



BSI Standards Publication

Mechanical standardization of semiconductor devices

Part 6-17: General rules for the preparation
of outline drawings of surface mounted
semiconductor device packages — Design
guide for stacked packages — Fine-pitch
ball grid array and fine-pitch land grid array
(P-PFBGA and P PFLGA)

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National foreword

This British Standard is the UK implementation of EN 60191-6-17:2011. It is identical to IEC 60191-6-17:2011.

The UK participation in its preparation was entrusted to Technical Committee EPL/47, Semiconductors.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Amd. No.	Date	Text affected
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EUROPEAN STANDARD
 NORME EUROPÉENNE
 EUROPÄISCHE NORM

EN 60191-6-17

April 2011

ICS 31.080.01

English version

**Mechanical standardization of semiconductor devices -
 Part 6-17: General rules for the preparation of outline drawings of surface
 mounted semiconductor device packages -
 Design guide for stacked packages -
 Fine-pitch ball grid array and fine-pitch land grid array (P-PFBGA and P-
 PFLGA)
 (IEC 60191-6-17:2011)**

Normalisation mécanique des dispositifs à
 semiconducteurs -
 Partie 6-17: Règles générales pour la
 préparation des dessins d'encombrement
 des dispositifs à semiconducteurs à
 montage en surface -
 Guide de conception pour les boîtiers
 empilés -
 Boîtiers matriciels à billes et à pas fins et
 boîtiers matriciels à zone de contact plate
 et à pas fins (P-PFBGA et P-PFLGA)
 (CEI 60191-6-17:2011)

Mechanische Normung von
 Halbleiterbauelementen -
 Teil 6-17: Allgemeine Regeln für die
 Erstellung von Gehäusezeichnungen von
 SMD-Halbleitergehäusen -
 Konstruktionsleitfaden für gestapelte
 Gehäuse -
 Feinraster-Ball-Grid-Array und Feinraster-
 Land-Grid-Array (P-PFBGA/P-PFLGA)
 (IEC 60191-6-17:2011)

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CENELEC

European Committee for Electrotechnical Standardization
 Comité Européen de Normalisation Electrotechnique
 Europäisches Komitee für Elektrotechnische Normung

Management Centre: Avenue Marnix 17, B - 1000 Brussels

Foreword

The text of document 47D/785/FDIS, future edition 1 of IEC 60191-6-17, prepared by SC 47D, Mechanical standardization for semiconductor devices, of IEC TC 47, Semiconductor devices, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60191-6-17 on 2011-03-03.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN and CENELEC shall not be held responsible for identifying any or all such patent rights.

The following dates were fixed:

- | | | |
|--|-------|------------|
| – latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement | (dop) | 2011-12-03 |
| – latest date by which the national standards conflicting with the EN have to be withdrawn | (dow) | 2014-03-03 |

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 60191-6-17:2011 was approved by CENELEC as a European Standard without any modification.

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60191-6	-	Mechanical standardization of semiconductor devices - Part 6: General rules for the preparation of outline drawings of surface mounted semiconductor device packages	EN 60191-6	-
IEC 60191-6-5	-	Mechanical standardization of semiconductor devices - Part 6-5: General rules for the preparation of outline drawings of surface mounted semiconductor device packages - Design guide for fine-pitch ball grid array (FBGA)	EN 60191-6-5	-

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INTRODUCTION

The trend toward downsizing and higher density of portable electronic devices has driven LSI packages into smaller and higher density configurations. The market demand of higher density has led to the development of the package stacking technology that enabled miniaturization and higher functionality. The objective of this design guide is to standardize outlines and to get interchangeability of individual stackable packages.

MECHANICAL STANDARDIZATION OF SEMICONDUCTOR DEVICES –

Part 6-17: General rules for the preparation of outline drawings of surface mounted semiconductor device packages – Design guide for stacked packages – Fine-pitch ball grid array and fine-pitch land grid array (P-PFBGA and P-PFLGA)

1 Scope

This part of IEC 60191 provides outline drawings and dimensions for stacked packages and individual stackable packages in the form of FBGA or FLGA.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document applies.

IEC 60191-6, *Mechanical standardization of semiconductor devices – Part 6: General rules for the preparation of outline drawings of surface mounted semiconductor device package*

IEC 60191-6-5, *Mechanical standardization of semiconductor devices – Part 6-5: General rules for the preparation of outline drawings of surface mounted semiconductor device packages - Design guide for fine-pitch ball grid array (FBGA)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60191-6 and the following apply.

3.1

individual stackable package

package with an array of metallic balls or lands on the underside of the package for the purpose of surface-mount on a printed circuit board and an array of footprints (lands) on the upper side of the package for stacking packages

NOTE The individual stackable cavity-up FLGA package is a part of this specification on the premise of stacking a cavity-down FBGA with cavity-up FLGA.

3.2

stacked package

assembly of multiple individual stackable packages in a stacked configuration

NOTE The top package can be a standard FBGA specified in IEC 60191-6-5 without any footprints on the upper side of the package. The stand-off height of this standard package, however, shall follow this design guide.

3.3

mould cap height (A_2)

height of the mould cap which contains wire-bonded die or of the exposed flip chip-bonded die with respect to the upper substrate surface of the package

3.4**distance between the mould cap edge and innermost balls (F)**

distance between the mould cap edge of the lower package and the innermost terminals of the upper package of the stacked package

3.5**upper side land grid pitch (e_1)**

grid pitch of the footprints (lands) on the upper side of the individual stackable package. They will be interconnected with the terminals of a mating upper package

3.6**parallelism tolerance of the mould cap surface (y_1)**

parallelism tolerance of the top mould-cap surface of the stacked package or the individual stackable package with respect to the seating plane (datum \boxed{S}), which is established by contact of the crowns of the balls

NOTE For the stacked package, " y_1 " is defined as the parallelism tolerance of the top-component surface with regard to the seating plane of the lowest component.

3.7**coplanarity (y)**

flatness tolerance controlling the lowest points of the terminals of the individual stackable package or the stacked package

3.8**diameter of the upper side lands (b_2)**

diameter of the upper side lands, which will be bonded to the terminals of the mating upper package

4 Terminal position numbering

When a package is viewed from the terminal side with the index corner in the bottom left corner position, terminal rows are lettered from bottom to top starting with A, then B, C, ..., AA, AB, etc., while terminal columns are numbered from left to right starting with 1. Terminal positions are designated by a row-column grid system and shown as alphanumeric identification, e.g., A1, B1, or AC34.

The letters I, O, Q, S, X and Z are not used for naming the terminal rows.

5 Drawings

Outline drawings are shown in Figure 1, 2, 3, 4, 5, 6 and 7.

