AFE8030 Octal-Channel RF Transceiver with Feedback Paths

1 Features

- Octal RF sampling 12-GSPS transmit DACs
- Octal RF sampling 4-GSPS receive ADCs
- Dual RF sampling 4-GSPS feedback ADCs
- Maximum RF signal bandwidth:
  - TX/FB: 800 MHz.
    - 1200 MHz in 4-channel mode
  - RX: 400 MHz
    - 800 MHz in 4-channel mode
- RF frequency range: up to 6GHz
- Digital Step Attenuators (DSA):
  - TX: 40-dB range, 1-dB analog and 0.125-dB digital steps
  - RX/FB: 31/25-dB range, 1-dB step
- Single or dual-band DUC/DDCs
- Dual NCO's per chain 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
  - 8 SerDes transceivers up to 32.5 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
- Distributed Antenna Systems (DAS)
- Repeater

3 Description

The AFE8030 is a high performance, wide bandwidth multi-channel transceiver, integrating eight RF sampling transmitter chains, eight RF sampling receiver chains and two separate RF front end for the auxiliary chains (feedback paths). The high dynamic range of the transmitter and receiver chains allows generating and receiving 3G, 4G and 5G signals for wireless base stations, while the wide bandwidth capability makes the AFE8030 devices suitable for multi-band 4G and 5G base stations.

Each receiver chain includes a 31-dB range DSA (Digital Step Attenuator), followed by a 4-GSPS ADC (analog-to-digital converter). Each receiver channel has analog peak power detectors and digital peak and 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) provides up to 400 MHz of combined signal BW in 8-channel mode and 800 MHz in 4-channel mode. In TDD mode, the receiver channel can be configured to dynamically switching between traffic receiver (TDD RX) and wideband feedback receiver (TDD FB), with the capability of re-using the same analog input for both purposes.

Each transmitter chain includes a single or dual digital up converters (DUCs) supporting up to 800-MHz combined signal bandwidth (1200 MHz in 4-channel mode). The output of the DUCs drives a 12-GSPS DAC (digital to analog converter) with a mixed mode output option to enhance 2nd 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 a 25-dB range DSA driving a 4-GSPS RF sampling ADC, followed by a single wide or dual narrow DDCs with up to combined 800-MHz bandwidth (1200 MHz in 4-channel mode).

Package Information(1)

PART NUMBER	PACKAGE	BODY SIZE (NOM)
AFE8030	ABJ FCBGA (400)	17.00 mm × 17.00 mm
	ALK FCBGA (400)	17.00 mm × 17.00 mm

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

4 AFE8030 Functional Block Diagram

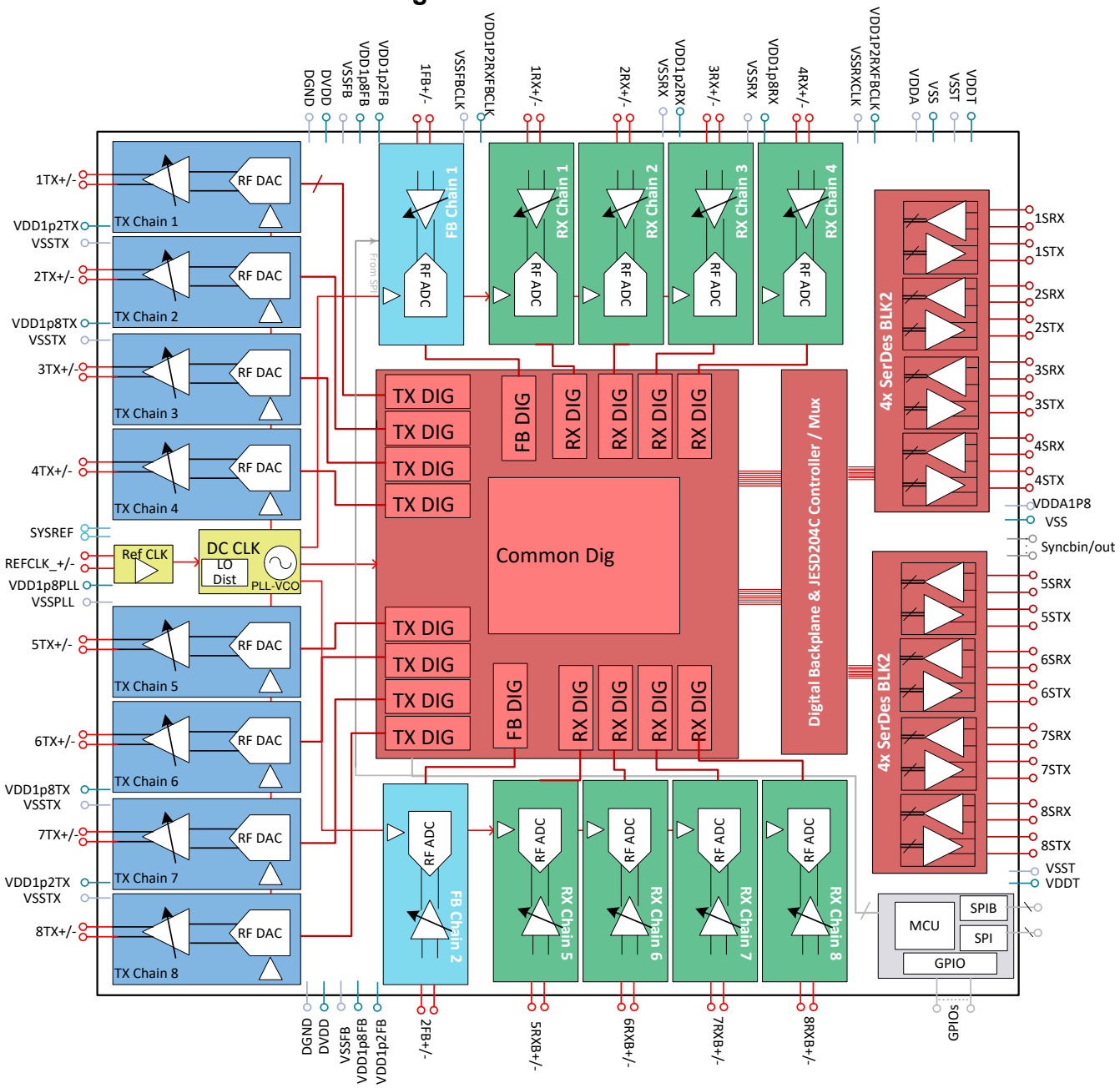

Table of Contents

5 Revision History

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

Changes from Revision * (December 2021) to Revision A (September 2022)	Page
• Added ALK (FCBGA) package to the data sheet	1
• Changed the *Device Information* table to *Package Information*	1

6 Device and Documentation Support

6.1 Device Support

6.2 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. Click on *Subscribe to updates* 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.

