TEXAS INSTRUMENTS

OPT8320

SBAS921 –APRIL 2018

OPT8320 3D Time-of-Flight Sensor

1 Features

- Imaging Array:
  - 80 × 60 Array
  - 1/6" Sensor Format
  - Pixel Pitch: 30 µm
  - Frame Rate: Scalable Up to 1000-FPS Depth Output Rate with an Internal Raw Rate of 4000 FPS
- Optical Properties:
  - Responsivity: 0.35 A/W at 850 nm
  - Demodulation Contrast: 70% at 50 MHz
  - Demodulation Frequency: 10 MHz to 100 MHz
- Output Interface:
  - Digital Video Port (DVP): 8 Data Lanes, HD and VD Pins, and Clock
  - Synchronous Serial Interface (SSI): 1 Data Lane, Clock, and Chip Select
- Timing Generator:
  - Sensor Addressing Engine
  - Modulation Control
  - De-Aliasing
  - Master, Slave Sync Operation
  - High Dynamic Range Operation
- Depth Engine:
  - Pixel Binning
  - De-Aliasing
  - Histogram
  - Calibration
- Power Supply:
  - 3.3-V I/O, Analog
  - 1.8-V Analog, Digital, I/O
  - 1.8-V Demodulation (Typical)
- Optimized Optical Package (COG-56):
  - 8.03 mm × 5.32 mm × 0.745 mm
  - Integrated Optical Band-Pass Filter (830 nm to 867 nm)
  - Optical Fiducials for Easy Alignment
- Built-In Illumination Driver for Low-Power Applications
- Operating Temperature: 0°C to 70°C

2 Applications

- Depth Sensing:
  - Location and Proximity Sensing
  - 3D Scanning
  - 3D Machine Vision
  - Security and Surveillance
  - Gesture Controls
  - Augmented and Virtual Reality

3 Description

The OPT8320 time-of-flight (ToF) sensor is part of the TI 3D ToF image sensor family. The device is a high-performance, highly-integrated, complete system-on-chip (SoC) for array depth sensing, consisting of a versatile timing generator (TG), an optimally designed analog-to-digital converter (ADC), a depth engine, and an illumination driver.
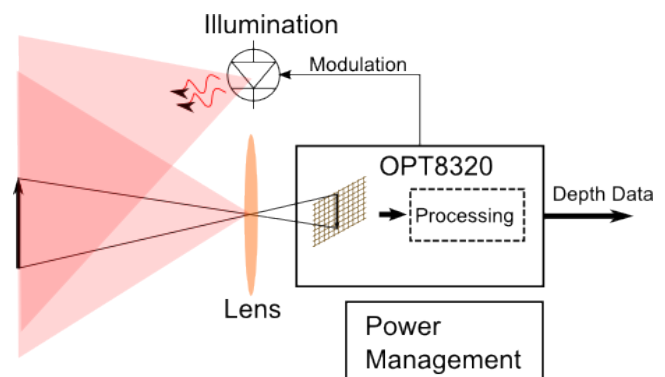
The programmability of the built-in TG offers the flexibility to optimize for various depth-sensing performance metrics [such as power, motion robustness, signal-to-noise ratio (SNR), and ambient cancellation]. The built-in depth engine computes the depth data from the digitized sensor data. In addition to the phase data, the depth engine provides auxiliary information consisting of amplitude, ambient, and flags for each pixel and the full-array statistical information in the form of a histogram.

Device Information[1]

PART NUMBER	PACKAGE	BODY SIZE (NOM)
OPT8320	COG (56)	8.03 mm x 5.32 mm x 0.745 mm

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

Application Block Diagram

Table of Contents

4 Revision History

DATE	REVISION	NOTES
April 2018	*	Initial release.

5 Device and Documentation Support

5.1 Documentation Support

5.1.1 Related Documentation

Time-of-Flight Camera – An Introduction, SLOA190

Introduction to the Time-of-Flight (ToF) System Design, SBAU219

Illumination Driving for Time-of-Flight (ToF) Camera System, SBAA209

Lenses for 3D Time-of-Flight (ToF) Image Sensors, SBAA217

3D ToF System Estimator Tool

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

These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.
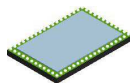
5.5 Glossary

SLYZ022 — *TI Glossary*.

