

具有反馈路径的 AFE7799 四通道射频收发器

1 特性

- 基于直接上变频架构的四路发送器：
 - 每个链的射频传输带宽高达 600MHz
- 基于 0-IF 下变频架构的四路接收器：
 - 每个链的射频接收带宽高达 200MHz
- 基于射频采样 ADC 的反馈链：
 - 射频接收带宽高达 600MHz
- 射频频率范围：600MHz 至 6GHz
- 用于 TX 和 RX LO 的宽带分数 N PLL、VCO
- 专门用于生成数据转换器时钟的整数 N PLL、VCO
- JESD204B 和 JESD204C 串行器/解串器接口支持：
 - 8 个高达 29.5Gbps 的串行器/解串器收发器
 - 8b/10b 和 64b/66b 编码
 - 16 位、12 位、24 位和 32 位格式
 - 子类 1 多器件同步
- 封装：17mm x 17mm BGA，0.8mm 间距

2 应用

- 电信 2G、3G、4G、5G 大型基站、微基站
- 电信 4G、5G 大规模 MIMO 基站
- 电信 2G、3G、4G、5G 小型蜂窝
- 微波回程连线

3 说明

AFE7799 是一款高性能的多通道收发器，集成了四条直接上变频发送器链、四条直接下变频接收器链和两条宽带射频采样数字化辅助链（反馈路径）。发送器链和接收器链的高动态范围允许为无线基站生成和接收 2G、3G、4G 和 5G 信号。低功率耗散和大规模通道集成使得 AFE7799 适合在功率和尺寸两方面都受限的 4G 和 5G 大规模 MIMO 基站。宽带和高动态范围反馈路径可以帮助发送器链中的功率放大器进行数字预失真 (DPD)。串行器/解串器的高速度有助于减少传入和传出数据时所需的通道数量。

AFE7799 的每个接收器链都具有一个 28dB 范围的数字步进衰减器 (DSA)，后跟一个宽带无源 IQ 解调器和一个基带放大器，此基带放大器具有集成式可编程抗混叠低通滤波器，用于驱动连续时间 Σ - Δ ADC。RX 链可接收高达 200MHz 的瞬时带宽 (IBW)。每个接收器通道都有两个模拟峰值功耗检测器和多个数字功耗检测器，可在接收器通道上辅助进行外部或内部自主 AGC，另外还具有一个射频过载检测器，可提供器件可靠性保护。集成式 QMC（正交不匹配补偿）算法能够持续监控和更正 RX 链 I 和 Q 不平衡不匹配的情况，无需注入任何专用信号或执行离线校准。

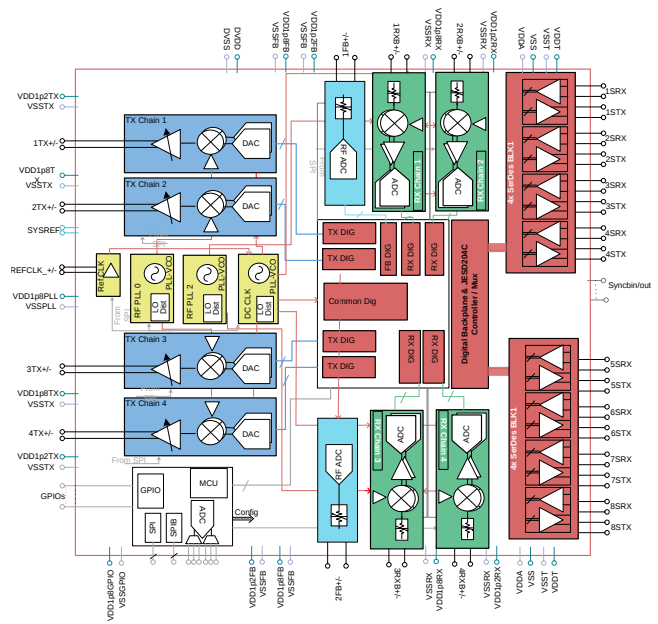
每个发送器链都具有两个 14 位、3Gsps IQ DAC，后跟一个可编程重建和 DAC 镜像抑制滤波器以及一个 IQ 调制器，用于驱动具有 39dB 范围增益控制功能的宽带射频放大器。TX 链集成了 QMC 和 LO 漏电消除算法，利用反馈路径来持续跟踪和更正 TX 链 IQ 不匹配和 LO 漏电的情况。

