

INTERNATIONAL STANDARD

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60191-6

Second edition
2004-09

Mechanical standardization of semiconductor devices –

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

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**MECHANICAL STANDARDIZATION
OF SEMICONDUCTOR DEVICES –****Part 6: General rules for the preparation of outline drawings of
surface mounted semiconductor device packages**

FOREWORD

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International Standard IEC 60191-6 has been prepared by subcommittee 47D: Mechanical standardization of semiconductor devices, of IEC technical committee 47: Semiconductor devices.

This second edition of IEC 60191-6 cancels and replaces the first edition, published in 1990 and its amendment 1 (1999), and constitutes a technical revision. This includes the following significant changes with respect to the previous edition: improvement of the geometrical drawing format and addition of the examples of the drawing of major packages.

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

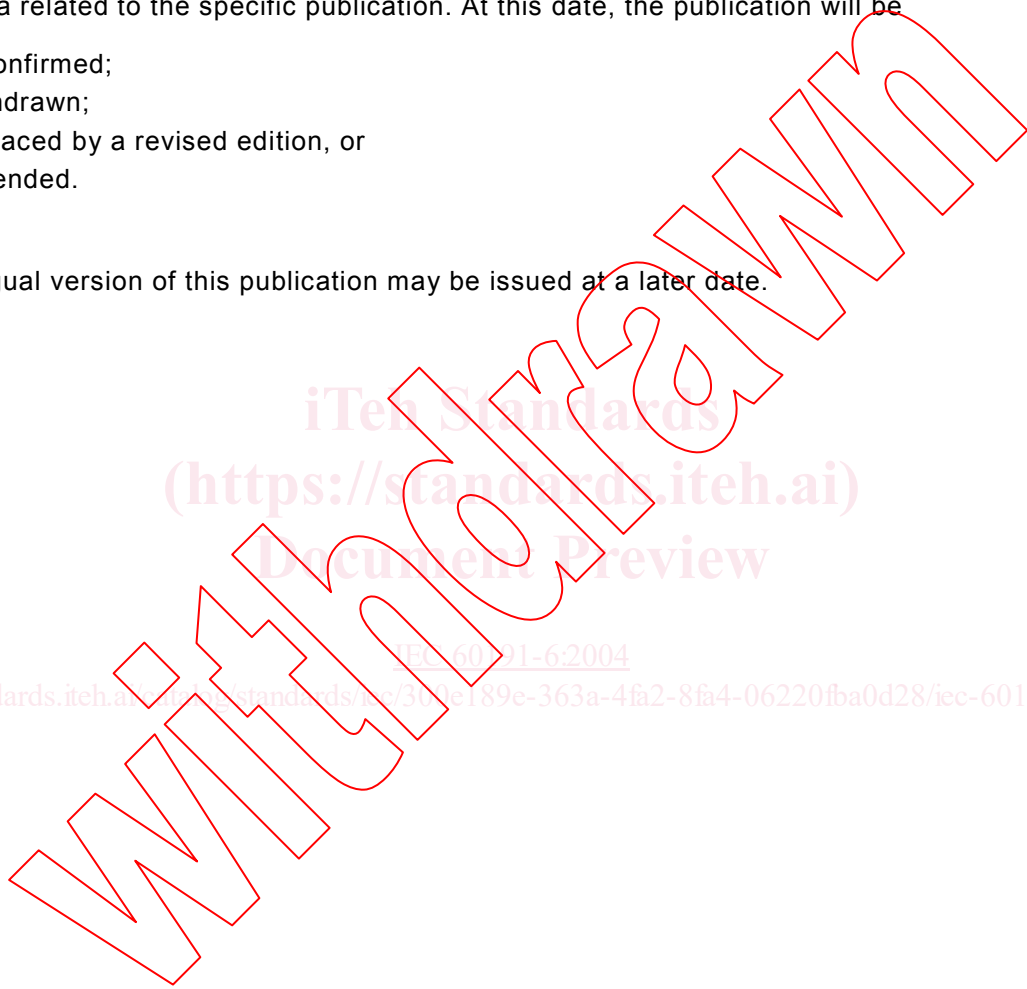
FDIS	Report on voting
47D/584/FDIS	47D/587/RVD

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

The committee has decided that the contents of this publication will remain unchanged until the maintenance result 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

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- withdrawn;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

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



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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 60191-3. It covers all surface-mounted devices-discrete semiconductors 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 60191-1:1966, *Mechanical standardization of semiconductor devices – Part 1: Preparation of drawings of semiconductor devices*