This glossary lists and explains terms, acronyms, and definitions.
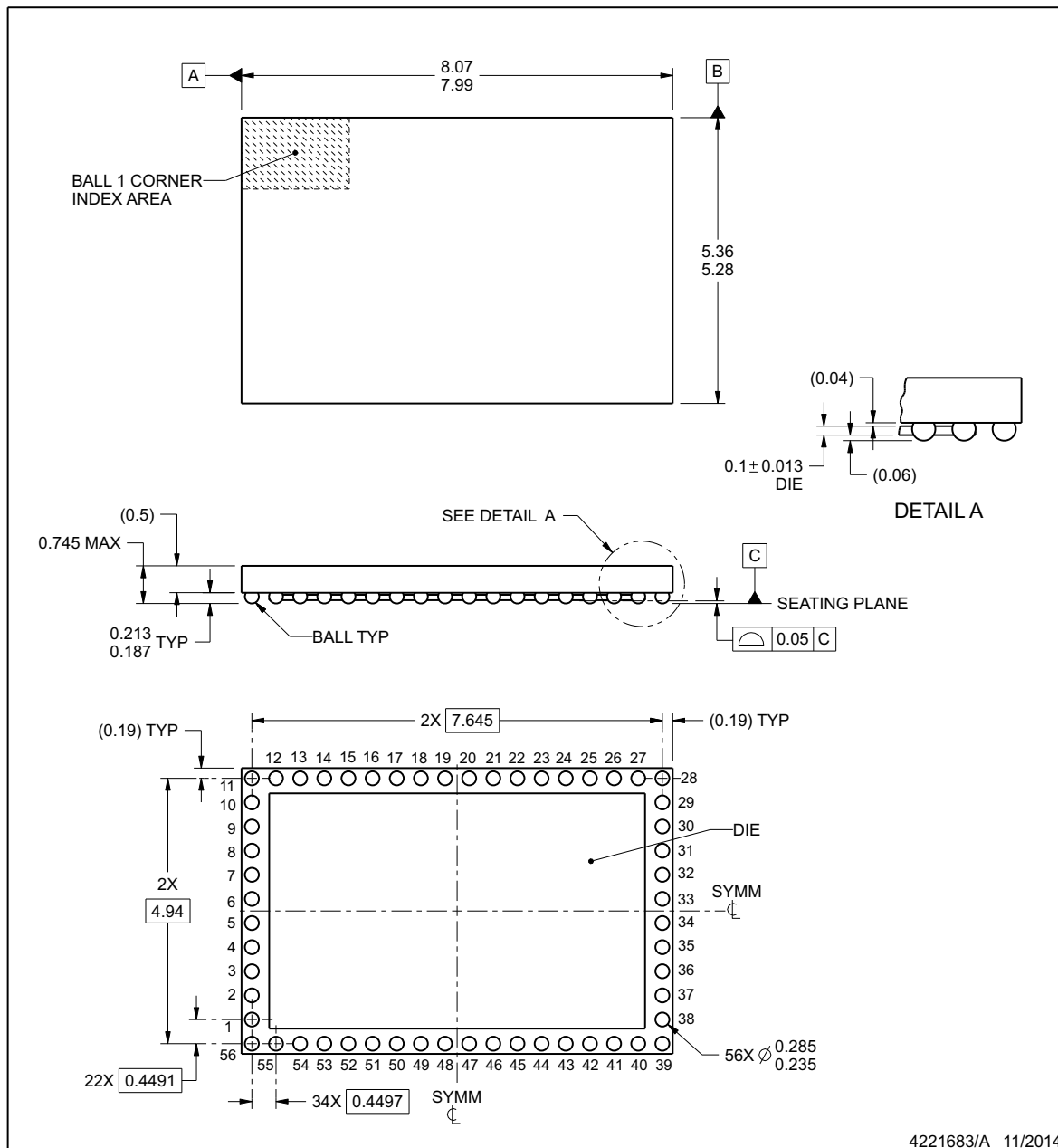
6 Mechanical, Packaging, and Orderable Information

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.