器件信息⁽¹⁾

器件型号	封装	封装尺寸（标称值）
AFE7799	FCBGA (400)	17.00mm x 17.00mm

(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。

AFE7799 方框图



目录

1	特性	1	6.1	接收文档更新通知	4
2	应用	1	6.2	社区资源	4
3	说明	1	6.3	商标	4
4	修订历史记录	2	6.4	静电放电警告	4
5	说明（续）	3	6.5	Glossary	4
6	器件和文档支持	4	7	机械、封装和可订购信息	4

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。

日期	修订版本	说明
2019 年 6 月	*	初始发行版。

5 说明（续）

反馈路径基于射频采样架构，并具有一个用于驱动 14 位 3Gsp/s 射频 ADC 的输入射频 DSA。直接采样架构提供了一个固有的宽带接收器链，并简化了 TX 链损失校准。每个反馈路径都集成了两个独立的 NCO，它们可以在两个观察到的射频输入带之间进行快速切换。

6 器件和文档支持

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.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，请查看任何已修订文档中包含的修订历史记录。

6.2 社区资源

The following links connect to TI community resources. Linked contents are provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's [Terms of Use](#).

TI E2E™ Online Community *TI's Engineer-to-Engineer (E2E) Community*. Created to foster collaboration among engineers. At e2e.ti.com, you can ask questions, share knowledge, explore ideas and help solve problems with fellow engineers.

Design Support *TI's Design Support* Quickly find helpful E2E forums along with design support tools and contact information for technical support.

6.3 商标

E2E is a trademark of Texas Instruments.
All other trademarks are the property of their respective owners.

6.4 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。

6.5 Glossary

[SLYZ022](#) — *TI Glossary*.

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

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的最新可用数据。数据如有变更，恕不另行通知，且不会对此文档进行修订。如需获取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)
AFE7799IABJ	Active	Production	FCBGA (ABJ) 400	90 JEDEC TRAY (5+1)	Yes	SNAGCU	Level-3-260C-168 HR	-40 to 85	AFE7799
AFE7799IABJ.B	Active	Production	FCBGA (ABJ) 400	90 JEDEC TRAY (5+1)	Yes	SNAGCU	Level-3-260C-168 HR	-40 to 85	AFE7799

- ⁽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.

Important Information and Disclaimer:The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

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.

FCBGA - 2.65 mm max height

Technical drawing of a 400X ball grid array (BGA) component. The drawing includes three views: a top view showing the overall dimensions (17.2 x 17.2 mm) and a 16x16 grid of balls; a side view showing the component's profile with dimensions for the balls (0.76 mm diameter, 0.56 mm height) and the component body (2.65 mm total height, 2.29 mm body height); and a detailed view of the ball grid showing a 16x16 array of balls with a pitch of 0.55 mm. The drawing also includes various callouts for dimensions, tolerances, and material specifications.

Top View:

- Overall dimensions: 17.2 x 17.2 mm.
- Inner dimensions: 16.8 x 16.8 mm.
- Feature A: 17.2 mm x 16.8 mm.
- Feature B: 17.2 mm x 16.8 mm.
- Feature C: 16 mm.

Side View:

- Overall height: 2.65 mm.
- Body height: 2.29 mm.
- Ball diameter: 0.76 mm.
- Ball height: 0.56 mm.
- Ball pitch: 0.5 mm (TYP).
- Seating Plane: NOTE 4.
- Feature C: 0.12 mm.

