

AFE7960: 4 发送、6 接收、8GHz 至 18GHz、支持最高 1,200MHz IBW 的射频采样收发器

1 特性

- [申请完整数据表](#)
- 四个射频采样 12GSPS DAC
- 六个射频采样 3GSPS ADC
- 最大射频信号带宽：
 - 4TX : 1200MHz ; 2TX : 2400MHz
 - 4RX : 1200MHz ; 6RX : 600MHz
- RF 频率范围：
 - TX : 8GHz 至 18GHz
 - RX : 8GHz 至 18GHz
- 数字上变频器 (DUC) 和数字下变频器 (DDC)：在 DDC 和 DUC 中使用 16 个可预配置的数控振荡器 (NCO) 实现快速跳频
- 灵活的时钟选项：
 - 外部射频时钟
 - 具有低速输入时钟的内部 PLL 模式
- 串行器/解串器数据接口：
 - JESD204B 8b/10b 和 JESD204C 64b/66b
 - TX : 8 个通道, RX/FB : 8 个通道, 速率高达 29.5Gbps
 - 子类 1 多器件同步
 - SYSREF 对齐检测器
- 封装：17mm × 17mm FCBGA，间距为 0.8mm

2 应用

- [雷达](#)
- [导引头前端](#)
- [国防无线电](#)
- [战术通信基础设施](#)
- [无线通信测试](#)
- [卫星星座地面站](#)

3 说明

AFE7960 是一款高性能、宽带宽、多通道收发器，集成了四个 (4T) 射频采样发送器 (TX) 链和总共六个 (6R) 射频采样接收器。在六个接收器中，四个具有完整功能，可在无线电应用中用作接收 (RX) 信号链。另外两个接收器可选择在数字预失真 (DPD) 信号链中配置为反馈 (FB) 接收器。也可以将全部六个信号都用作接收信号链。该 AFE 具有高达 18GHz 的工作频率，支持直接在 Ku 频带内进行射频采样，无需额外的频率转换级。高密度和可配置性支持高通道数、多任务系统。

TX 和 RX 接口数据速率可以根据信号带宽进行选择，并受到 JESD204B/C 接口速度的限制。使用 DUC 中的内插或 DDC 中的抽取功能，数据流与 DAC 更新速率或 ADC 转换率匹配。

DAC 以 12GSPS 的最大速率在第二和第三奈奎斯特区域运行，能够生成高达 18GHz 的射频信号。

每个接收链都有一个 3GSPS ADC，可转换更高的奈奎斯特区域，以数字化最高 18GHz 的射频信号。ADC 输出端的数字电源检测器可配置来辅助外部自动增益控制 (AGC) 环路，以控制射频前端链。

