

# AFE7952 Quad-Channel RF Transceiver

## 1 Features

- Quad RF sampling 12-GSPS transmit DACs
- Quad RF sampling 3-GSPS receive ADCs
- Dual RF sampling 3-GSPS feedback ADCs
- Maximum RF signal bandwidth:
  - TX: 2400 MHz for 2TX or 1200 MHz for 4TX
  - FB: 1200 MHz
  - RX: 1200 MHz (no FB); 600 MHz (with FB)
- RF frequency range: up to 12 GHz
- Digital Step Attenuators (DSA):
  - TX: 40 dB range, 1-dB analog and 0.125-dB digital steps
  - RX: 25 dB range, 0.5-dB steps
- Dual-band DUC/DDCs for TX and RX
- Dual NCOs for fast frequency switching
- Supports TDD operation with fast switching between TX and RX
- Internal PLL/VCO to generate DAC/ADC clocks
- Optional external CLK at DAC or ADC rate
- SerDes data interface:
  - JESD204B and JESD204C compliant
  - 8 SerDes transceivers up to 29.5 Gbps
  - 8b/10b and 64b/66b encoding
  - 12-bit, 16-bit, 24-bit, and 32-bit resolution
  - Subclass 1 multi-device synchronization
- Package: 17-mm × 17-mm FCBGA, 0.8-mm pitch

## 2 Applications

- [Macro remote radio unit \(RRU\)](#)
- [Active antenna system mMIMO \(AAS\)](#)
- [Small cell base station](#)
- [Repeater](#)
- 5G mmWave radio
- Distributed Antenna Systems (DAS)

## 3 Description

The high performance, wide bandwidth multi-channel transceiver, integrating four RF sampling transmitter chains, four RF sampling receiver chains, and two RF sampling digitizing auxiliary chains (feedback paths). The high dynamic range of the transmitter and receiver chains allows the device to generate and receive 3G, 4G, and 5G signals from wireless base stations, while the wide bandwidth capability of the is designed for multi-band 4G and 5G base stations.

Each receiver chain includes a 25-dB range DSA (Digital Step Attenuator), followed by a 3-GSPS ADC (analog-to-digital converter). Each receiver channel has an analog peak power detector and various digital power detectors to assist an external or internal autonomous automatic gain controller, and RF overload detectors for device reliability protection. The single or dual digital down converters (DDC) provide up to 600 MHz of combined signal BW in dual DDC mode or 1200-MHz BW in single DDC mode. In TDD mode, the receiver channel can be configured to dynamically switch between the traffic receiver (TDD RX) and wideband feedback receiver (TDD FB), with the capability of reusing the same analog input for both purposes.

Each transmitter chain includes a single or dual digital up-converters (DUCs) supporting up to 2400 MHz for 2TX or 1200 MHz BW for 4TX combined signal bandwidth. The output of the DUCs drives a 12-GSPS DAC (digital-to-analog converter) with a mixed mode output option to enhance 2nd or 3rd Nyquist operation. The DAC output includes a variable gain amplifier (TX DSA) with 40-dB range and 1-dB analog and 0.125-dB digital steps.

The feedback path includes an 25-dB range DSA driving a 3-GSPS RF sampling ADC, followed by a DDC with up to 1200 MHz bandwidth.