6.3 Support Resources

TI E2E™ support forums are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

Linked content is 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.

6.4 Trademarks

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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 Glossary

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

7 Mechanical, Packaging, and Orderable Information

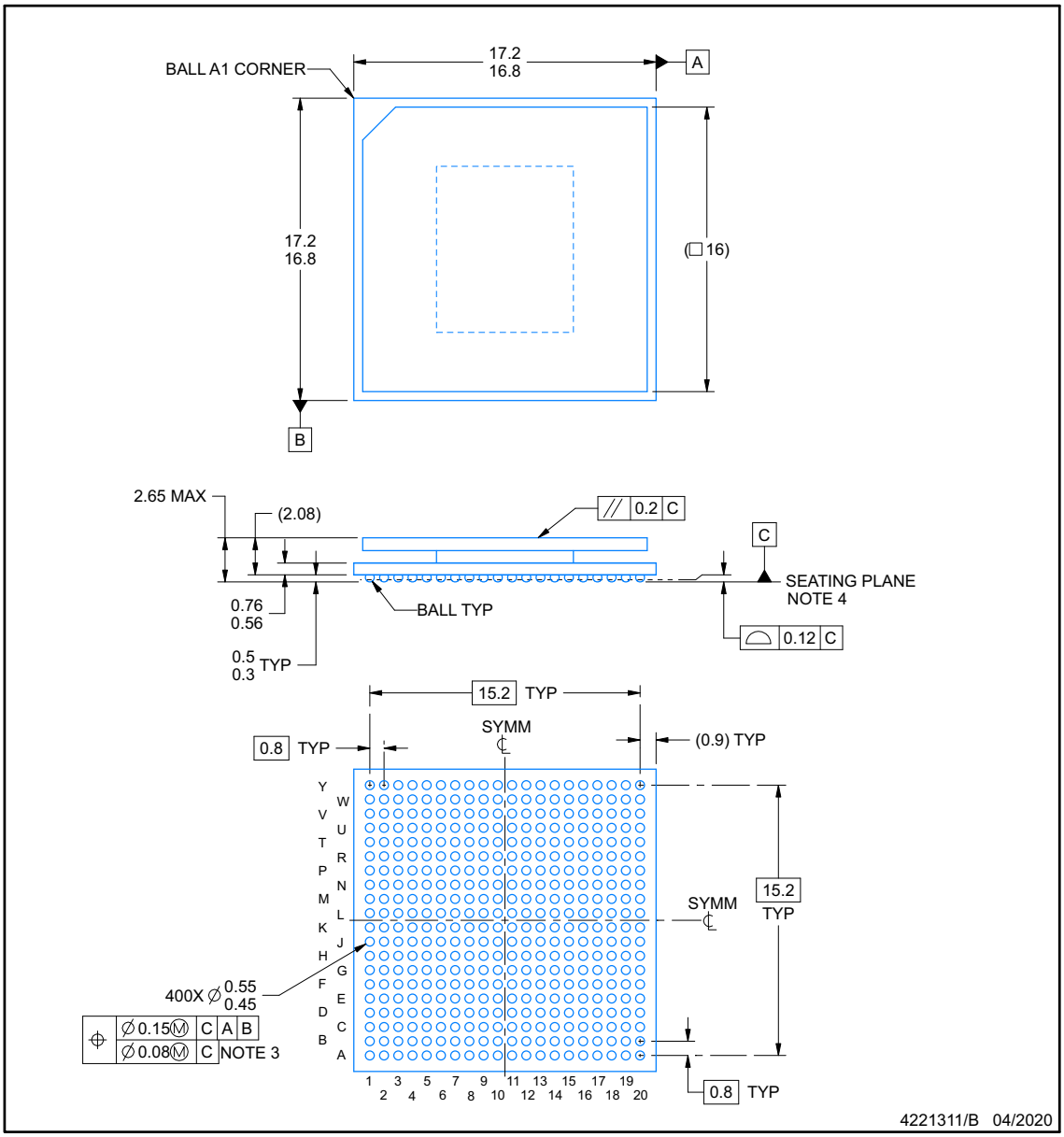
The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

PACKAGE OUTLINE

ABJ0400A

FCBGA - 2.65 mm max height

BALL GRID ARRAY



NOTES:

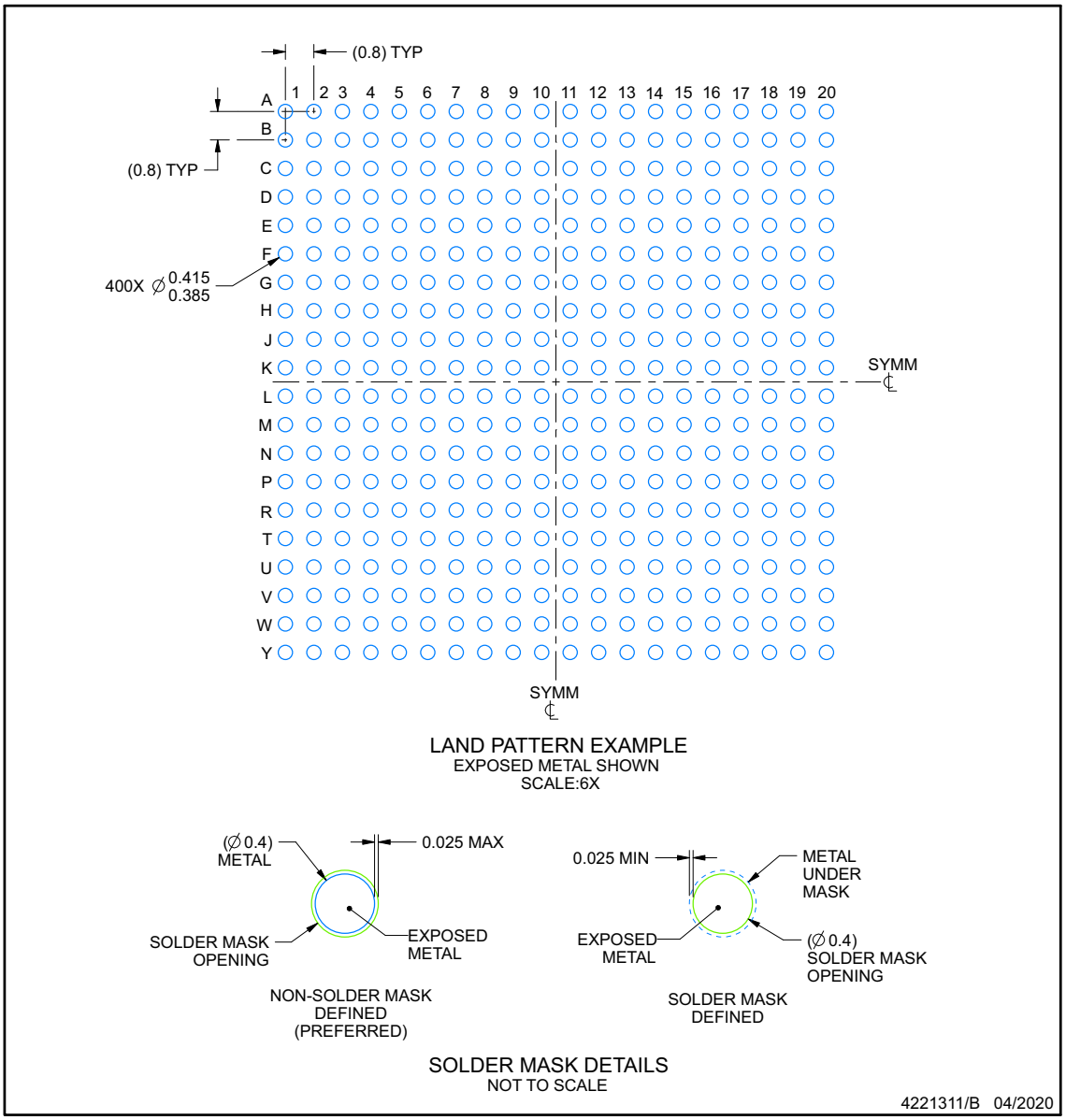
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Dimension is measured at the maximum solder ball diameter, parallel to primary datum C.
4. Primary datum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