PACKAGE OUTLINE

NBP0056A

COG - 0.745 mm max height

CHIP ON GLASS

A ───── 8.07 / 7.99 ───── B

BALL 1 CORNER
INDEX AREA

5.36
5.28

(0.04)

0.1± 0.013
DIE

(0.06)

DETAIL A

(0.5)

0.745 MAX

SEE DETAIL A

C

0.213
0.187 TYP

BALL TYP

SEATING PLANE

0.05 C

(0.19) TYP

2X 7.645

(0.19) TYP

12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27

11
10
9
8
7
6
5
4
3
2
1
56

28
29
30 DIE
31
32
33 SYMM ₵
34
35
36
37
38
39

2X 4.94

SYMM ₵

56X ⌀ 0.285 / 0.235

22X 0.4491

55 54 53 52 51 50 49 48 47 46 45 44 43 42 41 40 39

34X 0.4497

SYMM ₵

4221683/A   11/2014

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.
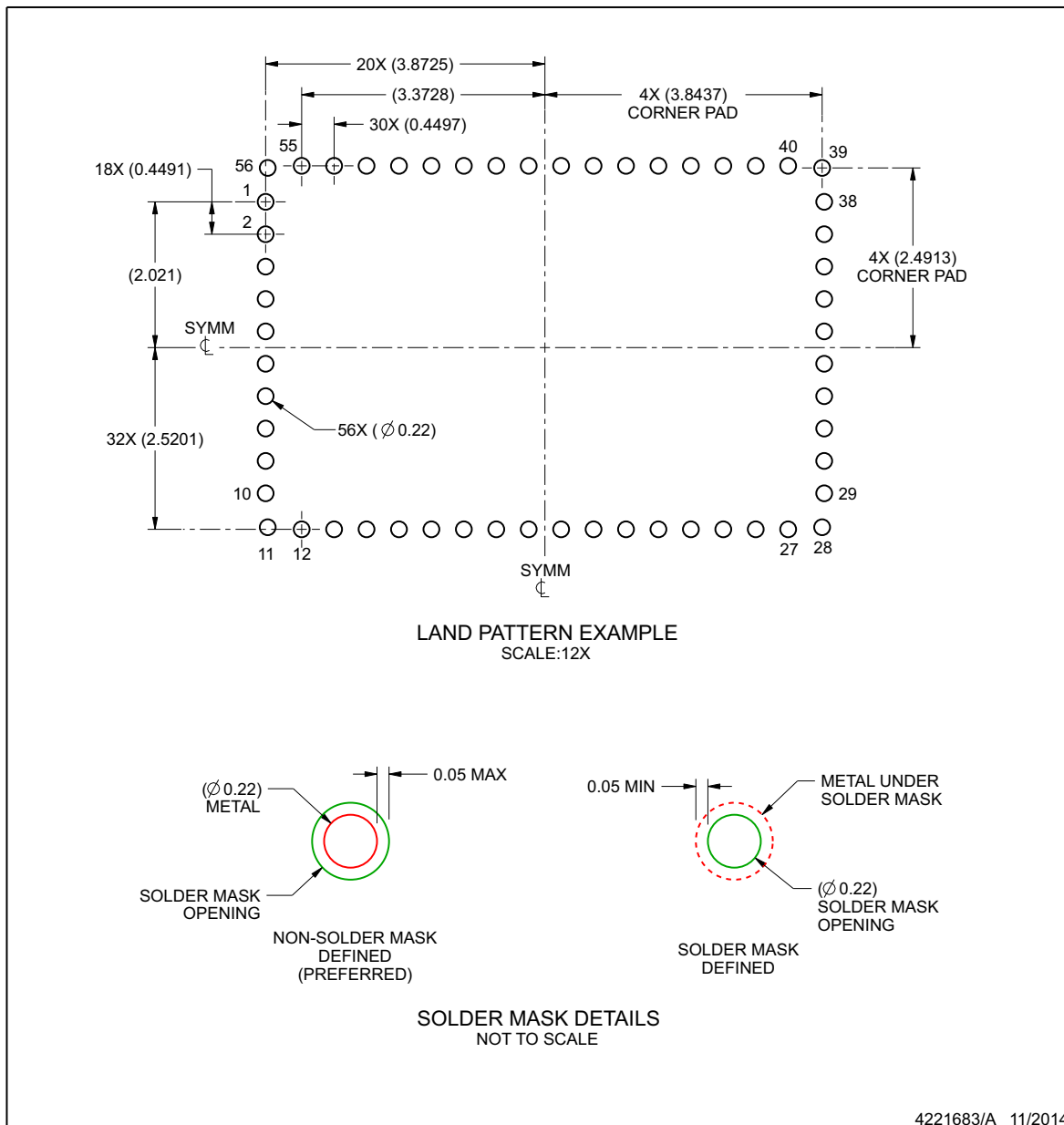
TEXAS INSTRUMENTS
www.ti.com

