Application Report

Small Body nFBGA Packages

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ABSTRACT

New fine ball grid arrays (nFBGAs) are TI's preferred low-cost wire bond BGA packaging solution. They are an ideal package for customers looking to minimize PCB real estate. The small footprint, lower height, and low weight of these packages are ideal for customers looking to minimize die size while maximizing IOs. For more information, visit www.ti.com.

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Trademarks

1 Small Body nFBGA Package Details

Figure 1-1 shows the structure of TI's small body nFBGAs. Structure is nearly identical to that of the standard nFBGA shown in the *Structure of TI's nFBGA Package* image in *nFBGA Packaging*. The major difference is the package thickness. Standard nFBGAs have a thickness of ~1 mm while the small body variants can range from 0.45 mm - 1 mm. This is achieved by using a thinner substrate material and die attach film instead of epoxy.

Package stack up can be minimized even further by using solder bumps rather than the standard BGA solder balls. The reduced height of the bumps allows the smallest possible package height while offering exceptional board level reliability performance. The package seating height will be dependent upon the solder paste volume and land pad design. Table 1-1 lists all of TIs small body nFBGA packages.

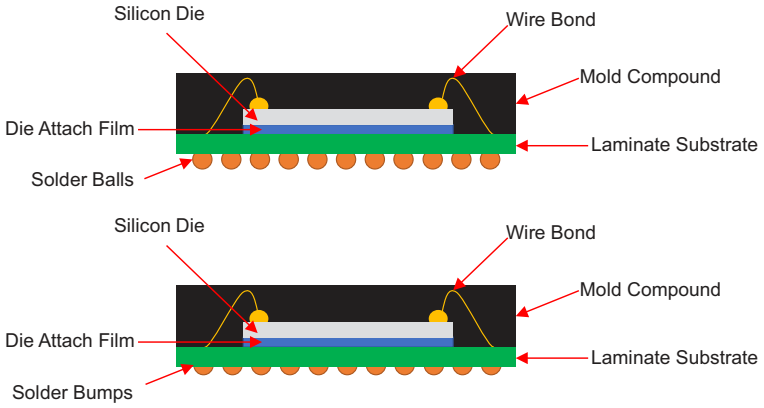


Figure 1-1. Structure of TI's Small Body nFBGAs

Table 1-1. Small Body nFBGA Package Dimensions

	NMB	ZWA	NMN	NME	ZEC
Total Number of Balls	8	11	12	20	36
*Length (L) (mm)	2	2	2	2.5	2.45
*Width (W) (mm)	2	1.4	2.5	3	2.45
Max Thickness (T) (mm)	1.00	0.45	1.00	0.80	0.65
Pitch (mm)	0.5	0.5	0.5	0.5	0.4
Ball Diameter (mm)	0.30	0.25	0.30	0.30	0.25
Total Balls in Width	3	3	4	5	6
Total Balls in Length	3	4	3	4	6

2 PCB Design Guidelines

The PCB design guidelines outlined in the *Conductor Width/Spacing* section of *nFBGA Packaging* are still applicable to small body nFBGAs. Figure 2-1, Table 2-1 and Table 2-2 outline examples of specific pad, trace, and width dimensions for small body packages.