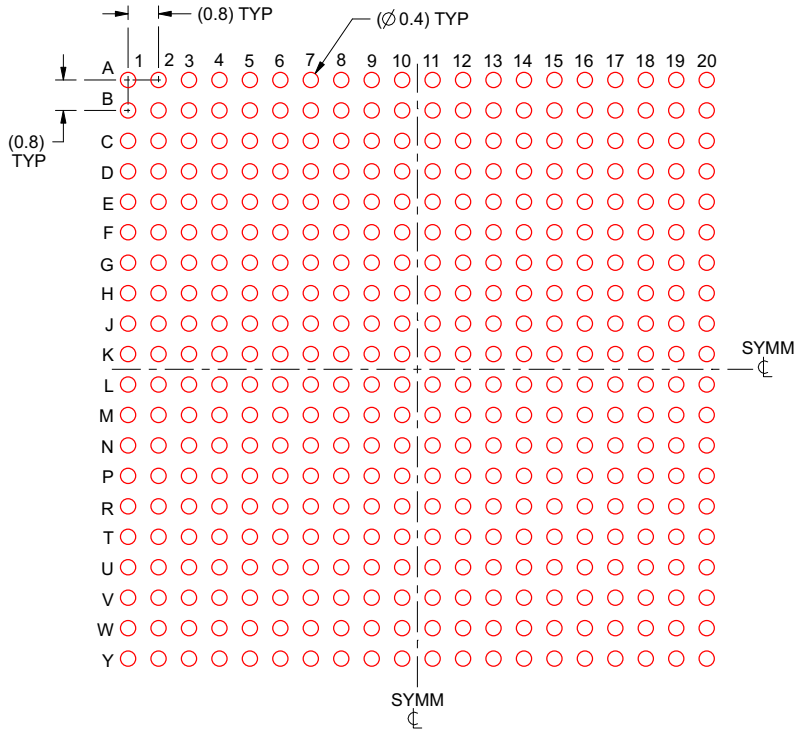
5. Final dimensions may vary due to manufacturing tolerance considerations and also routing constraints. For more information, see Texas Instruments literature number SPRU811 (www.ti.com/lit/spru811).

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/B 04/2020

NOTES: (continued)

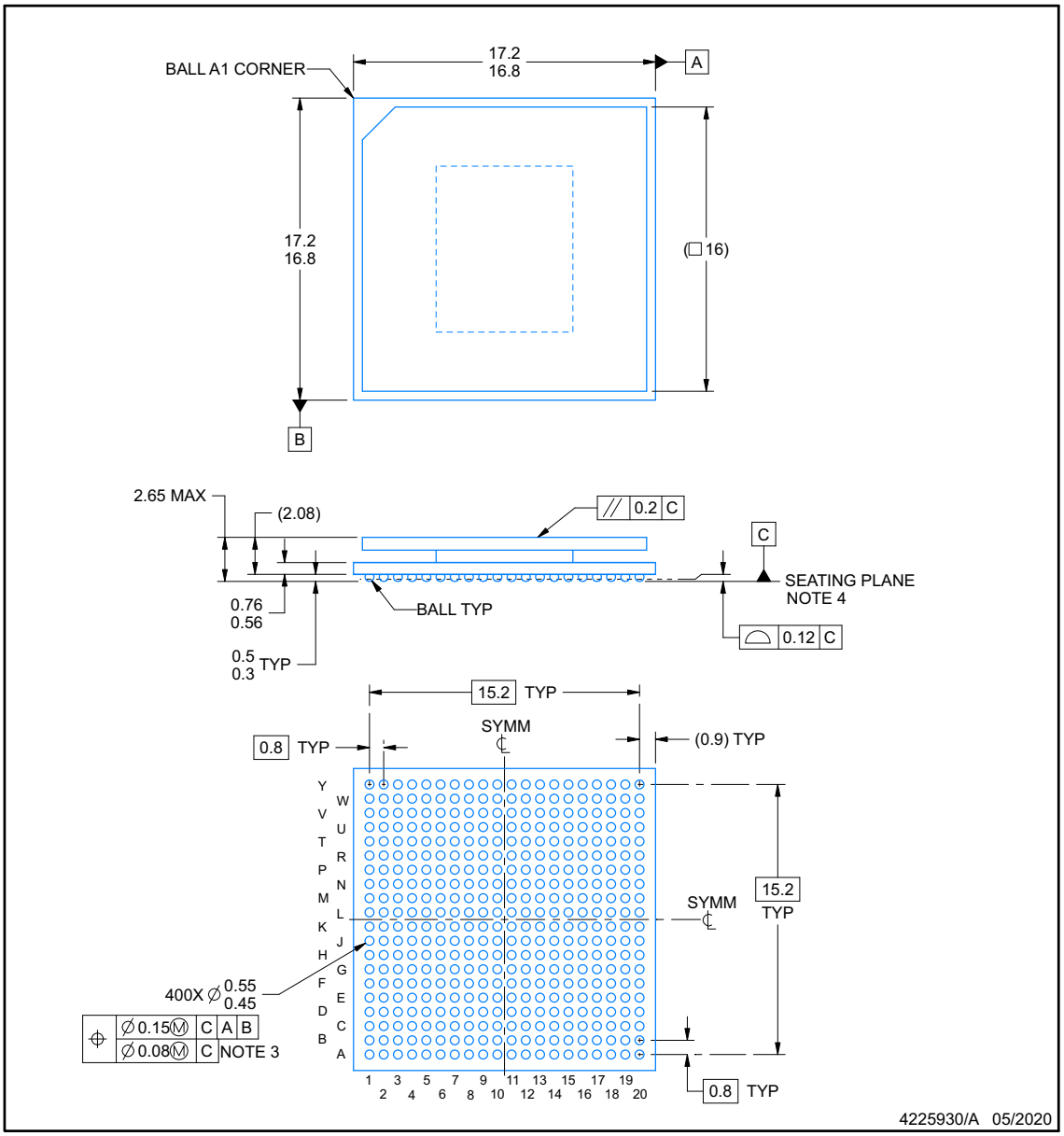
6. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release.

