BS EN 60191-6:2009

BSI Standards Publication

Mechanical standardization of semiconductor devices

Part 6: General rules for the preparation of outline drawings of surface mounted semiconductor device packages

National foreword

This British Standard is the UK implementation of EN 60191-6:2009. It is identical to IEC 60191-6:2009. It supersedes BS EN 60191-6:2004 which is withdrawn.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.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 30 April 2010.

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NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 60191-6

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ICS 31.080.01

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English version

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

(IEC 60191-6:2009)

Normalisation mécanique des dispositifs à semi-conducteurs - Partie 6: Règles générales pour la préparation des dessins d'encombrement des boîtiers pour dispositifs à semi-conducteurs pour montage en surface (CEI 60191-6:2009)

Mechanische Normung von Halbleiterbauelementen - Teil 6: Allgemeine Regeln für die Erstellung von Gehäusezeichnungen von SMD-Halbleitergehäusen (IEC 60191-6:2009)

This European Standard was approved by CENELEC on 2009-12-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

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CENELEC

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

Central Secretariat: Avenue Marnix 17, B - 1000 Brussels

Ref. No. EN 60191-6:2009 E

Foreword

The text of document 47D/736/CDV, future edition 3 of IEC 60191-6, 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 on 2009-12-01.

This European Standard supersedes EN 60191-6:2004.

EN 60191-6:2009 includes the following significant changes with respect to EN 60191-6:2004:

- scope is modified to cover all surface-mounted devices discrete semiconductors with lead count of greater or equal to 8;
- editorial modifications on several pages; and
- technical revision to ball grid array package (BGA) especially its geometrical drawing format. (two types of BGA would unify as one type as a result of revising drawing format.)

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)	2010-09-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2012-12-01

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 60191-6:2009 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 60191-3	NOTE Harmonized as EN 60191-3:1999 (not modified).
ISO 2692	NOTE Harmonized as EN ISO 2692:2006 (not modified).

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.

Publication	Year	Title	EN/HD	Year
IEC 60191-1	2007	Mechanical standardization of semiconductor devices - Part 1: General rules for the preparation of outline drawings of discrete devices	EN 60191-1	2007
IEC 60191-4 A1 A2	1999 2001 2002	Mechanical standardization of semiconductor devices - Part 4: Coding system and classification into forms of package outlines for semiconductor device packages	EN 60191-4 A1 A2	1999 2002 2002
ISO 1101	2004	Geometrical Product Specifications (GPS) - Geometrical tolerancing - Tolerances of form, orientation, location and run-out	EN ISO 1101	2005

CONTENTS

MECHANICAL STANDARDIZATION OF SEMICONDUCTOR DEVICES –

Part 6: General rules for the preparation of outline drawings of surface mounted semiconductor device packages

1 Scope

This part of IEC 60191 gives general rules for the preparation of outline drawings of surface-mounted semiconductor devices. It supplements IEC 60191-1 and IEC 60191-3. It covers all surface-mounted devices discrete semiconductors with lead count of greater or equal to 8, as well as integrated circuits classified as form E in Clause 3 of IEC 60191-4.

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 (including any amendments) applies.

IEC 60191-1:2007, *Mechanical standardization of semiconductor devices – Part 1: General rules for the preparation of outline drawings of discrete devices*

IEC 60191-4:2002, *Mechanical standardization of semiconductor devices – Part 4: Coding system and classification into forms of package outlines for semiconductor device packages*

ISO 1101:2004 *Geometrical Product Specifications (GPS) – Geometrical tolerancing – Tolerances of form, orientation, location and run-out*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
seating plane
plane which designates the plane of contact of the package, including any stand-off, with the surface on which it will be mounted

NOTE This plane is often used as the reference plane.

3.2
reference plane
plane parallel to the seating plane at a distance A3 above seating plane (does not apply to leadless package)

NOTE 1 The distance A3 is known as the reference plane distance. It determines the terminal projection zone (see Figure 1).

NOTE 2 This distance is a theoretical dimension which is not related to any feature of the package. Its value is chosen for each package so the length of terminal projection zone L_p is a good approximation of the terminal length used for mounting, e.g. the length of the part of the terminal that is soldered to the substrate.

3.3
terminal position area
maximum area on the seating plane within which the terminal projection zone is located, taking into account the maximum values of L_p and b_p

NOTE 1 The surface of the terminal position area is equal to $l_1 \times b_3$ with, generally

$$l_1 = L_p \text{ max.} + (\text{HDmax.} - \text{HDmin.})/2$$

$$= L_p \text{ max.} + (\text{HEmax.} - \text{HEmin.})/2$$

and $b_3 = b_p \text{ max.} + x$

NOTE 2 Checking can be carried out by means of an appropriate gauge (see Figure 2)

3.4
pattern of terminal position areas
group of all terminal position areas of a leaded package or folded lead package in the seating plane

NOTE 1 For a leadless package, it is the projection of its metallized pads or terminals on the seating plane.

NOTE 2 The true positions of the centres of the terminal position areas are located on a grid with a modulus

$$\boxed{e} / \boxed{eD} \quad \text{or} \quad \boxed{e} / \boxed{eE}$$

NOTE 3 The pattern of terminal position areas does not include tolerances stemming from mounting substrates (printed board) design and placement machine accuracy.

3.5
coplanarity of terminals
profile tolerance controlling the location of the crowns of the bottom terminals with respect to the seating plane

NOTE In all the other cases, the requirement for coplanarity of terminals is clarified by a note.

3.6
datum
geometrical established planes for controlling the tolerance zone

NOTE Datum S should be established by seating plane.

4 Design rules

The outline drawing of a surface-mounted semiconductor device package shall comprise in the given sequence:

– the drawing (strictly speaking);
– the tables of dimensions;
– the notes to the tables and the drawings;
– the codification.

The drawing shall conform with the general rules for drawings laid down in IEC 60191-1, Clause 4 and Clause 5, as well as with the specific definitions of Clause 3 above.

The following, Clause 5 and Clause 6 give, respectively, the tables of dimensions to be specified and the notes to be called, where relevant. Supplementary dimensions and notes may be added when required.

The codification of package outlines shall be in accordance with IEC 60191-4.

5 Dimensions to be specified

Crosses in the Table 1 and Table 2 indicate where values have to be specified. In the auxiliary right-hand column, a code indicates for which outline families each dimension is generally relevant, as follows:

L: leaded packages	packages with gull-wing leads	for example; QFP, SOP,TSOP
F: folded lead packages	packages with J-bent leads	for example; QFJ, SOJ
P: leadless packages	packages with no leads	for example; QFN
B: ball grid array packages	packages with ball leads	for example; BGA

6 Notes

Notes referred to in the tables and in the drawings appear after Table 2; in the auxiliary right-hand column, a code indicates for which outline families each note is generally relevant (with the same code as in Clause 5 above).

For each particular outline package or package family, the applicable notes shall be numbered sequentially from 1 in the order they are in the tables and then on the drawing.

