



BSI Standards Publication

Mechanical standardization of semiconductor devices

Part 6-13: Design guideline of open-top-type sockets for Fine-pitch Ball Grid Array (FBGA) and Fine-pitch Land Grid Array (FLGA)

National foreword

This British Standard is the UK implementation of EN 60191-6-13:2016. It is identical to IEC 60191-6-13:2016. It supersedes BS EN 60191-6-13:2007 which is withdrawn.

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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English Version

**Mechanical standardization of semiconductor devices -
Part 6-13: Design guideline of open-top-type sockets for Fine-
pitch Ball Grid Array (FBGA) and Fine-pitch Land Grid Array
(FLGA)
(IEC 60191-6-13:2016)**

Normalisation mécanique des dispositifs à semiconducteurs
- Partie 6-13: Guide de conception pour les supports sans
couvercle pour les boîtiers matriciels à billes et à pas fins
(FBGA) et les boîtiers matriciels à zone de contact plate et
à pas fins (FLGA)
(IEC 60191-6-13:2016)

Mechanische Normung von Halbleiterbauelementen -
Teil 6-13: Konstruktionsleitfaden für Open-top-Fassungen
für Feinraster-Ball-Grid-Array und Feinraster-Land-Grid-
Array (FBGA/FLGA)
(IEC 60191-6-13:2016)

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European Committee for Electrotechnical Standardization
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Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

European foreword

The text of document 47D/878/FDIS, future edition 2 of IEC 60191-6-13, prepared by SC 47D "Semiconductor devices packaging" of IEC/TC 47 "Semiconductor devices" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 60191-6-13:2016.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2017-08-01
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2019-11-01

This document supersedes EN 60191-6-13:2007.

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The text of the International Standard IEC 60191-6-13:2016 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 documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE 1 When an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60191-2	-	Mechanical standardization of semiconductor devices - Part 2: Dimensions	-	-
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	-

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

MECHANICAL STANDARDIZATION OF SEMICONDUCTOR DEVICES –**Part 6-13: Design guideline of open-top-type sockets for
Fine-pitch Ball Grid Array (FBGA) and Fine-pitch Land Grid Array (FLGA)**

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 60191-6-13 has been prepared by subcommittee 47D: Semiconductor devices packaging, of IEC technical committee 47: Semiconductor devices.

This second edition cancels and replaces the first edition published in 2007. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) BGA package nominal length and width have been newly expanded to 43 mm and 43 mm, respectively. Accordingly, six socket sizes have been added to the socket group numbers 1, 2 and 3, and twenty-two socket sizes have been added to the socket group number 4.

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

FDIS	Report on voting
47D/878/FDIS	47D/885/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 2.

A list of all the parts in the IEC 60191 series, under the general title *Mechanical standardization of semiconductor devices*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

INTRODUCTION

This part of IEC 60191 aims to standardize the outer dimensions of the sockets for FBGA and FLGA, where leading-edge developments are aggressively innovated, to establish their compatibility with the needs of the surface-mount industry that is globally expanding due to enhanced functions and performances of electrical devices.

For defining each dimension, the target was to indicate the standard design value which has the concept of the design centre as much as possible, aiming to enhance the function as a standardization index.

MECHANICAL STANDARDIZATION OF SEMICONDUCTOR DEVICES –

Part 6-13: Design guideline of open-top-type sockets for Fine-pitch Ball Grid Array (FBGA) and Fine-pitch Land Grid Array (FLGA)

1 Scope

This part of IEC 60191 specifies a design guideline of open-top-type semiconductor sockets for Fine-pitch Ball Grid Array (FBGA) and Fine-pitch Land Grid Array (FLGA). In particular, this part of IEC 60191 establishes the outline drawings and dimensions of the open-top-type test and burn-in sockets applied to FBGA and FLGA.

