	Level-3-260C-168 HR	-40 to 125	BQ79656	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.

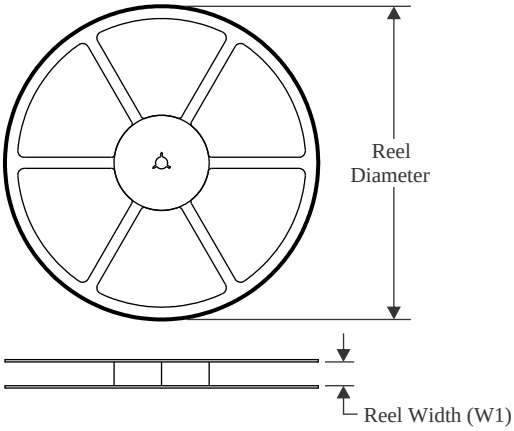
(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(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.

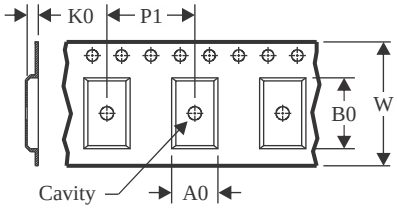
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

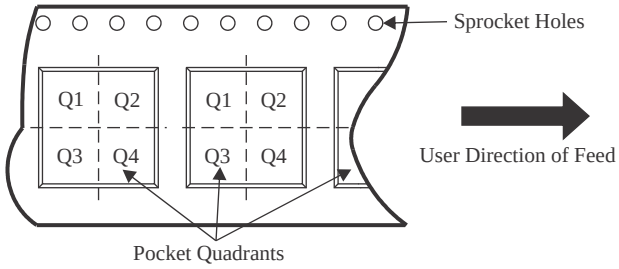


TAPE DIMENSIONS



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

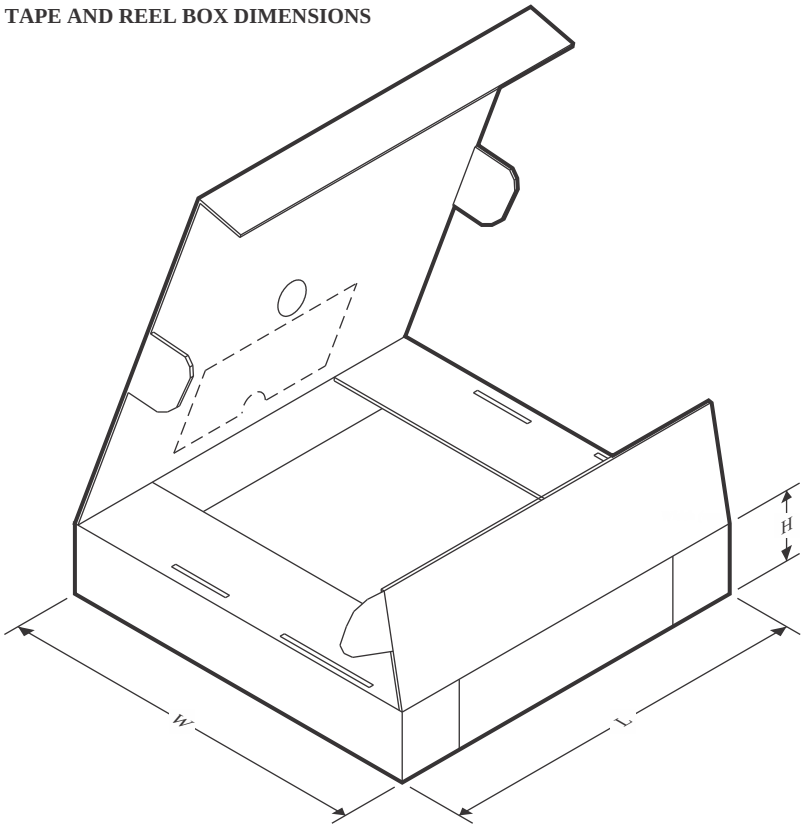
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
BQ79652PAPRQ1	HTQFP	PAP	64	1000	330.0	24.4	13.0	13.0	1.5	16.0	24.0	Q2
BQ79654PAPRQ1	HTQFP	PAP	64	1000	330.0	24.4	13.0	13.0	1.5	16.0	24.0	Q2
BQ79656PAPRQ1	HTQFP	PAP	64	1000	330.0	24.4	13.0	13.0	1.5	16.0	24.0	Q2

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
BQ79652PAPRQ1	HTQFP	PAP	64	1000	367.0	367.0	55.0
BQ79654PAPRQ1	HTQFP	PAP	64	1000	367.0	367.0	55.0
BQ79656PAPRQ1	HTQFP	PAP	64	1000	367.0	367.0	55.0