Table 1 – Dimensions to be specified for Group 1

Group 1 includes dimensions and numerals associated with mounting of packages and kinds of packages. The dimensions and numerals belonging to the group mean values guaranteed to users and imply that mechanical compatibility of mounting of packages can be recognized.

Ref.	Min.	Nom.	Max.	Notes	Concerned family
n	-	x	-	2	LFPB
nD	-	x	-	3	LFP
nE	-	x	-	3	LFP
A	-	-	x		LFPB
A1	x	-	x		LFB
A2	-	x	-		LF
A3	-	x(*)	-	4	LF
bp	x	-	x	4	LFP
∅bp	x	[x]	x	4	B
∅b	x	-	x	4	B
C	x	-	x		LF
D	x	x	x	4	LFPB
E	x	x	x	4	LFPB
e	-	x(*)	-	4	LFPB
f	-	-	x		LF
H_D	x	x	x	4	LF
H_E	x	x	x	4	LF
h	x	-	x		F
k	x	-	x		P
k1	x	-	x		P
Lp	x	-	x	4	LFP
t	-	-	x		LF
v	-	-	x		B
w	-	-	x		B
x	-	-	x		LFPB
x1	-	-	x		B
y	-	-	x		LFPB
y1	-	-	x		B
θ	x	-	x		L

Table 2 – Dimensions to be specified for Group 2

Group 2 includes dimensions that do not belong to Group 1, but are associated with the fabrication of packages and dimensions of terminal position areas. The group is to achieve its own original purpose as an industry standard. The group belongs to the dimensions and numerals of external shapes of packages useful for design and manufacture and the dimensions of terminal position areas that can be referenced to in fabrications of mounting boards. Therefore, external dimensions of a package shall have nominal design values specified thereto.

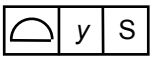
Ref.	Min.	Nom.	Max.	Notes	Concerned family
b1	-	x	-		LF
b2	x	-	x		F
b3	-	-	[x]	4	LFPB
c1	-	x	-		LF
eD	-	x	-	4	FP
eE	-	x	-	4	FP
L	-	x	-		LF
L1	-	x	-		F
L2	-	x	-		F
l1	-	-	[x]	4	LFP
S_D	-	x	-		B
S_E	-	x	-		B
Z_D	-	x	-		LFPB
Z_E	-	x	-		LFPB
G1D	-	x	-		L
G1E	-	x	-		L
h	-	x	-		F

Explanation of the symbols and notes to the tables

Explanation of the symbols

(∗) means true geometrical position

[ ] values given within square brackets are calculated values



means in this drawing that the distance from the seating plane to the nearest point of each terminal should not exceed *y* mm

projected tolerance zone (see ISO 1101, Clause 13)

NOTES

1 All dimensions are in millimetres.

2 n refers to the total number of terminal positions.

3 nD refers to the number of terminal positions on one side of the package in the direction of dimension D.

nE refers to the number of terminal positions on one side of the package in the direction of dimension E.

4 Check of the dimensions and positions of package terminal is validly performed when it is ensured that these terminal fit with the pattern of terminal position areas. This can be carried out by means of an appropriate gauge.

Annex A
(informative)

Illustration of the rules

The above rules are illustrated by examples of application to several package families.

A.1 Structures of the examples

– Gull-wing lead package with two parallel rows of terminals (see Clause A.2);
– gull-wing lead package with two parallel rows of terminals (TSOP Type 2)(see Clause A.3);
– gull-wing lead package with one row of terminals on each of four sides (see Clause A.4);
– J-bend lead package with two parallel rows of terminals (see Clause A.5);
– J-bend lead package with one row of terminals on each of four sides (see Clause A.6);
– leadless package (see Clause A.7);
– ball grid array package (see Clause A.8).

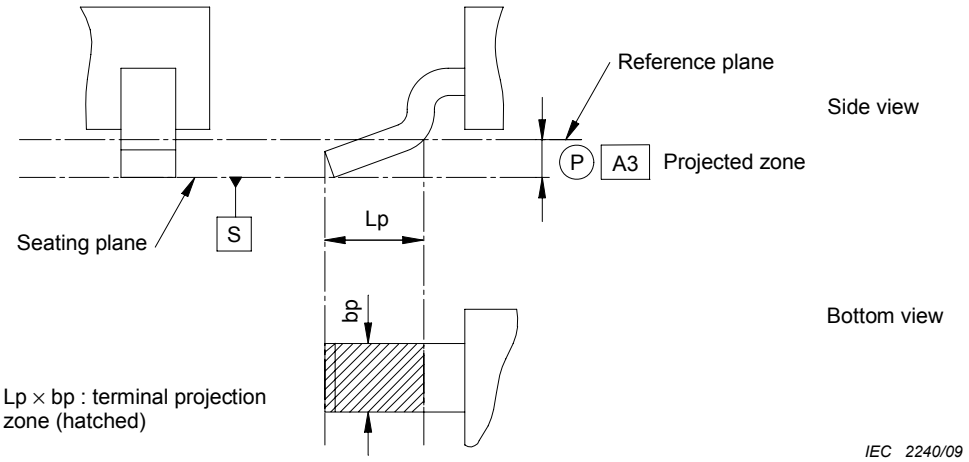


Figure A.1a

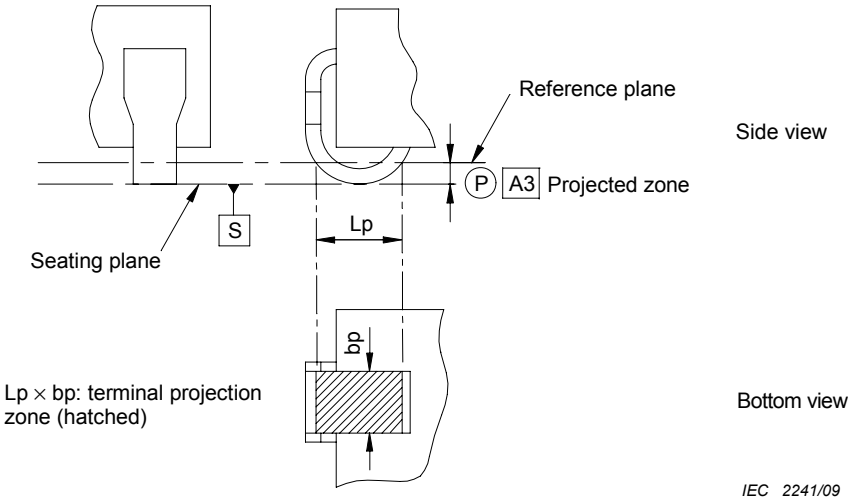


Figure A.1b

Figure A.1 – Illustrations of terminal projection zone

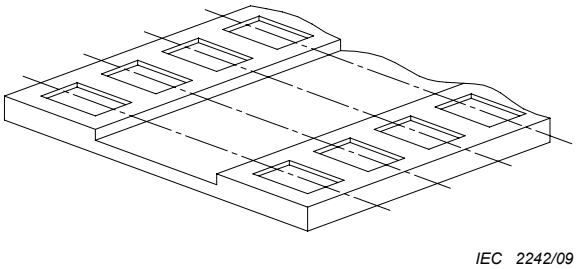


Figure A.2 – Isometric view of an example of gauge

A.2 Gull-wing lead package with two parallel rows of terminals (SOP, TSOP Type 2)