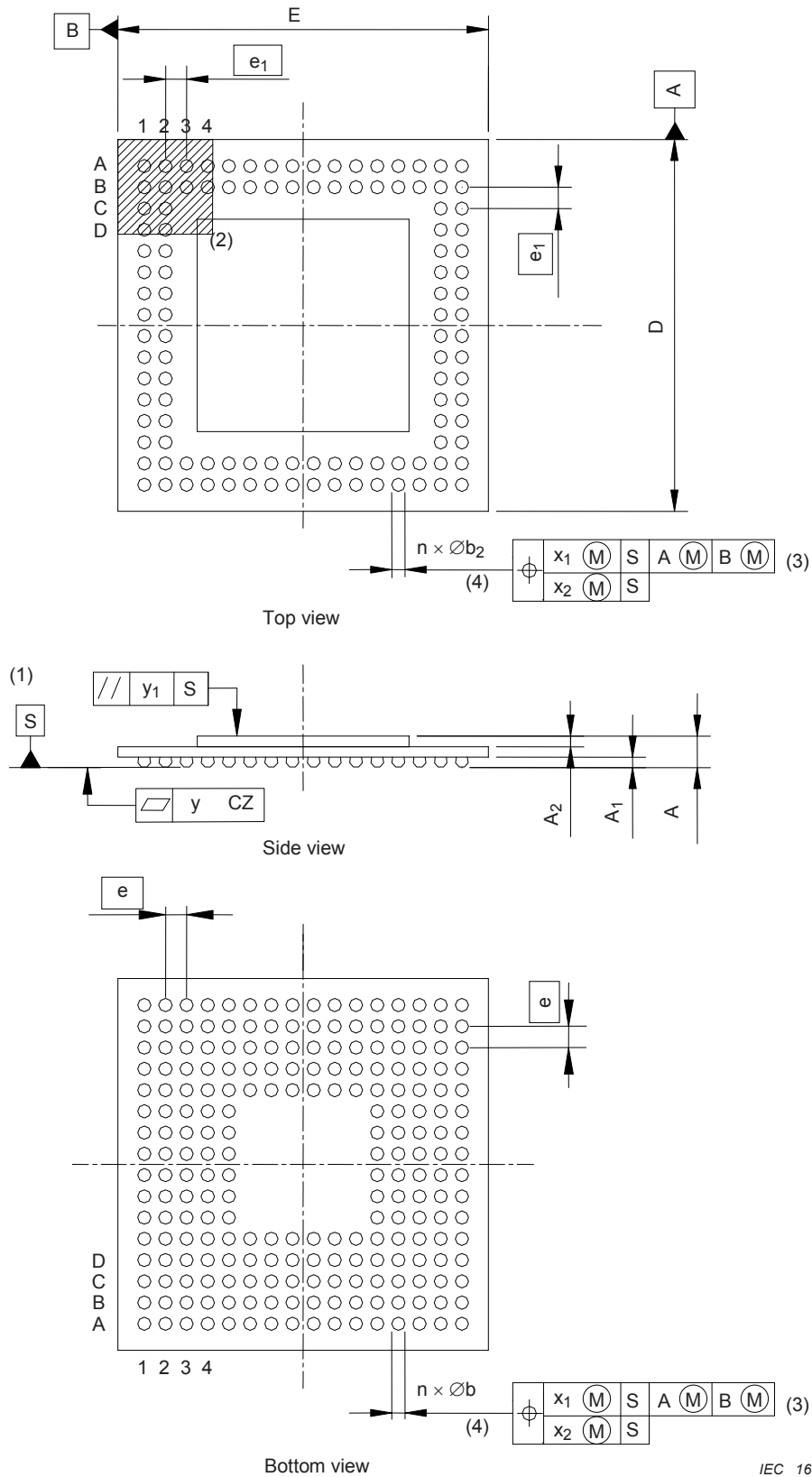


Figure 1 – Individual stackable package, P-FBGA (cavity-up)

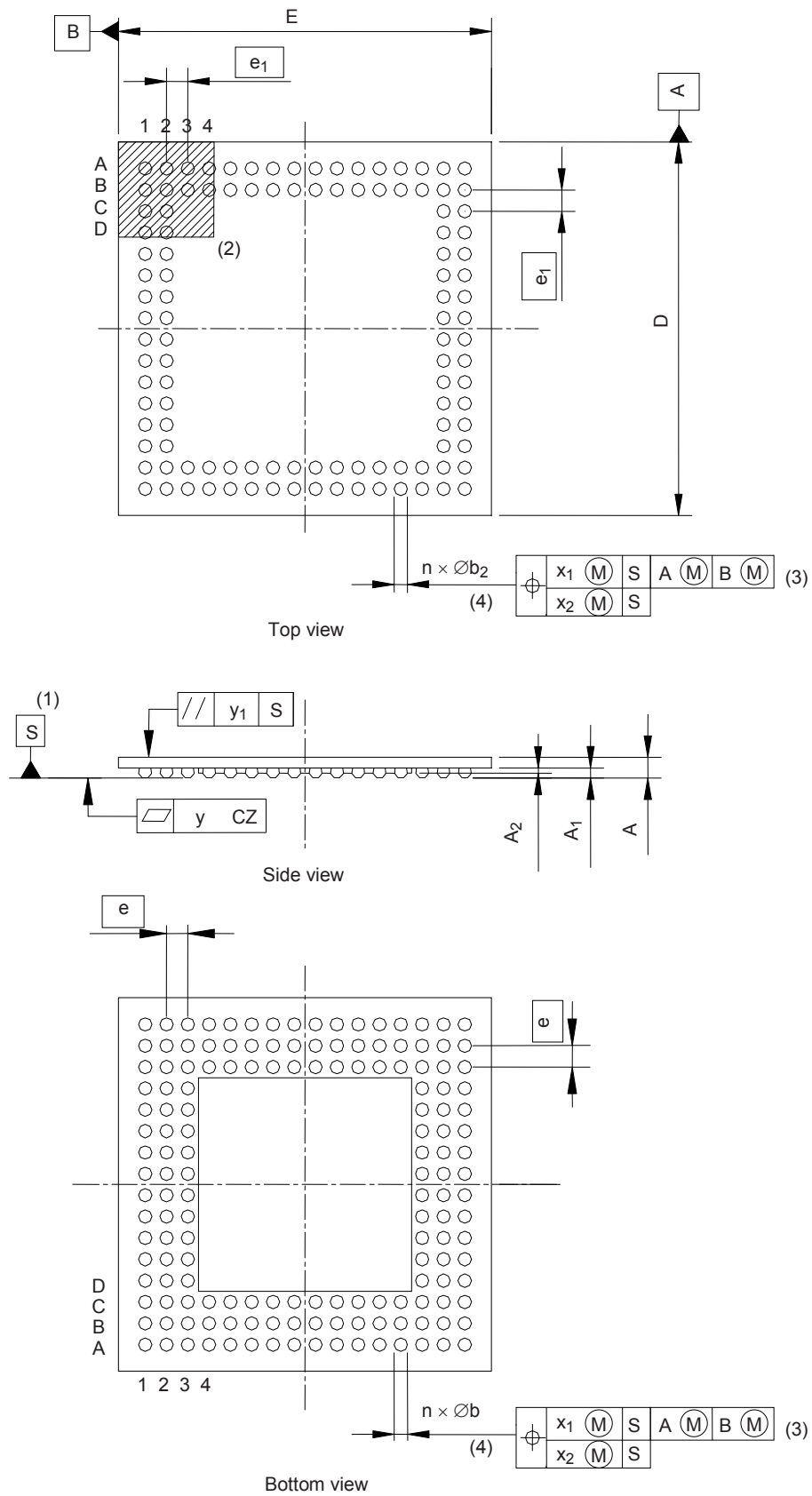


Figure 2 – Individual stackable package, P-FBGA (cavity-down)