Ball Grid View:

- Grid size: 16 x 16 balls.
- Ball pitch: 0.55 mm.
- Grid dimensions: 15.2 mm (TYP) x 15.2 mm (TYP).
- Feature A: 0.8 mm (TYP).
- Feature B: 0.9 mm (TYP).
- Feature C: 0.8 mm (TYP).
- Feature D: 0.8 mm (TYP).
- Feature E: 0.8 mm (TYP).
- Feature F: 0.8 mm (TYP).
- Feature G: 0.8 mm (TYP).
- Feature H: 0.8 mm (TYP).
- Feature I: 0.8 mm (TYP).
- Feature J: 0.8 mm (TYP).
- Feature K: 0.8 mm (TYP).
- Feature L: 0.8 mm (TYP).
- Feature M: 0.8 mm (TYP).
- Feature N: 0.8 mm (TYP).
- Feature O: 0.8 mm (TYP).
- Feature P: 0.8 mm (TYP).
- Feature Q: 0.8 mm (TYP).
- Feature R: 0.8 mm (TYP).
- Feature S: 0.8 mm (TYP).
- Feature T: 0.8 mm (TYP).
- Feature U: 0.8 mm (TYP).
- Feature V: 0.8 mm (TYP).
- Feature W: 0.8 mm (TYP).
- Feature X: 0.8 mm (TYP).
- Feature Y: 0.8 mm (TYP).
- Feature Z: 0.8 mm (TYP).

Notes:

- NOTE 3: 50X C A B, 18X C.
- NOTE 4: SEATING PLANE.

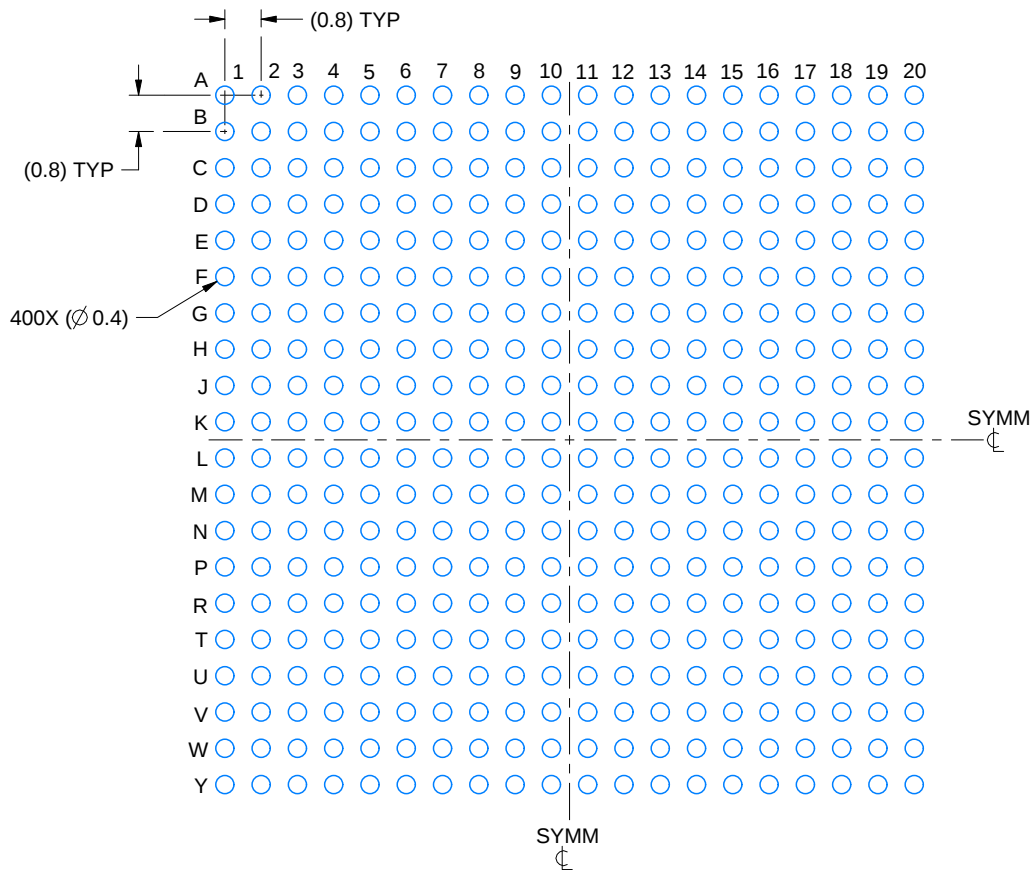
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Dimension is measured at the maximum solder ball diameter, parallel to primary datum C.
4. Primary datum 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