GENERIC PACKAGE VIEW

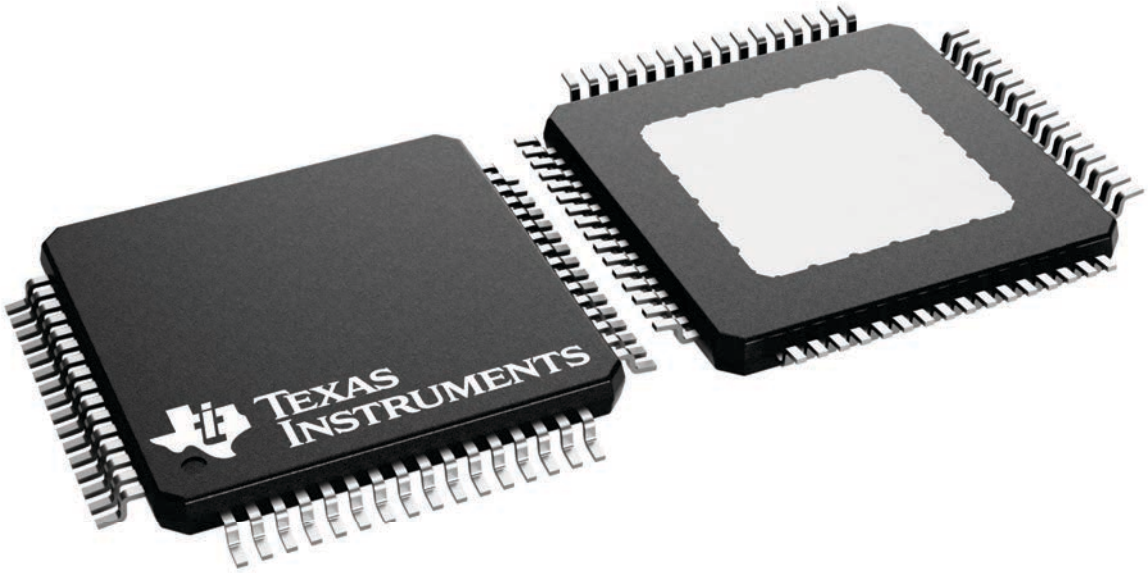
PAP 64

HTQFP - 1.2 mm max height

10 x 10, 0.5 mm pitch

QUAD FLATPACK

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



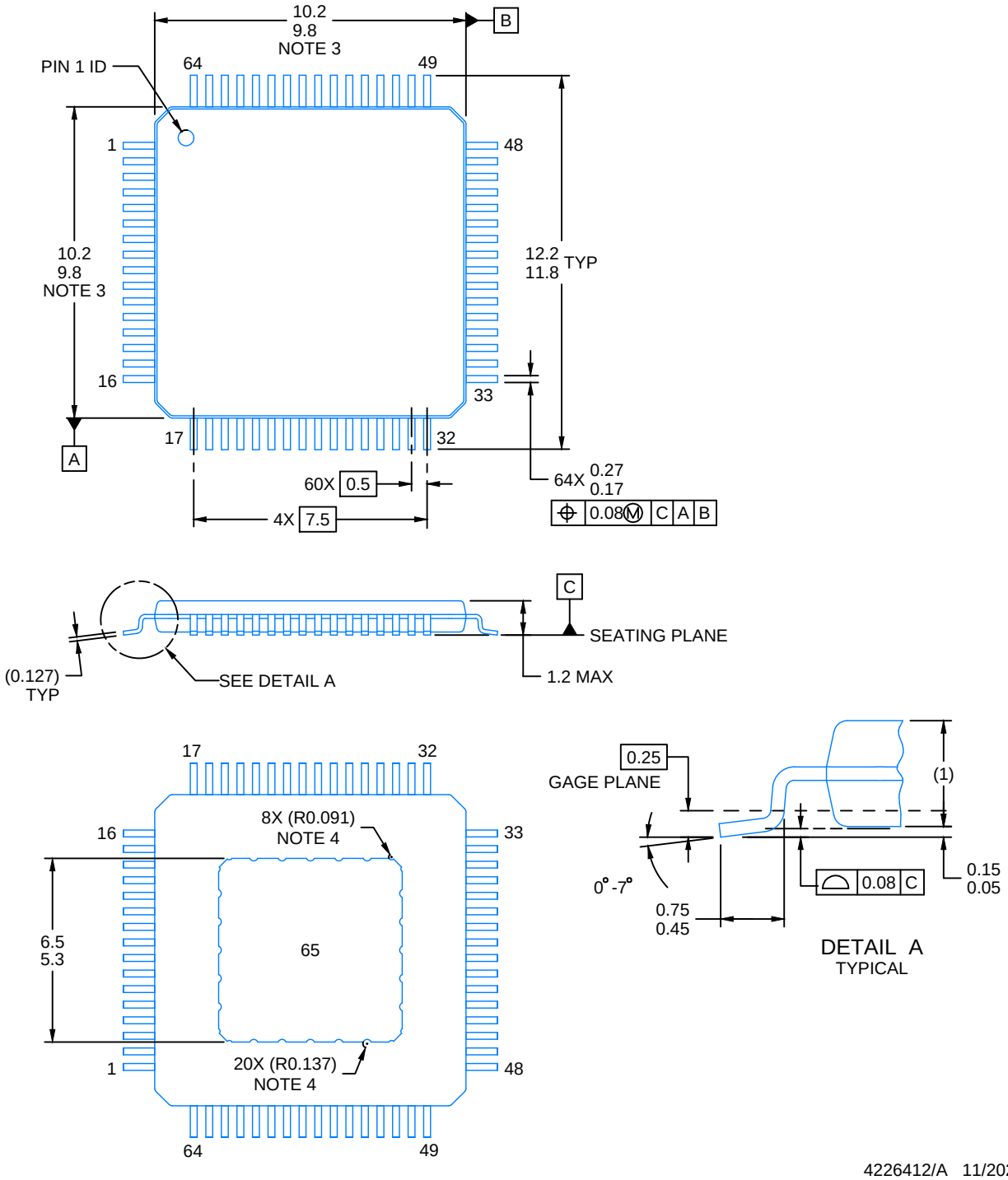
4226442/A

PACKAGE OUTLINE

PAP0064F

PowerPAD™ TQFP - 1.2 mm max height

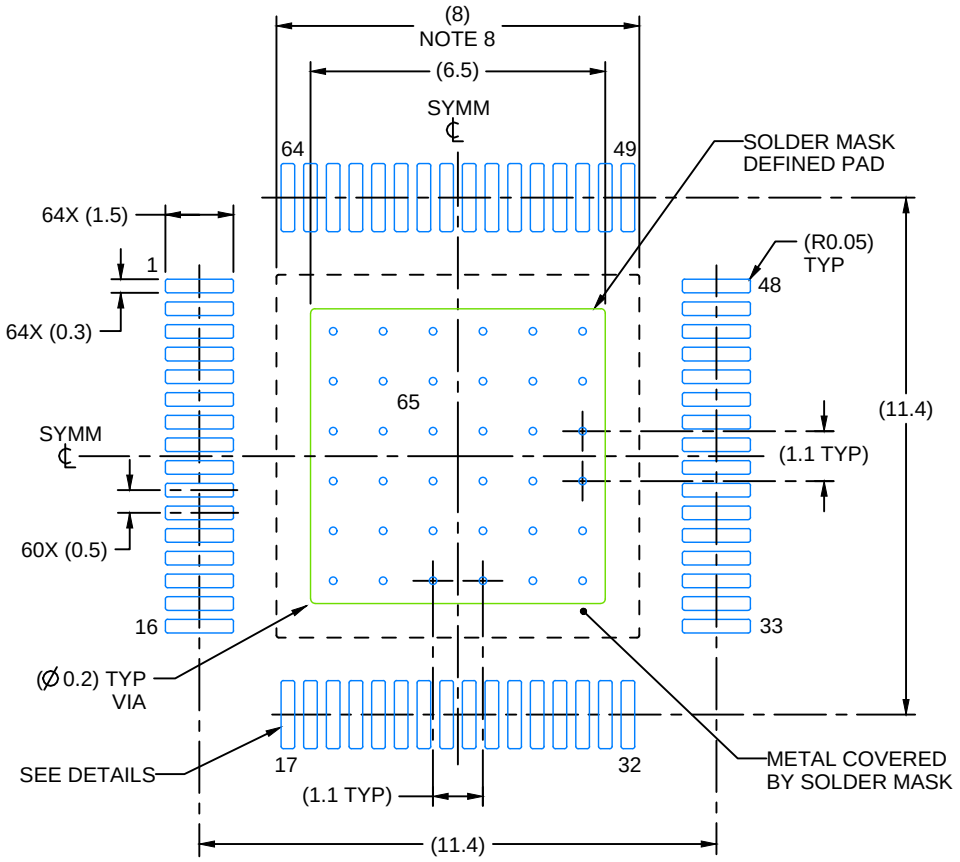
PLASTIC QUAD FLATPACK



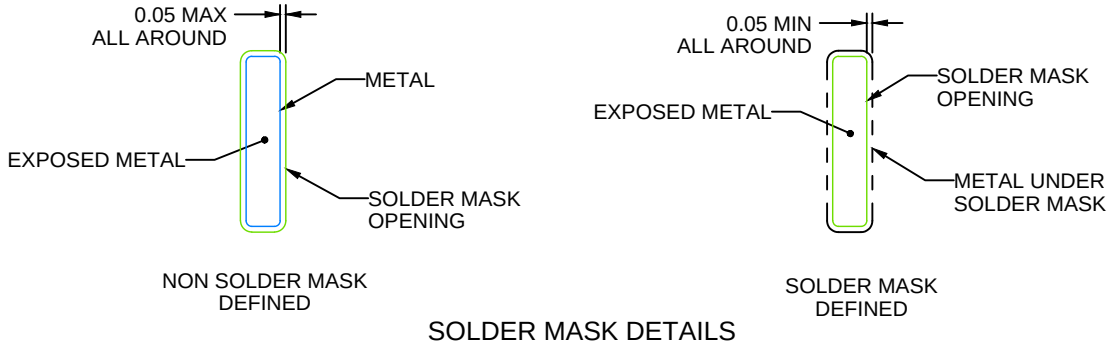
NOTES:

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.
