# AFE7422 Dual-channel, RF-sampling AFE with 14-bit, 9-GSPS DACs and 14-bit, 3-GSPS ADCs

## 1 Features

- Two, 14-bit, 9-GSPS DACs
  - Up to 1200-MHz signal bandwidth
  - 1 DSA per channel tunes output power
- Two, 14-Bit, 3-GSPS ADCs
  - Up to 1500-MHz signal bandwidth
  - NSD: –151 dBFS/Hz
  - AC performance at $f_{IN}$ = 2.6 GHz, –3 dBFS
    - SNR: 55 dBFS
    - SFDR: 73 dBc HD2 and HD3
    - SFDR: 91 dBc worst spur
  - 2 DSA per channel extends dynamic range
  - RF and digital power detectors
- RF frequency range: 10 MHz to 6 GHz
- Fast frequency hopping < 1 µs
- Receive digital signal path:
  - Bypassable quad DDC per ADC
  - 3-phase coherent 32-bit NCOs per DDC
  - Decimation ratio: 2x to 32x
- Transmit digital signal path:
  - Quad DUC per DAC with 32-bit NCOs
  - Interpolation ratio: 6x to 36x
  - Sin(x)/x correction and configurable delay
  - Power amplifier protection (PAP)
- JESD204B interface:
  - 8 transceivers at up to 15 Gbps
  - Subclass 1 multichip synchronization
- Clocks:
  - Internal PLL and VCO with bypass option
  - Clock output up to 3 GHz with clock divider
- DAC power dissipation: 1.8 W/ch at 9 GSPS
- ADC power dissipation: 1.9 W/ch at 3 GSPS
- Package: 17-mm x 17-mm FC BGA, 0.8-mm pitch

## 2 Applications

- Phased array radar
- SIGINT and ELINT
- Communications equipment and testers
- Wideband digitizers and waveform generators

## 3 Description

The AFE7422 is a dual-channel, wideband, RF-sampling analog front end (AFE) based on 14-bit, 9-GSPS DACs and 14-bit, 3-GSPS ADCs. With operation at an RF of up to 6 GHz, this device enables direct RF sampling into the C-band frequency range without the need for additional frequency conversions stages. This improvement in density and flexibility enables high-channel-count, multimission systems.

The DAC signal paths support interpolation and digital up conversion options that deliver up to 1200 MHz of signal bandwidth. The differential output path includes a digital step attenuator (DSA), which enables tuning of output power.

Each ADC input path includes a dual DSA and RF and Digital power detectors. Flexible decimation options provide optimization of data bandwidth and a decimation bypass mode is also available for widest signal bandwidth.

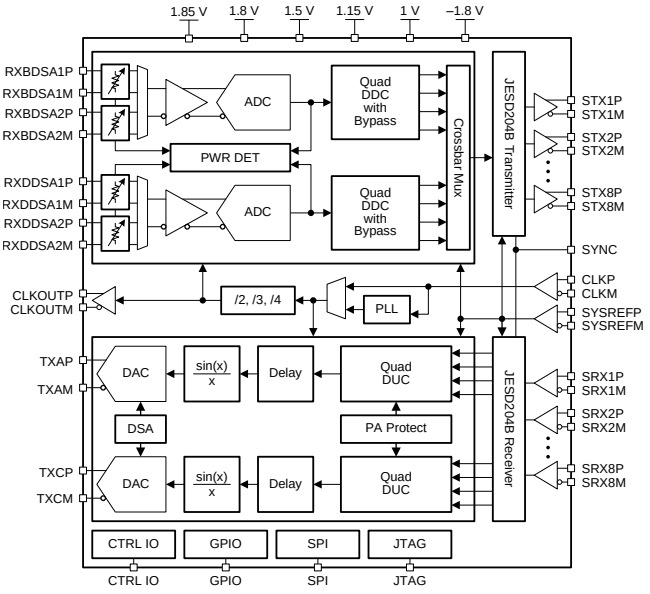
An 8-lane (8 TX + 8 RX) subclass-1 compliant JESD204B interface operates at up to 15 Gbps. A bypassable on-chip PLL simplifies clock operation with an optional clock output.