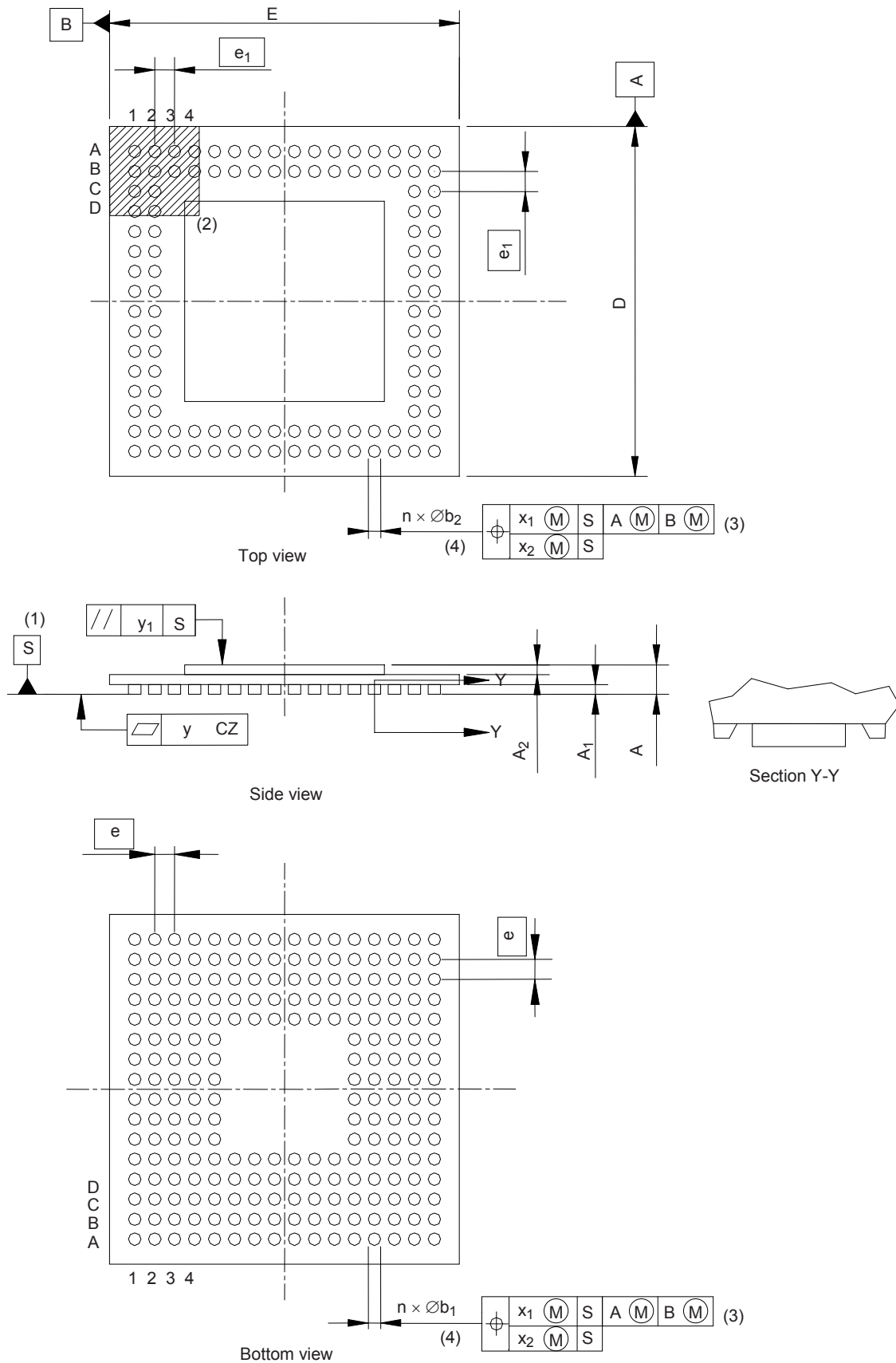
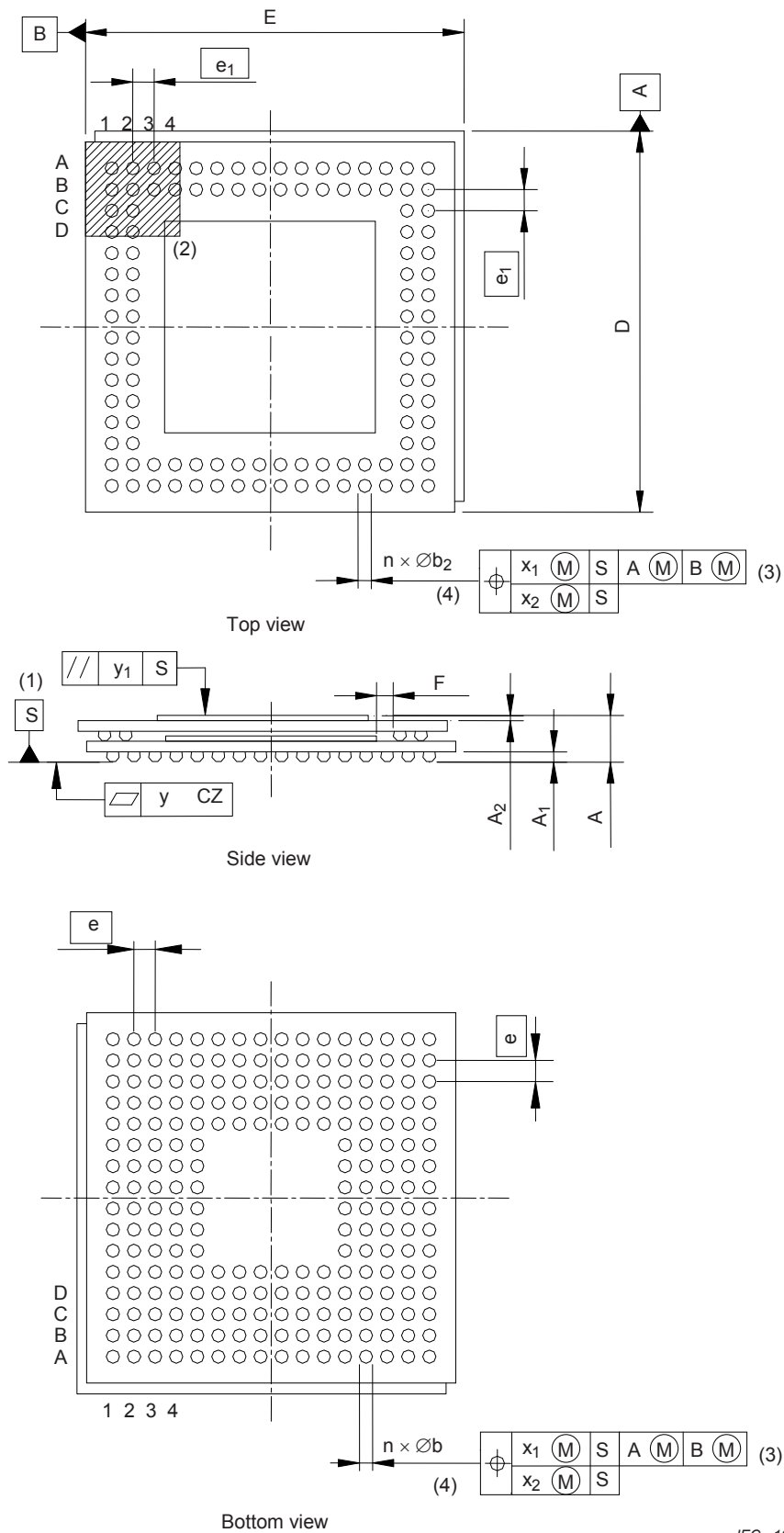
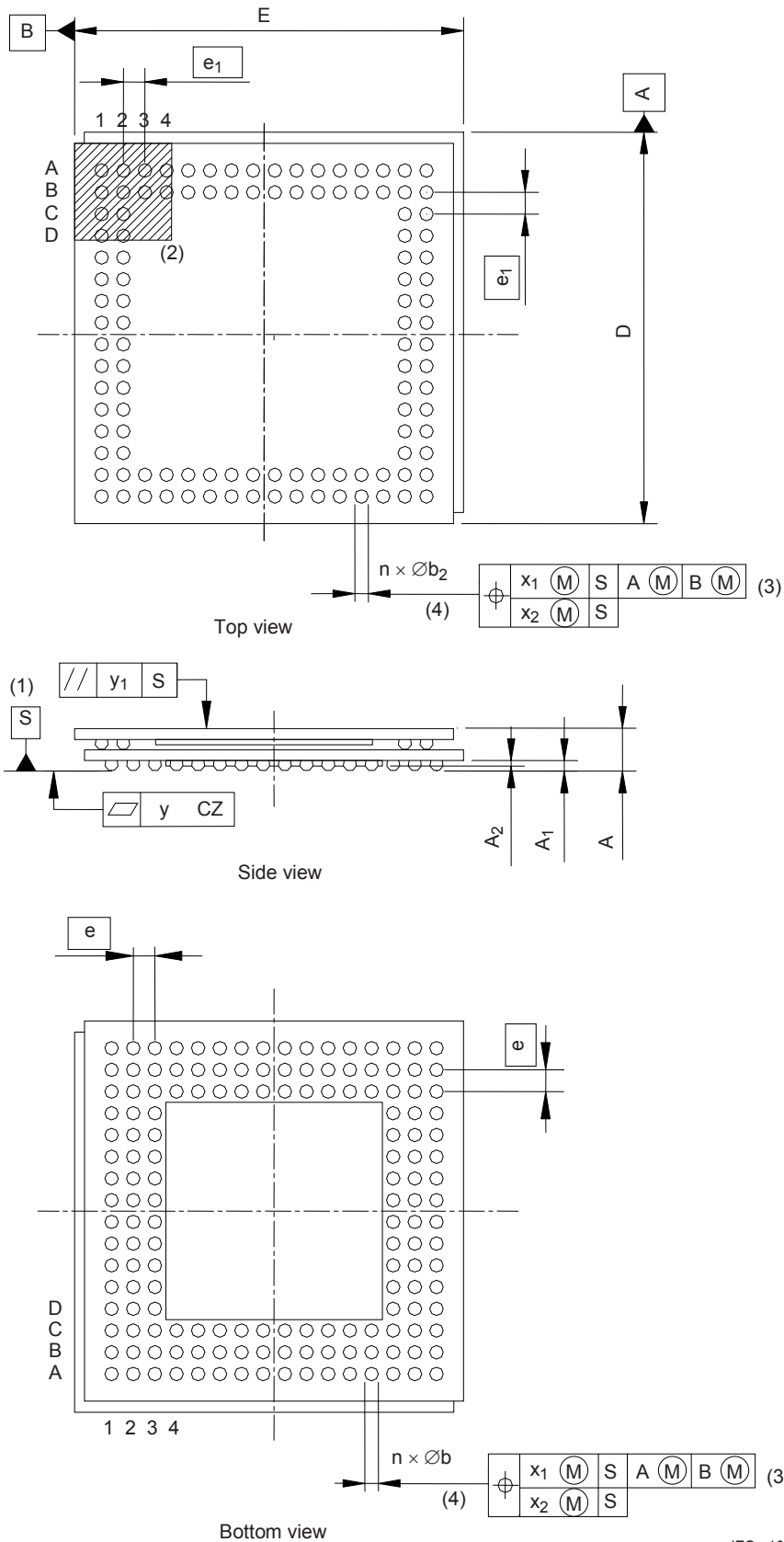


