TX7332 Three-Level, 32-Channel Transmitter With 1.2-A Pulser, T/R Switch, and Integrated Transmit Beamformer

1 Features

- TX7332 supports:
  - 32-channel three-level pulser and active transmit/receive (T/R) switch
  - Very low power on-chip beamforming mode:
    - In receive-only mode: 0.45 mW/ch
    - In transmit-receive mode: 16.4 mW/ch
    - In CW mode: 160 mW/ch
    - In global power-down mode: 0.1 mW/ch
- Three-level pulser:
  - Maximum output voltage: ±100 V
  - Minimum output voltage: ±1 V
  - Maximum output current: 1.2 A to 0.3 A
  - Maximum clamp current: 0.5 A to 0.12 A
  - Second harmonic : –45 dBc at 5 MHz
  - CW mode jitter: 100 fs measured from 100 Hz to 20 kHz
  - CW mode close-in phase noise: -154 dBc/Hz at 1 kHz offset for 5-MHz signal
  - –3-dB bandwidth with 2-kΩ || 120-pF load
    - 20 MHz (for ±100-V supply)
    - 25 MHz (for ±70-V supply)
- Active T/R switch with:
  - ON, OFF control signals
  - Bandwidth: 50 MHz
  - HD2: –50 dBc
  - Turnon resistance: 24 Ω
  - Turnon time: 0.5 µs
  - Turnoff time: 1.75 µs
  - Transient glitch: 50 mV_{PP}
- Off-chip beamformer with:
  - Jitter cleaning using synchronization feature
  - Maximum synchronization clock frequency: 200 MHz
- On-chip beamformer with:
  - Delay resolution: one beamformer clock period
  - Maximum delay: 2^{13} beamformer clock period
  - Maximum beamformer clock speed: 200 MHz
  - On-chip RAM to store
    - 16 delay profiles
    - 32 pattern profiles
- High-speed (100 MHz maximum) 1.8-V and 2.5-V CMOS serial programming interface
- Automatic thermal shutdown
- No specific power sequencing requirement
- Small package: 260-pin NFBGA (17 mm × 11 mm) with 0.8-mm pitch

2 Applications

- Ultrasound imaging system
- Piezoelectric driver
- In-probe ultrasound imaging

3 Description

The TX7332 is a highly integrated, high-performance transmitter solution for ultrasound imaging system. The device has total 32 pulser circuits (PULS), 32 transmit/receive (T/R) switches, and supports both on-chip and off-chip beamformer (TxBF). The device also integrates on-chip floating power supplies that reduce the number of required high voltage power supplies.

Device Information(1)

PART NUMBER	PACKAGE	BODY SIZE (NOM)
TX7332	NFBGA (260)	17.00 mm × 11.00 mm

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

Simplified Block Diagram

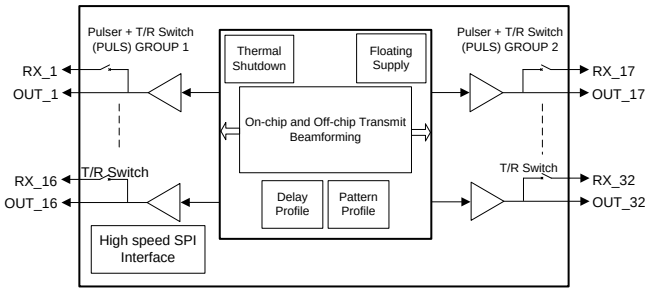


Table of Contents

4 Revision History

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

DATE	REVISION	NOTES
March 2019	*	Initial release

5 Description (continued)

The TX7332 has a pulser circuit that generates three-level high voltage pulses (up to ±100 V) that can be used to excite multiple channels of an ultrasound transducer. The device supports total 32 outputs. The maximum output current is configurable from 1.2 A to 0.3 A.

A T/R switch under OFF state protects the receiver circuit by providing high isolation between the high-voltage transmitter and the low-voltage receiver when the pulser is generating high-voltage pulses. When the transducer is receiving echo signals, the T/R switch turns ON and connects the transducer to the receiver. The ON/OFF operation of the T/R switch is either controlled by an external pin or controlled by on-chip beamforming engine in the device. The T/R switch offers 24-Ω impedance in the ON state.