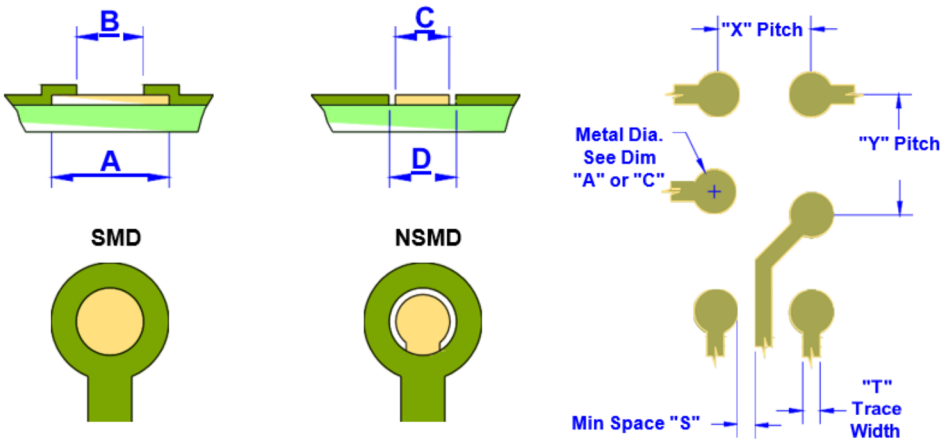


Figure 2-1. Solder Pad and Trace Dimensions

Table 2-1. Sample Small Body nFBGA Solder Pad Details

	Solder Mask Defined Pad (SMD)		Non-Solder Mask Defined Pad (SMD)	
Package Designator	Copper Pad (A)	Solder Mask Opening (B)	Copper Pad (C)	Solder Mask Opening (D)
ZWA	0.35 mm	0.25 mm	0.25 mm	0.35 mm
ZEC	0.30 mm	0.23 mm	0.23 mm	0.30 mm

Table 2-2. Trace Width Spacing Examples

	Pitch (mm)	Metal Diameter (“A” or ”C”)	Trace Width/ Spacing (“S” or “T”)
SMD pad	0.40	0.35	0.05
	0.50		0.10
NSMD Pad	0.40	0.25	0.08
	0.50		0.13

TI recommends the use of type 3 or finer solder paste when mounting nFBGA. The use of paste offers the following advantages:

- It acts as a flux to aid wetting of the solder ball to the PCB land.
- The adhesive properties of the paste will hold the component in place during reflow.
- Paste contributes to the final volume of solder in the joint, and thus allows this volume to be varied to give an optimum joint.
- Paste selection is normally driven by overall system assembly requirements. In general, the "noclean" compositions are preferred due to the difficulty in cleaning under the mounted components.

TI recommends a pressure safety zone in mounting the nFBGA package. Recommended force should be controlled to 5N maximum for static and 2.5N for impact.

3 Packaging Tape and Reel

The packaging method depicted in the *Recommended Reflow Profile of Eutectic SnPb nFBGA Package* image in *nFBGA Packaging* is the same for small body packages,however, the dimensions need to be reduced according to the package size. Table 3-1 gives examples dimensions for a few of the small body nFBGAs already have in production.

Table 3-1. Sample Small Body nFBGA Tape Dimensions

PKG	Tape Width	PocketPitch (P)	Pocket Width (A_0)	Pocket Length (B_0)	PocketDepth (K)	SPQ/MOQ
ZEC	12	4	2.8	2.8	0.8	2500
ZWA	8	4	1.6	2.2	0.55	2500
NMN	8	4	2.3	2.8	1.15	2500
NME	12	4	2.85	3.4	1.34	2500

4 Thermal Modeling

The thermal modeling process outlined in the *Solder Ball Collapse* image in *nFBGA Packaging* is applicable to both standard and small body nFBGAs. The results for some of TI's smaller nFBGA packages are listed in Table 4-1.

Table 4-1. Sample Small Body nFBGA Thermal Modeling Results

Package	ZEC	ZWA	NMN	NME
DieSize (mm)	1.565 x0.800	0.998 x0.628	1.468 x0.926	1.834 x1.88
Θ_{JA} (°C/W)	111.7	181.4	134.3	131.4
Θ_{JC} (°C/W)	49.2	136.7	90.7	56.5

5 Board Level Reliability

There is little difference between the structure of TIs standard and small body nFBGAs. However, small body nFBGA are subjected to rigorous reliability testing to ensure that the minor design differences do not impact reliability, especially BLR. Table 5-1 shows some of the BLR temperature cycle results for some of TI's small body nFBGA packages

Table 5-1. BLR Temperature Cycle Results

Conditions (With Solder Paste)						Failures/Sample Size						
						Requirements			Extended Range			
Package	TI Mfg. Site	Body	Pitch	Die	Temp.	500	800	1000	1500	2000	2500	3000
	Test Site	(mm)	(mm)	(mm)	Cycle (°C)	(Cycles)			(Cycles)			
ZWA 11 balls	TIPI	2 x 1.4	0.5	1.0x0.6	-40/85	0/33	0/33	0/33	0/33	0/33	0/33	0/33
ZEC 36 balls	TIPI	2.45 x 2.45	0.4	1.6x0.8	-40/125	TBD	TBD	TBD	TBD	TBD	TBD	TBD

A Frequently Asked Questions

A.1 Small Body nFBGA Package Questions

Q The solder ball tolerance of the small body nFBGA is wider than that of other similar WCSP packages. What is driving this wider tolerance?