可以使用 SPI 接口对 AFE7960 进行编程。该器件具有可编程的 GPIO，可配置为各种功能，如中断生成、快速跳频等。

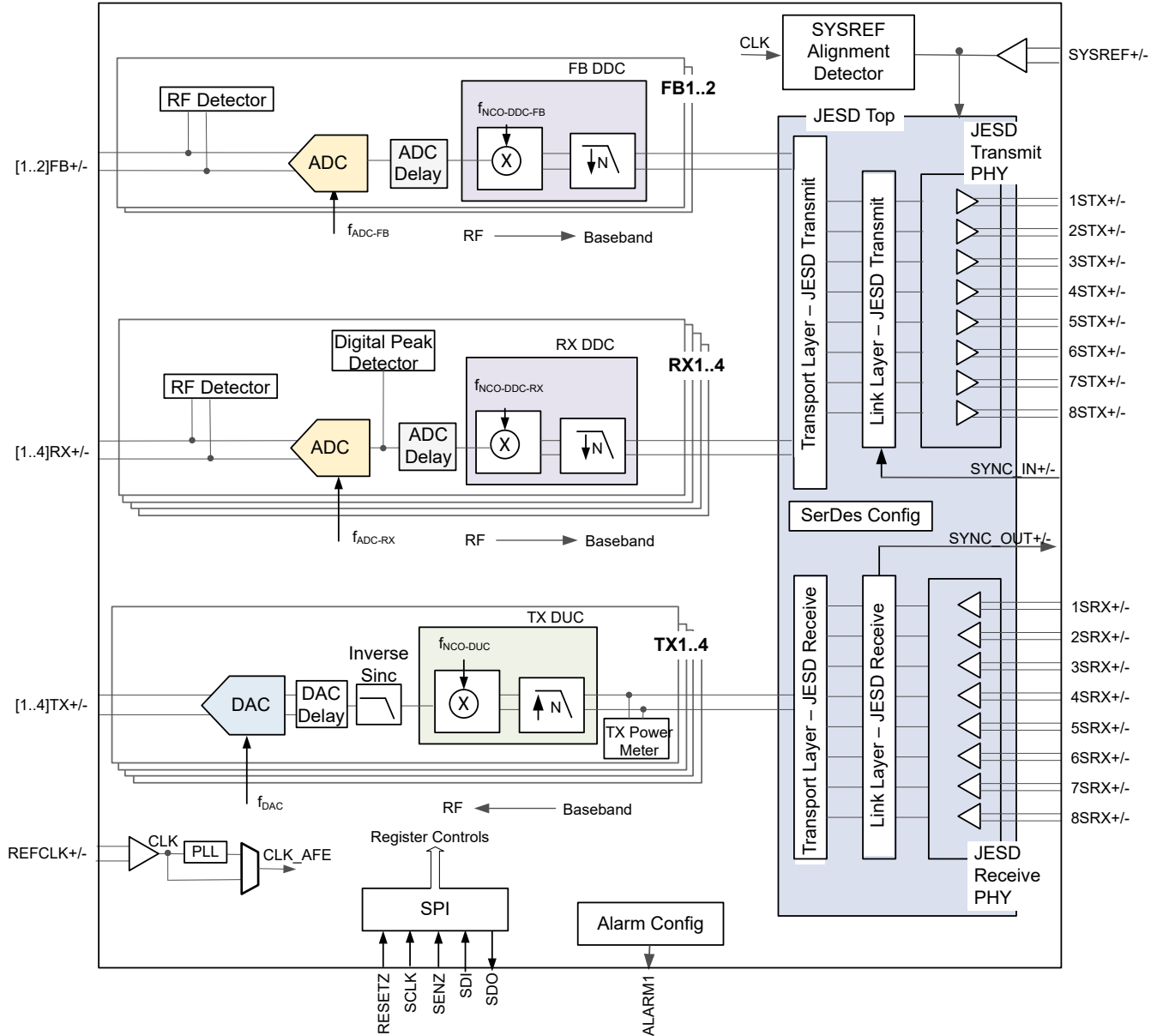
封装信息

器件型号	封装 ⁽¹⁾	封装尺寸 ⁽²⁾
AFE7960	ABJ (FC-BGA 400)	17mm × 17mm
	ALK (FC-BGA 400)	17mm × 17mm

(1) 有关更多信息，请参阅数据表末尾的“机械、封装和可订购信息”部分。

(2) 封装尺寸 (长 × 宽) 为标称值，并包括引脚 (如适用)。





功能方框图

4 器件和文档支持

4.1 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。

4.2 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](#)。

4.3 商标

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4.4 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。

4.5 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。

5 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

日期	修订版本	注释
May 2026	*	初始发行版

6 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)
AFE7960IABJ	Active	Production	FCBGA (ABJ) 400	90 JEDEC TRAY (5+1)	Yes	SNAGCU	Level-3-260C-168 HR	-40 to 85	AFE7960
AFE7960IALK	Active	Production	FCBGA (ALK) 400	90 JEDEC TRAY (5+1)	No	Call TI	Call TI	-40 to 85	AFE7960 SNPB

⁽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.