2 Normative references

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

IEC 60191-2, *Mechanical standardization of semiconductor devices – Part 2: Dimensions*

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

3 Terms and definitions

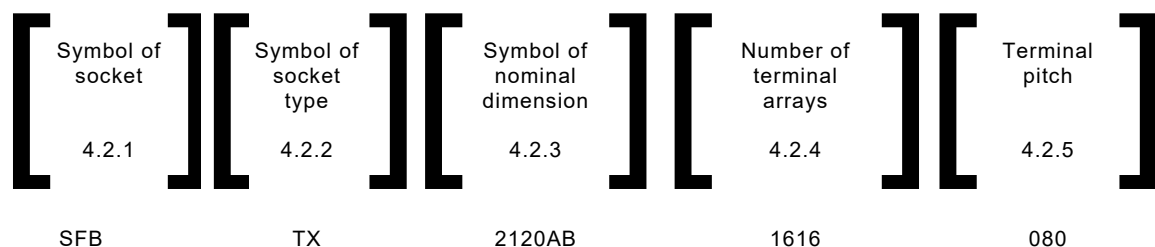
For the purposes of this document, the terms and definitions given in IEC 60191-6 apply.

4 Socket code

4.1 Construction of socket code

A socket code is constructed as follows.

EXAMPLE



4.2 Symbols

4.2.1 Semiconductor sockets symbol

The symbol for socket shall be expressed in three characters. The first character, “S”, refers to socket and the rest to the package code. FBGA shall be expressed as “FB”, FLGA shall be expressed as “FL”.

4.2.2 Socket type symbol

The symbol for socket type shall be expressed in two characters. The first character “T” refers to open-top type and the rest remains option “X”. Clamshell type socket is referred to as “C”.

4.2.3 Socket nominal dimension symbol

The symbol for nominal dimension shall be expressed in six characters, which consist of four numeric characters and two alphabetical characters. The first four numeric characters comply with nominal dimension $E \times D$, which refers to the applicable maximum width and length of FBGA/FLGA package.

The last two alphabetical characters refer to socket base matrix size either an even or an odd.

It refers to an odd contact row by “A” and an even contact row by “B” in the following order: socket width direction and then socket length direction.

Namely, it refers to “AA” in case row number is an odd number both for width and length direction, “BB” in case row number is an even number both for width and length direction, “AB” in case row number is an odd number for width direction and an even number for length direction, and “BA” in case row number is an even number for width direction and an odd number for length direction.

4.2.4 Number of terminal arrays

The symbol for the number of terminal arrays shall be expressed by four numeric characters applying applicable package matrix size in the E direction and the D direction.

4.2.5 Terminal pitch

The symbol for terminal pitch of applicable package shall be expressed in three numeric characters. The decimal sign is omitted.

5 Terminal number

The terminal number is provided in the following manner when the socket is viewed with the angle from topside. The horizontal row nearest to the index corner when the index is placed on the left topside is referred to as A.

As the row moves down, the number changes in the order of B, C, AA, AB.

The terminal number one (1) is defined for the vertical row nearest to the index corner. As the row moves rightward, the number is increased to two (2), three (3), etc. The terminal number is combined with these letters and numbers and expressed as A1 or B1. Six (6) alphabetical letters, “I”, “O”, “Q”, “S”, “X” and “Z”, shall not be used as symbols for a horizontal row.

6 Socket nominal dimension

The applicable package length and width which extend from 1,50 mm to 43,0 mm by 0,50 mm increments are divided into ten package groups. The socket nominal dimension is defined by the largest value of the package length or width in each socket group.

In consideration of a specific need for minimum socket outline size, the socket nominal dimension with 1,0 mm increments can be specified as an exception. The package length and width of 5,00 mm or less are unified in one socket nominal dimension.

7 Socket length and width

Socket length and width are categorized into four groups, from group one (1) to group four (4), to cover the difference of its terminal counts and mechanism (see Table 1).

