AFE7799 Quad-Channel RF Transceiver With Feedback Path

1 Features

- Quad transmitters based on direct up-conversion architecture:
  - Up to 600 MHz of RF transmitted bandwidth per chain
- Quad receivers based on 0-IF down-conversion architecture:
  - Up to 200 MHz of RF received bandwidth per chain
- Feedback chain based on RF sampling ADC:
  - Up to 600 MHz of RF received bandwidth
- RF frequency range: 600 MHz to 6 GHz
- Wideband fractional-N PLL, VCO for TX and RX LO
- Dedicated integer-N PLL, VCO for data converters clock generation
- JESD204B and JESD204C SerDes interface support:
  - 8 SerDes transceivers up to 29.5 Gbps
  - 8b/10b and 64b/66b encoding
  - 16-bit, 12-bit, 24-bit and 32-bit formatting
  - Subclass 1 multi-device synchronization
- Package: 17-mm x 17-mm BGA, 0.8-mm pitch

2 Applications

- Telecom 2G, 3G, 4G, 5G macro, micro base stations
- Telecom 4G, 5G massive MIMO base stations
- Telecom 2G, 3G, 4G, 5G small cell
- Microwave backhaul

3 Description

The AFE7799 is a high-performance, multichannel transceiver, integrating four direct up-conversion transmitter chains, four direct down-conversion receiver chains, and two wideband RF sampling digitizing auxiliary chains (feedback paths). The high dynamic range of the transmitter and receiver chains allows generating and receiving 2G, 3G, 4G, and 5G signals for wireless base stations. The low power dissipation and large channels integration makes the AFE7799 suitable to address the power and size constrained 4G and 5G massive MIMO base stations. The wideband and high dynamic range feedback path can assist the digital pre-distortion (DPD) of the power amplifiers in the transmitter chain. The fast SerDes speed can help reducing the number of lanes required to transfer the data in and out.

Each receiver chain of the AFE7799 includes a 28-dB range digital step attenuator (DSA), followed by a wideband passive IQ demodulator, and a baseband amplifier with integrated programmable antialiasing low pass filters, driving a continuous-time sigma-delta ADC. The RX chain can receive an instantaneous bandwidth (IBW) up to 200 MHz. Each receiver channel has two analog peak power detectors and various digital power detectors to assist an external or internal autonomous AGC control for receiver channels, and a RF overload detector for device reliability protection. The integrated QMC (quadrature mismatch compensation) algorithm is capable to continuously monitor and correct for the rx chain I and Q imbalance mismatch without the need to inject any specific signals or perform offline calibration.

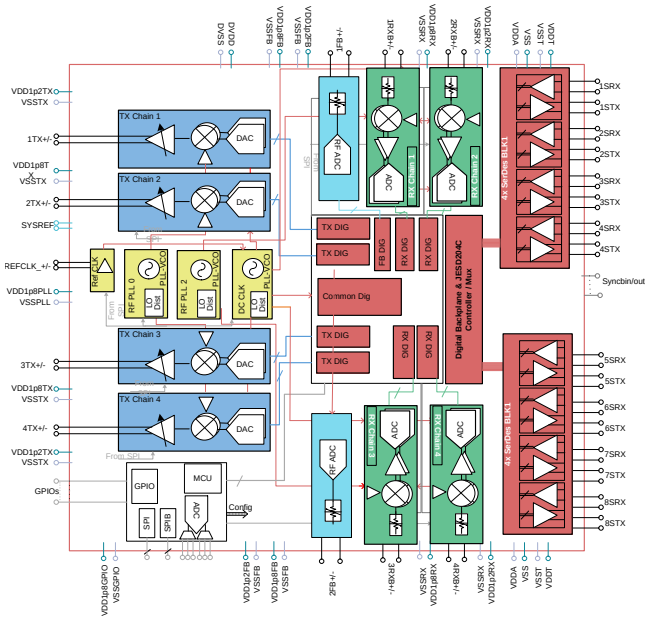
Each transmitter chain includes two 14-bit, 3-Gsps IQ DACs, followed by a programmable reconstruction and DAC image rejection filter, an IQ modulator driving a wideband RF amplifier with 39-dB range gain control. The TX chain integrated QMC and LO leakage cancellation algorithms, leveraging the FB path can constantly track and correct for the TX chain IQ mismatch and LO leakage.