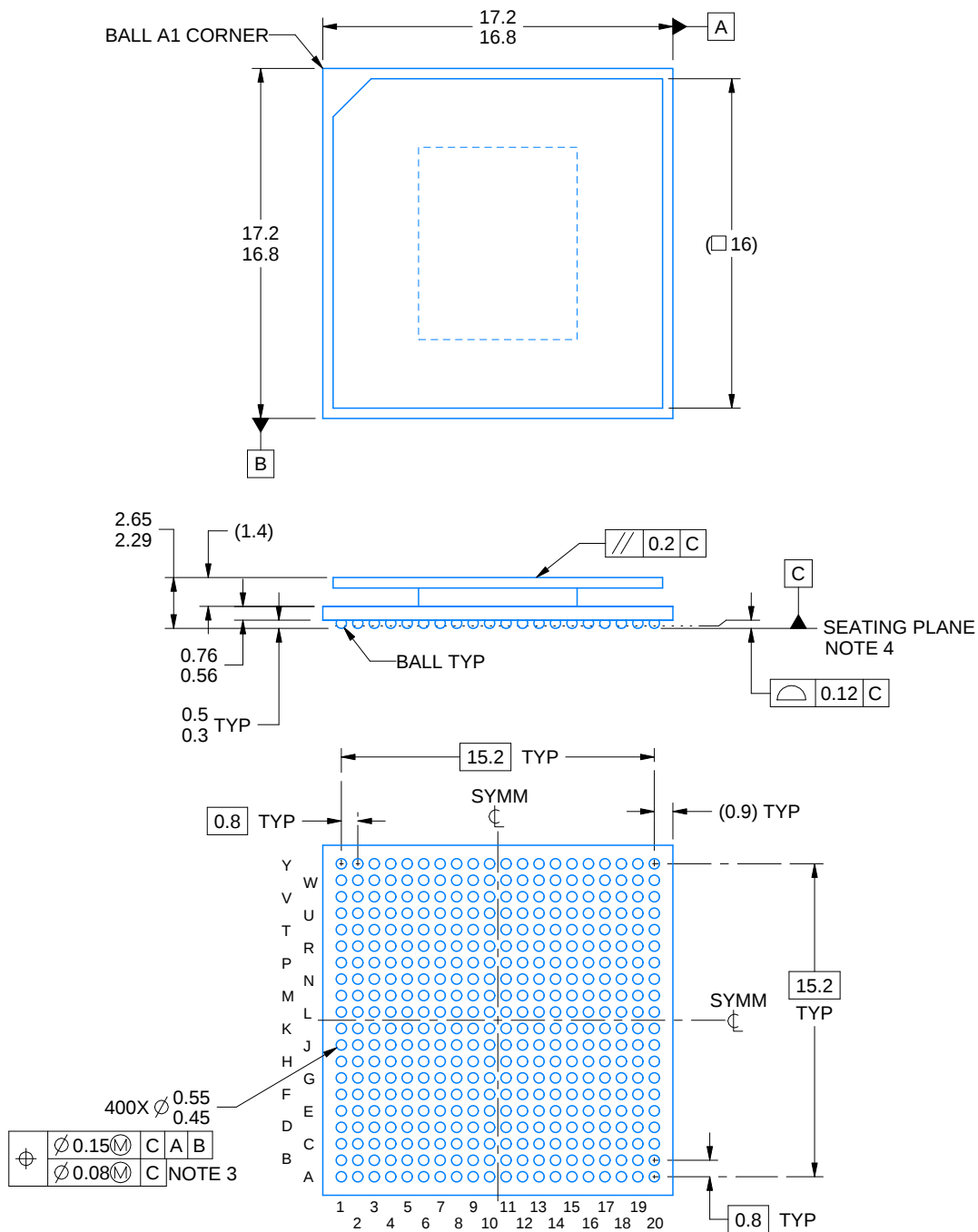
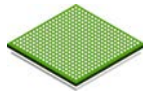
⁽⁵⁾ **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will 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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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. Dimension is measured at the maximum solder ball diameter, parallel to primary datum C.
4. Primary datum C and seating plane are defined by the spherical crowns of the solder balls.
5. The lids are electrically floating (e.g. not tied to GND).