Figure 3 – Individual stackable package, P-FLGA (cavity-up)

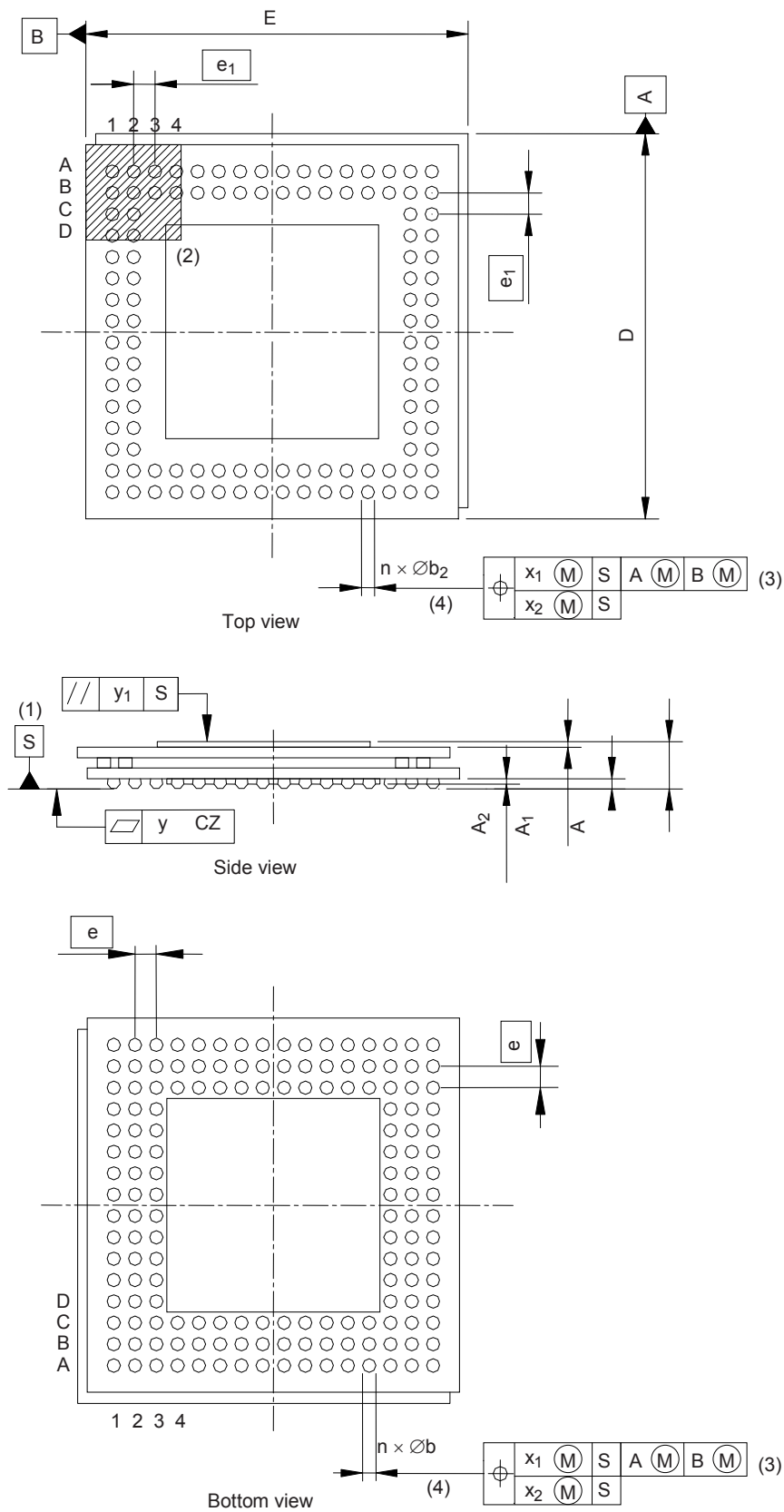


IEC 167/11

Figure 4 – Stacked package outline, P-PFBGA (cavity-up BGA and cavity-up BGA)