Product Folder Links: *OPT8320*

EXAMPLE BOARD LAYOUT

NBP0056A

COG - 0.745 mm max height

CHIP ON GLASS

LAND PATTERN EXAMPLE
SCALE:12X

SOLDER MASK DETAILS
NOT TO SCALE

NON-SOLDER MASK DEFINED (PREFERRED)

SOLDER MASK DEFINED

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NOTES: (continued)

5. PCB pads shift from original positions to prevent solder balls from touching sensor. X and Y direction: 0.05 mm. Corner pads: 0.03 mm.
6. Final dimensions may vary due to manufacturing tolerance considerations and also routing constraints.
   For information, see Texas Instruments literature number SSYZ015 (www.ti.com/lit/ssyz015).
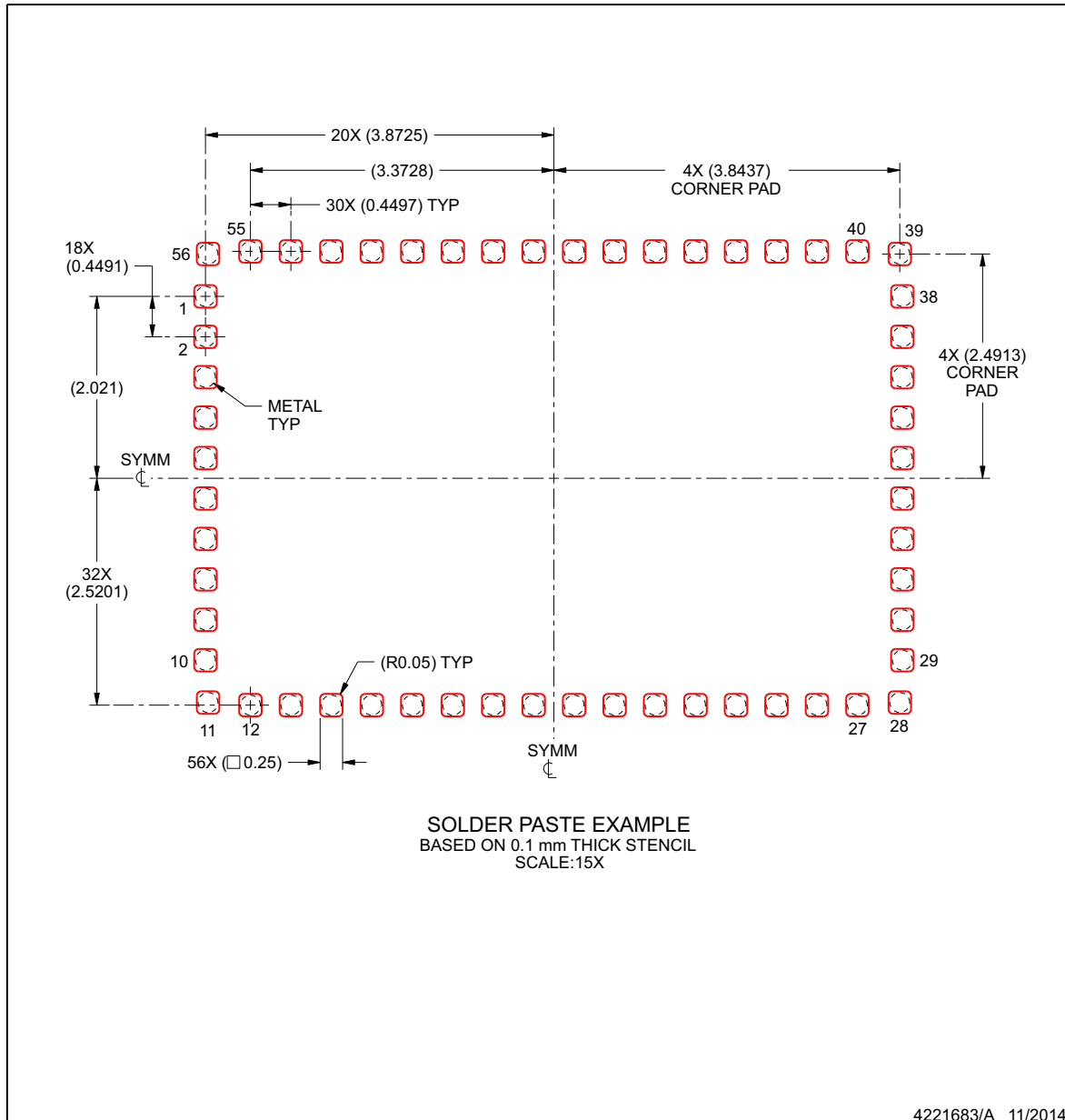
www.ti.com

