INTERNATIONAL STANDARD

IEC 60191-6-5

First edition
2001-08

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)**

Normalisation mécanique des dispositifs à semiconducteurs

*Partie 6-5:
Règles générales pour la préparation des dessins d'encombrement des dispositifs à semiconducteurs à montage en surface –
Guide de conception pour les boîtiers matriciels à billes et à pas fins (FBGA)*

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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)

FOREWORD

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The text of this standard is based on the following documents:

FDIS	Report on voting
47D/437/FDIS	47D/455/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 3.

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The committee has decided that the contents of this publication will remain unchanged until 2003. At this date, the publication will be

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A bilingual version of this publication may be issued at a later date.

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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)

1 Scope

This part of IEC 60191 provides common outline drawings and dimensions for all types of structures and composed materials of fine-pitch ball grid array (hereinafter called FBGA), whose terminal pitch is less than, or equal to, 0,80 mm and whose package body outline is square.

The demand for area array style packages exists according to the multi-functioning and high performance of electrical equipment. The object of this design guide is to standardize outlines and secure interchangeability of FBGA packages. The terminal pitch and package outlines of these fine-pitch array packages are smaller than those of BGA packages.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 60191. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of IEC 60191 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60191-6:1990, *Mechanical standardization of semiconductor devices – Part 6: General rules for the preparation of outline drawings of surface mounted semiconductor device packages*

3 Definitions

For the purposes of this part of IEC 60191, the definitions contained in IEC 60191-6 as well as the following definitions apply.

3.1
flanged type
type whose package body size (body length and width) consists of its own flange which is composed around the encapsulation or lid

3.2
type of real chip size
type whose package body size (body length and width) consists of an encapsulation just around the real chip only

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3.3
fine-pitch ball grid array (FBGA)
packages with metal balls whose terminal pitch is less than, or equal to, 0,80 mm positioned in an array on the base plane of the package as external terminals. This package structure makes it possible to surface-mount the packages to the printed circuit board

3.4
material designation
FBGA packages are classified according to the following two material designations:

3.4.1
plastic type (P-FBGA)
plastic-type classification is assigned to packages which consist of resin substrate as interposer material (e.g. glass-epoxy, polyimid)

3.4.2
ceramic type (C-FBGA)
ceramic-type classification is assigned to packages which consist of ceramic substrate as interposer material

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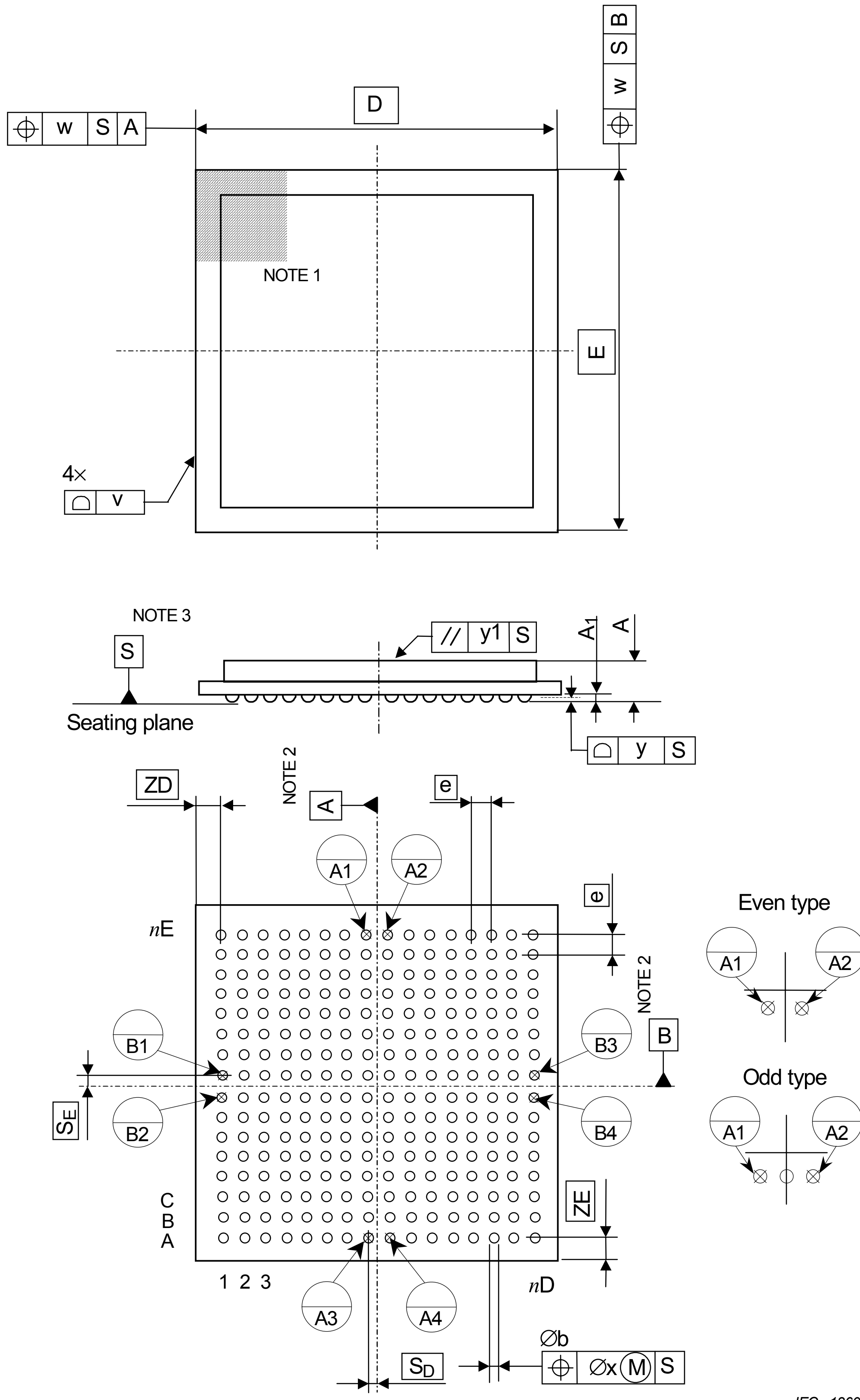