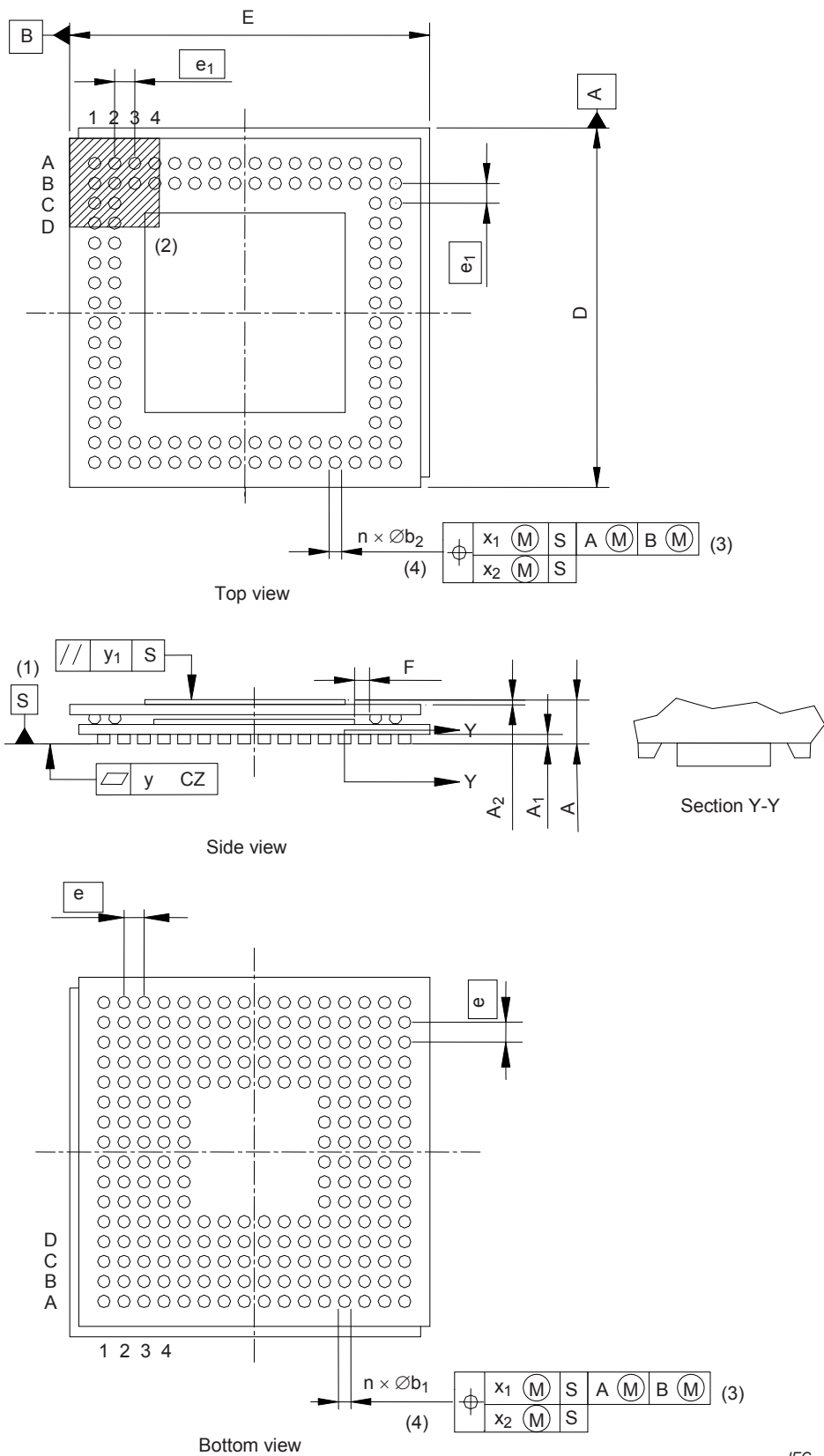


**Figure 5 – Stacked package outline, P-PFBGA
(cavity-down BGA and cavity-down BGA)**



IEC 169/11

Figure 6 – Stacked package outline, P-PFBGA (cavity-down BGA + cavity-up LGA)



IEC 170/11

Figure 7 – Stacked package outline, P-PFLGA (cavity-up LGA + cavity-up BGA)

Common notes for Figure 1 to Figure 7.

- (1) The datum \boxed{S} is defined as the seating plane on which a package free stands by contact of the balls.
- (2) The hatched zone indicates the index-marking area where **A1** terminal locates. The index-marking area is basically 1/16 of the package body area in compliance with IEC standard. Even if the index mark extends more than this area, it shall not extend more than 1/4 of the package body area.
- (3) The terminal true position tolerances x_1 and x_2 are applied to all terminals.
- (4) The terminal diameter b , b_1 , and b_2 are the largest diameters as measured in a plane parallel to the seating plane.

The functional gauge drawing indicates the pattern of the circles, in which terminals locate, with respect to the datum \boxed{S} , \boxed{A} , and \boxed{B} .

The pattern of terminal position area is composed of the circles, in which terminals locate, with respect to the datum \boxed{S} .

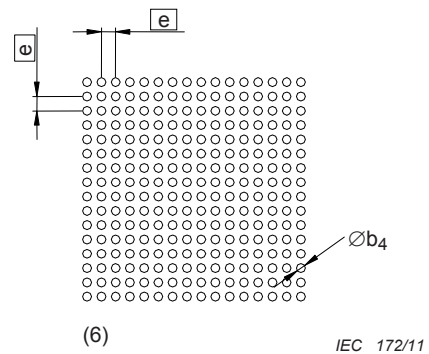
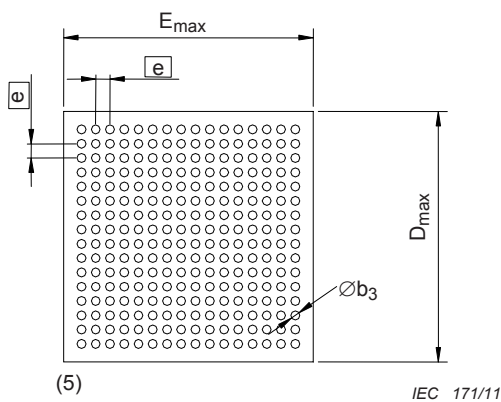


Figure 8 – Functional gauge

Figure 9 – Pattern of terminal position area

6 Dimensions

6.1 Group 1

Dimensions of group 1 are shown in Table 1.