A The WCSP has the solder ball mounted directly on the die. The nFBGA balls are mounted on the solder pad of the substrates. This pad size is driven by the solder mask opening so there is slight variation. In addition, the nominal solder ball size for the WCSP is smaller than the NFBGA. This larger ball size and variation in solder pad size are what causes there to be a wider tolerance for the nFBGA solder ball dimension.

Q Will design changes need to be made on the PCB if the package is switched from a WCSP to an nFBGA of the same size?

A No, in most cases, the recommended PCB pad size is the same for both packages so the so the same PCB can be used.

Q The small body nFBGA is slightly higher than the current package solution. Will this be an issue?

A Unless the final product has a strict height restriction, minor differences in package height (± 0.05mm) are not significant. The only impact would be to the pick and place process. The customer would simply need to measure the actual component thickness and adjust the process accordingly. This is standard procedure for component placement setup.

Q Will any changes need to be made to the SMT process to support small body nFBGAs?

A nFBGAs can support both flux dip and paste printing SMT processes. In addition, solder balls used for nFBGAs may be larger than that of other packages so, the stencil aperture will need to be reduced.

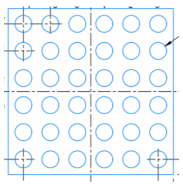
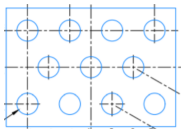
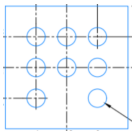
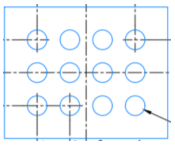
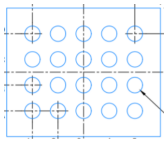
Q Are smaller pitch sizes available?

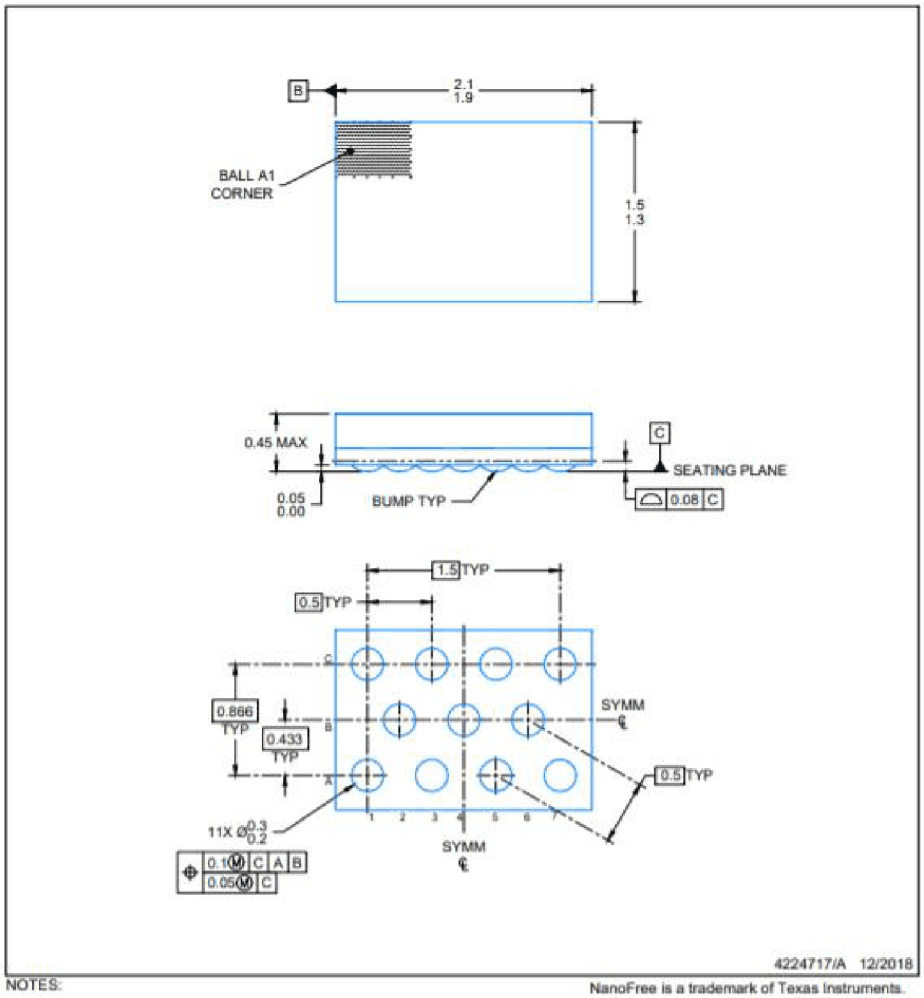
A Currently, 0.4mm is the smallest ball pitch that TI offers for nFBGA packages. Pitch sizes smaller than 0.4mm are not widely used in the industry for BGA packages and would require customization of the customer PCB.