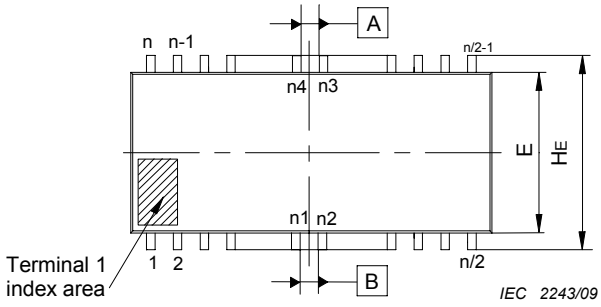


Figure A.3a – Top view

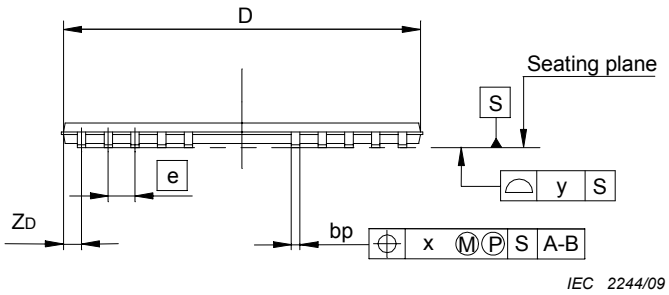


Figure A.3b – Side view

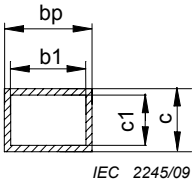


Figure A.3c – Lead section

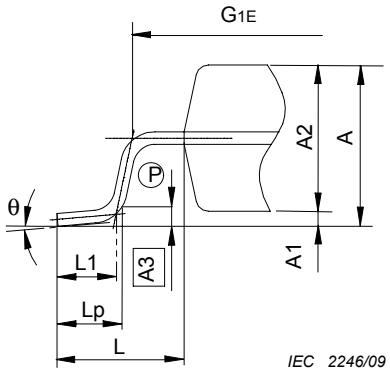


Figure A.3d – Lead side view

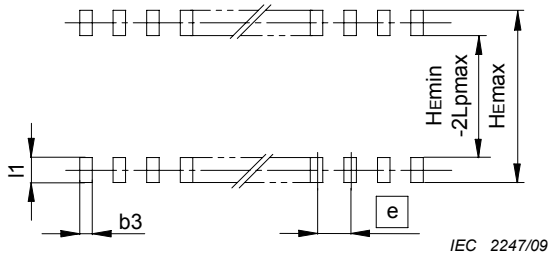


Figure A.4 – Pattern of terminal position areas

Group 1 includes dimensions and numerals associated with mounting of packages and kinds of packages. The dimensions and numerals belonging to the group mean values guaranteed to users and imply that mechanical compatibility of mounting of packages can be recognized.

Ref.	Min.	Nom.	Max.	Notes
n	-	x	-	2
A	-	-	x	
A1	x	-	x	
A2	-	x	-	
A3	-	x(*)	-	3
bp	x	-	x	3
c	x	-	x	
D	x	x	x	
E	x	x	x	
e	-	x(*)	-	3
H_E	x	x	x	3
Lp	x	-	x	3
x	-	-	x	
y	-	-	x	
θ	x	-	x	3

Group 2 includes dimensions that do not belong to Group 1, but are associated with the fabrication of packages and dimensions of terminal position areas. The group is to achieve its own original purpose as an industry standard. The group belongs to the dimensions and numerals of external shapes of packages useful for design and manufacture and the dimensions of terminal position areas that can be referenced to in fabrications of mounting boards. Therefore, external dimensions of a package shall have nominal design values specified thereto.

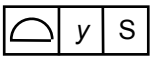
Ref.	Min.	Nom.	Max.	Notes
b1	-	x	-	
b3	-	-	x	3
c1	-	x	-	
L	-	x	-	
L1	-	x	-	
l1	-	-	x	3
(Z_D)	-	x	-	
G1E	-	x	-	

Explanation of the symbols

(∗) means true geometrical position

[ ] values given within square brackets are calculated values

Ⓟ means projected tolerance zone (see ISO 1101, Clause 13)



means in this drawing that the distance from the seating plane to the nearest point of each terminal should not exceed *y* mm

NOTES

1 All dimensions are in millimetres.

2 n refers to the total number of terminal positions.

3 Check of the dimensions and positions of package terminal is validly performed when it is ensured that these terminal fit with the pattern of terminal position areas. This can be carried out by means of an appropriate gauge.

A.3 Gull-wing lead package with two parallel rows of terminals (TSOP Type 1)

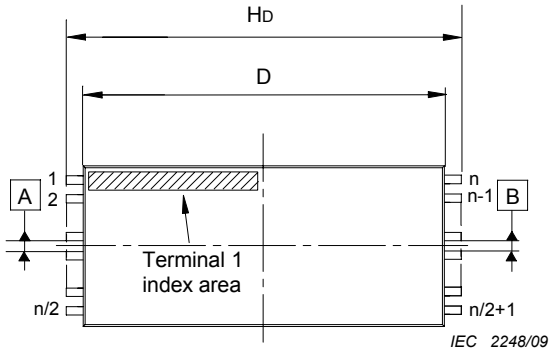


Figure A.5a – Top view

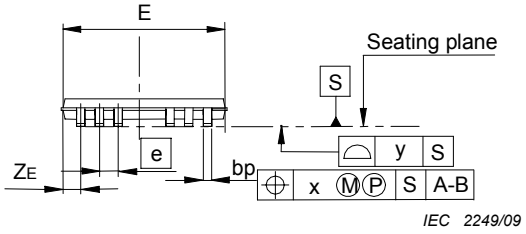


Figure A.5b – Side view

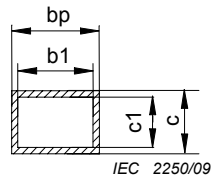


Figure A.5c – Lead section

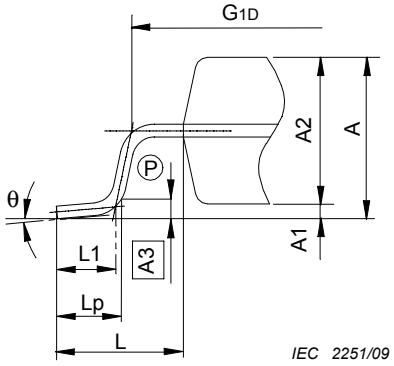


Figure A.5d – Lead side view

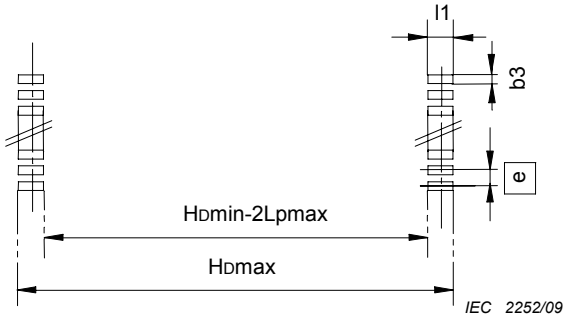


Figure A.6 – Pattern of terminal position areas

Group 1 includes dimensions and numerals associated with the mounting of packages and kinds of packages. The dimensions and numerals belonging to the group means values guaranteed to users and imply that mechanical compatibility of mounting of packages can be recognized.