Device Information(1)

PART NUMBER	PACKAGE	BODY SIZE (NOM)
AFE7799	FCBGA (400)	17.00 mm x 17.00 mm

(1) For all available packages, see the orderable addendum at the end of the data sheet.

AFE7799 Block Diagram



An IMPORTANT NOTICE at the end of this data sheet addresses availability, warranty, changes, use in safety-critical applications, intellectual property matters and other important disclaimers. PRODUCTION DATA.

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4 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

DATE	REVISION	NOTES
June 2019	*	Initial release.

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5 Description (continued)

The FB path is based on RF sampling architecture, and includes an input RF DSA driving a 14-bit, 3-Gsps RF ADC. The direct sampling architecture provides an inherently wideband receiver chain and simplifies the calibration of the TX chains impairments. Each FB path integrates two independent NCO that allows a fast switching between two observed RF input bands.

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6 Device and Documentation Support

6.1 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. In the upper right corner, click on *Alert me* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

6.2 Community Resources

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 Trademarks

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

6.4 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.

6.5 Glossary

SLYZ022 — *TI Glossary*.

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

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 Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
AFE7799IABJ	ACTIVE	FCBGA	ABJ	400	90	Green (RoHS & no Sb/Br)	SNAGCU	Level-3-260C-168 HR	-40 to 85	AFE7799	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/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

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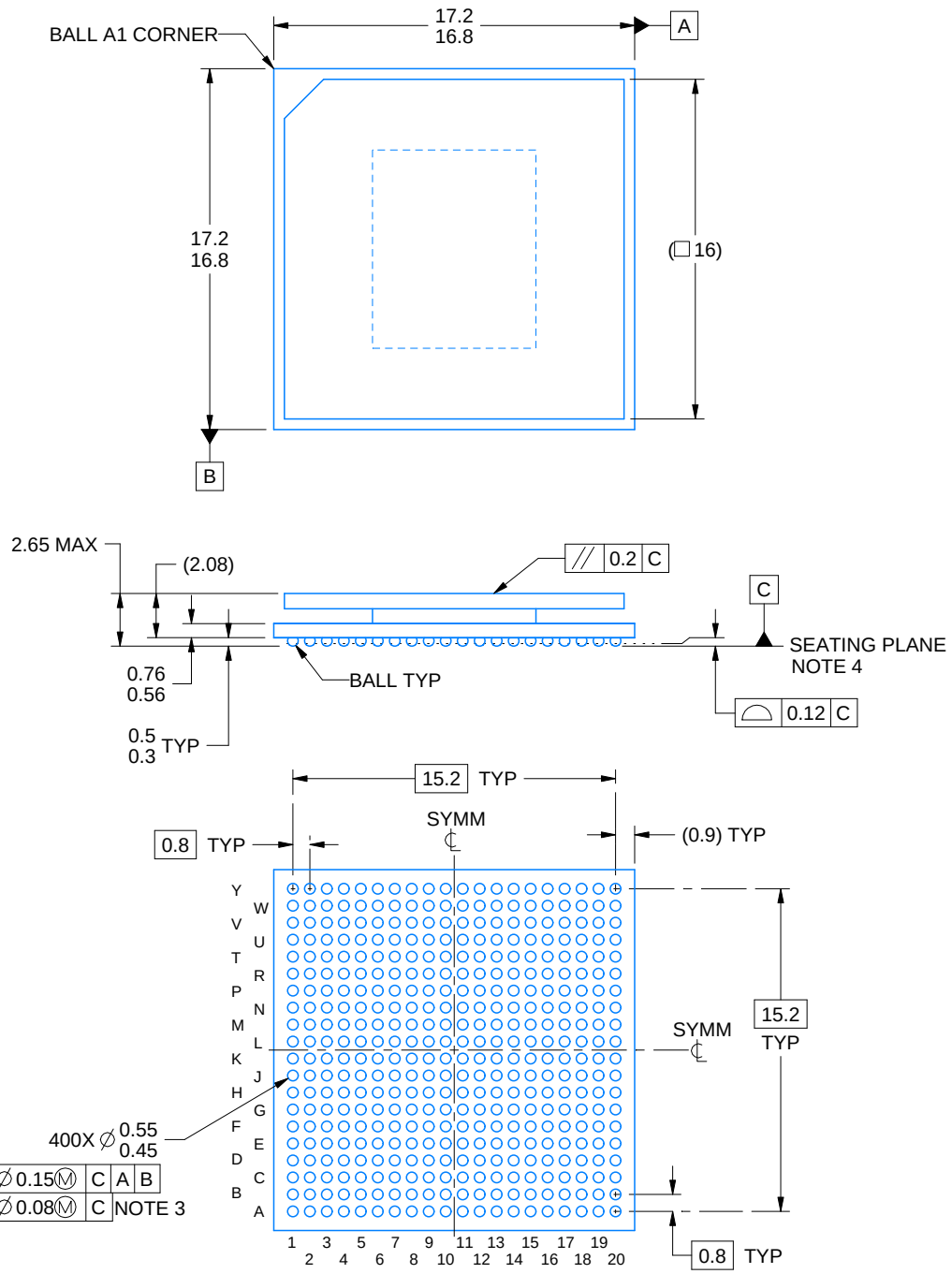
PACKAGE OUTLINE