In socket group one (1), two (2) and three (3), only the square socket outline is allowed. Socket length and width are determined by the nominal dimension value plus 36,0 mm, 24,0 mm and 12,0 mm, respectively.

In socket group four (4), square and rectangular socket outlines are allowed. Socket length and width are determined by the nominal dimension value plus 8,0 mm independently in each side.

Socket group one (1) is intended for a high terminal counts package or a FLGA socket which is composed of a complicated socket structure. Socket groups two (2) and three (3) are for the socket currently available. Socket group four (4) is for the socket which is required to have the smallest possible outline, such as for Memory IC.

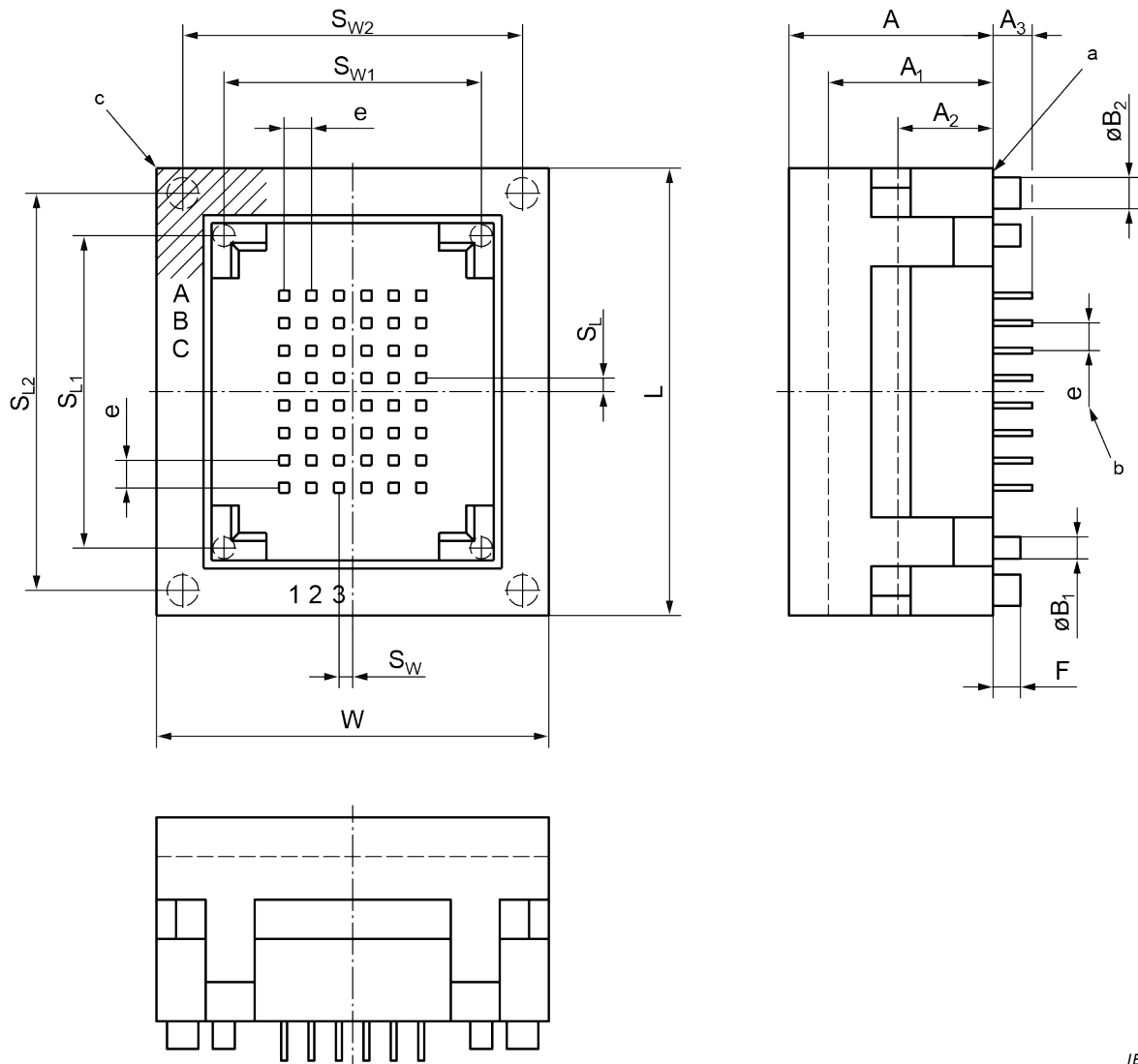
Table 1 – Overview of the different socket groups