IEC 60191-3:1999, *Mechanical standardization of semiconductor devices – Part 3: General rules for the preparation of outline drawings of integrated circuits*

IEC 60191-4:1999, *Mechanical standardization of semiconductor devices – Part 4: Coding system and classification into forms of package outlines for semiconductor devices*

ISO 1101:1983, *Technical drawings – Geometrical tolerancing – Tolerancing of form, orientation, location and run-out – Generalities, definitions, symbols, indications on drawings*

3 Definitions

For the purposes of this document, the following 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 A_3 above seating plane (does not apply to leadless package)

The distance A_3 is known as the reference plane distance. It determines the terminal projection zone (see Figure 1).

NOTE 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

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

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

$$= L_p \text{ max.} + (HE_{\text{max}} - HE_{\text{min}})/2$$

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

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

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

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

$$e / e_D \quad \text{or} \quad e / e_E$$

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

the requirement for coplanarity of terminals is given in a tolerance frame showing the ISO symbol for profile of a surface, the tolerance value y and the reference to the seating plane

Where the part of the terminal intended for soldering is a flat zone of defined dimension $b \times l$, with nominal position on the seating plane – e.g. pads of leadless packages – then the requirement for coplanarity of terminals is strictly the ISO requirement for flatness applied to these zones.

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

3.6 datum

theoretically, the exact geometrical reference is established for controlling the tolerance zone when specifying a geometrical tolerance as a related feature

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 indication of supporting countries;
- the codification.

The drawing shall conform with the general rules for drawings laid down in IEC 60191-1 sections 1 and 2, as well as with the specific definitions of Clause 3 above.

The following Clauses 5 and 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 Tables 1 and 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).

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

Table 1 – Dimensions to be specified for Group 1

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
n	-	x	-	2
nD	-	x	-	3
nE	-	x	-	3
A	-	-	x	
A1	x	-	x	
A2	-	x	-	
A3	-	x(*)	-	4
bp	x	-	x	4
∅bp	x	[x]	x	4
∅b	x	-	x	4
C	x	-	x	
D	x	x	x	4
E	x	x	x	4
e	-	x(*)	-	4
f	-	-	x	
HD	x	x	x	4
HE	x	x	x	4
h	x	-	x	
k	x	-	x	
k1	x	-	x	
Lp	x	-	x	4
t	-	-	x	
v	-	-	x	
w	-	-	x	
x	-	-	x	
x1	-	-	x	
y	-	-	x	
y1	-	-	x	
θ	x	-	x	

Concerned family

LFPB
LFP
LFP
LFPB
LFB
LF
LF
LFP
B
B
LF
LFPB
LFPB
LFPB
LF
LF
LF
F
P
P
LFP
LF
B
B
LFPB
B
LFPB
B
L

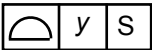

Table 2 – Dimensions to be specified for Group 2

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
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
Sd	-	x	-	
SE	-	x	-	
ZD	-	x	-	
ZE	-	x	-	
G1D	-	x	-	
G1E	-	x	-	
h	-	x	-	

Concerned family

LF
F
LFPB
LF
FP
FP
LF
F
F
LFP
B
B
LFPB
LFPB
L
L
F

Notes to the tables		
<p>1 All dimensions are in millimetres.</p> <p>2 n refers to the total number of terminal positions.</p> <p>3 n_D refers to the number of terminal positions on one side of the package in the direction of dimension D.</p> <p>n_E refers to the number of terminal positions on one side of the package in the direction of dimension E.</p> <p>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.</p> <p>(*) Means true geometrical position.</p> <p>[] Values given within square brackets are calculated values.</p> <p>5 Zone of a visible index on the top face.</p> <p>6 Terminal number designation shall be in accordance with annex C of IEC60191-3.</p> <p> Means in this drawing that the distance from the seating plane to the nearest point of each terminal should not exceed y mm.</p> <p> Means projected tolerance zone (see ISO 1101, clause 11).</p> <p>7 Length of terminal pad number 1 shall be visibly greater than the length of the other terminal pads.</p> <p>8 Index corner.</p> <p>9 Seating plane S is defined by the spherical crowns of the solder balls.</p> <p>10 Dimension ϕb is measured at the maximum solder ball diameter, parallel to seating plane S.</p> <p>11 The thickness A2 of the package body, exclusive of the lid or encapsulation and ball height.</p> <p>12 Stand-off A1 is optional, but when present they should be located on the ball matrix diagonals.</p>	LFPB	
		LF
		P
		F
		B