**Device Information(1)**

| PART NUMBER | PACKAGE | BODY SIZE (NOM) |
|---|---|---|
| AFE7422 | FCBGA (400) | 17.00 mm x 17.00 mm |

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

**Functional Block Diagram**



# 4 Revision History

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

| Changes from Original (October 2018) to Revision A | Page |
|---|---|
| • Changed status from advance information to production data | 1 |

# 5 Device and Documentation Support

## 5.1 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.

## 5.2 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.

## 5.3 Trademarks

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

## 5.4 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.

## 5.5 Glossary

SLYZ022 — *TI Glossary*.

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

# 6 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.

## 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) |
|---|---|---|---|---|---|---|---|---|---|
| AFE7422IABJ | Active | Production | FCBGA (ABJ) \| 400 | 90 \| JEDEC TRAY (5+1) | Yes | SNAGCU | Level-3-260C-168 HR | -40 to 85 | AFE7422I |
| AFE7422IALK | Active | Production | FCBGA (ALK) \| 400 | 90 \| JEDEC TRAY (10+1) | No | SNPB | Level-3-220C-168 HR | -40 to 85 | AFE7422IZ |

(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.

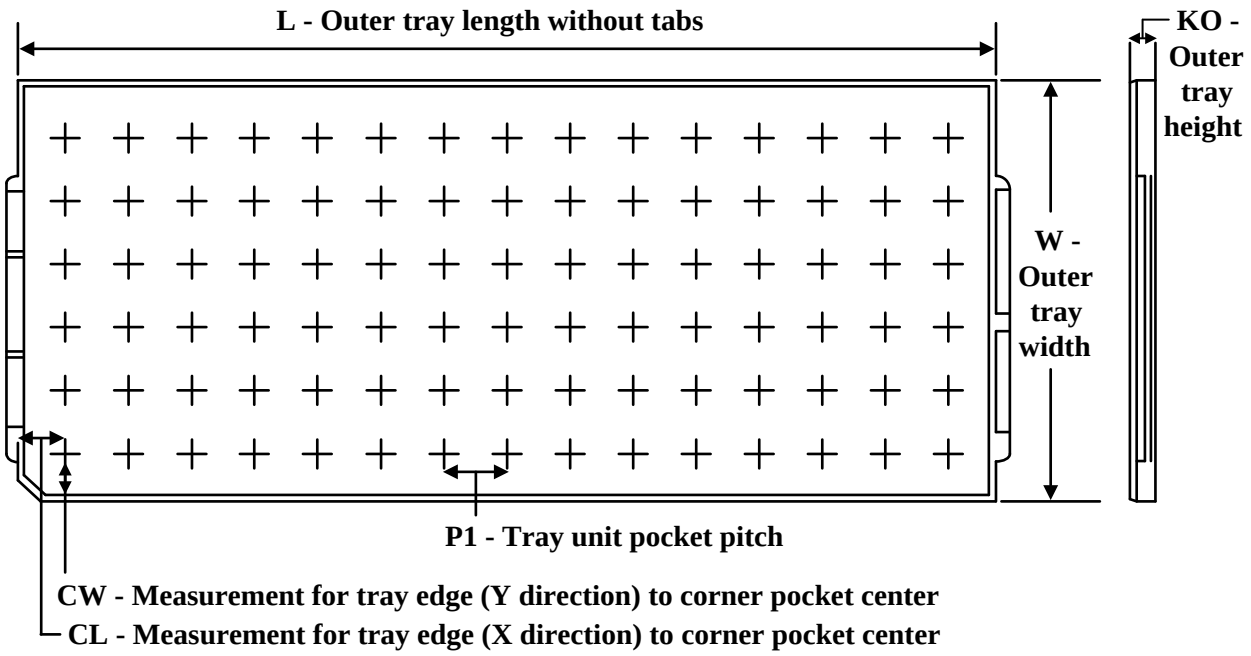
(4) **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

(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.