### Package Information<sup>(1)</sup>

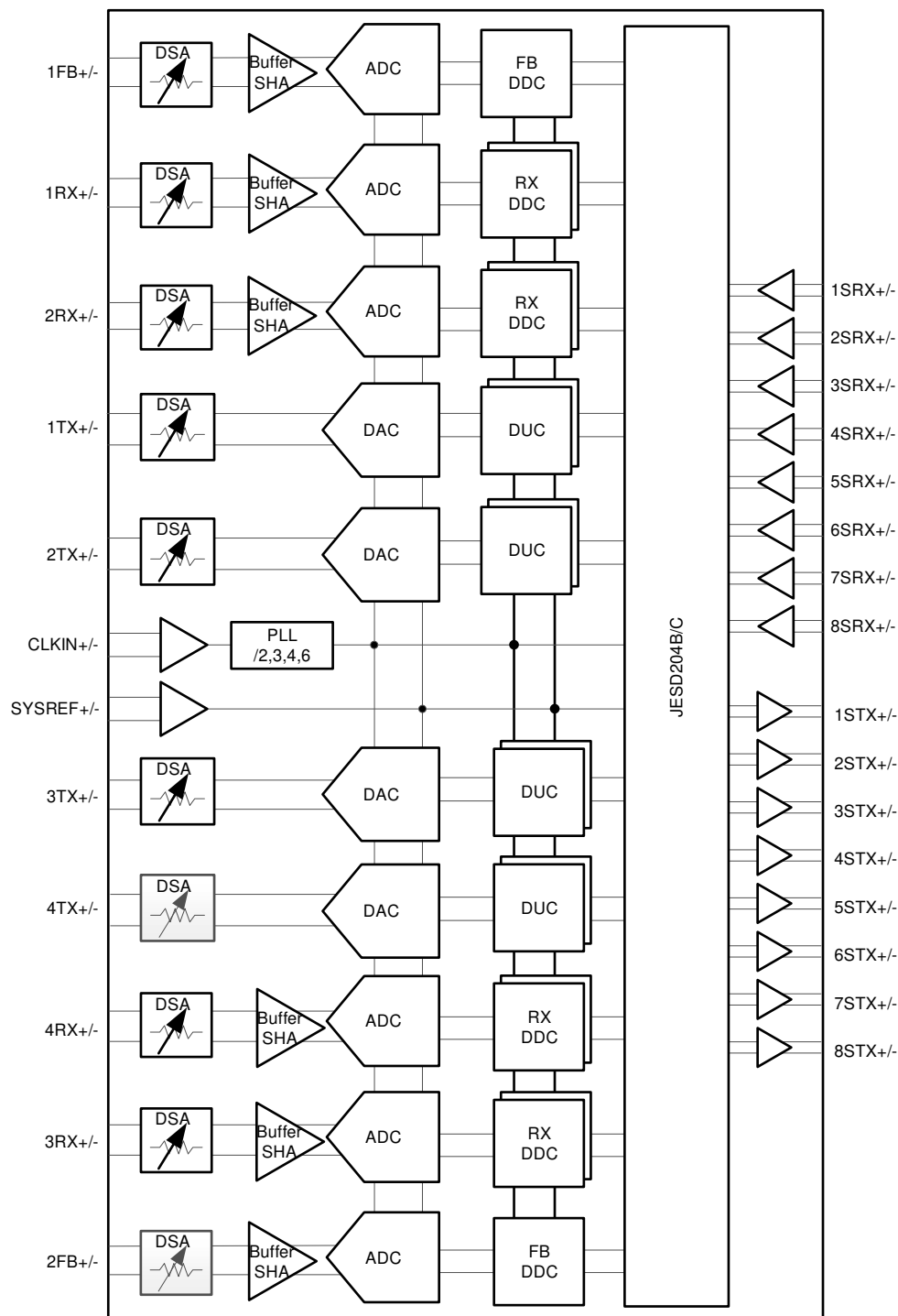
PART NUMBER	PACKAGE	BODY SIZE
AFE7952	FC BGA	17.00 mm × 17.00 mm

(1) For more information, see [Mechanical, Packaging, and Orderable Information](#).



## 4 Functional Block Diagram

### 4.1 AFE7952 Functional Block Diagram



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## 5 Revision History

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

DATE	VERSION	NOTES
November 2022	*	Initial release.

## 6 Device and Documentation Support

### 6.1 Trademarks

All trademarks are the property of their respective owners.