Ultrasound transmission relies on the excitation of multiple transducer elements with the delay profile of the excitation across the different elements defining the direction of the transmission. Such an operation is referred to as transmit beamforming. The TX7332 supports staggered pulsing of the different channels, allowing for transmit beamforming. The device supports both off-chip and on-chip beamforming operation.

In the off-chip beamformer mode, the output transition of each pulser and TR switch ON/OFF operation is controlled by external control pins. To eliminate the effect of jitter from the external control signals, the device supports a synchronization feature. When the synchronization feature is enabled, the external control signals are latched using a low-jitter beamformer clock signal.

In the on-chip beamformer mode, the delay profile for the pulsing of the different channels is stored within the device. The device supports a transmit beamformer delay resolution of one beamformer clock period and a maximum delay of 2^{13} beamformer clock periods. An internal pattern generator generates the output pulse patterns based on pattern profiles stored in a profile RAM. Up to 16 beamforming profiles and 32 pattern profiles can be stored in the profile RAM. On-chip beamforming mode reduces the number of control signals that must be routed from the FPGA to the device..

The TX7332 is available in a 17-mm × 11-mm 260-pin NFBGA package and is specified for operation from 0°C to 70°C.

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 www.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.

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)
TX7332ZBX	Active	Production	NFBGA (ZBX) | 260	120 | JEDEC TRAY (5+1)	Yes	SNAGCU	Level-3-260C-168 HR	0 to 70	TX7332
TX7332ZBX.B	Active	Production	NFBGA (ZBX) | 260	120 | JEDEC TRAY (5+1)	-	Call TI	Call TI	0 to 70	

(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.

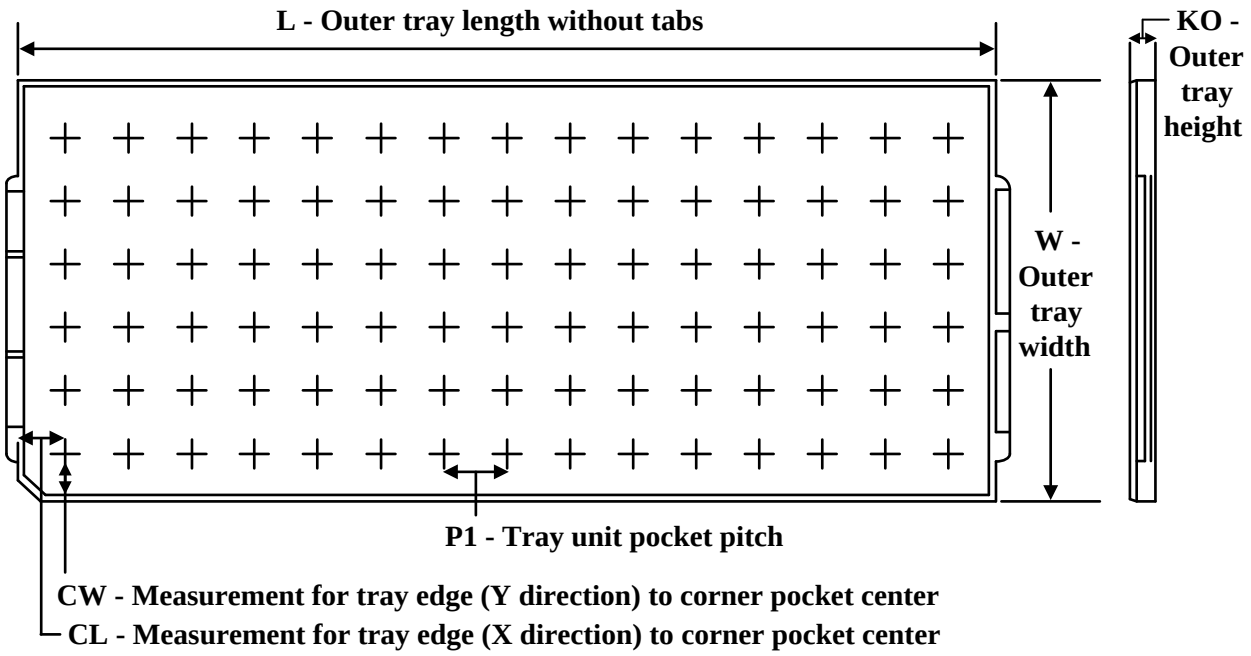
(4) **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