## TRAY




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

*All dimensions are nominal

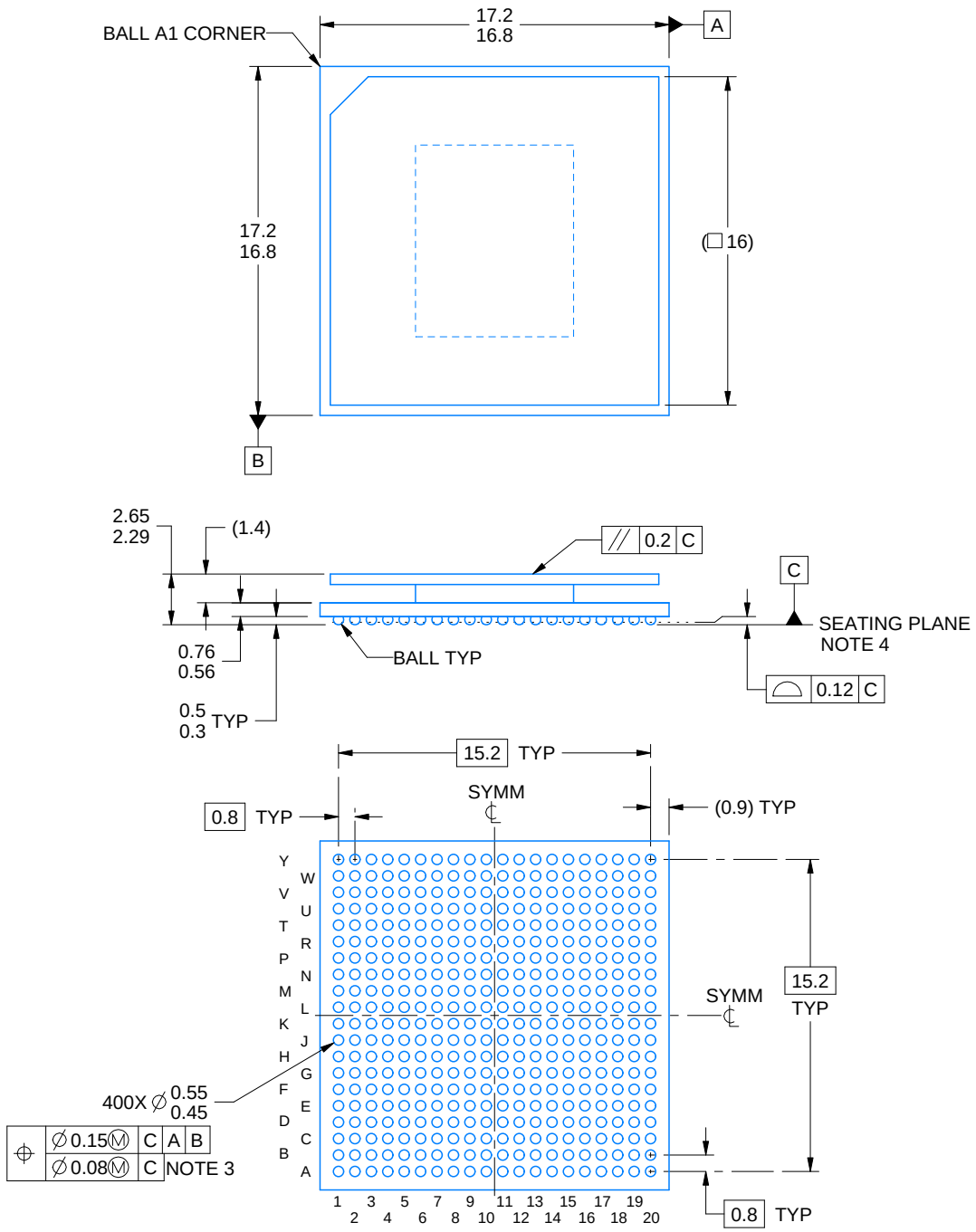
| Device | Package Name | Package Type | Pins | SPQ | Unit array matrix | Max temperature (°C) | L (mm) | W (mm) | K0 (µm) | P1 (mm) | CL (mm) | CW (mm) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AFE7422IABJ | ABJ | FCBGA | 400 | 90 | 6 x 15 | 150 | 315 | 135.9 | 7620 | 19.5 | 21 | 19.2 |
| AFE7422IABJ | ABJ | FCBGA | 400 | 90 | 6 x 15 | 150 | 315 | 135.9 | 7620 | 19.5 | 21 | 19.2 |
| AFE7422IALK | ALK | FCBGA | 400 | 90 | 6 x 15 | 150 | 315 | 135.9 | 7620 | 19.5 | 21 | 19.2 |
| AFE7422IALK | ALK | FCBGA | 400 | 90 | 6 x 15 | 150 | 315 | 135.9 | 7620 | 19.5 | 21 | 19.2 |