Socket group number	Allowed socket outline	Value added to the socket nominal dimension to determine the socket length and width
Group 1	Square	36,0 mm
Group 2	Square	24,0 mm
Group 3	Square	12,0 mm
Group 4	Square or rectangular	8,0 mm

8 Reference symbols and schematics

8.1 Outline drawings

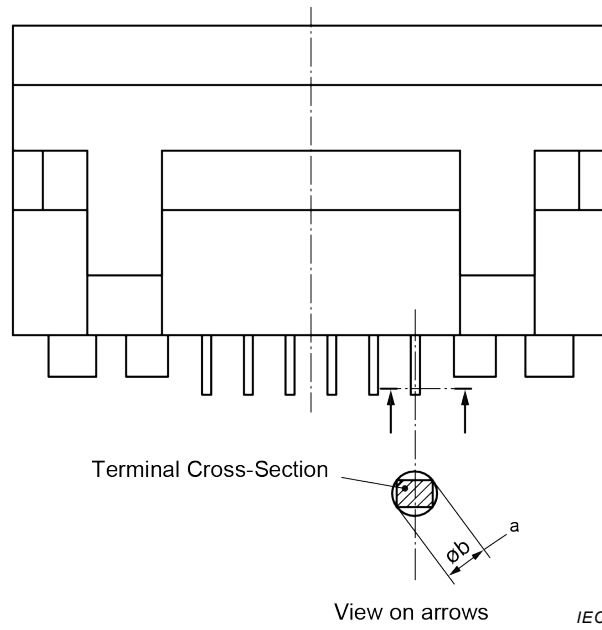
Outline drawings of the socket and the terminal diameter are shown in Figure 1 and Figure 2, respectively. The applicable package outline is presented in Figure 3. The overall dimensions are given in Table 2 and socket dimensions in Table 3 and Table 4.



IEC

- a Indicates the mounting plane. The mounting plane is defined by the plane where the socket contacts its mounting surface.
- b Stipulates the true geometric position of the terminals.
- c Indicates positional tolerance of the index mark. Index mark should be completely within the shaded area.

Figure 1 – Outline drawings of the socket



^a Terminal diameter is defined as the maximum diameter of a circle circumscribed about a horizontal cross-section of the terminal from the mounting plane.