Ref.	Min.	Nom.	Max.	Notes
n	-	x	-	2
A	-	-	x	
A1	x	-	x	
A2	-	x	-	
A3	-	x(*)	-	3
bp	x	-	x	3
c	x	-	x	
D	x	x	x	
E	x	x	x	
e	-	x(*)	-	3
H_D	x	x	x	3
Lp	x	-	x	3
x	-	-	x	
y	-	-	x	
θ	x		x	

Group 2 includes dimensions that do not belong to Group 1, but are associated with the fabrication of packages and dimensions of terminal position areas. The group is to achieve its own original purpose as an industry standard. The group belongs to the dimensions and numerals of external shapes of packages useful for design and manufacture and the dimensions of terminal position areas that can be referenced to in fabrications of mounting boards. Therefore, external dimensions of a package shall have nominal design values specified thereto.

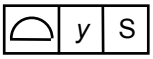
Ref.	Min.	Nom.	Max.	Notes
b1	-	x	-	
b3	-	-	x	3
c1	-	x	-	
eD	-	x	-	3
L	-	x	-	
l1	-	-	x	3
(Z_E)	-	x	-	
G1D	-	x	-	

Explanation of the symbols

(∗) means true geometrical position

[ ] values given within square brackets are calculated values

Ⓟ means projected tolerance zone (see ISO 1101, Clause 13)



means in this drawing that the distance from the seating plane to the nearest point of each terminal should not exceed *y* mm

NOTES

1 All dimensions are in millimetres.

2 n refers to the total number of terminal positions.

3 Check of the dimensions and positions of package terminal is validly performed when it is ensured that these terminal fit with the pattern of terminal position areas. This can be carried out by means of an appropriate gauge.

A.4 Gull-wing lead package with one row of terminals on each of four sides (QFP)

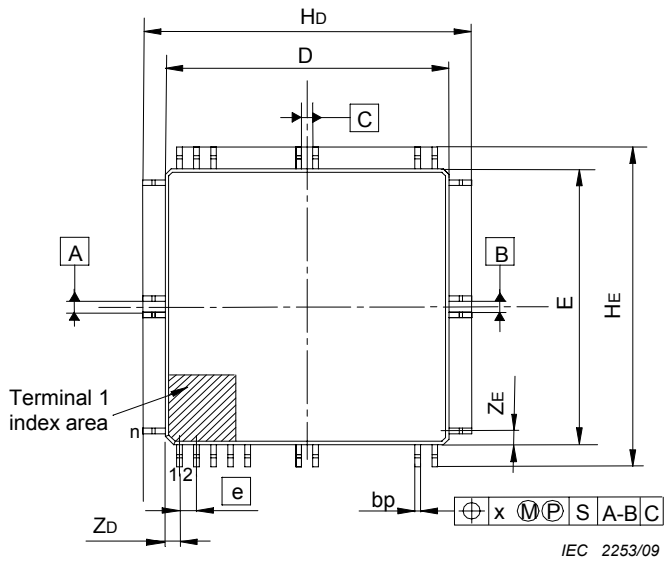


Figure A.7a – Top view

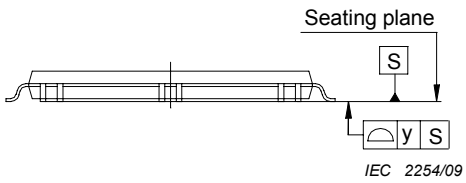


Figure A.7b – Side view

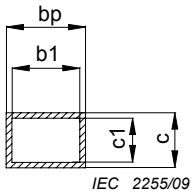


Figure A.7c – Lead section

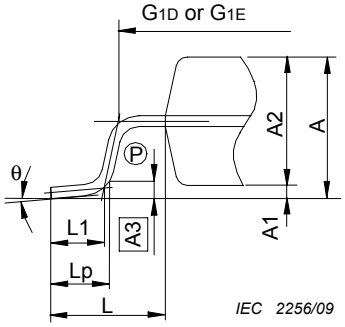


Figure A.7d – Lead side view

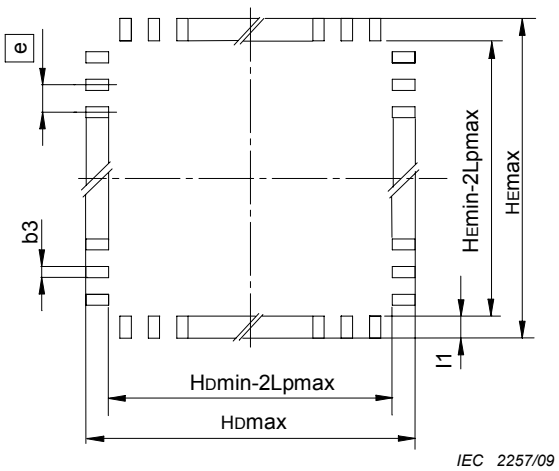


Figure A.8 – Pattern of terminal position areas

Group 1 includes dimensions and numerals associated with the mounting of packages and kinds of packages. The dimensions and numerals belonging to the group mean values guaranteed to users and imply that mechanical compatibility of mounting of packages can be recognized.

Ref.	Min.	Nom.	Max.	Notes
n	-	x	-	2
nD	-	x	-	3
nE	-	x	-	3
A	-	-	x	
A1	x	-	x	
A2	-	x	-	
A3	-	x(*)	-	4
bp	x	-	x	4
c	x	-	x	
D	x	x	x	
E	x	x	x	
e	-	x(*)	-	4
f	-	-	x	
H_D	x	x	x	4
H_E	x	x	x	4
Lp	x	-	x	4
x	-	-	x	
y	-	-	x	
θ	x	-	x	

Group 2 includes dimensions that do not belong to Group 1, but are associated with the fabrication of packages and dimensions of terminal position areas. The group is to achieve its own original purpose as an industry standard. The group belongs to the dimensions and numerals of external shapes of packages useful for design and manufacture and the dimensions of terminal position areas that can be referenced to in fabrications of mounting boards. Therefore, external dimensions of a package shall have nominal design values specified thereto.