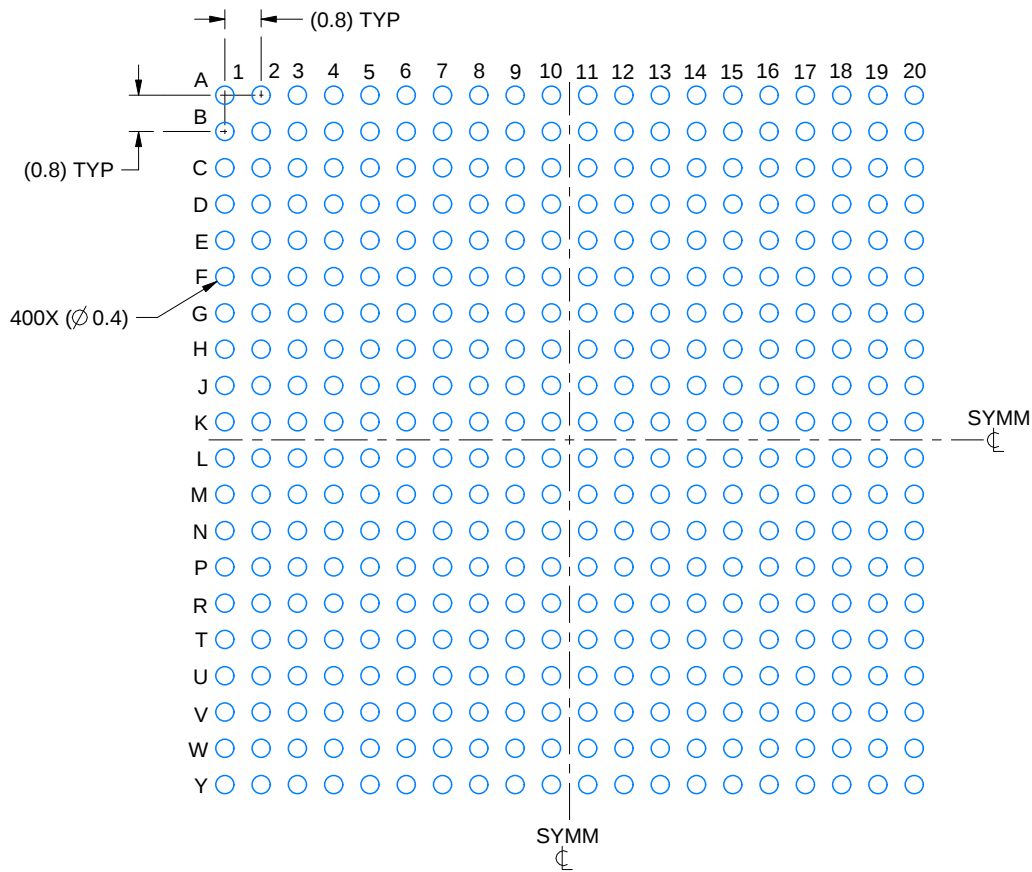


EXAMPLE BOARD LAYOUT

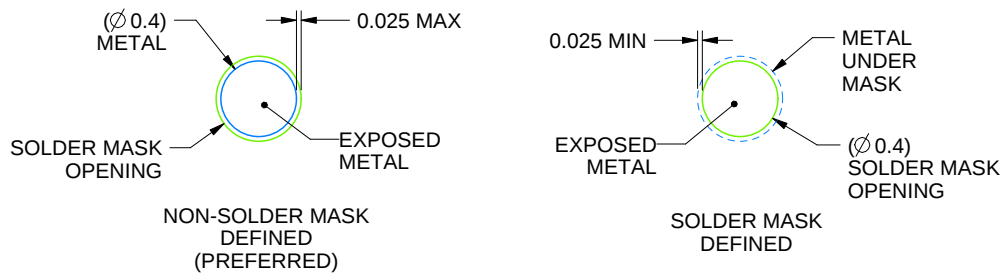
ABJ0400A

FCBGA - 2.65 mm max height

BALL GRID ARRAY



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:6X



SOLDER MASK DETAILS
NOT TO SCALE

4221311/D 03/2023

NOTES: (continued)