Figure 2 – Outline drawings for the definition of terminal diameter

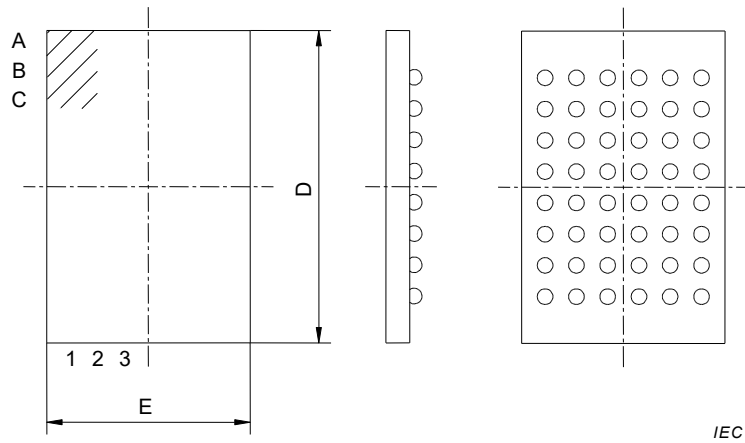
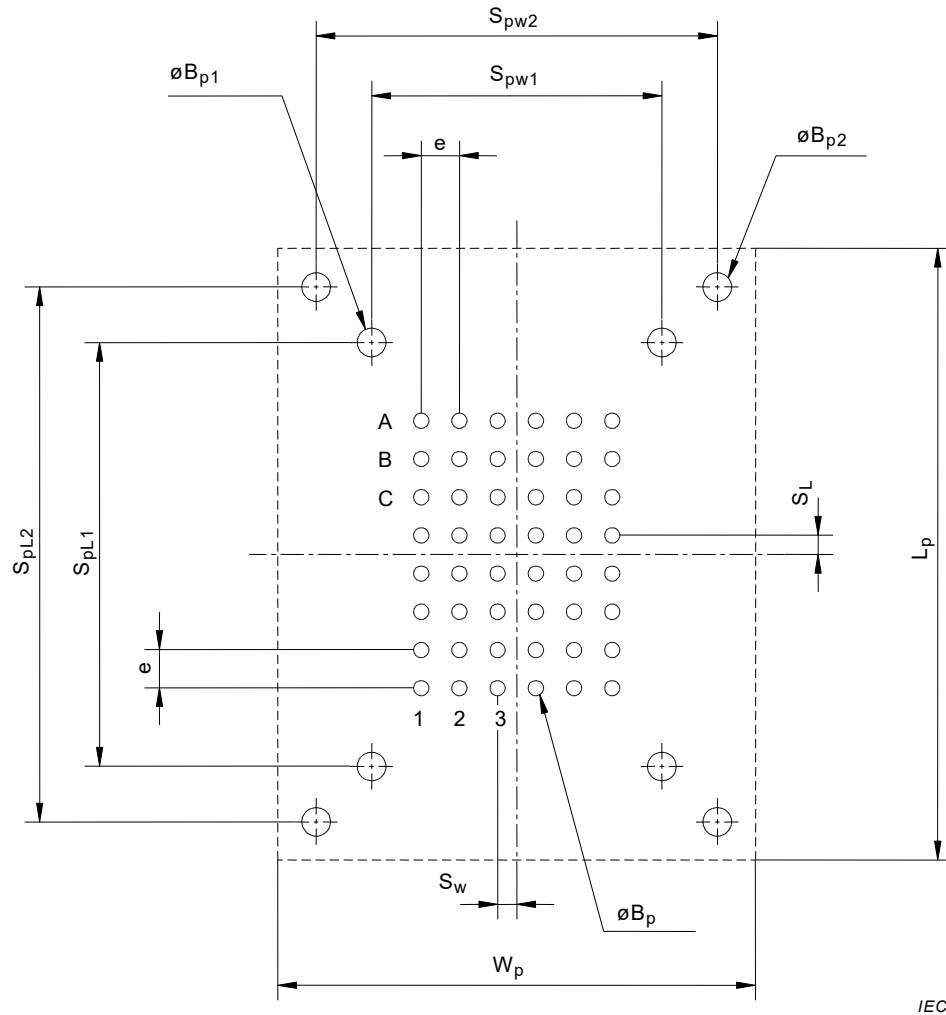


Figure 3 – Applicable package outline

8.2 Reference symbols and schematics of recommended socket mounting pattern on printed circuit board

The drawing of the recommended socket mounting pattern on a printed circuit board is shown in Figure 4 for reference in designing printed circuit board. See Table 5 for recommended dimensions.



NOTE The subscript "p" indicates projected dimension. For example, L_p is recognized automatically as the projected dimension "L" to the base plane.

Figure 4 – Socket mounting pattern

8.3 Overall dimensions

Overall socket dimensions are shown in Table 2. Every reference symbol is indicated in Figure 1 and Figure 2.