### 6.2 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.

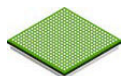
### 6.3 Glossary

#### [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.

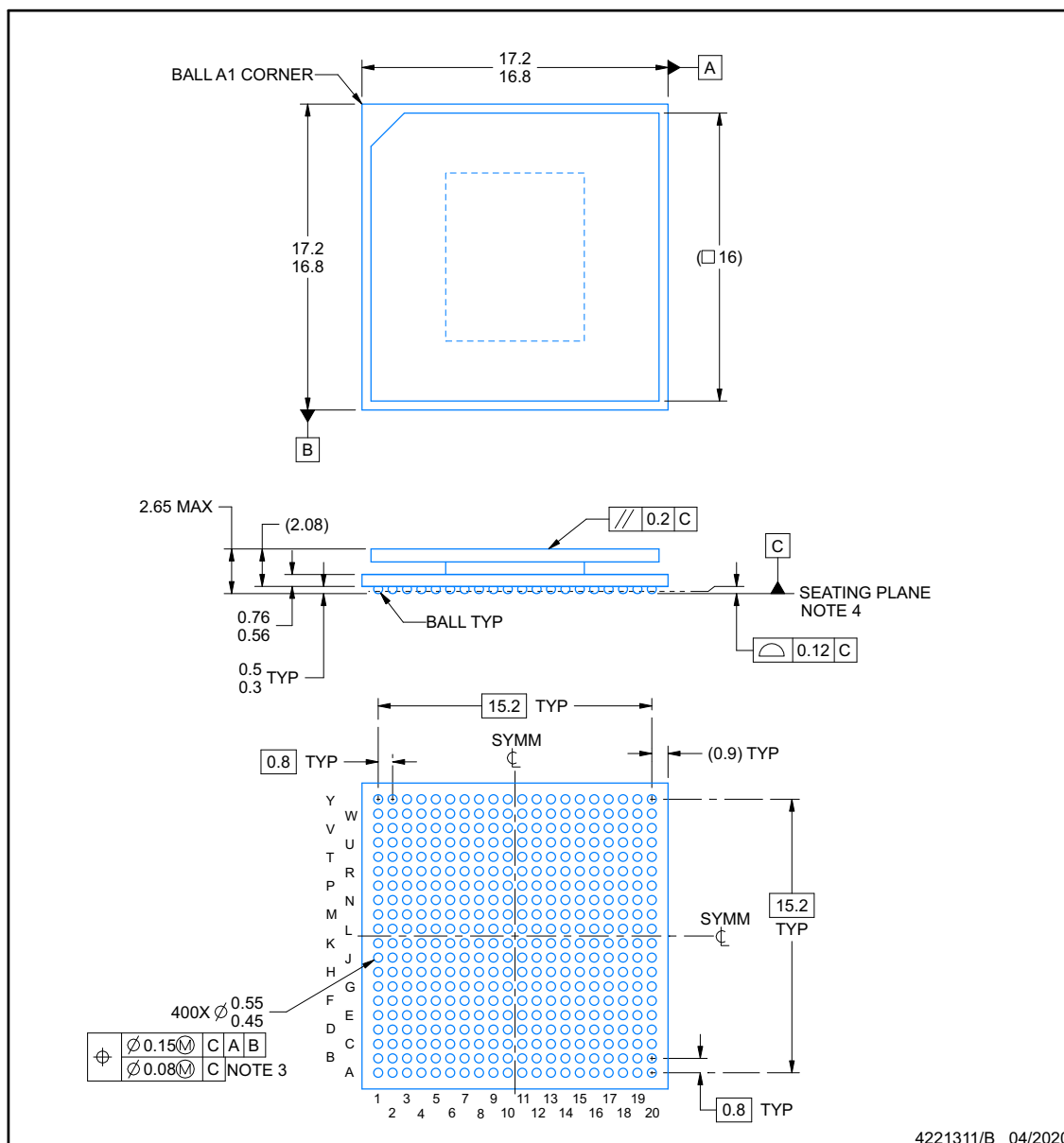


## PACKAGE OUTLINE

**ABJ0400A**

**FCBGA - 2.65 mm max height**

BALL GRID ARRAY



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### NOTES:

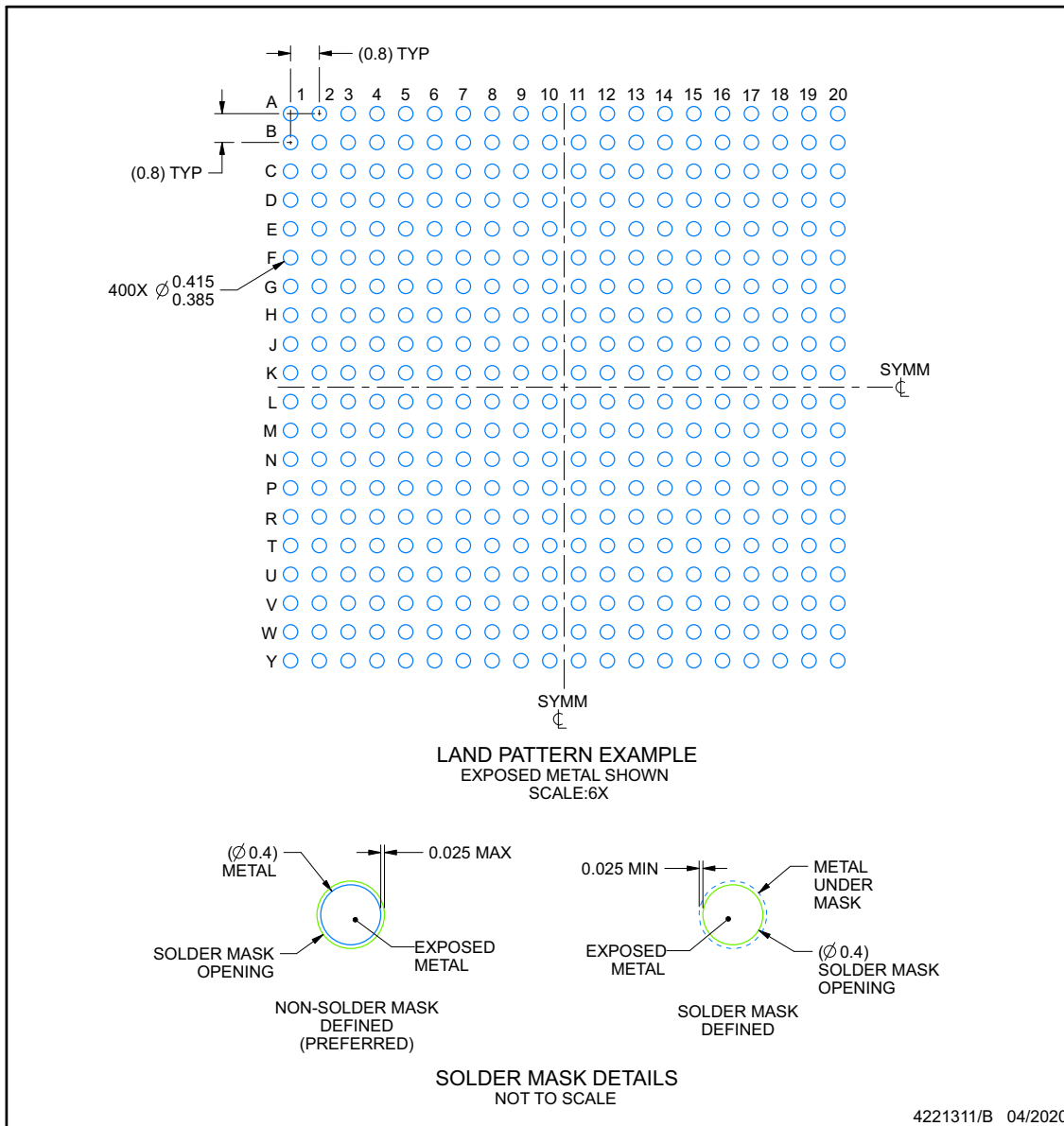
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Dimension is measured at the maximum solder ball diameter, parallel to primary datum C.
4. Primary datum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

## EXAMPLE BOARD LAYOUT

**ABJ0400A**

**FCBGA - 2.65 mm max height**

BALL GRID ARRAY



NOTES: (continued)