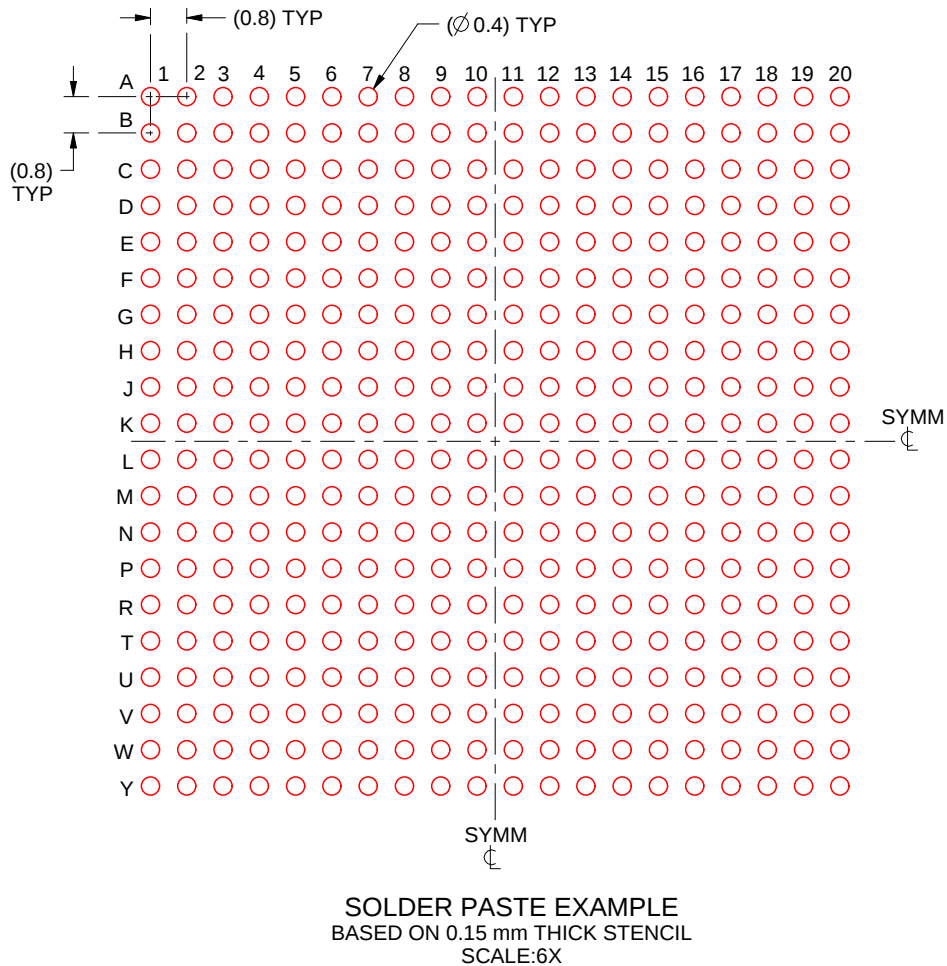
6. Final dimensions may vary due to manufacturing tolerance considerations and also routing constraints. For more information, see Texas Instruments literature number SPRU811 (www.ti.com/lit/spru811).

EXAMPLE STENCIL DESIGN

ABJ0400A

FCBGA - 2.65 mm max height

BALL GRID ARRAY



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NOTES: (continued)

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

FCBGA - 2.65 mm max height

Technical drawing of a 400X ball grid array (BGA) showing top, side, and bottom views with dimensions and callouts.

Top View:

- Overall dimensions: 17.2 (nominal) / 16.8 (actual) by 17.2 (nominal) / 16.8 (actual).
- Feature A: A rectangular feature in the top right corner.
- Feature B: A rectangular feature in the bottom left corner.
- Feature C: A rectangular feature in the top right corner, labeled (C) 16.
- Feature D: A rectangular feature in the bottom left corner, labeled (D) 16.