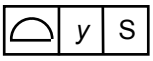
Ref.	Min.	Nom.	Max.	Notes
b1	-	x	-	
b3	-	-	x	4
c1	-	x	-	
L	-	x	-	
L1	-	x	-	
l1	-	-	x	4
(Z_D)	-	x	-	
(Z_E)	-	x	-	
G1D	-	x	-	
G1E	-	x	-	

Explanation of the symbols

(∗) means true geometrical position

[ ] values given within square brackets are calculated values

Ⓟ means projected tolerance zone (see ISO 1101, Clause 13)



means in this drawing that the distance from the seating plane to the nearest point of each terminal should not exceed *y* mm

NOTES

1 All dimensions are in millimetres.

2 n refers to the total number of terminal positions.

3 n_D refers to the number of terminal positions on one side of the package in the direction of dimension D.

n_E refers to the number of terminal positions on one side of the package in the direction of dimension E.

4 Check of the dimensions and positions of package terminal is validly performed when it is ensured that these terminal fit with the pattern of terminal position areas.
This can be carried out by means of an appropriate gauge.

A.5 J-bend lead package with two parallel rows of terminals (SOJ)

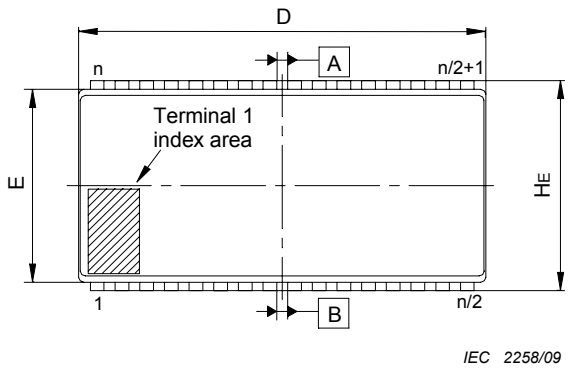


Figure A.9a – Top view

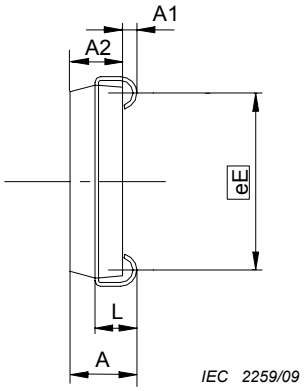


Figure A.9b – Side view

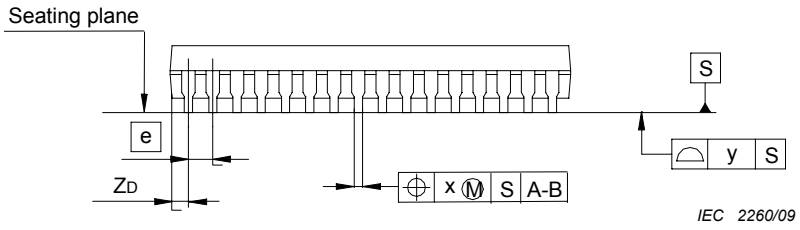


Figure A.9c – Side view

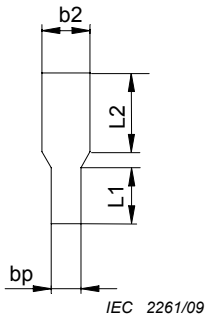


Figure A.9d – Lead shape

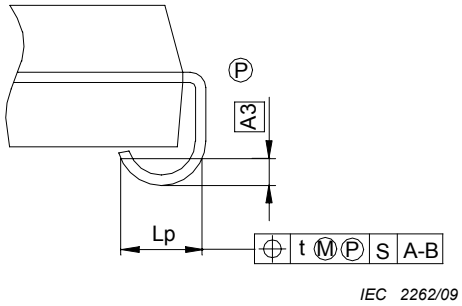


Figure A.9e – Lead side view

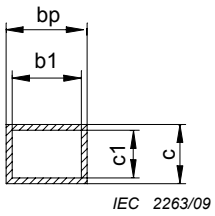


Figure A.9f – Lead section

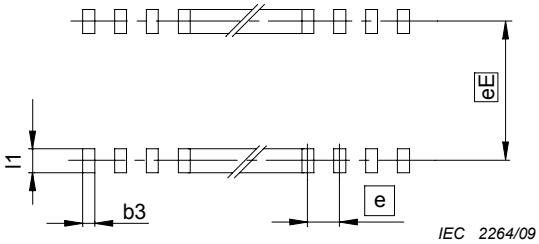


Figure A.10 – Pattern of terminal position areas

Group 1 includes dimensions and numerals associated with the mounting of packages and kinds of packages. The dimensions and numerals belonging to the group mean values guaranteed to users and imply that mechanical compatibility of mounting of packages can be recognized.

Ref.	Min.	Nom.	Max.	Notes
n	-	x	-	2
A	-	-	x	
A1	x	-	x	
A2	-	x	-	
A3	-	x(*)	-	3
bp	x	-	x	3
b_2	x	-	x	
c	x	-	x	
D	x	x	x	
E	x	x	x	
e	-	x(*)	-	3
H_E	x	x	x	
Lp	x	-	x	3
t	-	-	x	
x	-	-	x	
y	-	-	x	

Group 2 includes dimensions that do not belong to Group 1, but are associated with the fabrication of packages and dimensions of terminal position areas. The group is to achieve its own original purpose as an industry standard. The group belongs to the dimensions and numerals of external shapes of packages useful for design and manufacture and the dimensions of terminal position areas that can be referenced to in fabrications of mounting boards. Therefore, external dimensions of a package shall have nominal design values specified thereto.

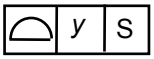
Ref.	Min.	Nom.	Max.	Degrees	Notes
b1	-	x	-		
b3	-	-	x		3
c1	-	x	-		
eE	-	x	-		3
L	-	x	-		
L1	-	x	-		
L2	-	x	-		
l1	-	-	x		3
(Z_D)	-	x	-		

Explanation of the symbols

(∗) means true geometrical position

[ ] values given within square brackets are calculated values

Ⓟ means projected tolerance zone (see ISO 1101, Clause 13)



means in this drawing that the distance from the seating plane to the nearest point of each terminal should not exceed *y* mm

NOTES

1 All dimensions are in millimetres.

2 n refers to the total number of terminal positions.

3 Check of the dimensions and positions of package terminal is validly performed when it is ensured that these terminal fit with the pattern of terminal position areas. This can be carried out by means of an appropriate gauge.