5

Product Folder Links: OPT8320

EXAMPLE STENCIL DESIGN

NBP0056A   COG - 0.745 mm max height

CHIP ON GLASS

SOLDER PASTE EXAMPLE
BASED ON 0.1 mm THICK STENCIL
SCALE:15X

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NOTES: (continued)

7. 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)
OPT8320NBPL	Last Time Buy	Production	COG (NBP) | 56	3000 | JEDEC TRAY (10+1)	Yes	SNAGCU	Level-3-260C-168 HR	0 to 70	OPT8320

(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.
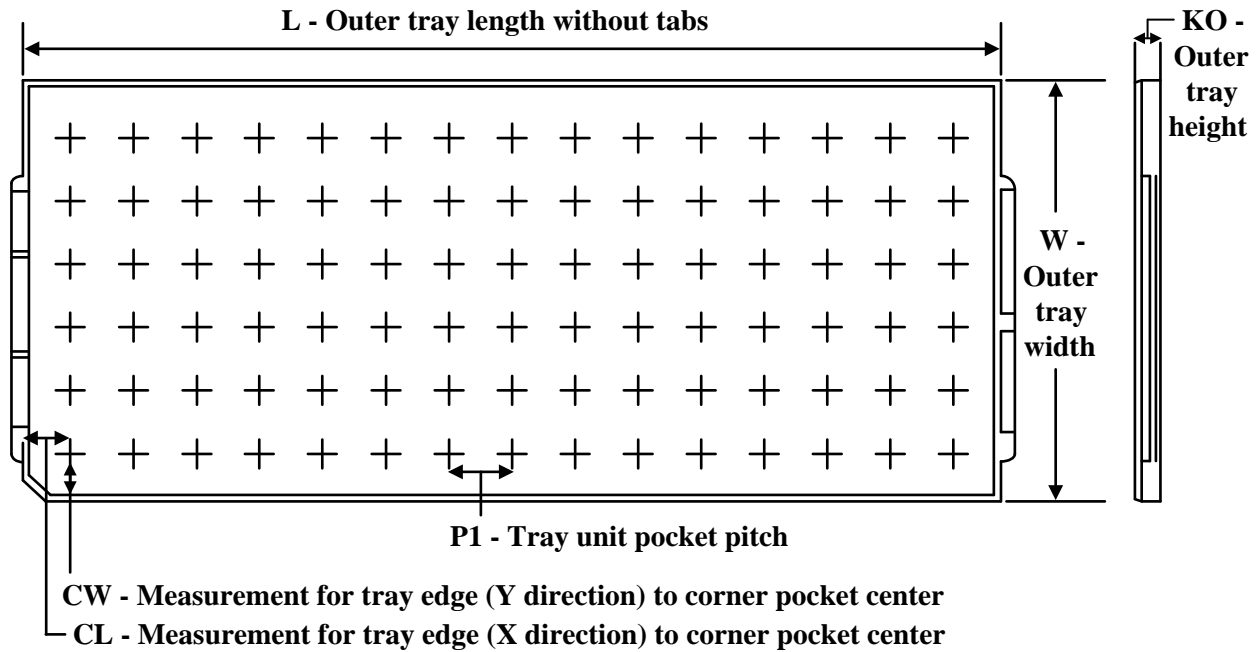
Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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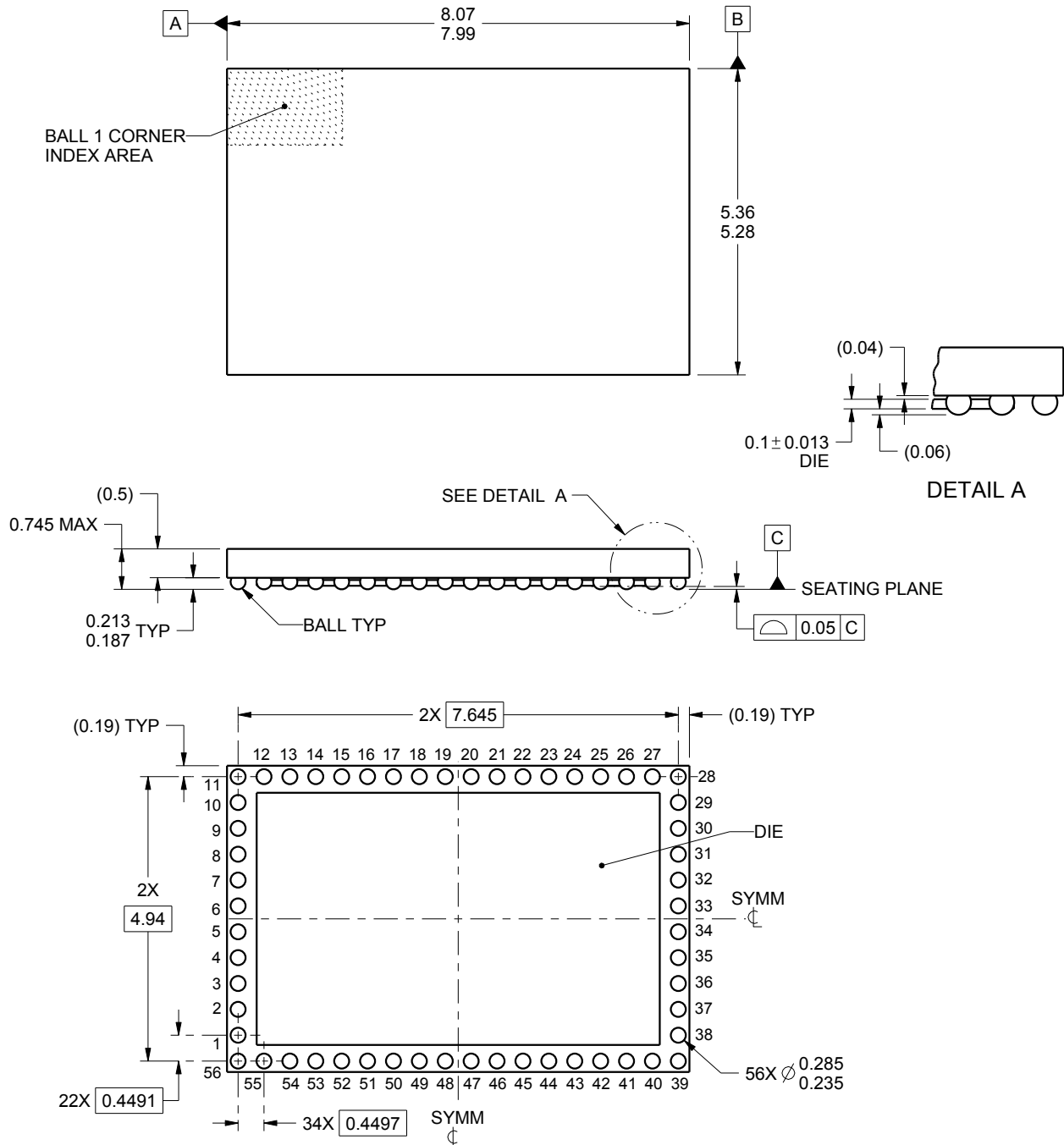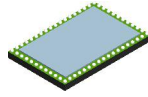
TRAY