Side View:

- Overall height: 2.65 (nominal) / 2.29 (actual).
- Feature E: A rectangular feature in the top right corner, labeled (E) 1.4.
- Feature F: A rectangular feature in the bottom left corner, labeled (F) 0.76 / 0.56.
- Feature G: A rectangular feature in the bottom left corner, labeled (G) 0.5 TYP / 0.3.
- Feature H: A rectangular feature in the top right corner, labeled (H) 0.2 C.
- Feature I: A rectangular feature in the bottom left corner, labeled (I) 0.12 C.
- Feature J: A rectangular feature in the bottom left corner, labeled (J) 0.12 C.
- Feature K: A rectangular feature in the bottom left corner, labeled (K) 0.12 C.
- Feature L: A rectangular feature in the bottom left corner, labeled (L) 0.12 C.
- Feature M: A rectangular feature in the bottom left corner, labeled (M) 0.12 C.
- Feature N: A rectangular feature in the bottom left corner, labeled (N) 0.12 C.
- Feature O: A rectangular feature in the bottom left corner, labeled (O) 0.12 C.
- Feature P: A rectangular feature in the bottom left corner, labeled (P) 0.12 C.
- Feature Q: A rectangular feature in the bottom left corner, labeled (Q) 0.12 C.
- Feature R: A rectangular feature in the bottom left corner, labeled (R) 0.12 C.
- Feature S: A rectangular feature in the bottom left corner, labeled (S) 0.12 C.
- Feature T: A rectangular feature in the bottom left corner, labeled (T) 0.12 C.
- Feature U: A rectangular feature in the bottom left corner, labeled (U) 0.12 C.
- Feature V: A rectangular feature in the bottom left corner, labeled (V) 0.12 C.
- Feature W: A rectangular feature in the bottom left corner, labeled (W) 0.12 C.
- Feature X: A rectangular feature in the bottom left corner, labeled (X) 0.12 C.
- Feature Y: A rectangular feature in the bottom left corner, labeled (Y) 0.12 C.
- Feature Z: A rectangular feature in the bottom left corner, labeled (Z) 0.12 C.

Bottom View:

- Overall dimensions: 15.2 TYP by 15.2 TYP.
- Feature A: A rectangular feature in the top right corner, labeled (A) 0.8 TYP.
- Feature B: A rectangular feature in the bottom left corner, labeled (B) 0.8 TYP.
- Feature C: A rectangular feature in the top right corner, labeled (C) 0.8 TYP.
- Feature D: A rectangular feature in the bottom left corner, labeled (D) 0.8 TYP.
- Feature E: A rectangular feature in the top right corner, labeled (E) 0.8 TYP.
- Feature F: A rectangular feature in the bottom left corner, labeled (F) 0.8 TYP.
- Feature G: A rectangular feature in the top right corner, labeled (G) 0.8 TYP.
- Feature H: A rectangular feature in the bottom left corner, labeled (H) 0.8 TYP.
- Feature I: A rectangular feature in the top right corner, labeled (I) 0.8 TYP.
- Feature J: A rectangular feature in the bottom left corner, labeled (J) 0.8 TYP.
- Feature K: A rectangular feature in the top right corner, labeled (K) 0.8 TYP.
- Feature L: A rectangular feature in the bottom left corner, labeled (L) 0.8 TYP.
- Feature M: A rectangular feature in the top right corner, labeled (M) 0.8 TYP.
- Feature N: A rectangular feature in the bottom left corner, labeled (N) 0.8 TYP.
- Feature O: A rectangular feature in the top right corner, labeled (O) 0.8 TYP.
- Feature P: A rectangular feature in the bottom left corner, labeled (P) 0.8 TYP.
- Feature Q: A rectangular feature in the top right corner, labeled (Q) 0.8 TYP.
- Feature R: A rectangular feature in the bottom left corner, labeled (R) 0.8 TYP.
- Feature S: A rectangular feature in the top right corner, labeled (S) 0.8 TYP.
- Feature T: A rectangular feature in the bottom left corner, labeled (T) 0.8 TYP.
- Feature U: A rectangular feature in the top right corner, labeled (U) 0.8 TYP.
- Feature V: A rectangular feature in the bottom left corner, labeled (V) 0.8 TYP.
- Feature W: A rectangular feature in the top right corner, labeled (W) 0.8 TYP.
- Feature X: A rectangular feature in the bottom left corner, labeled (X) 0.8 TYP.
- Feature Y: A rectangular feature in the top right corner, labeled (Y) 0.8 TYP.
- Feature Z: A rectangular feature in the bottom left corner, labeled (Z) 0.8 TYP.