A.6 J-bend lead package with one row of terminals on each of four sides (QFJ)

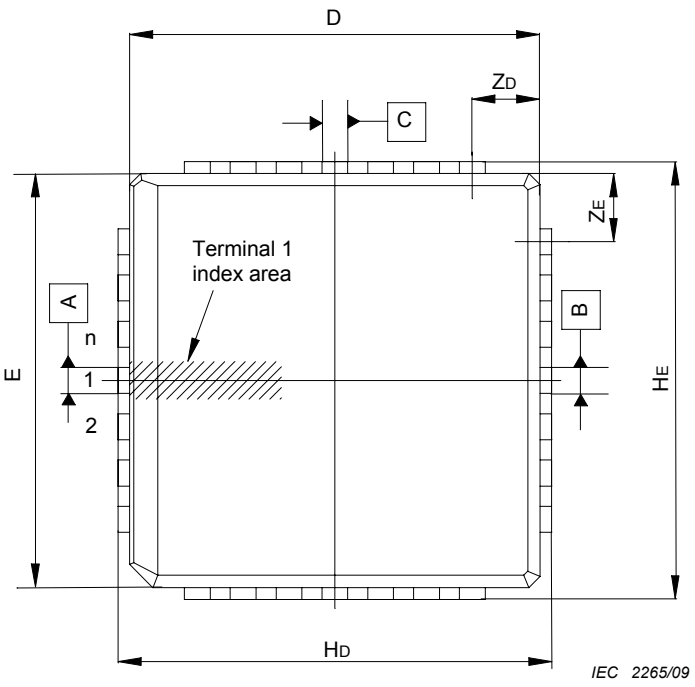


Figure A.11a – Top view

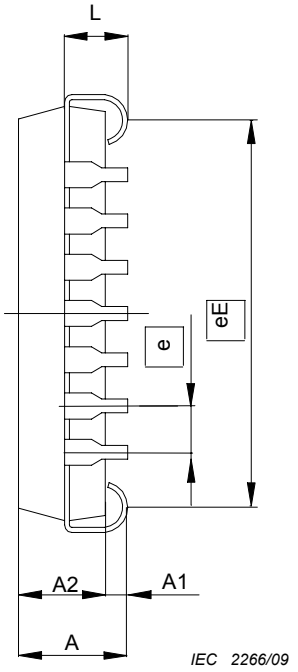


Figure A.11b – Side view

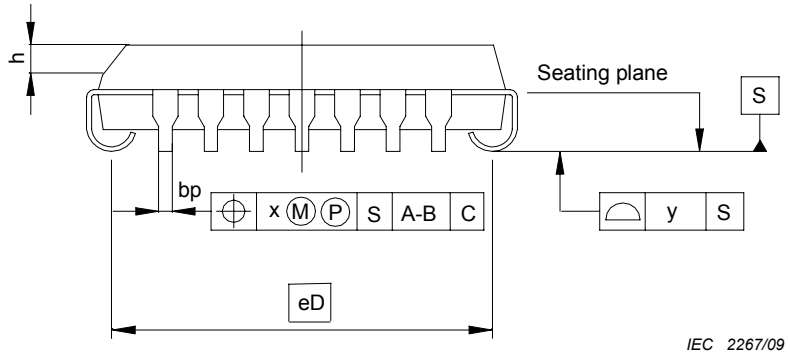


Figure A.11c – Side view

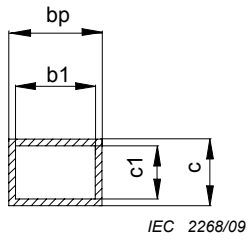


Figure A.11d – Lead section

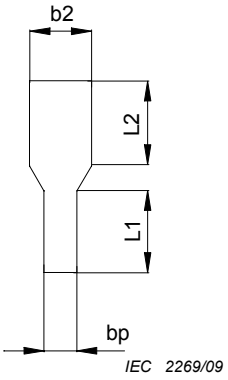


Figure A.11e – Lead shape

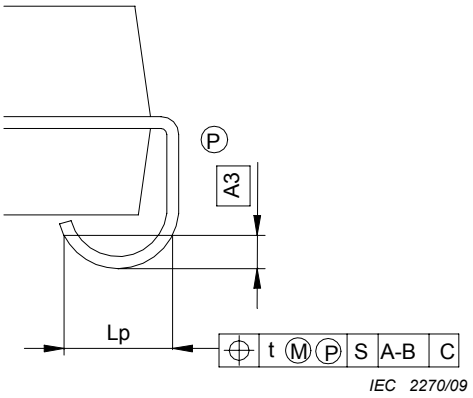


Figure A.11f – Lead side view

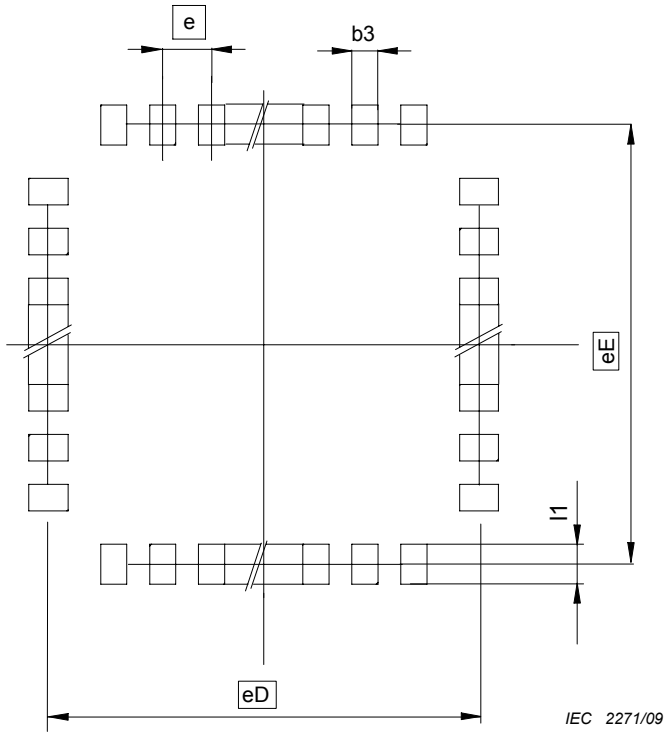


Figure A.12 – Pattern of terminal position areas

Group 1 includes dimensions and numerals associated with the mounting of packages and kinds of packages. The dimensions and numerals belonging to the group mean values guaranteed to users and imply that mechanical compatibility of mounting of packages can be recognized.

Ref.	Min.	Nom.	Max.	Notes
n	-	x	-	2
nD	-	x	-	3
nE	-	x	-	3
A	-	-	x	
A1	x	-	x	
A2	-	x	-	
A3	-	x(*)	-	4
bp	x	-	x	4
c	x	-	x	
D	x	x	x	
E	x	x	x	
e	-	x(*)	-	4
H_D	x	x	x	
H_E	x	x	x	
Lp	x	-	x	4
t	-	-	x	
x	-	-	x	
y	-	-	x	

Group 2 includes dimensions that do not belong to Group 1, but are associated with the fabrication of packages and dimensions of terminal position areas. The group is to achieve its own original purpose as an industry standard. The group belongs to the dimensions and numerals of external shapes of packages useful for design and manufacture and the dimensions of terminal position areas that can be referenced to in fabrications of mounting boards. Therefore, external dimensions of a package shall have nominal design values specified thereto.