4. Strap features may not be present.
5. Reference JEDEC registration MS-026.



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:6X

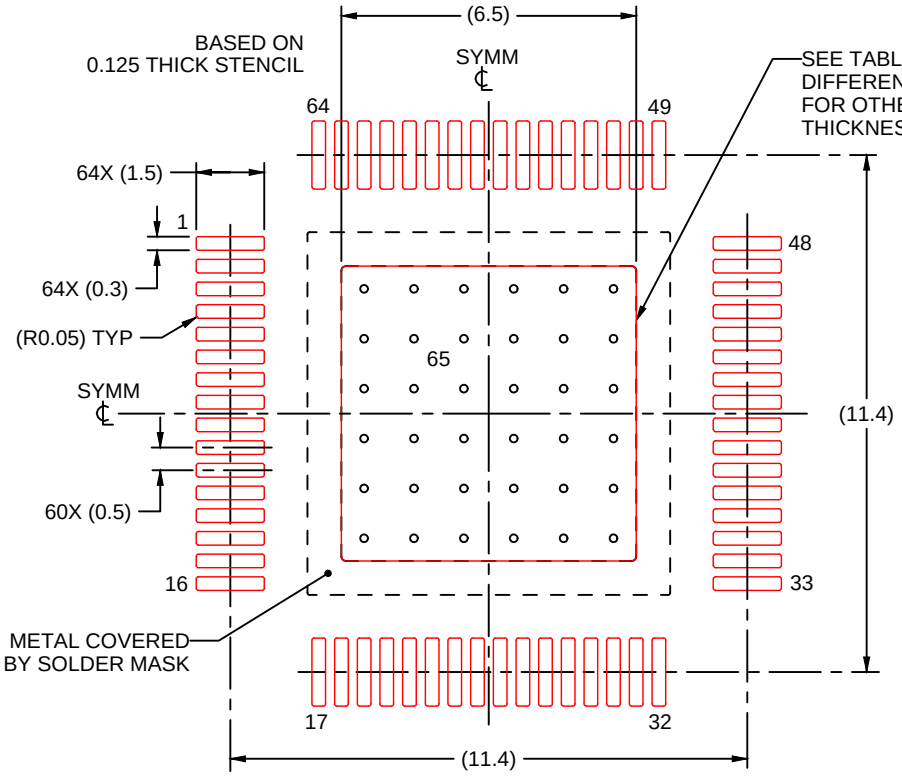


SOLDER MASK DETAILS

4226412/A 11/2020

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. See technical brief, Powerpad thermally enhanced package, Texas Instruments Literature No. SLMA002 (www.ti.com/lit/slma002) and SLMA004 (www.ti.com/lit/slma004).
9. Vias are optional depending on application, refer to device data sheet. It is recommended that vias under paste be filled, plugged or tented.
10. Size of metal pad may vary due to creepage requirement.



SOLDER PASTE EXAMPLE
EXPOSED PAD
100% PRINTED SOLDER COVERAGE BY AREA
SCALE:6X

STENCIL THICKNESS	SOLDER STENCIL OPENING
0.1	7.27 X 7.27
0.125	6.5 X 6.5 (SHOWN)
0.15	5.93 X 5.93
0.175	5.49 X 5.49

4226412/A 11/2020

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.

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