(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

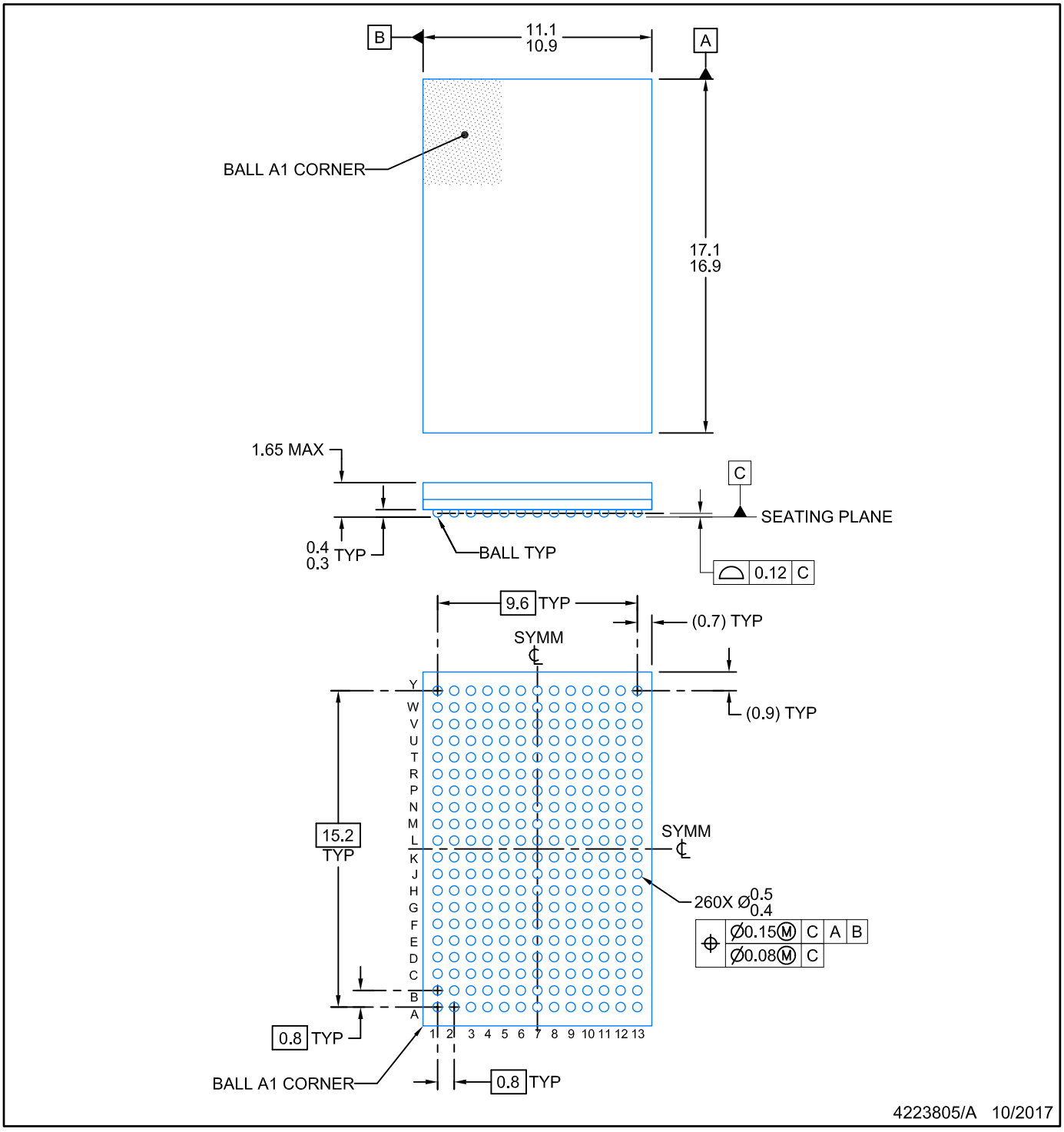
Device	Package Name	Package Type	Pins	SPQ	Unit array matrix	Max temperature (°C)	L (mm)	W (mm)	K0 (µm)	P1 (mm)	CL (mm)	CW (mm)
TX7332ZBX	ZBX	NFBGA	260	120	8 x 15	150	315	135.9	7620	19.5	21	15.45