Table 1 – Dimensions, Group 1

Unit: *mm*

Term	Symbol	Specification	Recommended value	Remarks
Package nominal dimension	$E \times D$	A package nominal dimension is defined as “package width E × length D ”, which is expressed in the tenths place in millimetre.	-	-
Package length	D	For rectangular bodies, the package length D ranges from 4,0 to 21,0 in increments of 0,5. For square bodies, the package length D ranges from 4,0 to 14,5 in increments of 0,5, and from 15,0 to 21,0 in increments of 1,0. Tolerances of D are $\pm 0,1$ for the individual stackable packages and $\pm 0,15$ for the stacked packages.	-	Rectangular outlines are allowed. D includes burr
Package width	E	For rectangular bodies, the package width E ranges from 4,0 to 21,0 in increments of 0,5. For square bodies, the package width E ranges from 4,0 to 14,5 in increments of 0,5, and from 15,0 to 21,0 in increments of 1,0. Tolerances of E are $\pm 0,1$ for the individual stackable packages and $\pm 0,15$ for the stacked packages.	-	Rectangular outlines are allowed. E includes burr
Maximum profile height	A	The maximum profile height A is categorized as: 0,30, 0,40, 0,50, 0,65, 0,80, 1,00, 1,20, 1,40, 1,60, 1,80, 2,00, 2,20, or 2,50.	-	A includes package warpage and tilt errors

Table 1 – Dimensions, Group 1 (continued overleaf)

Unit: mm

Term	Symbol	Specification	Recommended value	Remarks																								
True position tolerance of terminals with respect to the body datum	x_1	<p>(1) For the individual stackable packages:</p> <table border="1"> <thead> <tr> <th>\overline{e}</th> <th>x_1</th> </tr> </thead> <tbody> <tr><td>0,80</td><td>0,15</td></tr> <tr><td>0,65</td><td>0,15</td></tr> <tr><td>0,50</td><td>0,15</td></tr> <tr><td>0,40</td><td>0,12</td></tr> <tr><td>0,30</td><td>0,12</td></tr> </tbody> </table> <p>(2) For the stacked packages:</p> <table border="1"> <thead> <tr> <th>\overline{e}</th> <th>x_1</th> </tr> </thead> <tbody> <tr><td>0,80</td><td>0,20</td></tr> <tr><td>0,65</td><td>0,20</td></tr> <tr><td>0,50</td><td>0,20</td></tr> <tr><td>0,40</td><td>0,15</td></tr> <tr><td>0,30</td><td>0,15</td></tr> </tbody> </table>	\overline{e}	x_1	0,80	0,15	0,65	0,15	0,50	0,15	0,40	0,12	0,30	0,12	\overline{e}	x_1	0,80	0,20	0,65	0,20	0,50	0,20	0,40	0,15	0,30	0,15	-	Positional tolerances reflect the current process capabilities
\overline{e}	x_1																											
0,80	0,15																											
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0,50	0,15																											
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0,65	0,20																											
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0,40	0,15																											
0,30	0,15																											
Terminal-to-terminal positional tolerance	x_2	<p>(1) For the individual stackable packages:</p> <table border="1"> <thead> <tr> <th>\overline{e}</th> <th>x_2</th> </tr> </thead> <tbody> <tr><td>0,80</td><td>0,08</td></tr> <tr><td>0,65</td><td>0,08</td></tr> <tr><td>0,50</td><td>0,05</td></tr> <tr><td>0,40</td><td>0,05</td></tr> <tr><td>0,30</td><td>0,03</td></tr> </tbody> </table> <p>(2) For the stacked packages:</p> <table border="1"> <thead> <tr> <th>\overline{e}_1</th> <th>x_2</th> </tr> </thead> <tbody> <tr><td>0,80</td><td>0,08</td></tr> <tr><td>0,65</td><td>0,08</td></tr> <tr><td>0,50</td><td>0,05</td></tr> <tr><td>0,40</td><td>0,05</td></tr> <tr><td>0,30</td><td>0,03</td></tr> </tbody> </table>	\overline{e}	x_2	0,80	0,08	0,65	0,08	0,50	0,05	0,40	0,05	0,30	0,03	\overline{e}_1	x_2	0,80	0,08	0,65	0,08	0,50	0,05	0,40	0,05	0,30	0,03	-	Positional tolerances reflect the current process capabilities. $\overline{e}=0,30$ is applied to the cavity-up FLGA. $\overline{e}_1=0,30$ is applied to the cavity-down packages
\overline{e}	x_2																											
0,80	0,08																											
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Table 1 – Dimensions, Group 1 (continued overleaf)

Unit: mm

Term	Symbol	Specification	Recommended value	Remarks																																																		
Stand-off height	A ₁	(1) For FBGA: <table border="1"> <thead> <tr> <th>\overline{e}</th> <th>b</th> <th>MIN</th> <th>NOM</th> <th>MAX</th> </tr> </thead> <tbody> <tr> <td>0,80</td> <td>0,50</td> <td>0,36</td> <td>0,40</td> <td>0,44</td> </tr> <tr> <td></td> <td>0,45</td> <td>0,30</td> <td>0,34</td> <td>0,38</td> </tr> <tr> <td></td> <td>0,40</td> <td>0,24</td> <td>0,28</td> <td>0,32</td> </tr> <tr> <td>0,65</td> <td>0,45</td> <td>0,32</td> <td>0,36</td> <td>0,40</td> </tr> <tr> <td></td> <td>0,40</td> <td>0,26</td> <td>0,30</td> <td>0,34</td> </tr> <tr> <td></td> <td>0,35</td> <td>0,20</td> <td>0,24</td> <td>0,28</td> </tr> <tr> <td>0,50</td> <td>0,35</td> <td>0,26</td> <td>0,30</td> <td>0,34</td> </tr> <tr> <td></td> <td>0,30</td> <td>0,19</td> <td>0,23</td> <td>0,27</td> </tr> <tr> <td>0,40</td> <td>0,25</td> <td>0,17</td> <td>0,20</td> <td>0,23</td> </tr> </tbody> </table>	\overline{e}	b	MIN	NOM	MAX	0,80	0,50	0,36	0,40	0,44		0,45	0,30	0,34	0,38		0,40	0,24	0,28	0,32	0,65	0,45	0,32	0,36	0,40		0,40	0,26	0,30	0,34		0,35	0,20	0,24	0,28	0,50	0,35	0,26	0,30	0,34		0,30	0,19	0,23	0,27	0,40	0,25	0,17	0,20	0,23	-	For the lowest package, the stand-off height shall follow either these criteria or ones specified in IEC 60191-6-5
		\overline{e}	b	MIN	NOM	MAX																																																
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Maximum mould cap height	A ₂	(1) For FBGA: <table border="1"> <thead> <tr> <th>\overline{e}</th> <th>b</th> <th>A₂ (MAX)</th> </tr> </thead> <tbody> <tr> <td>0,80</td> <td>0,50</td> <td>0,28</td> </tr> <tr> <td>0,80</td> <td>0,45</td> <td>0,22</td> </tr> <tr> <td>0,80</td> <td>0,40</td> <td>0,16</td> </tr> <tr> <td>0,65</td> <td>0,45</td> <td>0,26</td> </tr> <tr> <td>0,65</td> <td>0,40</td> <td>0,20</td> </tr> <tr> <td>0,65</td> <td>0,35</td> <td>0,14</td> </tr> <tr> <td>0,50</td> <td>0,35</td> <td>0,22</td> </tr> <tr> <td>0,50</td> <td>0,30</td> <td>0,15</td> </tr> <tr> <td>0,40</td> <td>0,25</td> <td>0,14</td> </tr> </tbody> </table>	\overline{e}	b	A ₂ (MAX)	0,80	0,50	0,28	0,80	0,45	0,22	0,80	0,40	0,16	0,65	0,45	0,26	0,65	0,40	0,20	0,65	0,35	0,14	0,50	0,35	0,22	0,50	0,30	0,15	0,40	0,25	0,14	-	A ₂ shall be taken into account in specifying A ₁																				
		\overline{e}	b	A ₂ (MAX)																																																		
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(2) For FLGA: <table border="1"> <thead> <tr> <th>\overline{e}_1</th> <th>b</th> <th>A₂ (MAX)</th> </tr> </thead> <tbody> <tr> <td>0,80</td> <td>0,50</td> <td>0,28</td> </tr> <tr> <td>0,80</td> <td>0,45</td> <td>0,22</td> </tr> <tr> <td>0,80</td> <td>0,40</td> <td>0,16</td> </tr> <tr> <td>0,65</td> <td>0,45</td> <td>0,26</td> </tr> <tr> <td>0,65</td> <td>0,40</td> <td>0,20</td> </tr> <tr> <td>0,65</td> <td>0,35</td> <td>0,14</td> </tr> <tr> <td>0,50</td> <td>0,35</td> <td>0,22</td> </tr> <tr> <td>0,50</td> <td>0,30</td> <td>0,15</td> </tr> <tr> <td>0,40</td> <td>0,25</td> <td>0,14</td> </tr> </tbody> </table>	\overline{e}_1	b	A ₂ (MAX)	0,80	0,50	0,28	0,80	0,45	0,22	0,80	0,40	0,16	0,65	0,45	0,26	0,65	0,40	0,20	0,65	0,35	0,14	0,50	0,35	0,22	0,50	0,30	0,15	0,40	0,25	0,14																								
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Table 1 – Dimensions, Group 1 (continued overleaf)