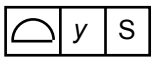
Ref.	Min.	Nom.	Max.	Notes
b1	-	x	-	
b2	x	-	x	
b3	-	-	x	4
c1	-	x	-	
eD	-	x	-	4
eE	-	x	-	4
L	-	x	-	
L1	-	x	-	
L2	-	x	-	
l1	-	-	x	4
h	-	x	-	
(Z_D)	-	x	-	
(Z_E)	-	x	-	

Explanation of the symbols

(∗) means true geometrical position

[ ] values given within square brackets are calculated values

Ⓟ means projected tolerance zone (see ISO 1101, Clause 13)



means in this drawing that the distance from the seating plane to the nearest point of each terminal should not exceed *y* mm

NOTES

1 The millimetre (inch) dimensions are derived from the original inch (millimetre) dimensions.

2 n refers to the total number of terminal positions.

3 n_D refers to the number of terminal positions on one side of the package in the direction of dimension D.

n_E refers to the number of terminal positions on one side of the package in the direction of dimension E.

4 Check of the dimensions and positions of package terminal is validly performed when it is ensured that these terminal fit with the pattern of terminal position areas. This can be carried out by means of an appropriate gauge.

A.7 Leadless package

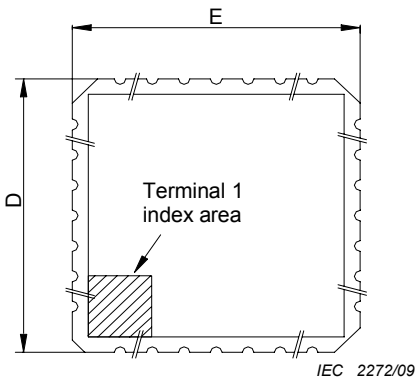


Figure A.13a – Top View

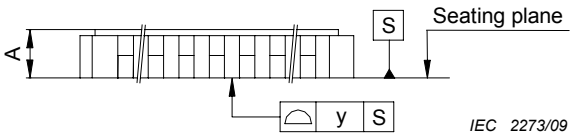


Figure A.13b – Side View

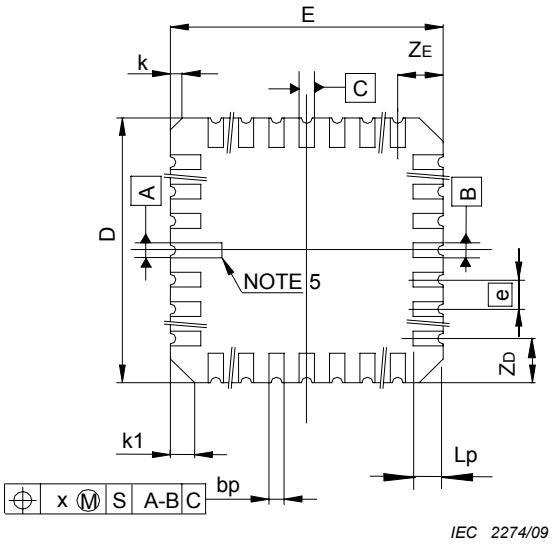


Figure A.13c – Bottom view

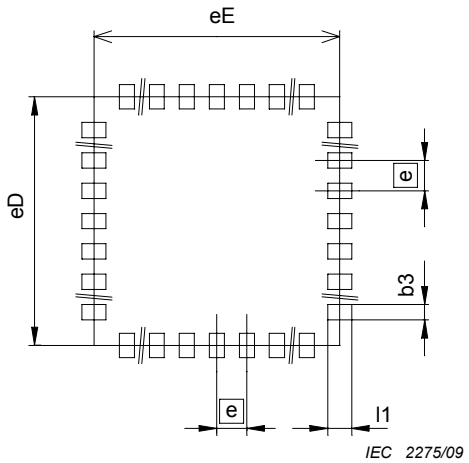


Figure A.14 – Pattern of terminal position areas

		Date 2009

Group 1 includes dimensions and numerals associated with the mounting of packages and kinds of packages. The dimensions and numerals belonging to the group mean values guaranteed to users and imply that mechanical compatibility of mounting of packages can be recognized.

Ref.	Min.	Nom.	Max.	Notes
n	-	x	-	2
nD	-	x	-	3
nE	-	x	-	3
A	-	-	x	
bp	x	-	x	4
D	x	x	x	
E	x	x	x	
e	-	x(*)	-	4
Lp	x	-	x	4
w	-	-	x	
x	-	-	x	
y	-	-	x	

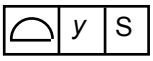
Group 2 includes dimensions that do not belong to Group 1, but are associated with the fabrication of packages and dimensions of terminal position areas. The group is to achieve its own original purpose as an industry standard. The group belongs to the dimensions and numerals of external shapes of packages useful for design and manufacture and the dimensions of terminal position areas that can be referenced to in fabrications of mounting boards. Therefore, external dimensions of a package shall have nominal design values specified thereto.

Ref.	Min.	Nom.	Max.	Notes
b3	-	-	x	4
eD	-	x	-	4
eE	-	x	-	4
k	x	-	x	
k1	x	-	x	
l1	-	-	x	4
(Z_D)	-	x	-	
(Z_E)	-	x	-	

Explanation of the symbols

(∗) means true geometrical position

[ ] values given within square brackets are calculated values



means in this drawing that the distance from the seating plane to the nearest point of each terminal should not exceed *y* mm

NOTES

1 All dimensions are in millimetres.

2 n refers to the total number of terminal positions.

3 nD refers to the number of terminal positions on one side of the package in the direction of dimension D.

nE refers to the number of terminal positions on one side of the package in the direction of dimension E.

4 Check of the dimensions and positions of package terminal is validly performed when it is ensured that these terminal fit with the pattern of terminal position areas. This can be carried out by means of an appropriate gauge.

5 Length of terminal pad number 1 shall be visibly greater than the length of the other terminal pads.

A.8 Ball grid array package (BGA)