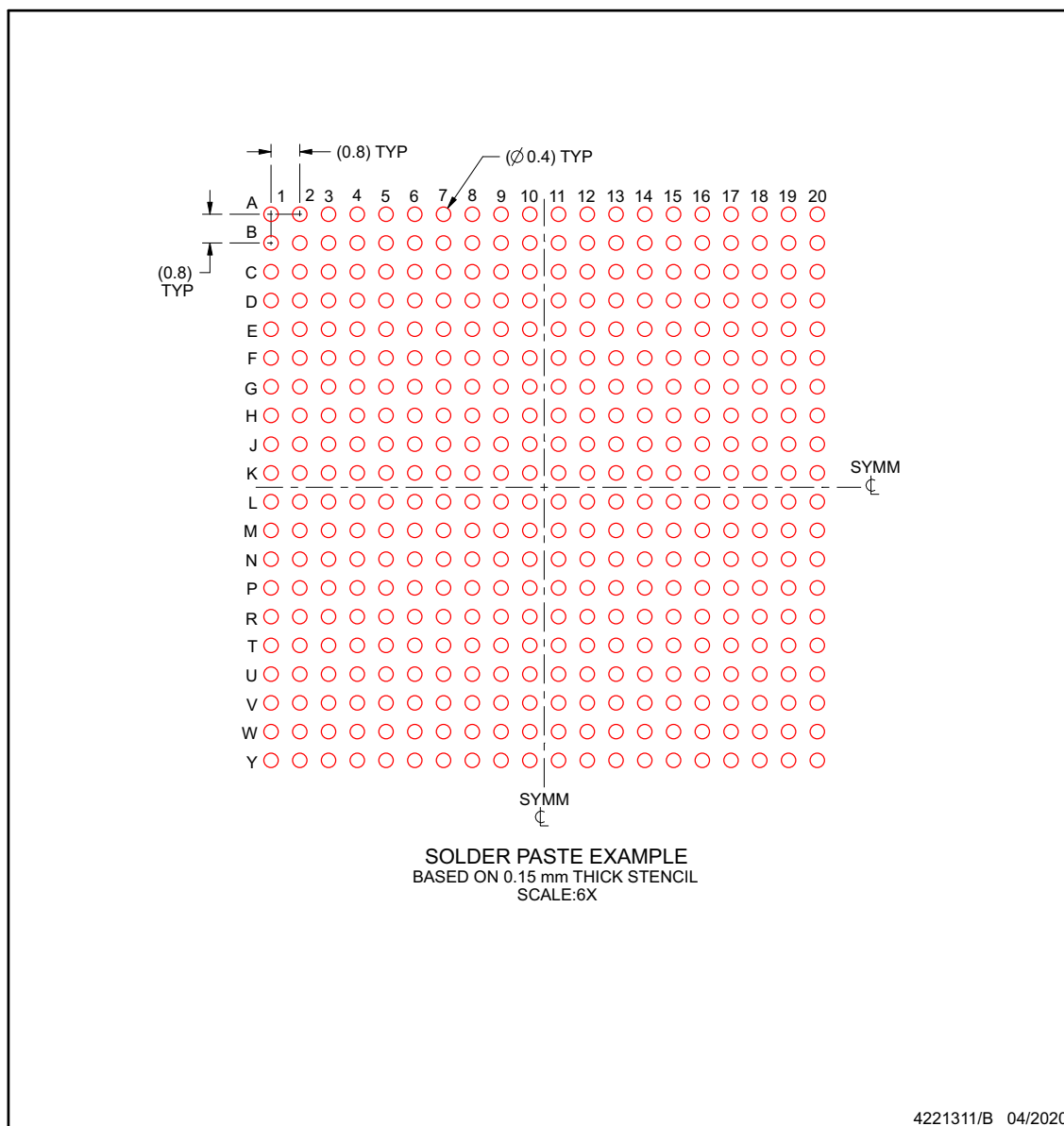
- Final dimensions may vary due to manufacturing tolerance considerations and also routing constraints. For more information, see Texas Instruments literature number SPRU811 ([www.ti.com/lit/spru811](http://www.ti.com/lit/spru811)).

## EXAMPLE STENCIL DESIGN

**ABJ0400A**

**FCBGA - 2.65 mm max height**

BALL GRID ARRAY



NOTES: (continued)

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

## 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)
AFE7952IABJ	Active	Production	FCBGA (ABJ)   400	90   JEDEC TRAY (5+1)	Yes	SNAGCU	Level-3-260C-168 HR	-40 to 85	AFE7952I

<sup>(1)</sup> **Status:** For more details on status, see our [product life cycle](#).

<sup>(2)</sup> **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.

<sup>(3)</sup> **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

<sup>(4)</sup> **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.

<sup>(5)</sup> **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.