Notes:

- 400X $\varnothing$ 0.55 / 0.45
- 50X C A B
- 18X C NOTE 3
- SEATING PLANE NOTE 4

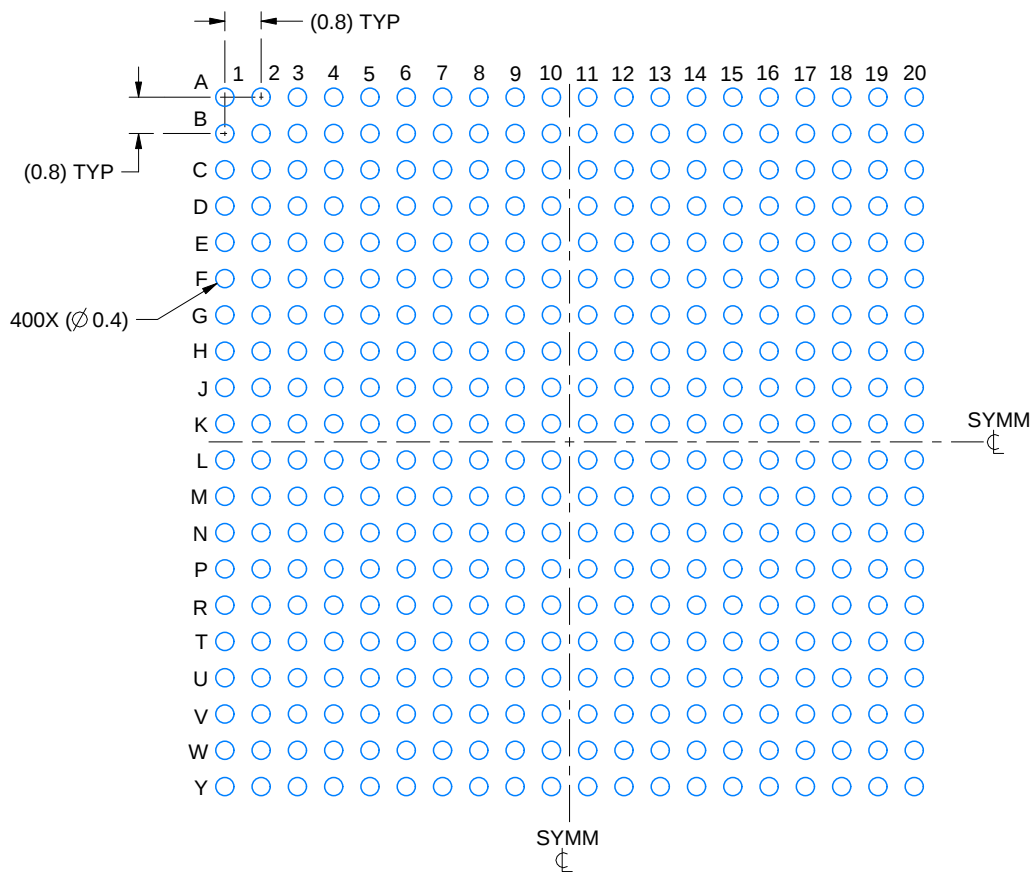
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Dimension is measured at the maximum solder ball diameter, parallel to primary datum C.
4. Primary datum C and seating plane are defined by the spherical crowns of the solder balls.
5. Pb-Free die bump and SnPb solder ball.
6. The lids are electrically floating (e.g. not tied to GND).