B Package Data Sheets

Table B-1 shows TI's strategic Small Body nFBGA package lineup, followed by package data sheets for many of the package families offered as standard products by Texas Instruments. As new packages are added, they will be placed on the strategic package lineup. For information on the most current offerings, contact your TI field sales office.

Table B-1. TI's Strategic Small Body Package Line-Up

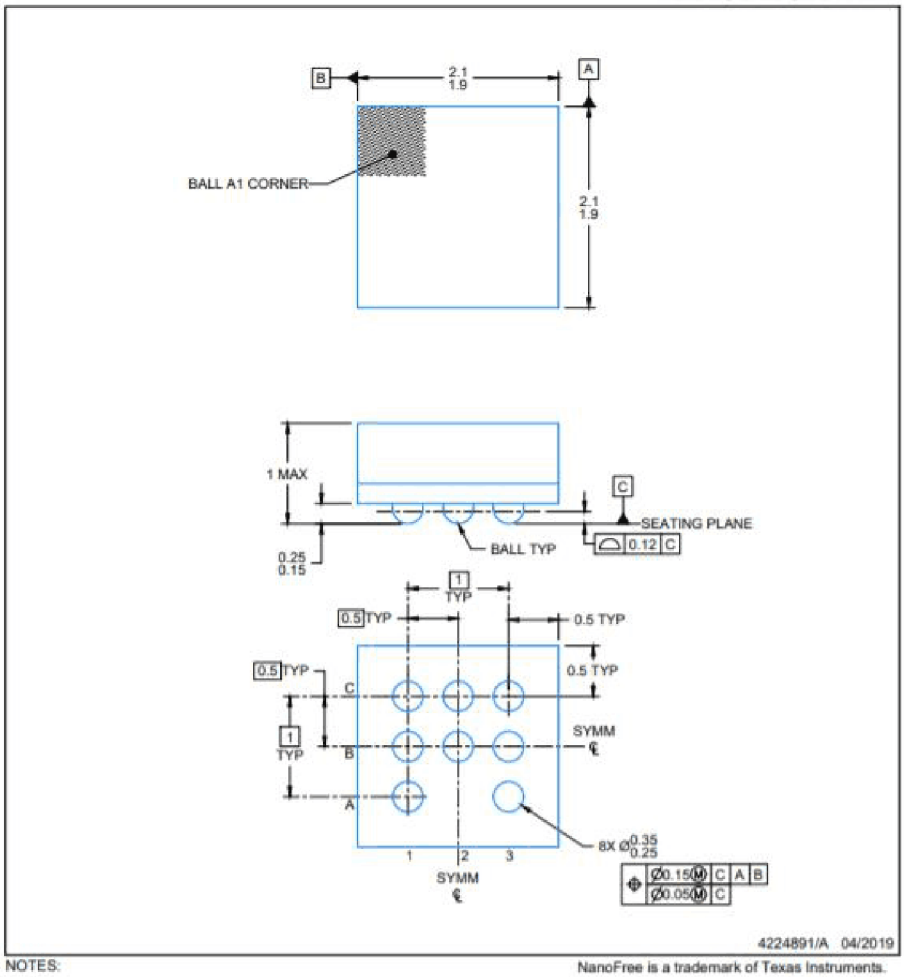
nFBGA Package Product Guide					
Pitch (mm)	**Package Size (mm)**				
	2 x 1.4	**2 x 2**	**2 x 2.5**	**2.45 x 2.45**	**2.5 x 3**
0.4					
0.5					



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.