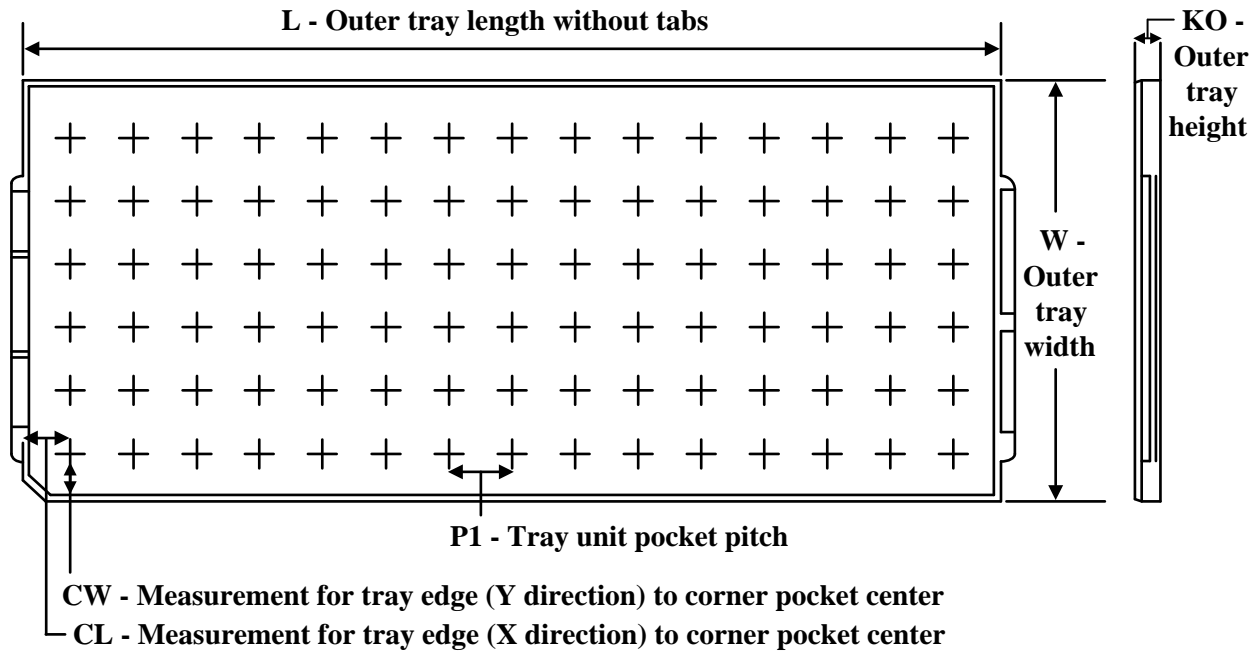
<sup>(6)</sup> **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

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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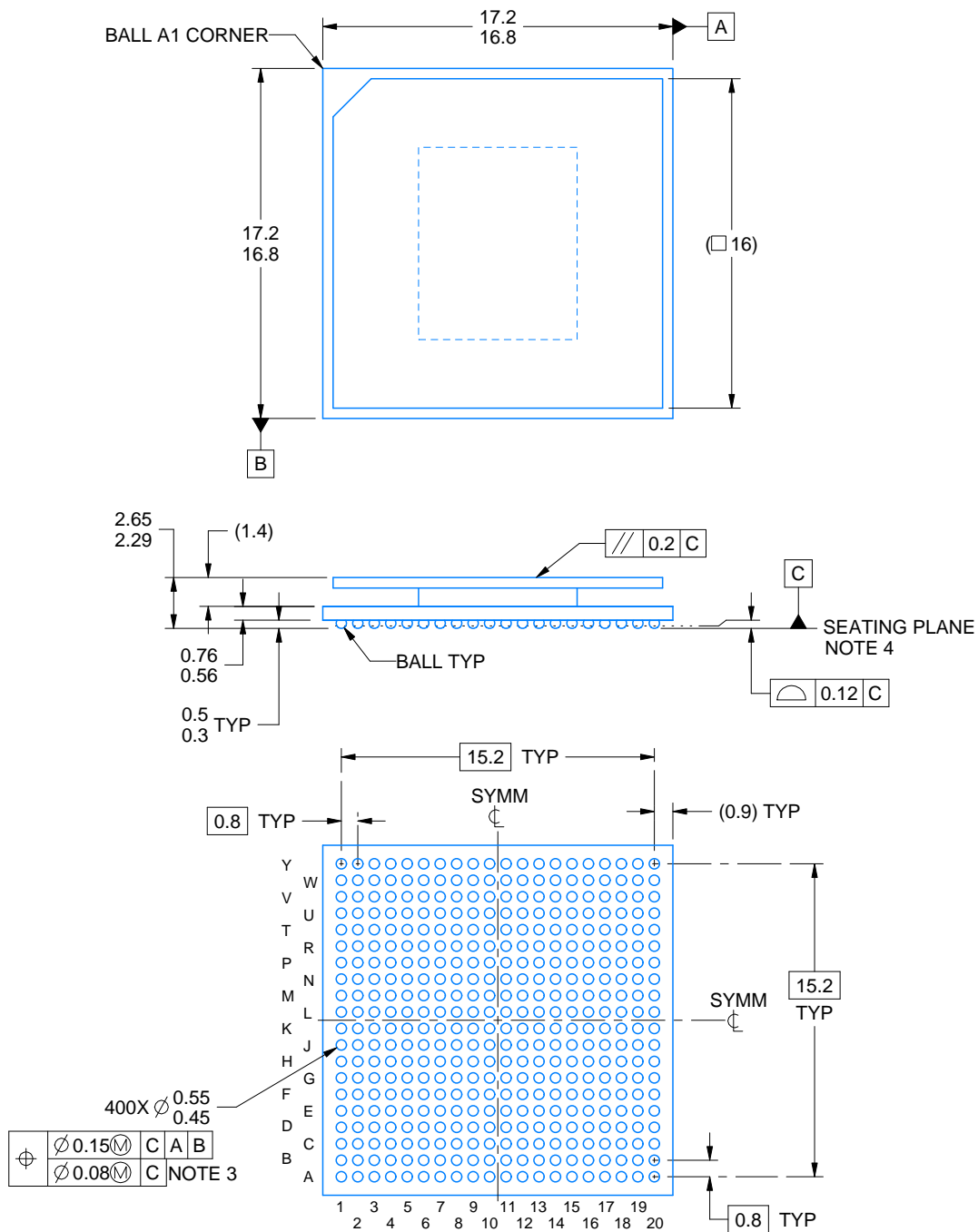
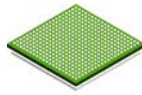
## TRAY