EXAMPLE BOARD LAYOUT

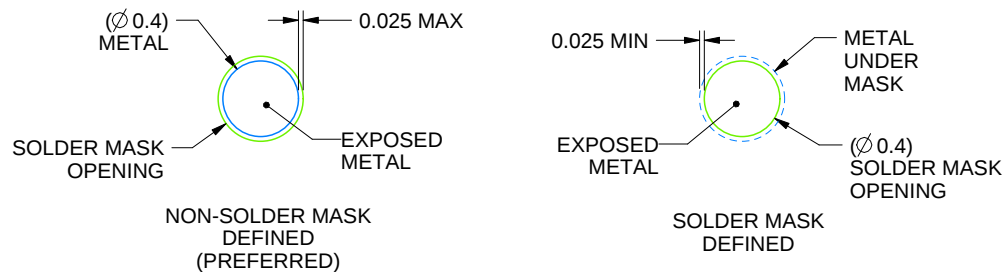
ALK0400A

FCBGA - 2.65 mm max height

BALL GRID ARRAY



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:6X



SOLDER MASK DETAILS
NOT TO SCALE

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NOTES: (continued)

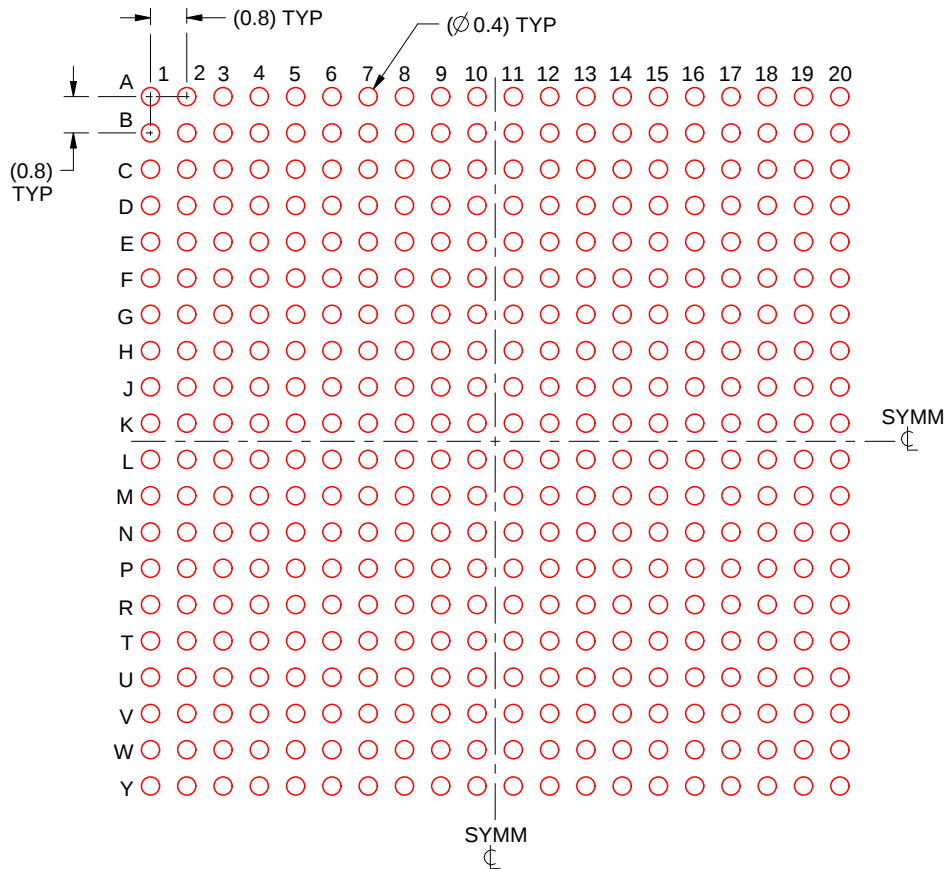
- Final dimensions may vary due to manufacturing tolerance considerations and also routing constraints. For more information, see Texas Instruments literature number SPRU811 (www.ti.com/lit/spru811).

EXAMPLE STENCIL DESIGN

ALK0400A

FCBGA - 2.65 mm max height

BALL GRID ARRAY



SOLDER PASTE EXAMPLE
 BASED ON 0.15 mm THICK STENCIL
 SCALE:6X

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NOTES: (continued)

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

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