PACKAGE OUTLINE

ALK0400A

FCBGA - 2.65 mm max height

BALL GRID ARRAY



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EXAMPLE BOARD LAYOUT

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FCBGA - 2.65 mm max height

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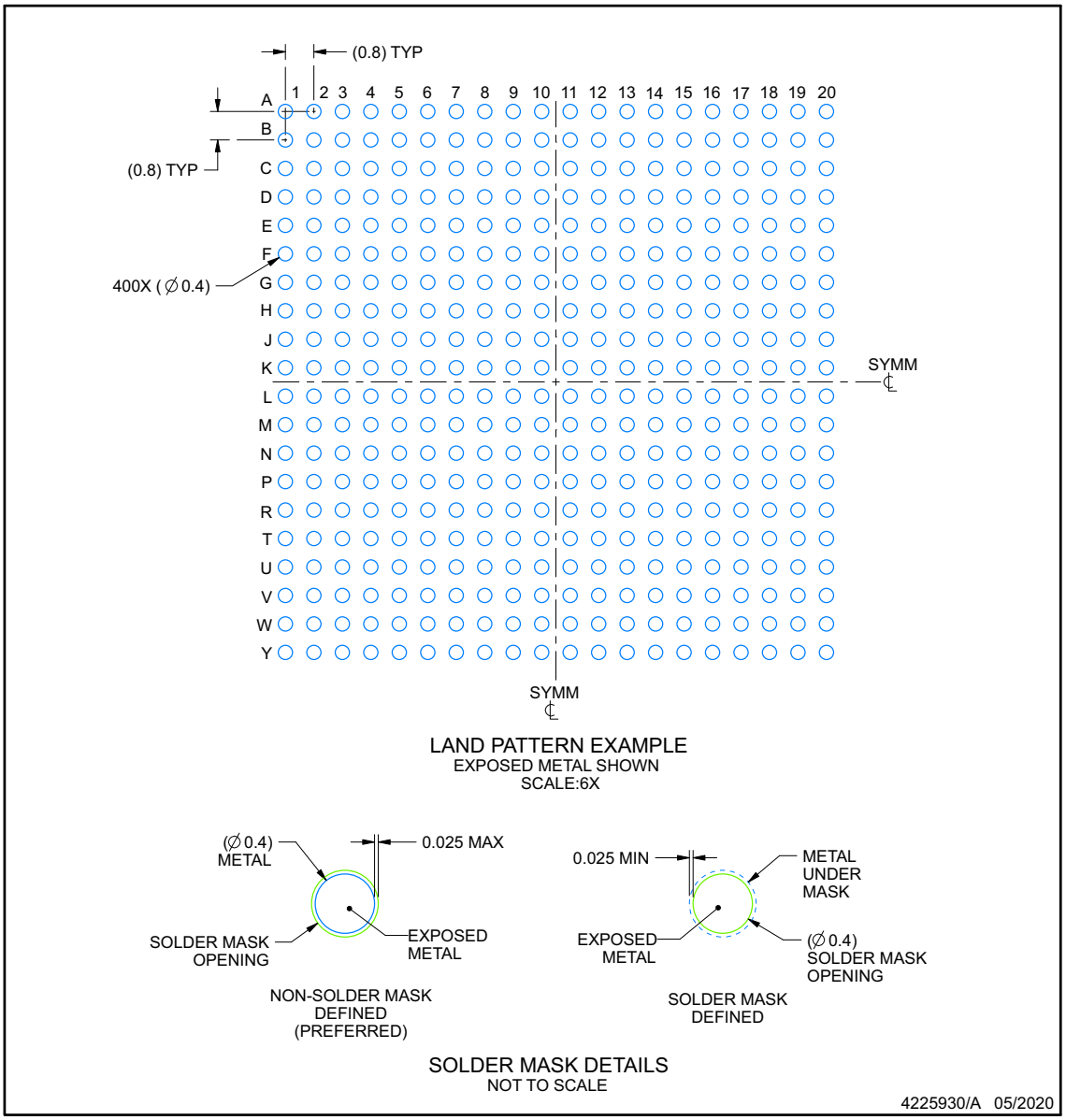

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EXAMPLE STENCIL DESIGN

ALK0400A

FCBGA - 2.65 mm max height

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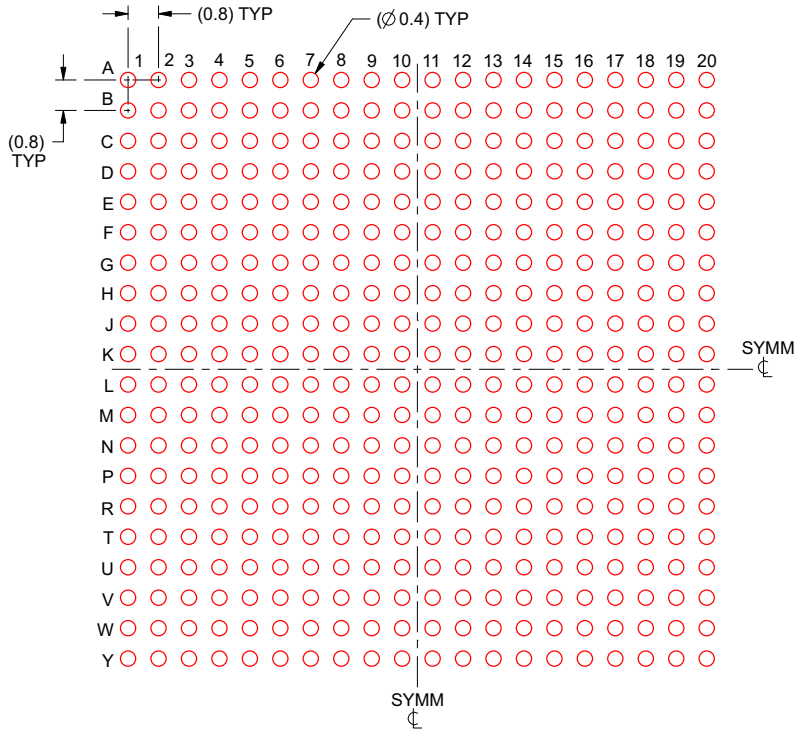