Chamfer on Tray corner indicates Pin 1 orientation of packed units.

\*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	Unit array matrix	Max temperature (°C)	L (mm)	W (mm)	K0 (μm)	P1 (mm)	CL (mm)	CW (mm)
AFE7952IABJ	ABJ	FCBGA	400	90	6 x 15	150	315	135.9	7620	19.5	21	19.2
AFE7952IABJ	ABJ	FCBGA	400	90	6 x 15	150	315	135.9	7620	19.5	21	19.2



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## NOTES:

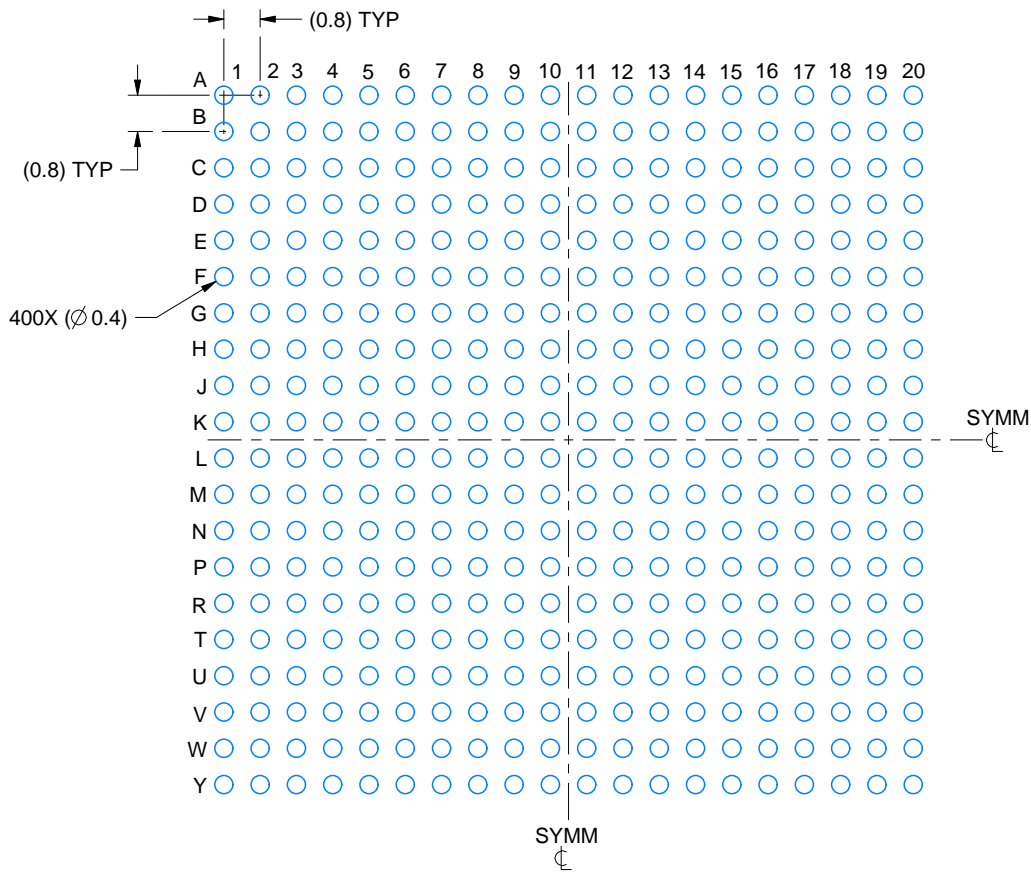
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Dimension is measured at the maximum solder ball diameter, parallel to primary datum C.
4. Primary datum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