Table 2 – Overall dimensions (1 of 2)

Name	Reference symbol	Stipulations mm	Recommended value mm	Supplement										
Socket nominal dimension	$E \times D$	This value is based on the nominal dimensions of FBGA and FLGA compatible with the socket.	–	Table 3, Table 4										
Socket length	L	Socket length: L nominal defined. L = W (group 4 is exception).	–	Table 3, Table 4										
Socket width	W	Socket width: W nominal defined W = L (group 4 is exception).	–	Table 3, Table 4										
Socket height	A	A max = 22,0	–											
End stroke height	A_1	A_1 max = 16,0	14,0 13,5											
Seating plane height	A_2	A_2 max = 14,0	9,7 8,2											
Terminal pitch	e	e = 0,80 e = 0,65 e = 0,50 e = 0,40	–											
Terminal length	A_3	A_3 = 0,7 to 6,3	–											
Terminal diameter	$\varnothing b$	Maximum dimension of the terminal cross-section <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>e</th> <th>$\varnothing b$ max</th> </tr> </thead> <tbody> <tr> <td>0,80</td> <td>0,28</td> </tr> <tr> <td>0,65</td> <td>0,21</td> </tr> <tr> <td>0,50</td> <td>0,20</td> </tr> <tr> <td>0,40</td> <td>0,19</td> </tr> </tbody> </table>	e	$\varnothing b$ max	0,80	0,28	0,65	0,21	0,50	0,20	0,40	0,19	–	
e	$\varnothing b$ max													
0,80	0,28													
0,65	0,21													
0,50	0,20													
0,40	0,19													
Number of alignment pins (inside)	n_1	n_1 = 0, 2, 3, 4 (one to be selected)	–											
Number of alignment pins (outside)	n_2	n_2 = 0, 2, 3, 4 (one to be selected)	–											
Alignment pin length	F	F_{\min} = 1,0	–											
Distance between alignment pins in L-direction (inside)	S_{L1}	Group 1, 2, 3: Socket nominal dimension plus 5,0 Group 4: No pins exist	–	Table 3, Table 4										
Distance between alignment pins in W-direction (inside)	S_{W1}	Group 1, 2, 3: Socket nominal dimension plus 5,0 Group 4: No pins exist	–	Table 3, Table 4										

Table 2 (2 of 2)

Name	Reference symbol	Stipulations mm	Recommended value mm	Supplement
Distance between alignment pins in L-direction (outside)	S_{L2}	Group 1: Socket nominal dimension plus 30,0 Group 2: Socket nominal dimension plus 18,0 Group 3: Socket nominal dimension plus 9,0 Group 4: Socket nominal dimension plus 5,0	–	Table 3, Table 4
Distance between alignment pins in W-direction (outside)	S_{W2}	Group 1: Socket nominal dimension plus 30,0 Group 2: Socket nominal dimension plus 18,0 Group 3: Socket nominal dimension plus 9,0 Group 4: Socket nominal dimension plus 5,0	–	Table 3, Table 4
Alignment pin diameter (inside)	$\varnothing B_1$	$\varnothing B_1 \text{ max} = 1,5$	–	
Alignment pin diameter (outside)	$\varnothing B_2$	Group 1 and 2: $\varnothing B_2 \text{ max} = 2,0$ Group 3 and 4: $\varnothing B_2 \text{ max} = 1,5$	–	Table 3, Table 4
Centre terminal position in L-direction	S_L	When M_L is an odd number, $S_L = 0$ When M_L is an even number, $S_L = e/2$	–	
Centre terminal position in W-direction	S_W	When M_W is an odd number, $S_W = 0$ When M_W is an even number, $S_W = e/2$	–	
Number of terminals	N	Number of terminals and matrix sizes shall be equal to those of the applicable package specified in IEC 60191-2. Matrix layout with partially thinning-out terminal is accepted.	–	
Matrix size in L-direction	M_L			
Matrix size in W-direction	M_W			
Package setting direction		Direction of shifting for package insertion. This is to provide the direction of package shifting in order to ensure uniformity when fitting a package to a socket that has a larger terminal matrix than the package, when that package has an odd number of rows less than the socket. The direction of shifting shall be upper left.	–	