SOLDER PASTE EXAMPLE
BASED ON 0.15 mm THICK STENCIL
SCALE:6X

4225930/A 05/2020

NOTES: (continued)

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

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
AFE8030EDIABJ	ACTIVE	FCBGA	ABJ	400	90	RoHS & Green	SNAGCU	Level-3-260C-168 HR	-40 to 85	AFE8030	Samples
AFE8030EDIALK	ACTIVE	FCBGA	ALK	400	90	Non-RoHS & Green	Call TI	Level-3-220C-168 HR	-40 to 85	AFE8030 SNPB	Samples
AFE8030IABJ	ACTIVE	FCBGA	ABJ	400	90	RoHS & Green	SNAGCU	Level-3-260C-168 HR	-40 to 85	AFE8030	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.

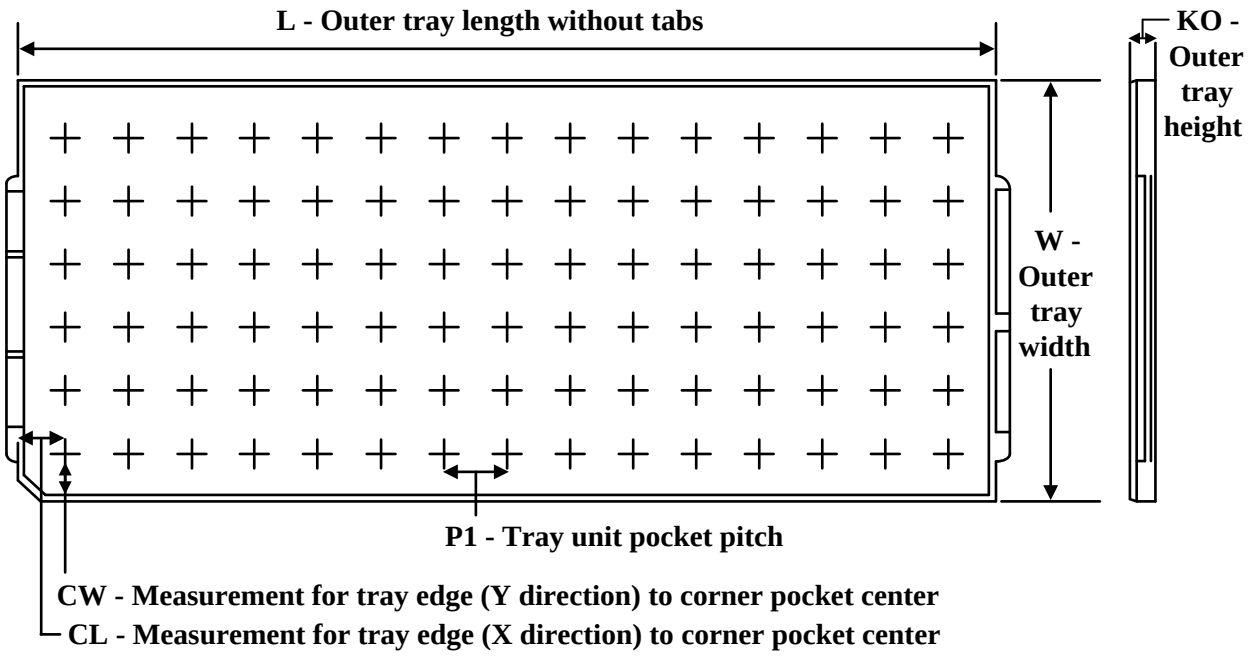
(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(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.

TRAY



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

*All dimensions are nominal

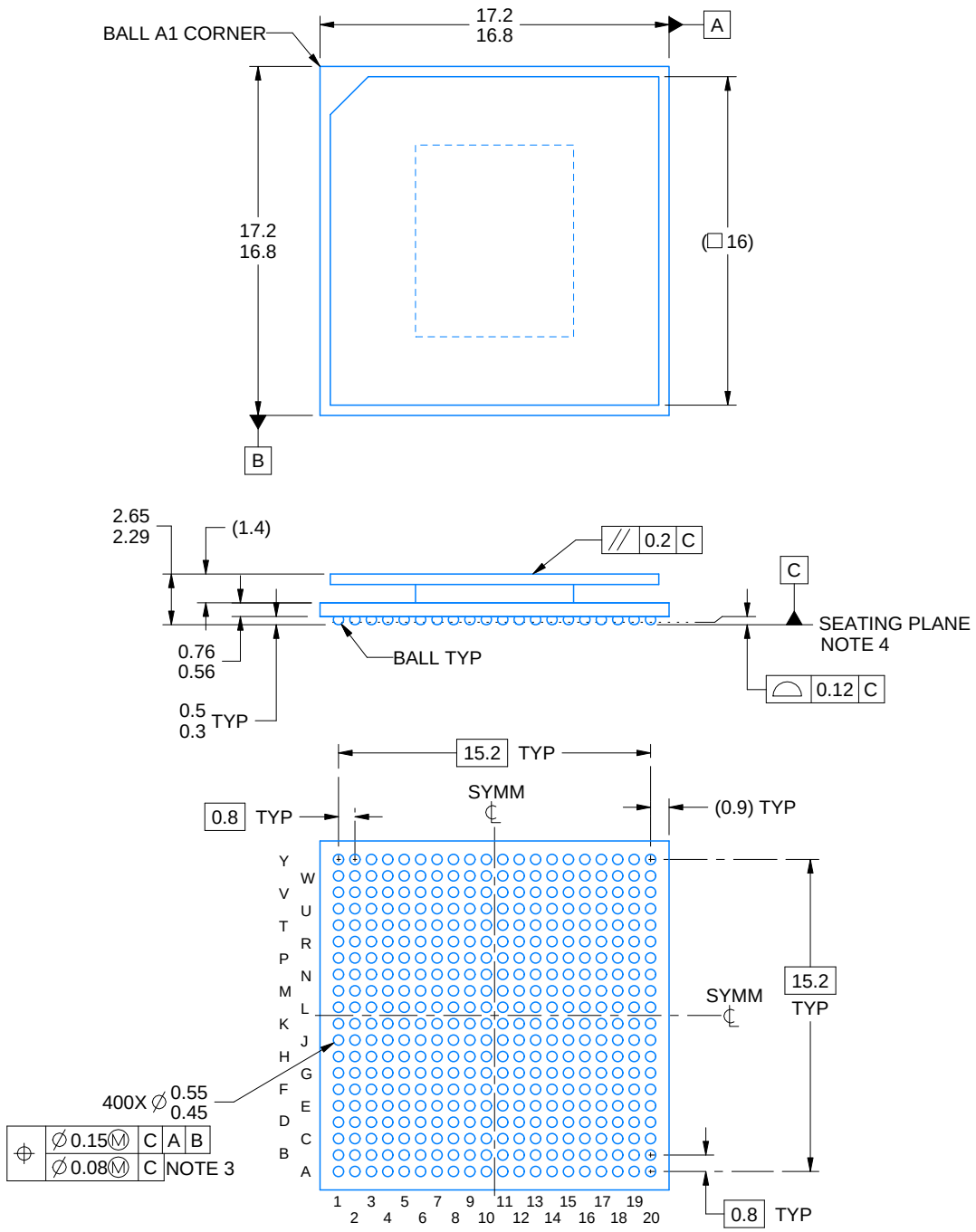
Device	Package Name	Package Type	Pins	SPQ	Unit array matrix	Max temperature (°C)	L (mm)	W (mm)	K0 (µm)	P1 (mm)	CL (mm)	CW (mm)
AFE8030EDIABJ	ABJ	FCBGA	400	90	6 x 15	150	315	135.9	7620	19.5	21	19.2
AFE8030EDIALK	ALK	FCBGA	400	90	6 x 15	150	315	135.9	7620	19.5	21	19.2
AFE8030IABJ	ABJ	FCBGA	400	90	6 x 15	150	315	135.9	7620	19.5	21	19.2