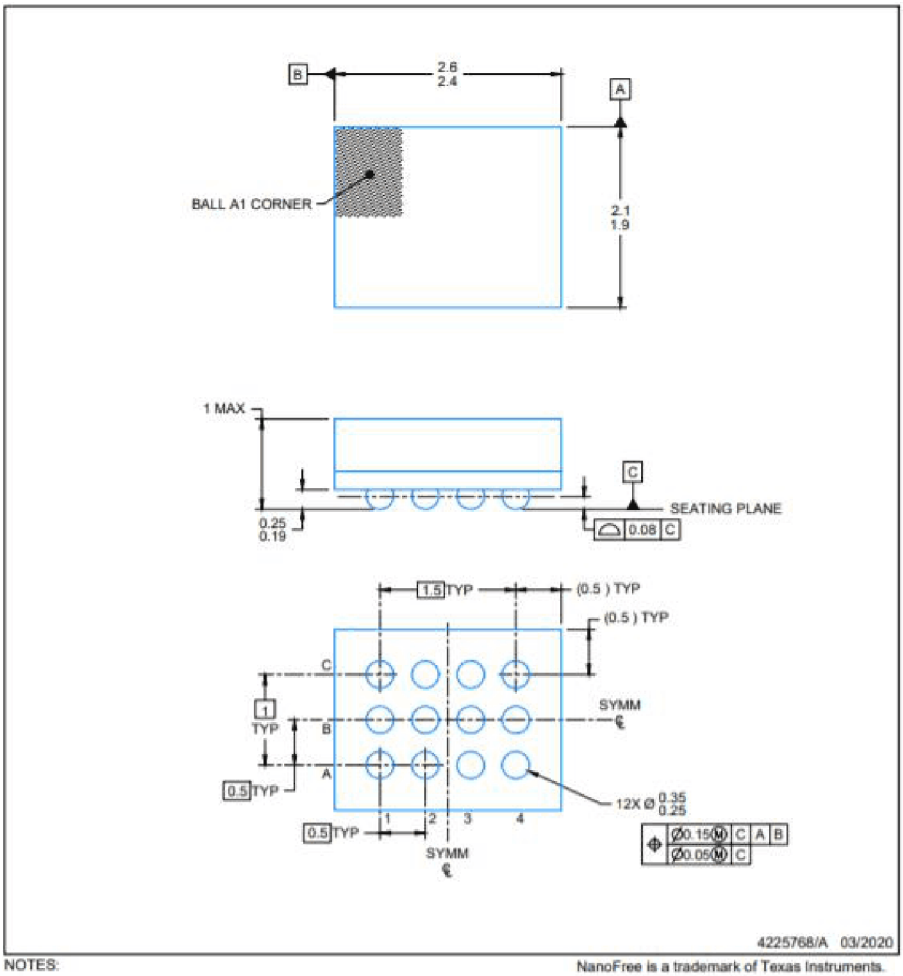
Figure B-1. 11ZWA Package Outline (2 x 1.4mm, 0.5mm pitch)



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.

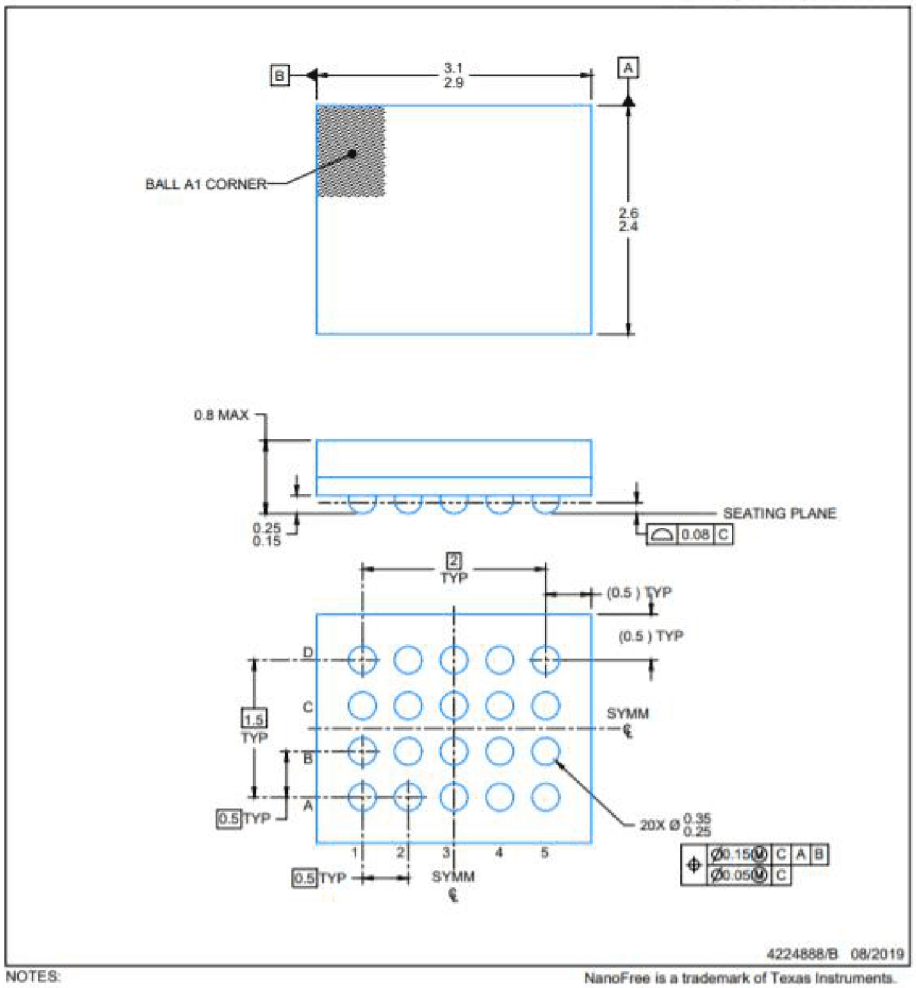
Figure B-2. 8 NMB Package Outline (2 x 2mm, 0.5mm pitch)