Unit: mm

Term	Symbol	Specification	Recommended value	Remarks																																								
Distance between the mould cap edge and innermost balls	F	$F \geq 0,20$	-	-																																								
Terminal grid pitch	e	$e = 0,8$ 0,65 0,50 0,40 0,30	-	$e = 0,30$ is applied to the cavity-up FLGA																																								
Upper side land grid pitch	e_1	$e_1 = 0,80$ 0,65 0,50 0,40 0,30	-	$e_1 = 0,30$ is applied to the cavity-down packages																																								
Ball diameter of FBGA	b	<table border="1"> <thead> <tr> <th>e</th> <th>MIN</th> <th>NOM</th> <th>MAX</th> </tr> </thead> <tbody> <tr><td>0,80</td><td>0,45</td><td>0,50</td><td>0,55</td></tr> <tr><td>0,80</td><td>0,40</td><td>0,45</td><td>0,50</td></tr> <tr><td>0,80</td><td>0,35</td><td>0,40</td><td>0,45</td></tr> <tr><td>0,65</td><td>0,40</td><td>0,45</td><td>0,50</td></tr> <tr><td>0,65</td><td>0,35</td><td>0,40</td><td>0,45</td></tr> <tr><td>0,65</td><td>0,30</td><td>0,35</td><td>0,40</td></tr> <tr><td>0,50</td><td>0,30</td><td>0,35</td><td>0,40</td></tr> <tr><td>0,50</td><td>0,25</td><td>0,30</td><td>0,35</td></tr> <tr><td>0,40</td><td>0,20</td><td>0,25</td><td>0,30</td></tr> </tbody> </table>	e	MIN	NOM	MAX	0,80	0,45	0,50	0,55	0,80	0,40	0,45	0,50	0,80	0,35	0,40	0,45	0,65	0,40	0,45	0,50	0,65	0,35	0,40	0,45	0,65	0,30	0,35	0,40	0,50	0,30	0,35	0,40	0,50	0,25	0,30	0,35	0,40	0,20	0,25	0,30	Nominal of b is recommended as the diameter of raw balls.	-
e	MIN	NOM	MAX																																									
0,80	0,45	0,50	0,55																																									
0,80	0,40	0,45	0,50																																									
0,80	0,35	0,40	0,45																																									
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0,50	0,30	0,35	0,40																																									
0,50	0,25	0,30	0,35																																									
0,40	0,20	0,25	0,30																																									
Land diameter of FLGA	b_1	<table border="1"> <thead> <tr> <th>e</th> <th>MIN</th> <th>NOM</th> <th>MAX</th> </tr> </thead> <tbody> <tr><td>0,80</td><td>0,35</td><td>0,40</td><td>0,45</td></tr> <tr><td>0,65</td><td>0,28</td><td>0,33</td><td>0,38</td></tr> <tr><td>0,50</td><td>0,20</td><td>0,25</td><td>0,30</td></tr> <tr><td>0,40</td><td>0,15</td><td>0,20</td><td>0,25</td></tr> <tr><td>0,30</td><td>0,12</td><td>0,15</td><td>0,18</td></tr> </tbody> </table>	e	MIN	NOM	MAX	0,80	0,35	0,40	0,45	0,65	0,28	0,33	0,38	0,50	0,20	0,25	0,30	0,40	0,15	0,20	0,25	0,30	0,12	0,15	0,18	-	$e = 0,30$ is applied to the cavity-up FLGA																
e	MIN	NOM	MAX																																									
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Table 1 – Dimensions, Group 1 (continued overleaf)

Unit: mm

Term	Symbol	Specification	Recommended value	Remarks																								
Diameter of the upper side lands	b_2	<table border="1"> <thead> <tr> <th>e_1</th> <th>MIN</th> <th>NOM</th> <th>MAX</th> </tr> </thead> <tbody> <tr> <td>0,80</td> <td>0,35</td> <td>0,40</td> <td>0,45</td> </tr> <tr> <td>0,65</td> <td>0,28</td> <td>0,33</td> <td>0,38</td> </tr> <tr> <td>0,50</td> <td>0,20</td> <td>0,25</td> <td>0,30</td> </tr> <tr> <td>0,40</td> <td>0,15</td> <td>0,20</td> <td>0,25</td> </tr> <tr> <td>0,30</td> <td>0,12</td> <td>0,15</td> <td>0,18</td> </tr> </tbody> </table>	e_1	MIN	NOM	MAX	0,80	0,35	0,40	0,45	0,65	0,28	0,33	0,38	0,50	0,20	0,25	0,30	0,40	0,15	0,20	0,25	0,30	0,12	0,15	0,18	-	$e_1=0,30$ is applied to the cavity-down packages
e_1	MIN	NOM	MAX																									
0,80	0,35	0,40	0,45																									
0,65	0,28	0,33	0,38																									
0,50	0,20	0,25	0,30																									
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Coplanarity	y	<table border="1"> <thead> <tr> <th>e</th> <th>y</th> </tr> </thead> <tbody> <tr> <td>0,80</td> <td>0,10</td> </tr> <tr> <td>0,65</td> <td>0,10</td> </tr> <tr> <td>0,50</td> <td>0,08</td> </tr> <tr> <td>0,40</td> <td>0,08</td> </tr> <tr> <td>0,30</td> <td>0,05</td> </tr> </tbody> </table>	e	y	0,80	0,10	0,65	0,10	0,50	0,08	0,40	0,08	0,30	0,05	-	$e=0,30$ is applied to the cavity-up FLGA												
e	y																											
0,80	0,10																											
0,65	0,10																											
0,50	0,08																											
0,40	0,08																											
0,30	0,05																											
Parallelism tolerance of the top mould- cap surface	y_1	For the individual stackable package, $y_1=0,15$. For the stacked package, $y_1=0,20$.	-	-																								
Terminal matrix		Terminal matrix is determined by terminal pitch e , upper side land pitch e_1 , and matrix sizes M_D and M_E .	-	-																								

Table 1 – Dimensions, Group 1 (continued overleaf)

Unit: mm

Term	Symbol	Specification	Recommended value	Remarks
Number of terminals	n	(1) For both FBGA and FLGA; $n \leq M_E \times M_D$	-	Maximum matrix sizes for these combinations are listed in Table 3 to Table 7
Longitudinal maximum matrix size	M_D	$(M_E - 1) \times M_D$ $M_E \times (M_D - 1)$ $(M_E - 1) \times (M_D - 1)$		
Lateral matrix size	M_E	(2) In addition to the above algorithms, the following combinations are allowed for FLGA: $n \leq (M_E + 1) \times M_D$ $M_E \times (M_D + 1)$ $(M_E + 1) \times (M_D + 1)$		

6.2 Group 2

Dimensions of group 2 are shown in Table 2.