# PACKAGE OUTLINE

## ABJ0400A

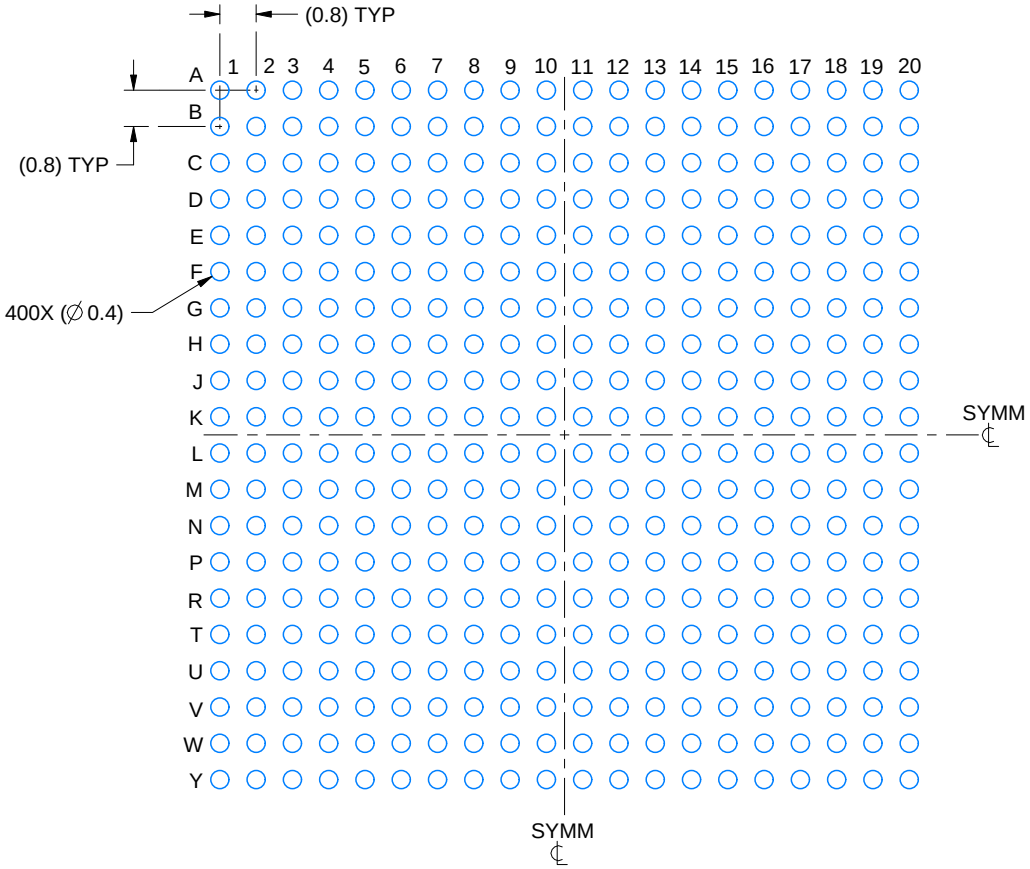
## FCBGA - 2.65 mm max height

BALL GRID ARRAY

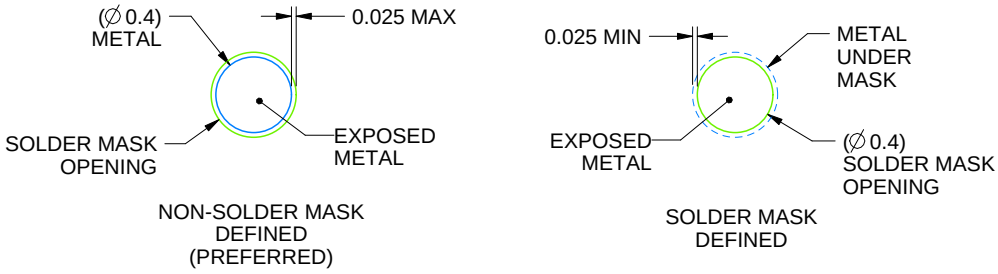



NOTES:

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).




LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:6X

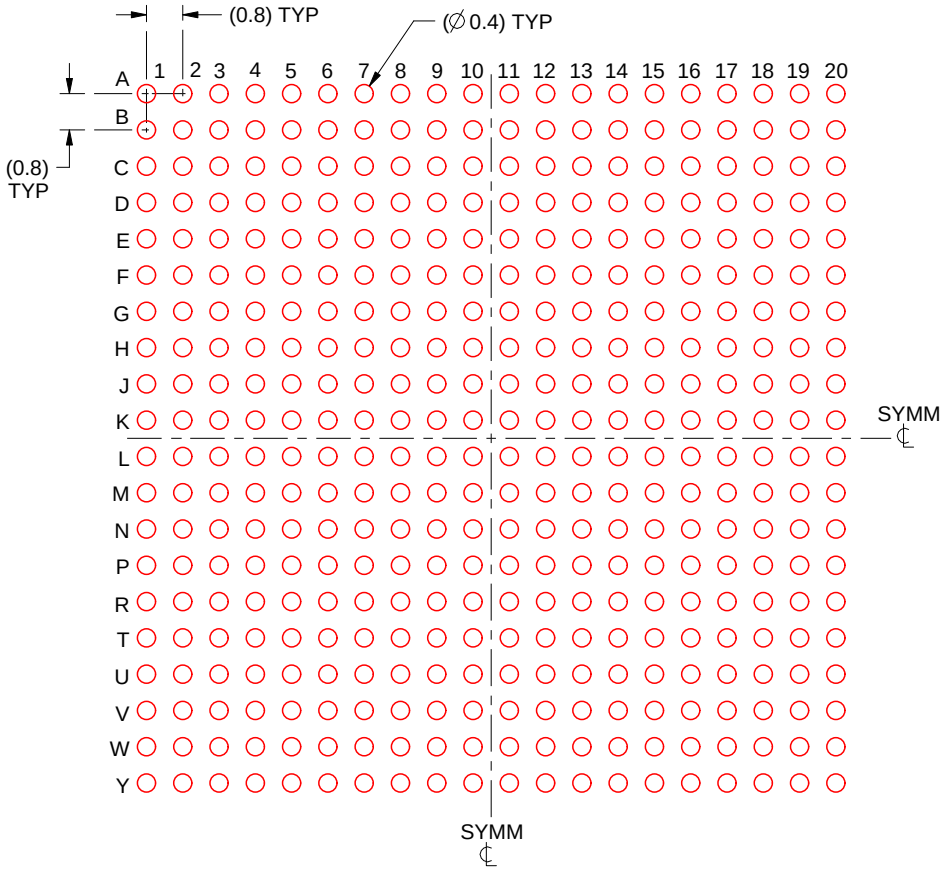



SOLDER MASK DETAILS
NOT TO SCALE

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).