NOTE 1 Zone of a visible index on the top surface.

NOTE 2 Datum A and B are the axes defined by the terminal positions indicated with datum targets.

NOTE 3 Primary datum S and seating plane to be defined by the method of least squares of spherical crowns of land.

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Table 1 – Group 1: Dimensions appropriate to mounting and interchangeability

Ref.	Limits to be observed			Recommended values for the dimensions mm	Note
	Min.	Nom.	Max.		
n		X			1, 2
*n*D *n*E		X X			
A			X	A max. = 1,20, 1,70, 2,00	Includes heat slug Includes package warpage and tilt
A1	X	X	X	Min. Nom. Max. at e = 0,80 0,35 0,40 0,45 at e = 0,65 0,28 0,33 0,38 at e = 0,50 0,20 0,25 0,30 at e = 0,40 0,15 0,20 0,25	
øb	X	X	X	Min. Nom. Max. at e = 0,80 0,45 0,50 0,55 at e = 0,65 0,35 0,40 0,45 at e = 0,50 0,25 0,30 0,35 at e = 0,40 0,20 0,25 0,30	
D E		X X		At flanged type D = 4,0, 5,0, 6,0, 7,0, 8,0, 9,0, 10,0, 11,0, 12,0, 13,0, 14,0, 15,0, 16,0, 17,0, 18,0, 19,0, 20,0, 21,0 at type of real chip size D = from 3,1 to 21,0 at flanged type E = 4,0, 5,0, 6,0, 7,0, 8,0, 9,0, 10,0, 11,0, 12,0, 13,0, 14,0, 15,0, 16,0, 17,0, 18,0, 19,0, 20,0, 21,0 at type of real chip size E = from 3,1 to 21,0	Dimension range shows nominal value Dimension range shows nominal value
e		X		e = 0,80, 0,65, 0,50, 0,40	
v			X	v = 0,15	Includes burrs
w			X	at e = 0,80 w = 0,20 at e = 0,65 w = 0,20 at e = 0,50 w = 0,20 at e = 0,40 w = 0,15	
x			X	at e = 0,80 x = 0,08 at e = 0,65 x = 0,08 at e = 0,50 x = 0,05 at e = 0,40 x = 0,05	

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Table 1 – *(continued)*

Ref.	Limits to be observed			Recommended values for the dimensions mm	Note
	Min.	Nom.	Max.		
y			X	at e = 0,80 y = 0,10 at e = 0,65 y = 0,10 at e = 0,50 y = 0,08 at e = 0,40 y = 0,08	
y1			X	y1 = 0,2	

NOTE 1 The values stipulated by the mathematical expression must be applied to the individual overall dimensional standards.

NOTE 2 Symbol *n* refers to the total number of terminal positions.