Table 3 – Socket dimensions for Group 1, 2 and 3 (square socket) (1 of 2)

Longer side of package length or width mm	Socket nominal dimension E × D mm	Socket length and width mm		
		Group 1	Group 2	Group 3
		L = W	L = W	L = W
1,50 2,00 2,50 3,00 3,50 4,00 4,50 5,00 5,50 6,00 6,50 7,00 7,50 8,00 8,50 9,00	9 × 9	45,0	33,0	21,0
9,50 10,00 10,50 11,00 11,50 12,00 12,50 13,00	13 × 13	49,0	37,0	25,0
13,50 14,00 14,50 15,00 15,50 16,00 16,50 17,00	17 × 17	53,0	41,0	29,0
17,50 18,00 18,50 19,00 19,50 20,00 20,50 21,00	21 × 21	57,0	45,0	33,0

Table 3 (2 of 2)

Longer side of package length or width mm	Socket nominal dimension E × D mm	Socket length and width mm		
		Group 1	Group 1	Group 1
		L = W	L = W	L = W
21,50 22,00 22,50 23,00 23,50 24,00 24,50 25,00	25 × 25	61,0	49,0	37,0
25,50 26,00 26,50 27,00 27,50 28,00 28,50 29,00	29 × 29	65,0	53,0	41,0
29,50 30,00 30,50 31,00 31,50 32,00 32,50 33,00	33 × 33	69,0	57,0	45,0
33,50 34,00 34,50 35,00 35,50 36,00 36,50 37,00	37 × 37	73,0	61,0	49,0
37,50 38,00 38,50 39,00 39,50 40,00 40,50 41,00	41 × 41	77,0	65,0	53,0
41,50 42,00 42,50 43,00	43 × 43	81,0	69,0	57,0

Table 4 – Socket dimension for Group 4 (square or rectangular socket)

Package length or width mm	Socket nominal dimension E × D mm	Socket length and width mm
		Group 4
		L = W
1,50	5 × 5	13,0
2,00		
2,50		
3,00		
3,50		
4,00		
4,50		
5,00		
5,50		
6,00	7 × 7	15,0
6,50		
7,00		
7,50	8 × 8	16,0
8,00		
8,50		
9,00	9 × 9	17,0
9,50		
10,00		
10,50	10 × 10	18,0
11,00		
11,50		
12,00	12 × 12	20,0
12,50		
13,00		
13,50	13 × 13	21,0
14,00		
14,50		
15,00	14 × 14	22,0
15,50		
16,00		
16,50	15 × 15	23,0
17,00		
17,50		
18,00	16 × 16	24,0
18,50		
19,00		
19,50	17 × 17	25,0
20,00		
20,50		
21,00	18 × 18	26,0
21,50		
22,00		
22,00	19 × 19	27,0
	20 × 20	28,0
	21 × 21	29,0
	22 × 22	30,0

Package length or width mm	Socket nominal dimension E × D mm	Socket length and width mm
		Group 4
		L = W
22,50	23 × 23	31,0
23,00		
23,50		
24,00	24 × 24	32,0
24,50		
25,00		
25,50	25 × 25	33,0
26,00		
26,50		
27,00	26 × 26	34,0
27,50		
28,00		
28,50	27 × 27	35,0
29,00		
29,50		
30,00	28 × 28	36,0
30,50		
31,00		
31,50	29 × 29	37,0
32,00		
32,50		
33,00	30 × 30	38,0
33,50		
34,00		
34,50	31 × 31	39,0
35,00		
35,50		
36,00	32 × 32	40,0
36,50		
37,00		
37,50	33 × 33	41,0
38,00		
38,50		
39,00	34 × 34	42,0
39,50		
40,00		
40,50	35 × 35	43,0
41,00		
41,50		
42,00	36 × 36	44,0
42,50		
43,00		
43,00	37 × 37	45,0
	38 × 38	46,0
	39 × 39	47,0
	40 × 40	48,0
	41 × 41	49,0
	42 × 42	50,0
	43 × 43	51,0

8.4 Recommended dimensions of socket mounting pattern on printed circuit board

Dimensions of socket mounting pattern on printed circuit board are shown in Table 5. Every reference symbol is indicated in Figure 1 and Figure 4.