L - Outer tray length without tabs

KO - Outer tray height

W - Outer tray width

P1 - Tray unit pocket pitch

CW - Measurement for tray edge (Y direction) to corner pocket center

CL - Measurement for tray edge (X direction) to corner pocket center

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)
OPT8320NBPL	NBP	COG	56	3000	10 x 30	150	315	135.9	7620	12.5	11.7	9.6

A

8.07
7.99

B

BALL 1 CORNER
INDEX AREA

5.36
5.28

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0.1 ± 0.013
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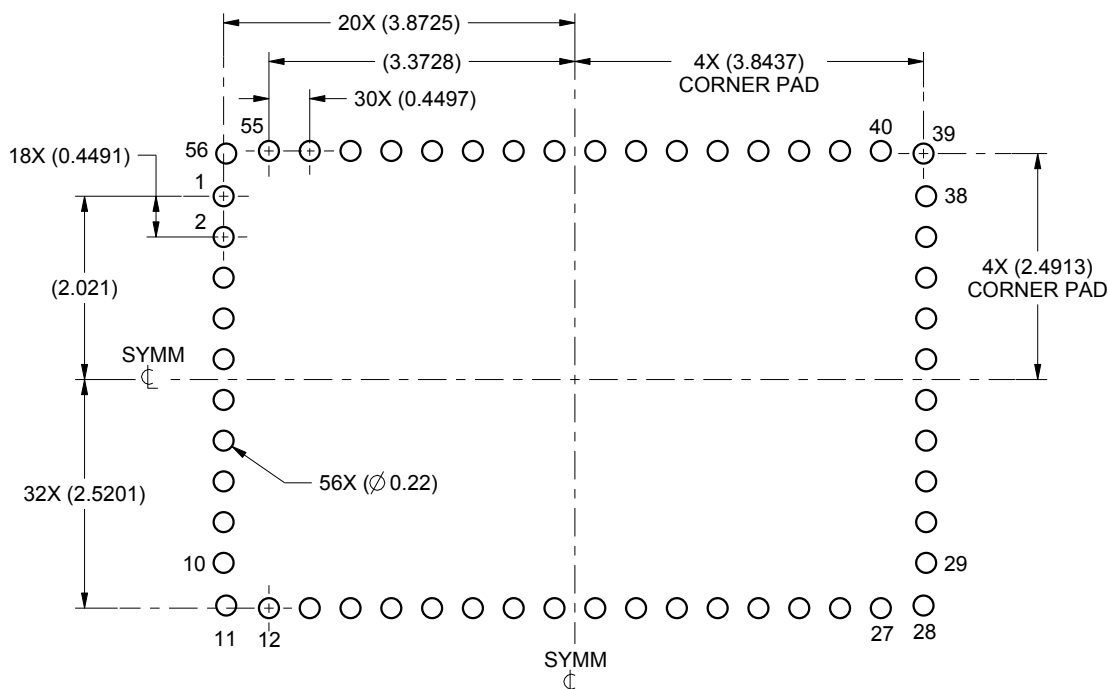
NBP0056A

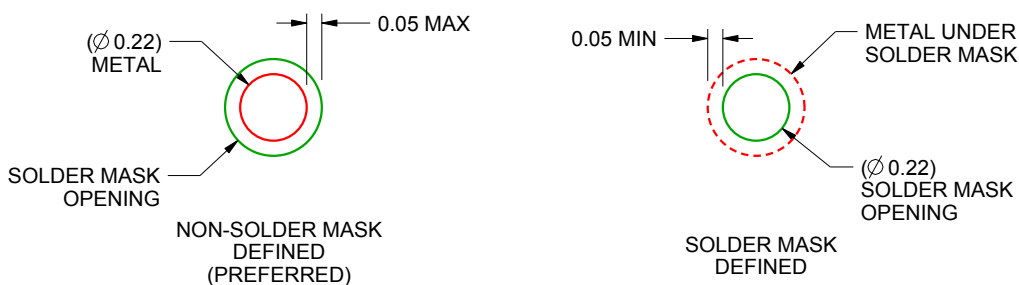## COG - 0.745 mm max height

CHIP ON GLASS

20X (3.8725)

(3.3728)

4X (3.8437)
CORNER PAD

30X (0.4497)

55

56

18X (0.4491)

1

2

(2.021)