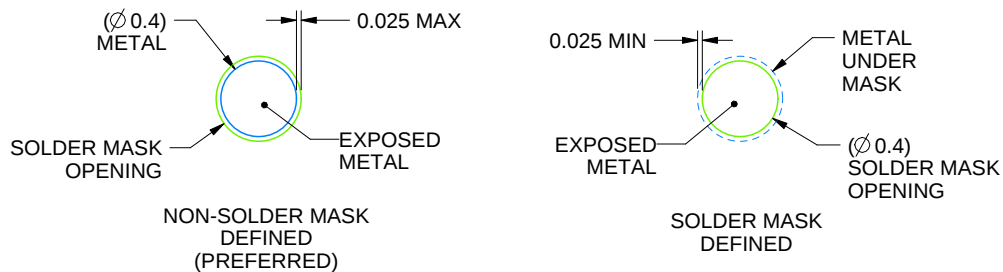
ABJ0400A

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)

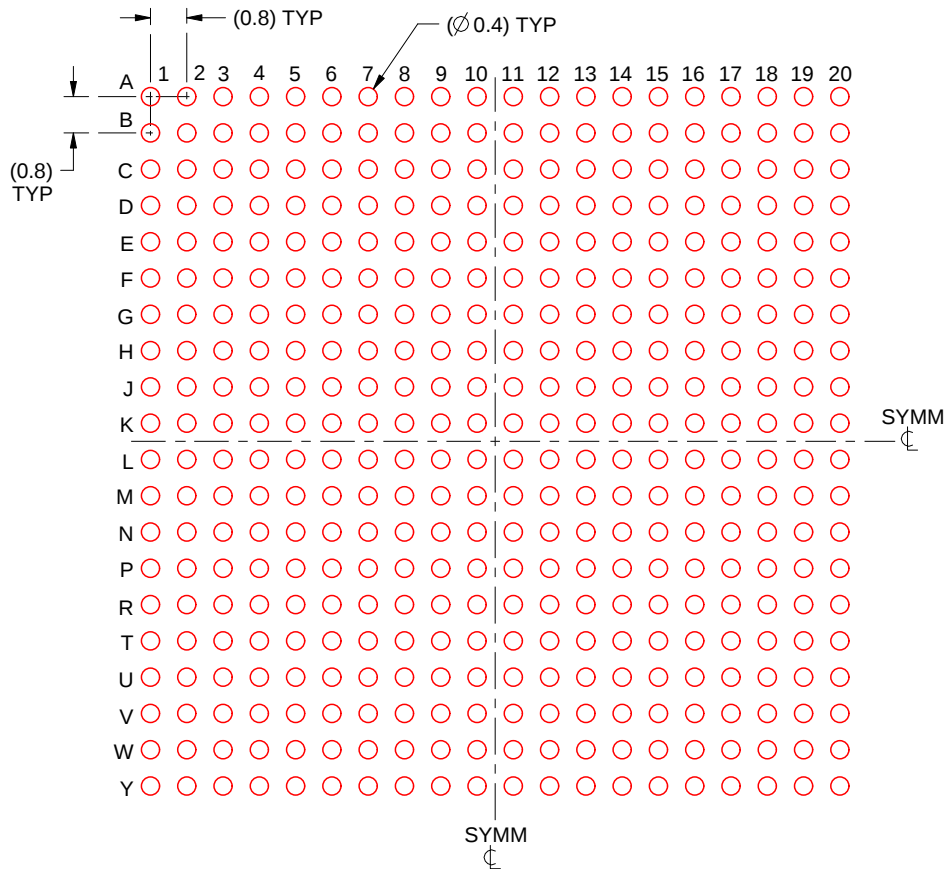
- Final dimensions may vary due to manufacturing tolerance considerations and also routing constraints. For more information, see Texas Instruments literature number SPRU811 (www.ti.com/lit/spru811).

EXAMPLE STENCIL DESIGN

ABJ0400A

FCBGA - 2.65 mm max height

BALL GRID ARRAY



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

4221311/D 03/2023

NOTES: (continued)

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

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。

版权所有 © 2025，德州仪器 (TI) 公司

最后更新日期：2025 年 10 月