Table 5 – Socket mounting dimensions

Name	Reference symbol	Stipulations mm	Recommended value mm	Supplement										
Socket mounting length	L_p	Socket mounting length: L_p max $L_p = L + 0,8$	–											
Socket mounting width	W_p	Socket mounting width: W_p max $W_p = W + 0,8$	–											
Terminal length	A_3	$A_3 = 0,7$ to $6,3$	–											
Through hole diameter	$\varnothing b_p$	Through hole diameter: $\varnothing b_p$ min <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>e</th> <th>$\varnothing b_p$ min</th> </tr> </thead> <tbody> <tr> <td>0,80</td> <td>0,30</td> </tr> <tr> <td>0,65</td> <td>0,23</td> </tr> <tr> <td>0,50</td> <td>0,22</td> </tr> <tr> <td>0,40</td> <td>0,20</td> </tr> </tbody> </table>	e	$\varnothing b_p$ min	0,80	0,30	0,65	0,23	0,50	0,22	0,40	0,20	–	
e	$\varnothing b_p$ min													
0,80	0,30													
0,65	0,23													
0,50	0,22													
0,40	0,20													
Distance between holes for alignment pin in L-direction (inside)	S_{PL1}	Group 1, 2, 3: Socket nominal dimension plus 5,0 Group 4: No holes exist	–	Table 3, Table 4										
Distance between holes for alignment pin in W-direction (inside)	S_{PW1}	Group 1, 2, 3: Socket nominal dimension plus 5,0 Group 4: No holes exist	–	Table 3, Table 4										
Distance between holes for alignment pin in L-direction (outside)	S_{PL2}	Group 1: Socket nominal dimension plus 30,0 Group 2: Socket nominal dimension plus 18,0 Group 3: Socket nominal dimension plus 9,0 Group 4: Socket nominal dimension plus 5,0	–	Table 3, Table 4										
Distance between holes for alignment pin in W-direction (outside)	S_{PW2}	Group 1: Socket nominal dimension plus 30,0 Group 2: Socket nominal dimension plus 18,0 Group 3: Socket nominal dimension plus 9,0 Group 4: Socket nominal dimension plus 5,0	–	Table 3, Table 4										
Diameter of alignment pin hole (inside)	$\varnothing B_{p1}$	$\varnothing B_{p1min} = 1,6$	–											
Diameter of alignment pin hole (outside)	$\varnothing B_{p2}$	Group 1 and 2: $\varnothing B_{p2min} = 2,1$ Group 3 and 4: $\varnothing B_{p2min} = 1,6$	–											

9 Individual outline drawing standard registration

To propose the registration of an individual standard for a new outline, any section marked with “X” as in Table 6 below shall be filled with dimensions or letters.

Table 6 – Registration table

Reference number	XXX-XX-XXXXX-XXXX-XXX-XX		
Socket code	XXX-XX-XXXXX-XXXX-XXX-XX		
Reference symbol	Minimum	Nominal	Maximum
L		X	
W		X	
A			X
A ₁			X
A ₂			X
e		X	
A ₃	X	X	X
Øb			X
n ₁	X		X
n ₂	X		X
F	X		
S _{L1}		X	
S _{W1}		X	
S _{L2}		X	
S _{W2}		X	
ØB ₁			X
ØB ₂			X
S _L		X	
S _W		X	
N		X	
M _L		X	
M _W		X	

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