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

4221311/D 03/2023

NOTES: (continued)

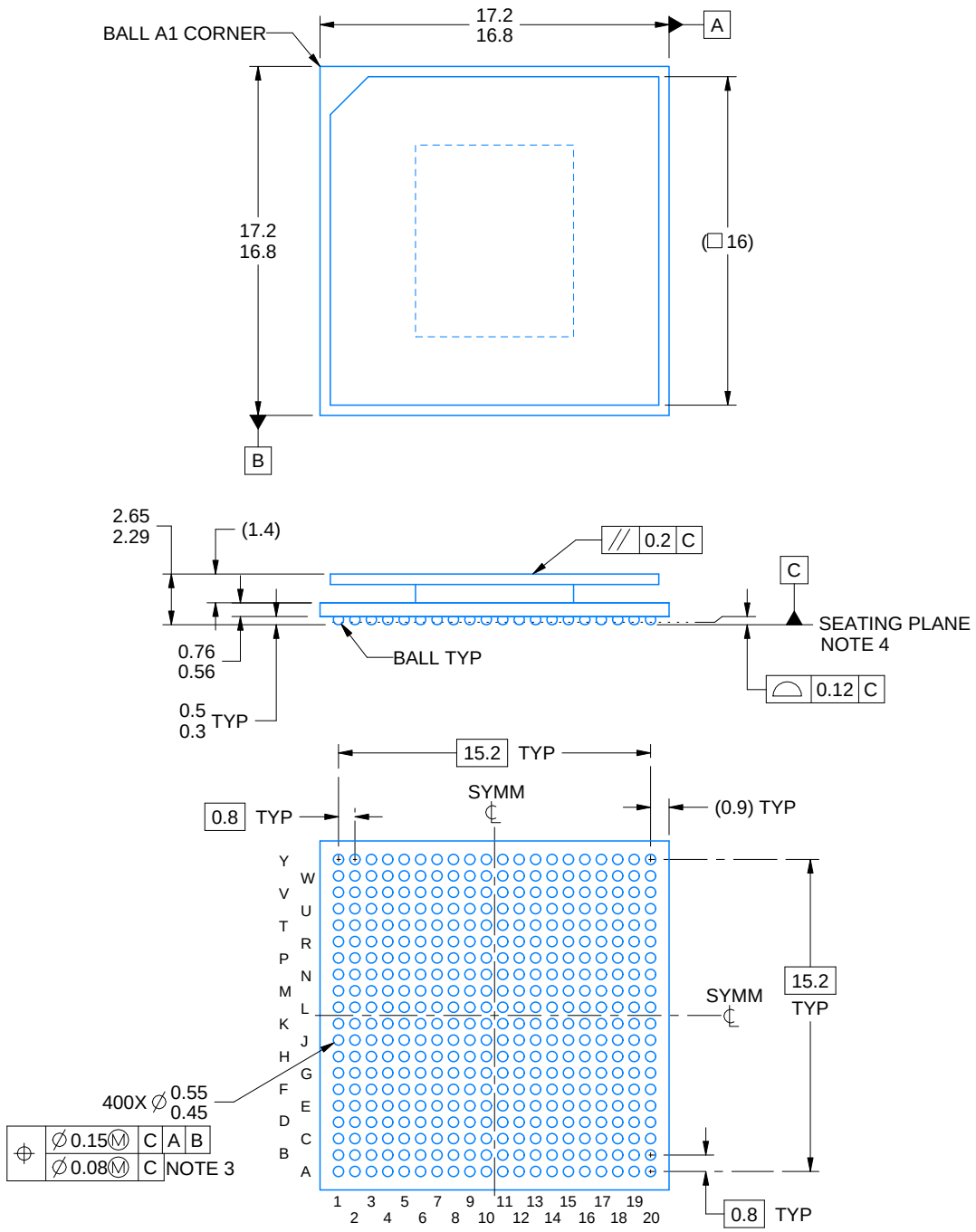
7. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release.