Table 2 – Group 2: Dimensions appropriate to mounting and gauging

Ref.	Limits to be observed			Recommended values for the dimensions mm	Note
	Min.	Nom.	Max.		
øb2			X	at e = 0,80 b2 = 0,63 at e = 0,65 b2 = 0,53 at e = 0,50 b2 = 0,40 at e = 0,40 b2 = 0,35	b2 = bmax. + x
e		X		e = 0,80, 0,65, 0,50, 0,40	
eD		X		eD = e × (*n*D – 1)	
eE		X		eD = e × (*n*E – 1)	

Table 3 – Group 3: Dimensions appropriate to automated handling

Ref.	Limits to be observed			Recommended values for the dimensions mm	Note
	Min.	Nom.	Max.		
A			X	A max. = 1,20, 1,70, 2,00	Includes heat slug Includes package warpage and tilt
D E		X X		D/E = 4,0, 5,0, 6,0, 7,0, 8,0, 9,0, 10,0, 11,0, 12,0, 13,0, 14,0, 15,0, 16,0, 17,0, 18,0, 19,0, 20,0, 21,0	
y1			X	y1 = 0,2	

Table 4 – Group 4: Dimensions for information only

Ref.	Limits to be observed			Recommended values for the dimensions mm	Note
	Min.	Nom.	Max.		
ZD		X		ZD = (D – e × (*n*D – 1)) / 2	
ZE		X		ZE = (E – e × (*n*E – 1)) / 2	

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Table 5 – Dimensions and ball matrix

e = 0,80	**Maximum matrix family**					**Maximum matrix – 1 row family**				
E × D	***n*D**	***n*E**	***n***	ZD	ZE	***n*D**	***n*E**	***n***	ZD	ZE
4 × 4	4	4	16	0,80	0,80	3	3	9	1,20	1,20
5 × 5	5	5	25	0,90	0,90	4	4	16	1,30	1,30
6 × 6	7	7	49	0,60	0,60	6	6	36	1,00	1,00
7 × 7	8	8	64	0,70	0,70	7	7	49	1,10	1,10
8 × 8	9	9	81	0,80	0,80	8	8	64	1,20	1,20
9 × 9	10	10	100	0,90	0,90	9	9	81	1,30	1,30
10 × 10	12	12	144	0,60	0,60	11	11	121	1,00	1,00
11 × 11	13	13	169	0,70	0,70	12	12	144	1,10	1,10
12 × 12	14	14	196	0,80	0,80	13	13	169	1,20	1,20
13 × 13	15	15	225	0,90	0,90	14	14	196	1,30	1,30
14 × 14	17	17	289	0,60	0,60	16	16	256	1,00	1,00
15 × 15	18	18	324	0,70	0,70	17	17	289	1,10	1,10
16 × 16	19	19	361	0,80	0,80	18	18	324	1,20	1,20
17 × 17	20	20	400	0,90	0,90	19	19	361	1,30	1,30
18 × 18	22	22	484	0,60	0,60	21	21	441	1,00	1,00
19 × 19	23	23	529	0,70	0,70	22	22	484	1,10	1,10
20 × 20	24	24	576	0,80	0,80	23	23	529	1,20	1,20
21 × 21	25	25	625	0,90	0,90	24	24	576	1,30	1,30
e = 0,65	**Maximum matrix family**					**Maximum matrix – 1 row family**				
E × D	***n*D**	***n*E**	***n***	ZD	ZE	***n*D**	***n*E**	***n***	ZD	ZE
4 × 4	5	5	25	0,700	0,700	4	4	16	1,025	1,025
5 × 5	7	7	49	0,550	0,550	6	6	36	0,875	0,875
6 × 6	8	8	64	0,725	0,725	7	7	49	1,050	1,050
7 × 7	10	10	100	0,575	0,575	9	9	81	0,900	0,900
8 × 8	11	11	121	0,750	0,750	10	10	100	1,075	1,075
9 × 9	13	13	169	0,600	0,600	12	12	144	0,925	0,925
10 × 10	14	14	196	0,775	0,775	13	13	169	1,100	1,100
11 × 11	16	16	256	0,625	0,625	15	15	225	0,950	0,950
12 × 12	17	17	289	0,800	0,800	16	16	256	1,125	1,125
13 × 13	19	19	361	0,650	0,650	18	18	324	0,975	0,975
14 × 14	20	20	400	0,825	0,825	19	19	361	1,150	1,150
15 × 15	22	22	484	0,675	0,675	21	21	441	1,000	1,000
16 × 16	23	23	529	0,850	0,850	22	22	484	1,175	1,175
17 × 17	25	25	625	0,700	0,700	24	24	576	1,025	1,025
18 × 18	27	27	729	0,550	0,550	26	26	676	0,875	0,875
19 × 19	28	28	784	0,725	0,725	27	27	729	1,050	1,050
20 × 20	30	30	900	0,575	0,575	29	29	841	0,900	0,900
21 × 21	31	31	961	0,750	0,750	30	30	900	1,075	1,075