PACKAGE OUTLINE

ZBX0260A

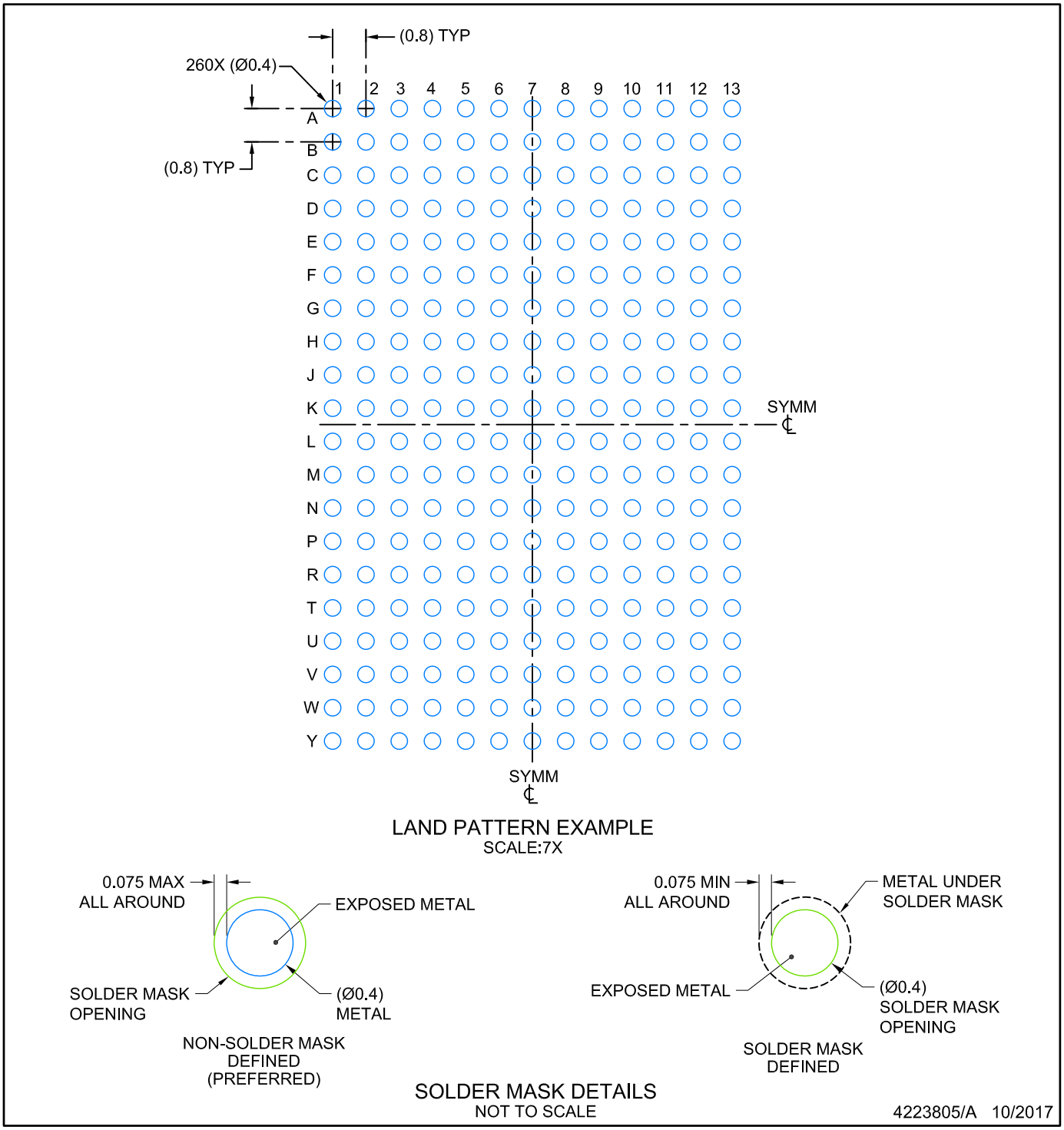
NFBGA - 1.65 mm max height

PLASTIC 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. The package thermal pad must be soldered to the printed circuit board for optimal thermal and mechanical performance.