# ALK0400A

# PACKAGE OUTLINE

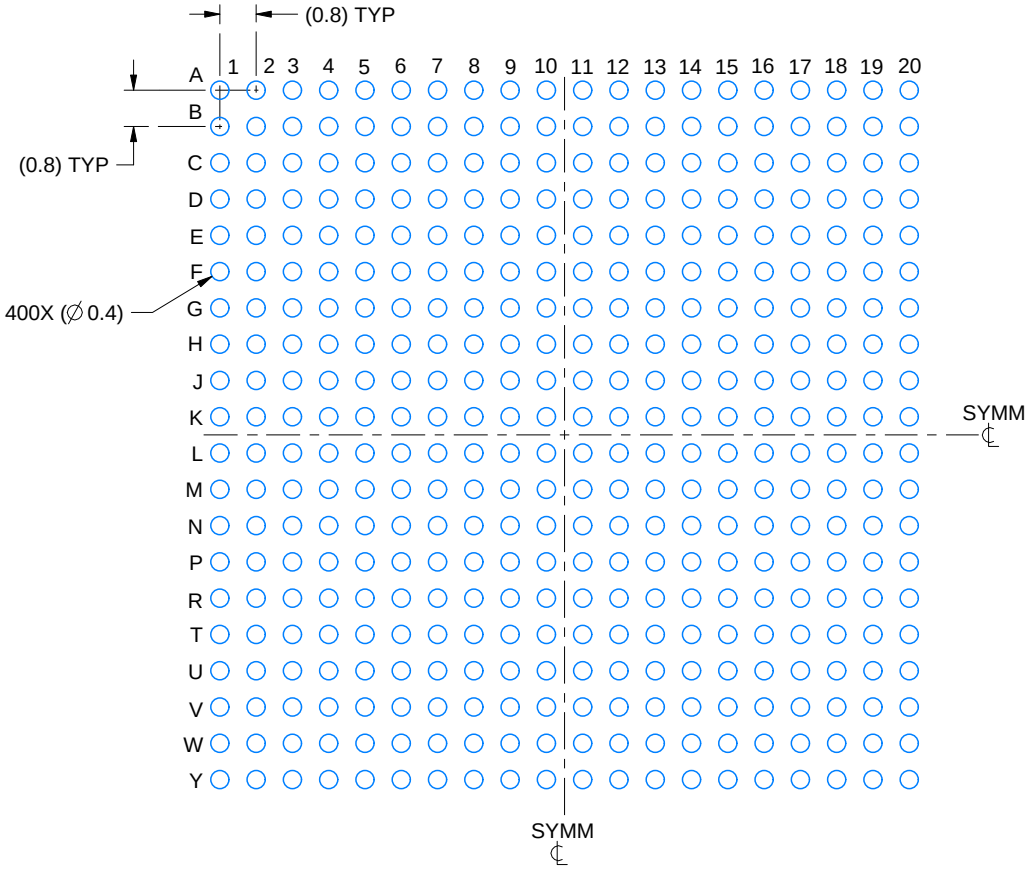
## FCBGA - 2.65 mm max height

BALL GRID ARRAY

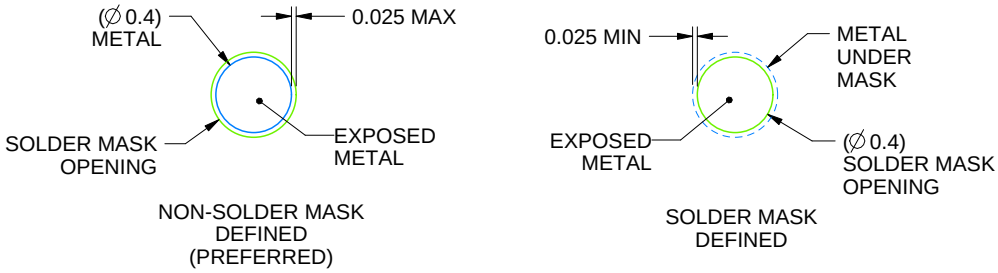



NOTES:

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. Pb-Free die bump and SnPb solder ball.
6. The lids are electrically floating (e.g. not tied to GND).




LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:6X

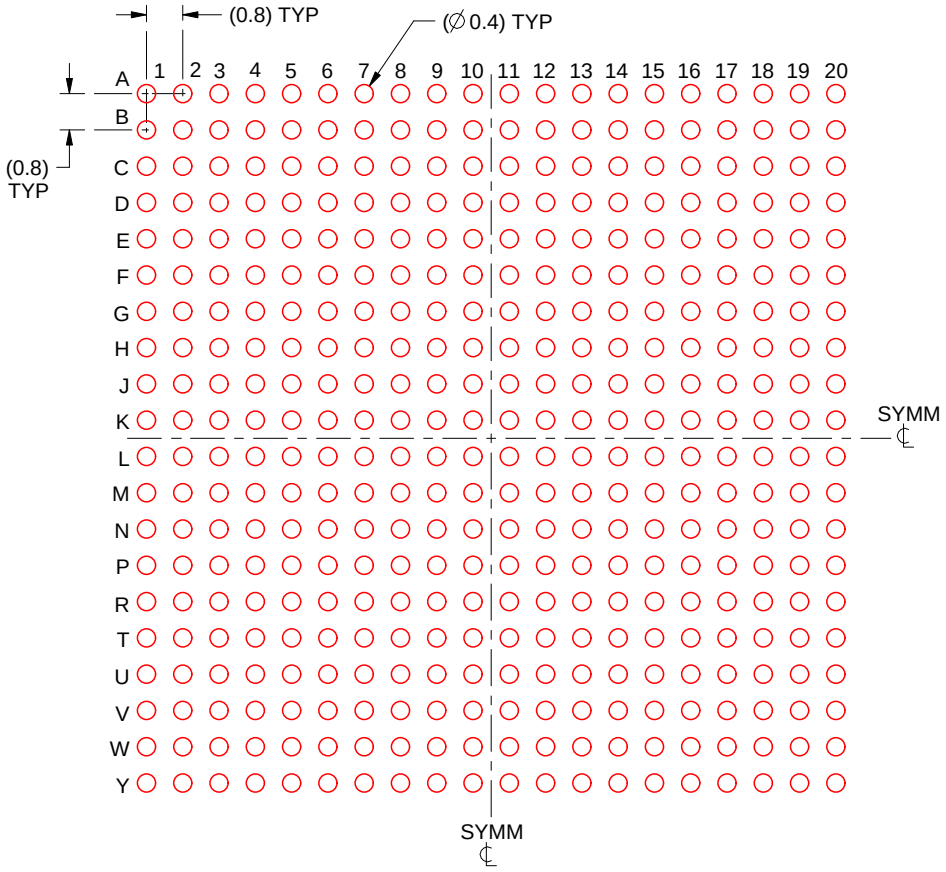



SOLDER MASK DETAILS
NOT TO SCALE

4225930/C 03/2023

NOTES: (continued)

7. 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

4225930/C 03/2023

NOTES: (continued)

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

# IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES “AS IS” AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, regulatory or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you fully indemnify TI and its representatives against any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI’s products are provided subject to TI’s Terms of Sale, TI’s General Quality Guidelines, or other applicable terms available either on ti.com or provided in conjunction with such TI products. TI’s provision of these resources does not expand or otherwise alter TI’s applicable warranties or warranty disclaimers for TI products. Unless TI explicitly designates a product as custom or customer-specified, TI products are standard, catalog, general purpose devices.

TI objects to and rejects any additional or different terms you may propose.



Last updated 10/2025