SYMM

32X (2.5201)

56X (⌀ 0.22)

10

11   12

40   39

38

4X (2.4913)
CORNER PAD

29

27   28

SYMM

LAND PATTERN EXAMPLE
SCALE:12X

0.05 MAX

(⌀ 0.22)
METAL

SOLDER MASK
OPENING

NON-SOLDER MASK
DEFINED
(PREFERRED)

0.05 MIN

METAL UNDER
SOLDER MASK

(⌀ 0.22)
SOLDER MASK
OPENING

SOLDER MASK
DEFINED

SOLDER MASK DETAILS
NOT TO SCALE

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NOTES: (continued)

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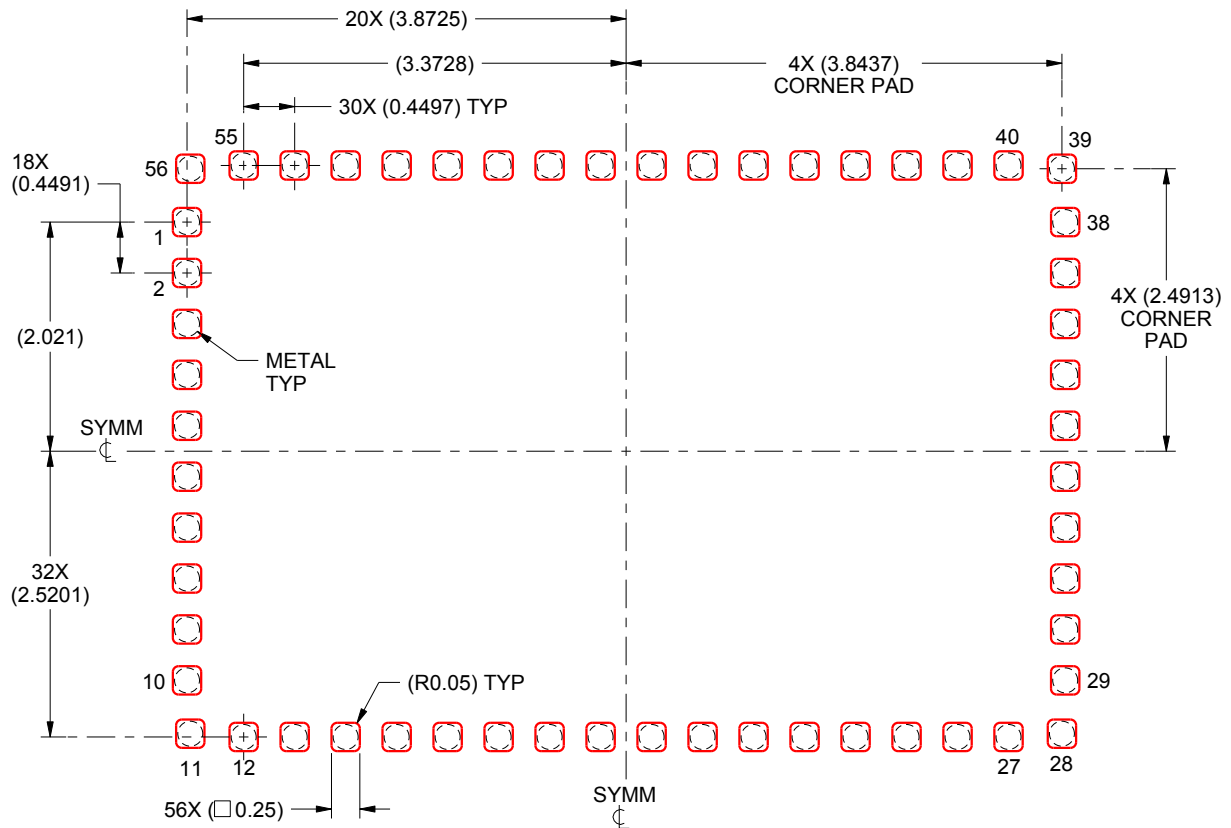   For information, see Texas Instruments literature number SSYZ015 (www.ti.com/lit/ssyz015).

SOLDER PASTE EXAMPLE
BASED ON 0.1 mm THICK STENCIL
SCALE:15X

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NOTES: (continued)

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