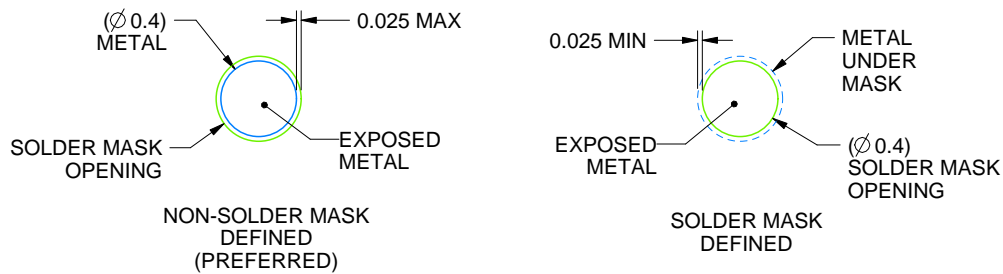
ABJ0400A

FCBGA - 2.65 mm max height

BALL GRID ARRAY



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE:6X



SOLDER MASK DETAILS  
NOT TO SCALE

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NOTES: (continued)

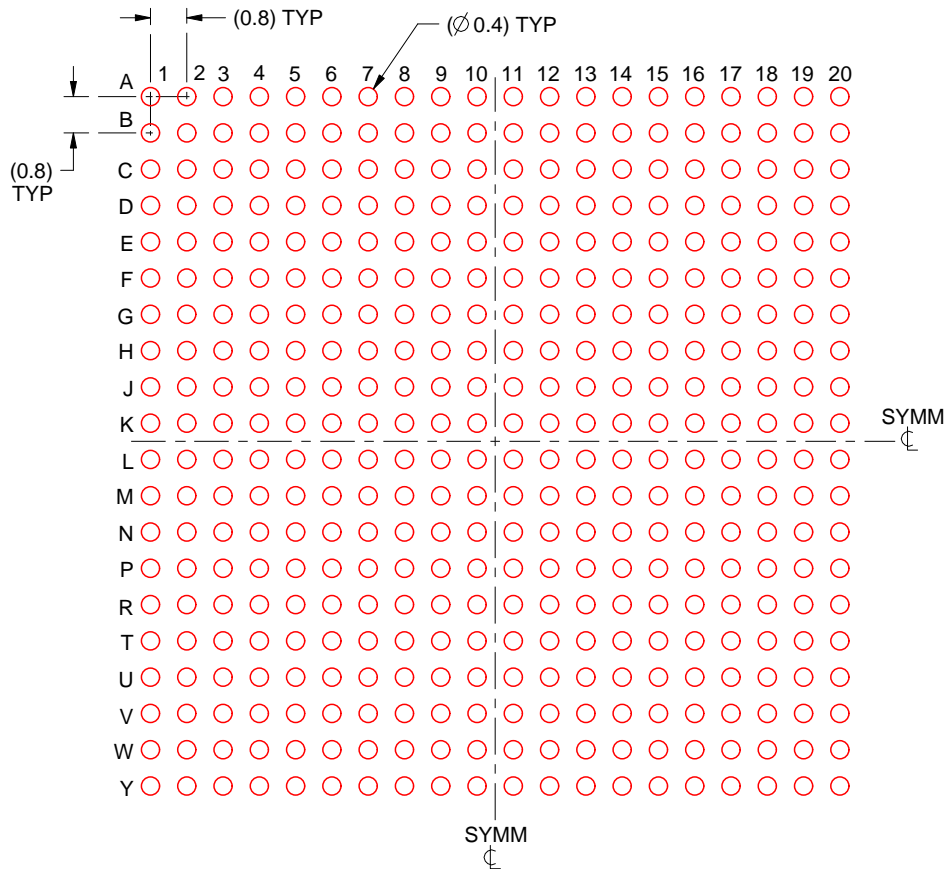
- Final dimensions may vary due to manufacturing tolerance considerations and also routing constraints.  
For more information, see Texas Instruments literature number SPRU811 ([www.ti.com/lit/spru811](http://www.ti.com/lit/spru811)).

# 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

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NOTES: (continued)

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

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