PACKAGE OUTLINE

ABJ0400A

FCBGA - 2.65 mm max height

BALL GRID ARRAY



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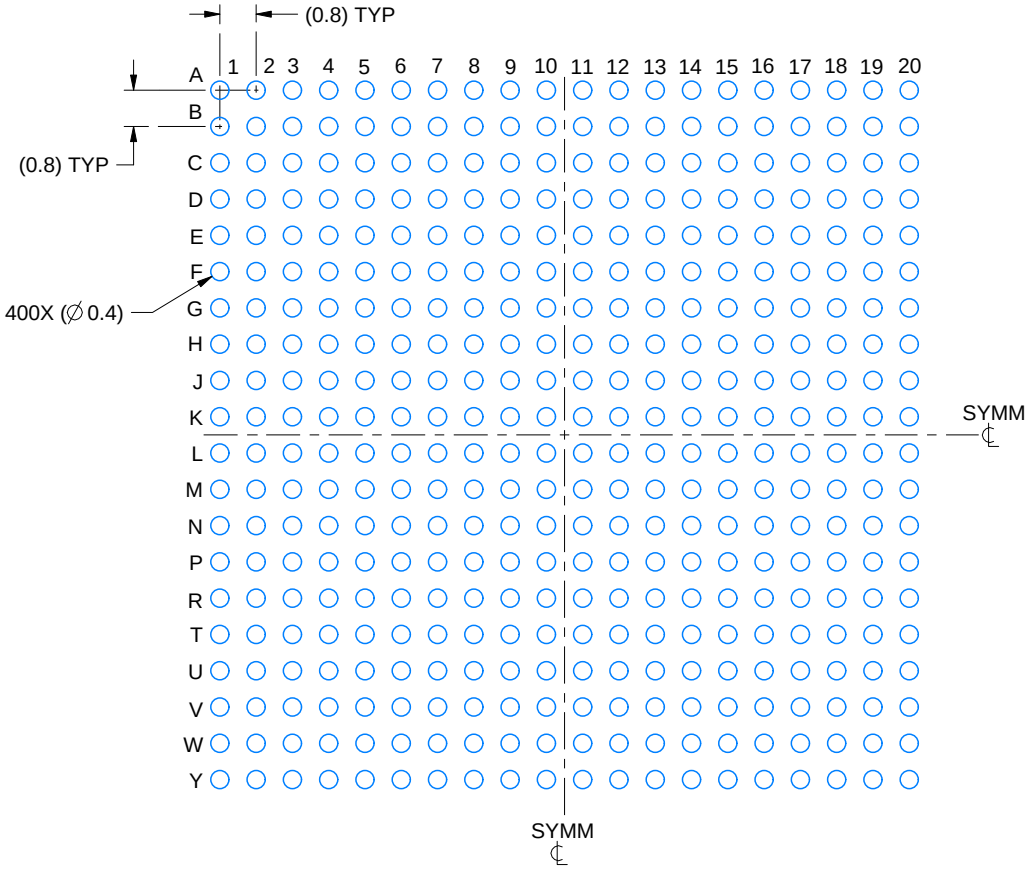
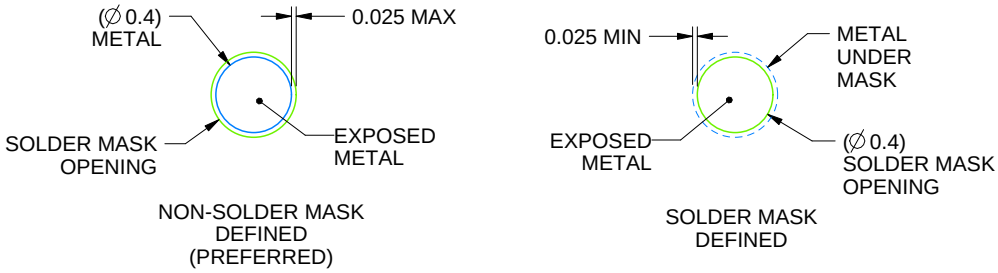
4. Primary datum C and seating plane are defined by the spherical crowns of the solder balls.
5. The lids are electrically floating (e.g. not tied to GND).