ABJ0400A

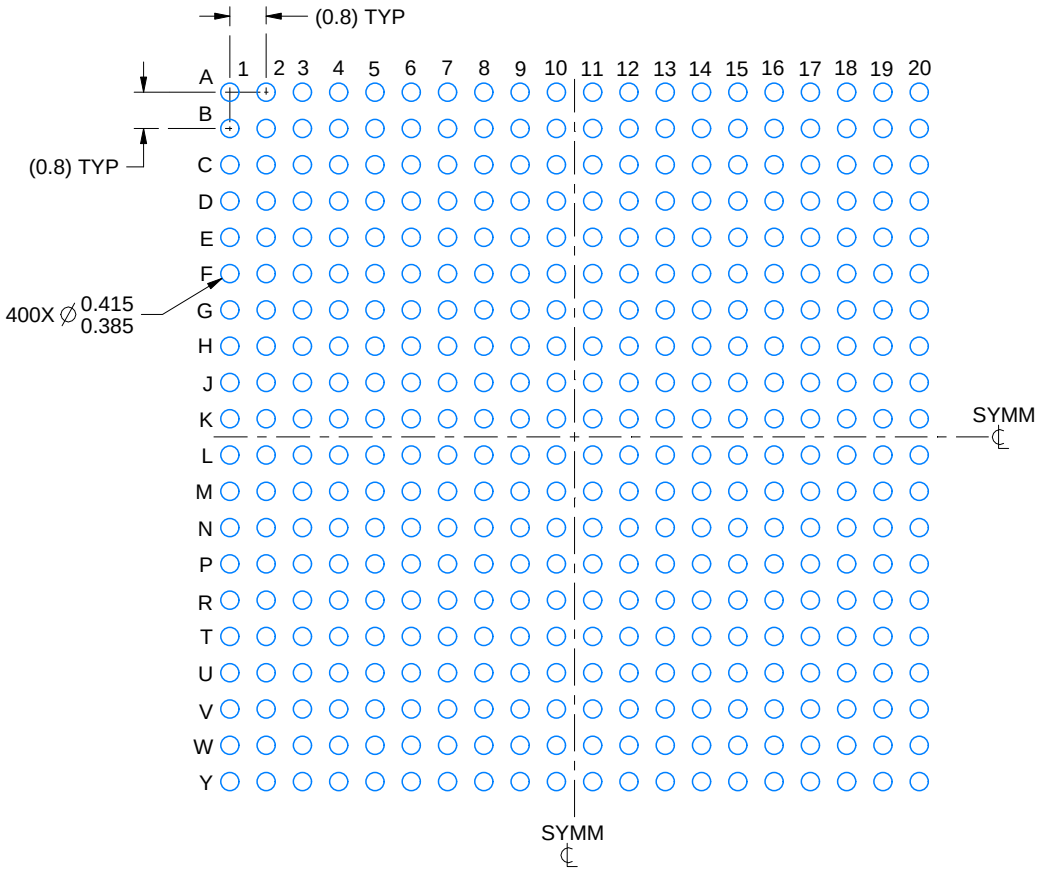
FCBGA - 2.65 mm max height

BALL GRID ARRAY

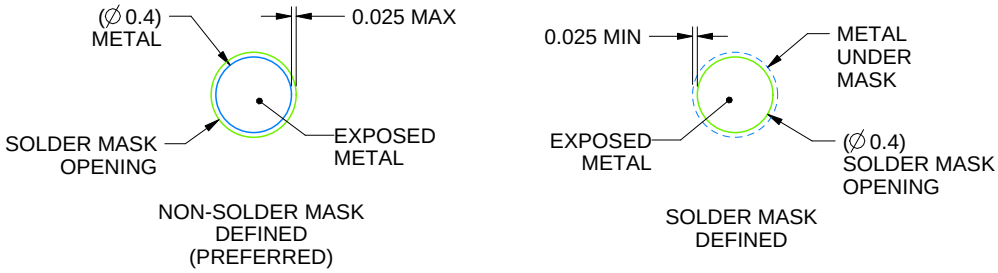


NOTES:

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.



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:6X



SOLDER MASK DETAILS
NOT TO SCALE

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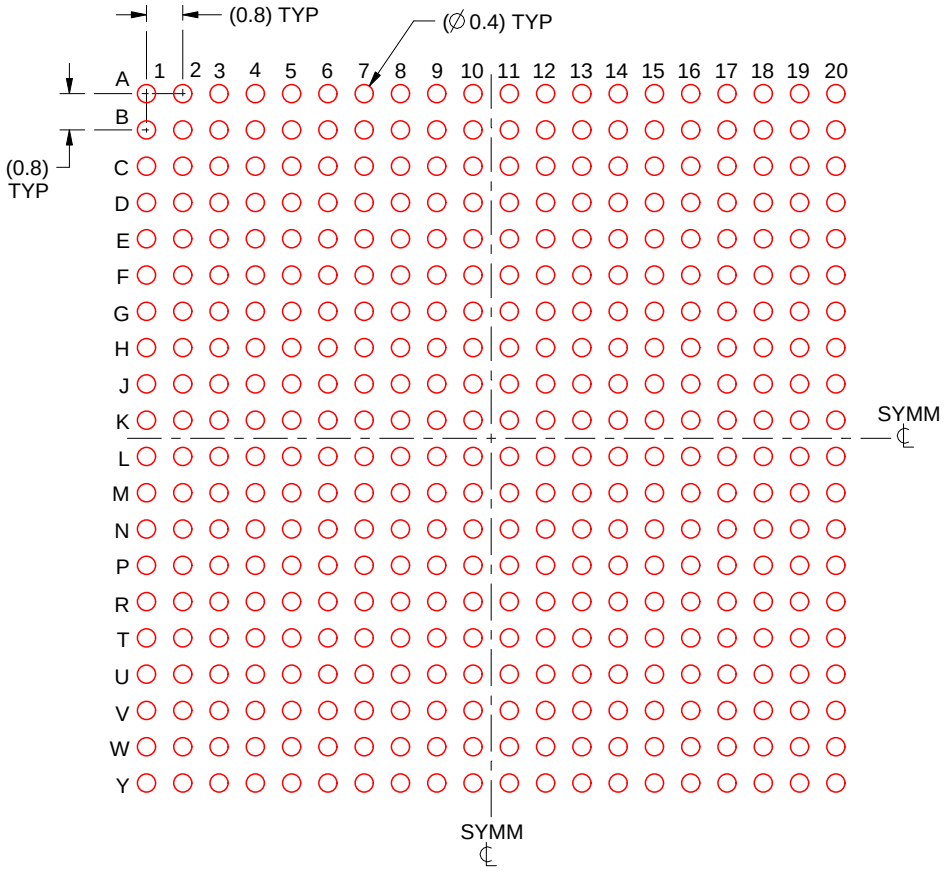
NOTES: (continued)

5. 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).



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

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NOTES: (continued)

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

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