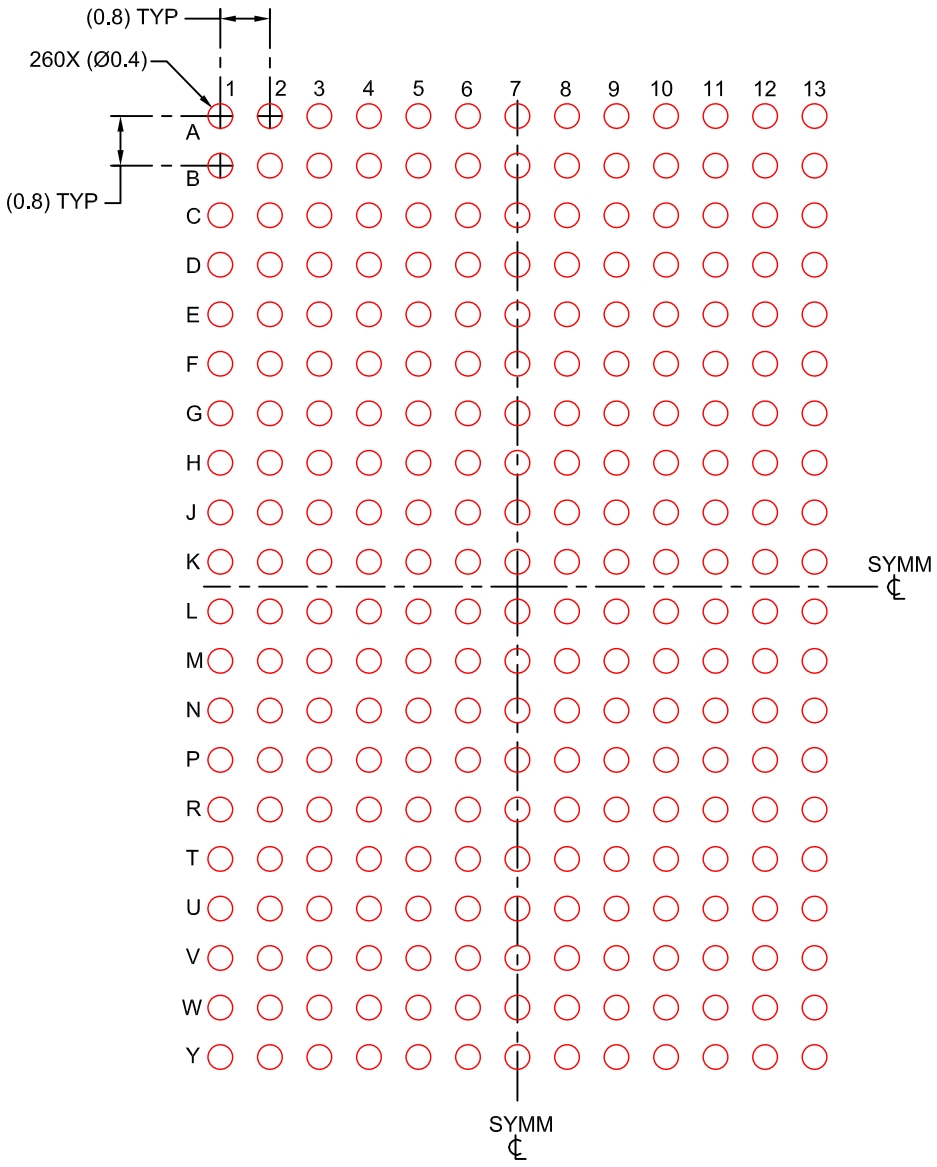
NOTES: (continued)

4. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/slua271).
5. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.

EXAMPLE STENCIL DESIGN

NFBGA - 1.65 mm max height

PLASTIC BALL GRID ARRAY



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:8X

4223805/A 10/2017

NOTES: (continued)

6. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.

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