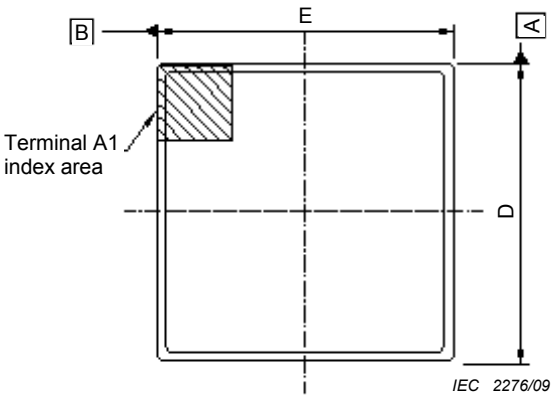


Figure A.15a – Top view

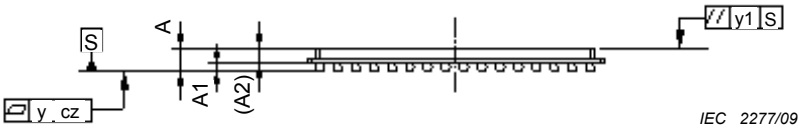


Figure A.15b – Side view

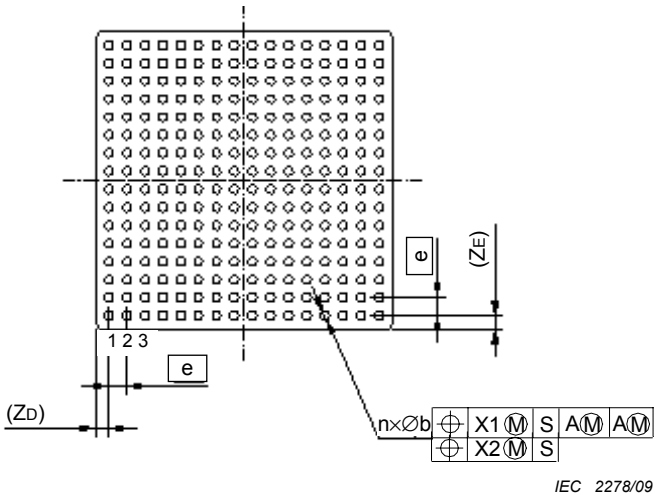


Figure A.15c – Bottom view

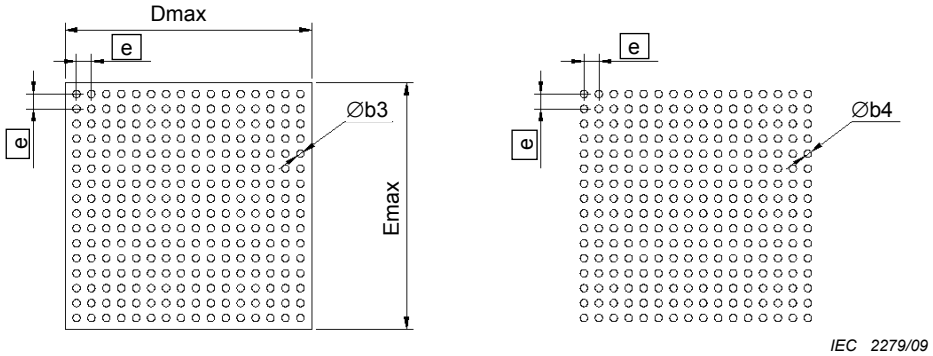


Figure A.16 – Pattern of terminal position areas

		Date 2009

Group 1 includes dimensions and numerals associated with the mounting of packages and kinds of packages. The dimensions and numerals belonging to the group mean values guaranteed to users and imply that mechanical compatibility of mounting of packages can be recognized.

Symbol	Min.	Nom.	Max.	Theoretically exact dimension	Notes
n	-	x	-	-	1
A	-	-	x	-	
A1	x	-	x	-	
A2	-	(x)	-	-	3
b	x	-	x	-	2
D	x	x	x		
E	x	x	x		
e	-	-	-	x	2
v	-	-	x	-	
X1	-	-	x	-	
X2	-	-	x	-	
y	-	-	x	-	
y1	-	-	x	-	

Group 2 includes dimensions that do not belong to Group 1, but are associated with the fabrication of packages and dimensions of terminal position areas. The group is to achieve its own original purpose as an industry standard. The group belongs to the dimensions and numerals of external shapes of packages useful for design and manufacture and the dimensions of terminal position areas that can be referenced to in fabrications of mounting boards. Therefore, external dimensions of a package shall have nominal design values specified thereto.

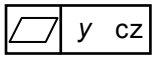
Symbol	Min.	Nom.	Max.	Notes
b3	-	-	[x]	1, 2
b4	-	-	[x]	1, 2
Z_D	-	(x)	-	3
Z_E	-	(x)	-	3

Explanation of the symbols

(∗) means true geometrical position

[ ] values given within square brackets are calculated values

Ⓟ means projected tolerance zone (see ISO 1101, Clause 13)



means in this drawing the distance from the common zone of each terminal

NOTES

1 All dimensions are in millimetres.

2 n refers to the total number of terminal positions.

3 Check of the dimensions and positions of package terminal is validly performed when it is ensured that these terminal fit with the pattern of terminal position areas.
This can be carried out by means of an appropriate gauge.

4 Verification of the dimensions and positions of package terminal is validly performed when it is ensured that these terminal fit with the pattern of terminal position areas. This verification may be carried out by means of an appropriate functional gauge.

5 b3 and b4 are virtual size obtained from maximum material size of the ball diameter and positional tolerance.

$$b3 = b\ max. + x1$$

$$b4 = b\ max. + x2$$

Annex B
(informative)

Optional table format

In case the dimension table specifies a large number of package variations, the examples in tables below may be used.

B.1 Overall dimension table (example)

	Ref.	Min.	Nom.	Max.	Degrees	Notes
Group 1	n	-	V	-		
	A	-	-	X		
	A1	X	-	X		
	A2	-	X	-		
	A3	-	X	-		
	bp	V	-	V		
	c	X	-	X		
	D	X	V	X		
	E	X	V	X		
	e	-	V	-		
	f	-	-	X		
	H_E	-	V	-		
	Lp	X	-	X		
	t	-	-	X		
	⋮					
Group 2	b1	-	V	-		
	b3	-	-	V		
	c1	-	X	-		
	l1	-	-	X		
	⋮					

"X" = common dimension.

"V" = variable dimension.

B.2 Common dimension table (example)

	Ref.	Min.	Nom.	Max.	Degrees	Notes
Group 1	A	X	-	X		
	A1	X	-	X		
	A2	X	X	X		
	A3	-	X	-		
	c	X	-	X		
	f	-	-	X		
	Lp	X	-	X		
	t	-	-	X		
	⋮					
Group 2	c1	-	X	-		
	l1	-	-	X		
	⋮					

B.3 Variable dimension table (example)

	Ref.	**Package variation AA**			**Package variation AB**			**Package variation AC**			····· ·····		
		Min.	**Nom.**	**Max.**	**Min.**	**Nom.**	**Max.**	**Min.**	**Nom.**	**Max.**	**Min.**	**Nom.**	**Max.**
Group 1	n	-	V	-	-	V	-	-	V	-			
	bp	V	-	V	V	-	V	V	-	V			
	D	V	V	V	V	V	V	V	V	V			
	E	V	V	V	V	V	V	V	V	V			
	e	-	V	-	-	V	-	-	V	-			
	HE	-	V	-	-	V	-	-	V	-			
	⋮												
Group 2	b1	-	V	-	-	V	-	-	V	-			
	b3	-	-	V	-	-	V	-	-	V			
	⋮												

Bibliography

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

IEC 60191-3, *Mechanical standardization of semiconductor devices – Part 3: General rules for the preparation of outline drawings of integrated circuits*

ISO 2692: *Technical drawings – Geometrical tolerancing – Maximum material principle*

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