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:6X



SOLDER MASK DETAILS
NOT TO SCALE

4221311/D 03/2023

NOTES: (continued)

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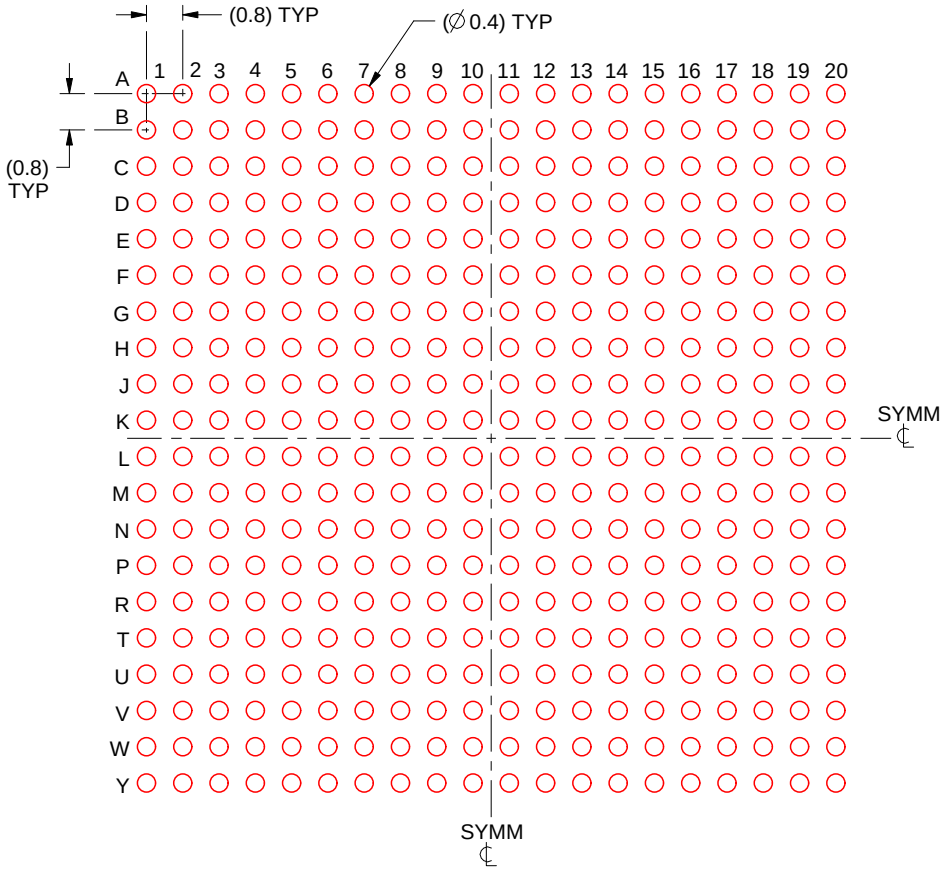


SOLDER PASTE EXAMPLE
BASED ON 0.15 mm THICK STENCIL
SCALE:6X

4221311/D 03/2023

NOTES: (continued)

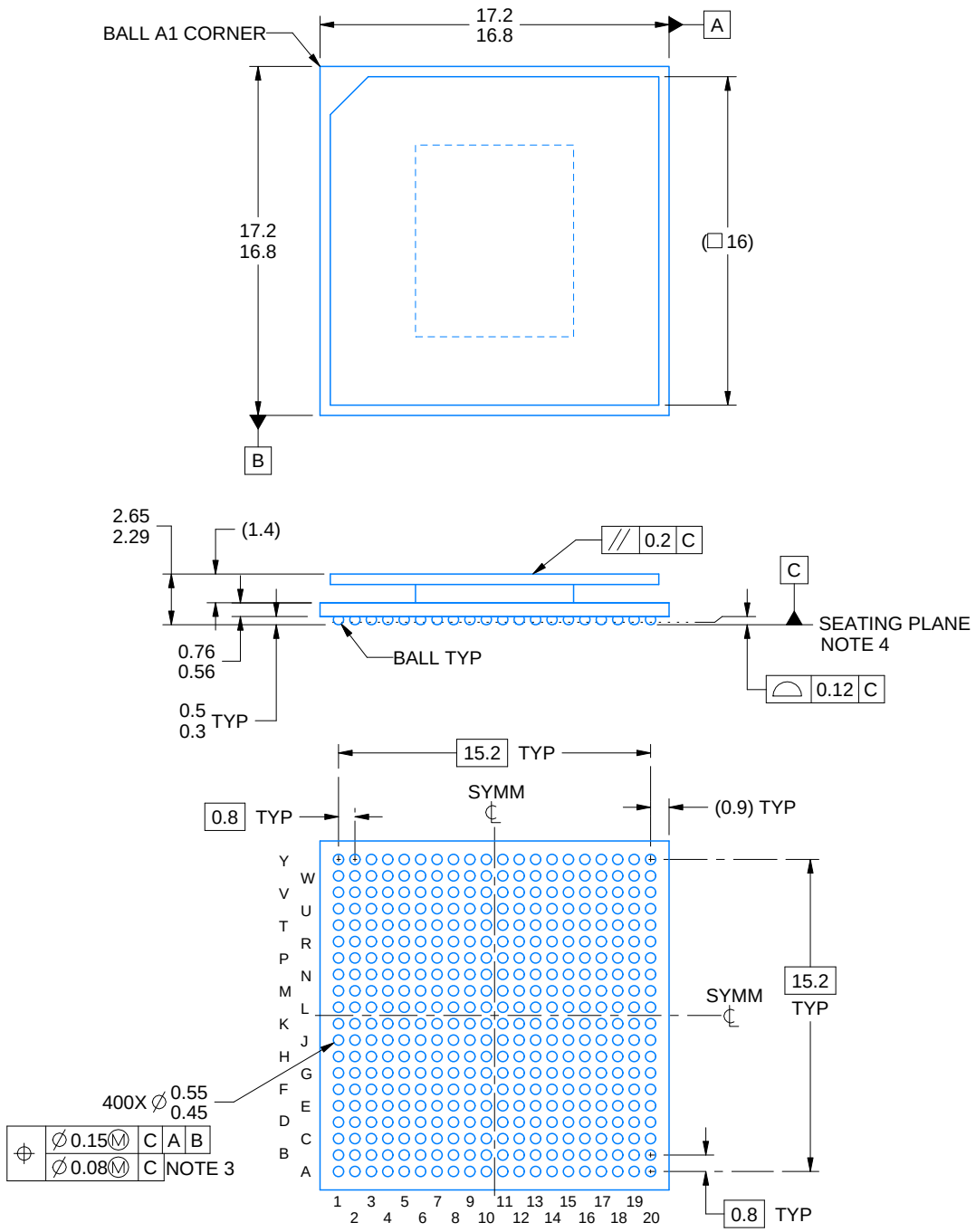
7. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release.