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e = 0,50	**Maximum matrix family**					**Maximum matrix – 1 row family**				
E × D	***n*D**	***n*E**	***n***	**ZD**	**ZE**	***n*D**	***n*E**	***n***	**ZD**	**ZE**
4 × 4	7	7	49	0,50	0,50	6	6	36	0,75	0,75
5 × 5	9	9	81	0,50	0,50	8	8	64	0,75	0,75
6 × 6	11	11	121	0,50	0,50	10	10	100	0,75	0,75
7 × 7	13	13	169	0,50	0,50	12	12	144	0,75	0,75
8 × 8	15	15	225	0,50	0,50	14	14	196	0,75	0,75
9 × 9	17	17	289	0,50	0,50	16	16	256	0,75	0,75
10 × 10	19	19	361	0,50	0,50	18	18	324	0,75	0,75
11 × 11	21	21	441	0,50	0,50	20	20	400	0,75	0,75
12 × 12	23	23	529	0,50	0,50	22	22	484	0,75	0,75
13 × 13	25	25	625	0,50	0,50	24	24	576	0,75	0,75
14 × 14	27	27	729	0,50	0,50	26	26	676	0,75	0,75
15 × 15	29	29	841	0,50	0,50	28	28	784	0,75	0,75
16 × 16	31	31	961	0,50	0,50	30	30	900	0,75	0,75
17 × 17	33	33	1089	0,50	0,50	32	32	1024	0,75	0,75
18 × 18	35	35	1225	0,50	0,50	34	34	1156	0,75	0,75
19 × 19	37	37	1369	0,50	0,50	36	36	1296	0,75	0,75
20 × 20	39	39	1521	0,50	0,50	38	38	1444	0,75	0,75
21 × 21	41	41	1681	0,50	0,50	40	40	1600	0,75	0,75
e = 0,40	**Maximum matrix family**					**Maximum matrix – 1 row family**				
E × D	***n*D**	***n*E**	***n***	**ZD**	**ZE**	***n*D**	***n*E**	***n***	**ZD**	**ZE**
4 × 4	8	8	64	0,60	0,60	7	7	49	0,80	0,80
5 × 5	11	11	121	0,50	0,50	10	10	100	0,70	0,70
6 × 6	13	13	169	0,60	0,60	12	12	144	0,80	0,80
7 × 7	16	16	256	0,50	0,50	15	15	225	0,70	0,70
8 × 8	18	18	324	0,60	0,60	17	17	289	0,80	0,80
9 × 9	21	21	441	0,50	0,50	20	20	400	0,70	0,70
10 × 10	23	23	529	0,60	0,60	22	22	484	0,80	0,80
11 × 11	26	26	676	0,50	0,50	25	25	625	0,70	0,70
12 × 12	28	28	784	0,60	0,60	27	27	729	0,80	0,80
13 × 13	31	31	961	0,50	0,50	30	30	900	0,70	0,70
14 × 14	33	33	1089	0,60	0,60	32	32	1024	0,80	0,80
15 × 15	36	36	1296	0,50	0,50	35	35	1225	0,70	0,70
16 × 16	38	38	1444	0,60	0,60	37	37	1369	0,80	0,80
17 × 17	41	41	1681	0,50	0,50	40	40	1600	0,70	0,70
18 × 18	43	43	1849	0,60	0,60	42	42	1764	0,80	0,80
19 × 19	46	46	2116	0,50	0,50	45	45	2025	0,70	0,70
20 × 20	48	48	2304	0,60	0,60	47	47	2209	0,80	0,80
21 × 21	51	51	2601	0,50	0,50	50	50	2500	0,70	0,70

NOTE The relations among package body size, maximum number of terminals, maximum number of matrices, terminal pitch, and package overhang are shown in this table. (Depopulated matrices and numbers of terminals are also involved.)

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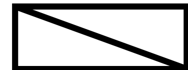

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