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.

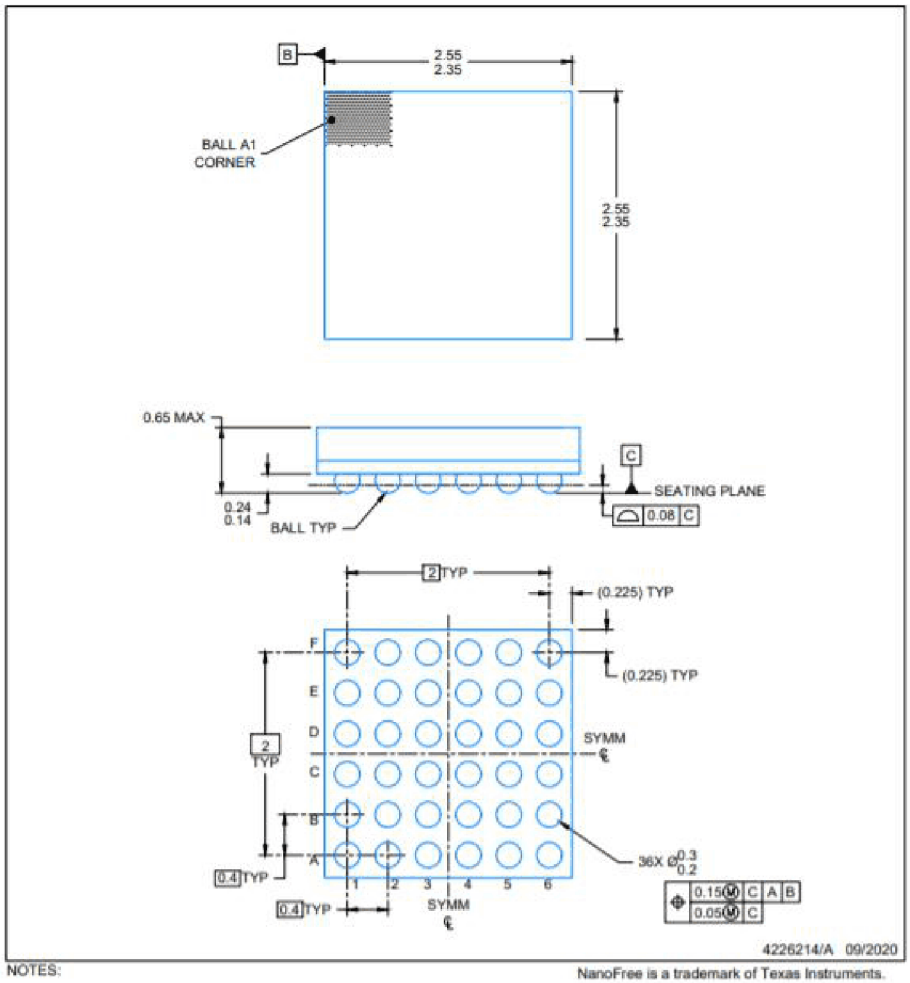
Figure B-3. 12NMN Package Outline (2 x 2.5mm, 0.5mm pitch)



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.

Figure B-4. 20NME Package Outline (2.5 x 3 mm, 0.5mm pitch)



NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
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Figure B-5. 36ZEC Package Outline (2.45 x 2.45 mm, 0.4mm pitch)

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