ALK0400A

PACKAGE OUTLINE

FCBGA - 2.65 mm max height

BALL GRID ARRAY



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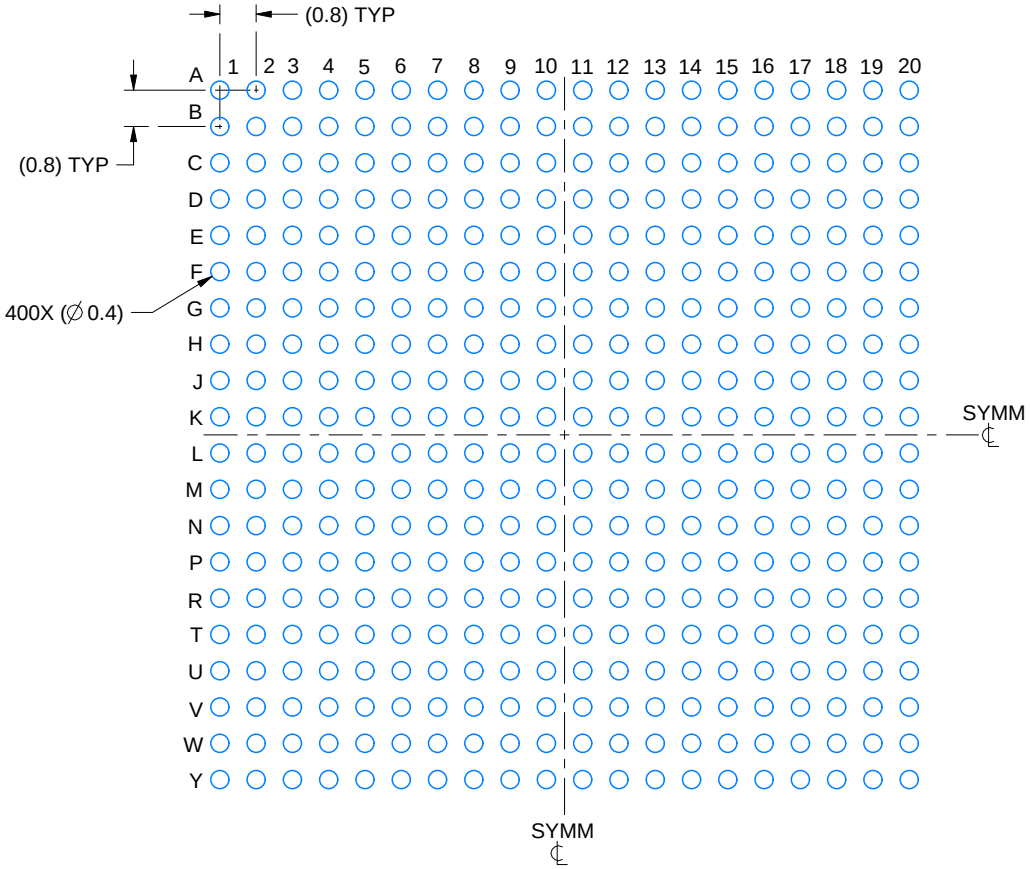

LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
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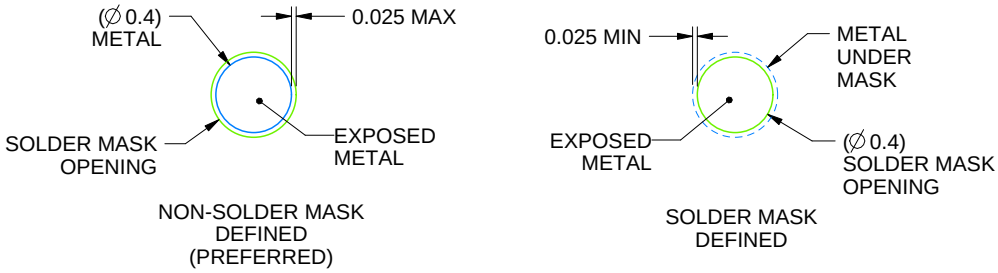

SOLDER MASK DETAILS
NOT TO SCALE

4225930/C 03/2023

NOTES: (continued)

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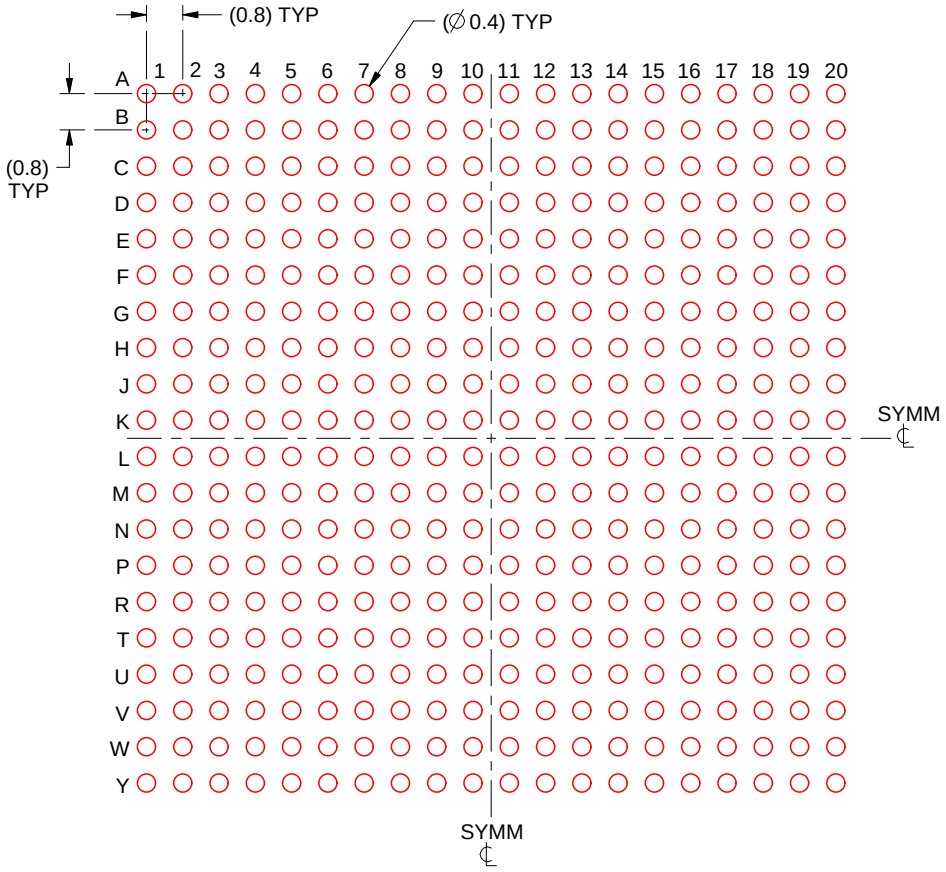

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4225930/C 03/2023

NOTES: (continued)

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