Table 2 – Dimensions Group 2

Unit: mm

Term	Symbol	Specification	Recommended value	Remarks
Diameter of the circle that contains entire terminal with respect to the body datum	b_3	$b_3 = b(\text{MAX}) + x_1$	-	-
Diameter of the circle that contains entire terminal with respect to other balls	b_4	$b_4 = b(\text{MAX}) + x_2$	-	-

6.3 Combination of D, E, M_D, and M_E

Combinations of D, E, M_D, and M_E are shown in Table 3, 4, 5, 6 and 7

Table 3 – Combination of D, E, M_D, and M_E, $e = 0,80\text{mm}$ pitch FBGA and FLGA

D or E	M _D or M _E	(M _D -1) or (M _E -1)	(M _D +1) or (M _E +1) (Only for FLGA)
4,0	4	3	5
4,5	5	4	6
5,0			
5,5	6	5	7
6,0	7	6	8
6,5			
7,0	8	7	9
7,5			
8,0	9	8	10
8,5	10	9	11
9,0			
9,5	11	10	12
10,0	12	11	13
10,5			
11,0	13	12	14
11,5			
12,0	14	13	15
12,5	15	14	16
13,0			
13,5	16	15	17
14,0	17	16	18
14,5			
15,0	18	17	19
15,5			
16,0	19	18	20
16,5	20	19	21
17,0			
17,5	21	20	22
18,0	22	21	23
18,5			
19,0	23	22	24
19,5			
20,0	24	23	25
20,5	25	24	26
21,0			

Table 4 – Combination of D, E, M_D, and M_E, e = 0,65mm pitch FBGA and FLGA

D or E	M _D or M _E	(M _D -1) or (M _E -1)	(M _D +1) or (M _E +1) (Only for FLGA)
4,0	5	4	6
4,5	6	5	7
5,0			
5,5	7	6	8
6,0	8	7	9
6,5	9	8	10
7,0	10	9	11
7,5			
8,0	11	10	12
8,5	12	11	13
9,0	13	12	14
9,5			
10,0	14	13	15
10,5	15	14	16
11,0	16	15	17
11,5			
12,0	17	16	18
12,5	18	17	19
13,0	19	18	20
13,5	20	19	21
14,0			
14,5	21	20	22
15,0	22	21	23
15,5	23	22	24
16,0			
16,5	24	23	25
17,0	25	24	26
17,5	26	25	27
18,0			
18,5	27	26	28
19,0	28	27	29
19,5	29	28	30
20,0	30	29	31
20,5			
21,0	31	30	32

Table 5 – Combination of D, E, M_D, and M_E, e = 0,50mm pitch FBGA and FLGA

D or E	M _D or M _E	(M _D -1) or (M _E -1)	(M _D +1) or (M _E +1) (Only for FLGA)
4,0	7	6	8
4,5	8	7	9
5,0	9	8	10
5,5	10	9	11
6,0	11	10	12
6,5	12	11	13
7,0	13	12	14
7,5	14	13	15
8,0	15	14	16
8,5	16	15	17
9,0	17	16	18
9,5	18	17	19
10,0	19	18	20
10,5	20	19	21
11,0	21	20	22
11,5	22	21	23
12,0	23	22	24
12,5	24	23	25
13,0	25	24	26
13,5	26	25	27
14,0	27	26	28
14,5	28	27	29
15,0	29	28	30
15,5	30	29	31
16,0	31	30	32
16,5	32	31	33
17,0	33	32	34
17,5	34	33	35
18,0	35	34	36
18,5	36	35	37
19,0	37	36	38
19,5	38	37	39
20,0	39	38	40
20,5	40	39	41
21,0	41	40	42

Table 6 – Combination of D, E, M_D, and M_E, $e = 0,40\text{mm}$ pitch FBGA an FLGA

D or E	M _D or M _E	(M _D -1) or (M _E -1)	(M _D +1) or (M _E +1) (Only for FLGA)
4,0	8	7	9
4,5	10	9	11
5,0	11	10	12
5,5	12	11	13
6,0	13	12	14
6,5	15	14	16
7,0	16	15	17
7,5	17	16	18
8,0	18	17	19
8,5	20	19	21
9,0	21	20	22
9,5	22	21	23
10,0	23	22	24
10,5	25	24	26
11,0	26	25	27
11,5	27	26	28
12,0	28	27	29
12,5	30	29	31
13,0	31	30	32
13,5	32	31	33
14,0	33	32	34
14,5	35	34	36
15,0	36	35	37
15,5	37	36	38
16,0	38	37	39
16,5	40	39	41
17,0	41	40	42
17,5	42	41	43
18,0	43	42	44
18,5	45	44	46
19,0	46	45	47
19,5	47	46	48
20,0	48	47	49
20,5	50	49	51
21,0	51	50	52

Table 7 – Combination of D, E, M_D, and M_E, $e = 0,30\text{mm}$ pitch FLGA

D or E	M _D or M _E	(M _D -1) or (M _E -1)	(M _D +1) or (M _E +1) (Only for FLGA)
4,0	-	-	12
4,5	-	-	14
5,0	-	-	16
5,5	-	-	17
6,0	-	-	19
6,5	-	-	21
7,0	-	-	22
7,5	-	-	24
8,0	-	-	26
8,5	-	-	27
9,0	-	-	29
9,5	-	-	31
10,0	-	-	32
10,5	-	-	34
11,0	-	-	36
11,5	-	-	37
12,0	-	-	39
12,5	-	-	41
13,0	-	-	42
13,5	-	-	44
14,0	-	-	46
14,5	-	-	47
15,0	-	-	49
15,5	-	-	51
16,0	-	-	52
16,5	-	-	54
17,0	-	-	56
17,5	-	-	57
18,0	-	-	59
18,5	-	-	61
19,0	-	-	62
19,5	-	-	64
20,0	-	-	66
20,5	-	-	67
21,0	-	-	69

7 Dimension table

Specific dimension table is shown in Table 8.

Table 8 – Dimension table

Package codes		P-PFBGA - , × , - , P-PFLGA - , × , - ,		
Symbols		MIN	NOM	MAX
Group 1	D	X	X	X
	E	X	X	X
	A			X
	A ₁	X	X	X
	A ₂			X
	F	X		
	\boxed{e}		X	
	$\boxed{e_1}$		X	
	b	X	X	X
	b ₁	X	X	X
	b ₂	X	X	X
	x ₁			X
	x ₂			X
	y			X
	y ₁			X
	n		X	
	M _D		X	
	M _E		X	
	Terminal depopulation	X ^a		
Group 2	b ₃			X
	b ₄			X

^a "Full matrix", "Staggered matrix", or "Perimeter matrix with × rows" should be shown in this cell, where "x" is natural number, Any other unique patterns would be defined or illustrated in each standard of individual package outline.

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