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Second edition
2007-04

Mechanical standardization of semiconductor devices –

Part 1:
General rules for the preparation of outline drawings of discrete devices

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Commission Electrotechnique Internationale
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INTERNATIONAL ELECTROTECHNICAL COMMISSION

MECHANICAL STANDARDIZATION OF SEMICONDUCTOR DEVICES –

Part 1: General rules for the preparation of outline drawings of discrete devices

FOREWORD

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International Standard IEC 60191-1 has been prepared by subcommittee 47D: Mechanical standardization for semiconductor devices, of IEC technical committee 47: Semiconductor devices.

This second edition cancels and replaces the first edition published in 1966 together with supplements 60191-1A:1969, 60191-1B:1970 and 60191-1C:1974 and constitutes a technical revision. The main changes from the previous edition are as follows:

– requirement added for SI-dimensions for new drawings to be published;
– former rules concerning inch-dimensions are given in an informative annex;
– former rules for coding are given in an informative annex;
– incorporation of the supplements;
– updating of references;
– restructuring and renumbering.

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

FDIS	Report on voting
47D/678/FDIS	47D/682/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.

The IEC 60191 series, published under the general title *Mechanical standardization of semiconductor devices*, comprises the following parts:

Part 1: General rules for the preparation of outline drawings of discrete devices

Part 2: Dimensions

Part 3: General rules for the preparation of outline drawings of integrated circuits

Part 4: Coding system and classification into forms of package outlines for semiconductor device packages

Part 5: Recommendations applying to integrated circuit packages using tape automated bonding (TAB)

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

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

- reconfirmed;
- 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 1: General rules for the preparation of outline drawings of discrete devices

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1 Scope and object

This part of IEC 60191 gives guidelines on the preparation of outline drawings of discrete devices.

NOTE For preparation of outline drawings of surface mounted discrete devices, IEC 60191-6 should be referred to as well.

The primary object of these drawings is to indicate the space which should be allowed for devices in an equipment, together with other dimensional characteristics required to ensure mechanical interchangeability.

It should be noted that complete interchangeability involves other considerations such as the electrical and thermal characteristics of the semiconductor devices concerned.

The international standardization represented by these drawings therefore encourages the manufacturers of devices to comply with the tolerances shown on the drawings in order to extend their range of customers internationally. It also gives equipment designers an assurance of mechanical interchangeability between the devices obtained from suppliers in different countries, provided they allow the space in their equipment that is indicated by the drawings and take note of the more precise information on bases, studs, etc.

NOTE Additional details on the standardization philosophy used in this standard are given in Annex B.

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 60191-2:1966, *Mechanical standardization of semiconductor devices – Part 2: Dimensions* (including all supplements and amendments)

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

ISO 370, *Toleranced dimensions – Conversion from inches to millimetres and vice versa (withdrawn 2000-05)*

3 Terms and definitions

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

3.1
device outline drawing
drawing which includes all dimensional characteristics required for the mechanical interchangeability of the complete device. It includes the case or body, all terminals and the locating tab if present

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3.2
terminal
that part of the semiconductor device primarily used in making an electrical, mechanical or thermal connection. Examples of terminals are flexible leads, rigid leads, pins, studs, etc.

3.3
case outline drawing
drawing which includes all dimensional characteristics required for the mechanical interchangeability of the case or body. It does not include the dimensions of the terminals or the locating tab if present, but their positions are shown by dotted lines

3.4
base drawing
drawing which includes all dimensional characteristics required for the mechanical interchangeability of the terminals and mechanical index

NOTE 1 Examples of these characteristics are: lead length, lead diameters with controlled zones, lead spacing, pitch circle diameter, thickness, width and length of a tab, etc

NOTE 2 The diameter or major axis of the case outline should not be given on the base drawing.

NOTE 3 Many semiconductor devices have identical cases, but differ in the number or the length of terminals. It is also possible to have the same type of base associated with cases which are not identical.

Consequently, there are advantages in having:

a) a single drawing including only the dimensional characteristics of the case outline and separate drawings for the various bases which can be associated with this case outline,

or

b) a single drawing including only the dimensional characteristics of the base and separate drawings for the various case outlines which can be associated with this base.

3.5
mechanical index
locating feature, or that portion of the device specifically designed to provide orientation.

NOTE Examples of a mechanical index are: key, keyway, locating tab, etc.

3.6
visual index
any single terminal (or omission of) readily distinguished by the eye from others or any distinctive boss, stippled pattern or colour mark adjacent to a terminal

3.7
datum
a theoretically exact geometric reference (such as axes, planes, straight lines etc.) to which toleranced features are related. Datums may be based on one or more datum features of a part

[ISO 5459:1981, definition 3.1]

3.8
seating plane or seating base
reference plane from which, in general, outline and base dimensions are given

3.9
seated height or mounted height
distance from the seating plane to the top of any exposed tip or rigid terminal present, otherwise to the top of the outline. Flexible terminals should not be included as part of the seated height, but the mounted height should include a minimum allowance necessary for an axially mounted flexible lead to be bent at right angles

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3.10
controlled cylindrical zone
zone which defines a portion of the body of minimum length over which the diameter is controlled to closer tolerances than is allowed over the full length of the body

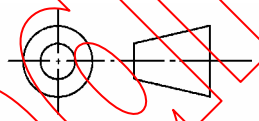
4 General rules for all drawings

NOTE General rules for the preparation of outline drawings of surface mounted semiconductor device packages are given in IEC 60191-6.

4.1 Drawing layout

General rules for the drawing layout are as follows.

a) A drawing should show all dimensions required to ensure mechanical interchangeability.
b) The drawing using third angle projection, should include:
   – a suitable side-view;
   – suitable end-views, where appropriate;
   – such additional views and details as are required to show any special configuration or features.
c) The following information should be put in the cartouche, at the bottom of the page:
   – the projection method where there is more than one view, indicated as follows:



   – date of publication of the drawing;
   – IEC code number;
   – country of origin and code of that country indicated by sign Δ;

     NOTE This is no longer in practice.
   – other interested countries and codes of those countries.
d) When a drawing is re-issued because of modifications, the changes made should be indicated by arrows in the margin. The date of publication of the revised issue and of the superseded issue should be stated.
e) While drawings need not to be drawn to scale, they should be roughly in proportion and, where necessary for clarity, enlarged detail drawing(s) should be used.

4.2 Dimensions and tolerances

Application of dimensions and tolerances are as follows.

a) Dimensions of bases, outlines, etc. quoted shall apply to the finished product. They should, therefore, not quote manufacturing tolerances, but give customers acceptance limits.

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b) The following types of dimension may be used on the drawings as appropriate:

i) Toleranced dimensions
A toleranced dimension can be expressed:

- preferably by both minimum and maximum limits
(example: L_{min} = 5,77 mm, L_{max} = 5,82 mm); or
- by a nominal value and maximum and minimum limits. Such a nominal value need not necessarily be the average of two limits
(example: $L = 6^{+0,4}_{-0,2}$ mm).

ii) Untoleranced dimensions

- Untoleranced limiting dimensions
i.e.: minimum only or maximum only
(example: L_{max} = 5,85 mm) .
- Untoleranced nominal dimensions
These dimensions may be used:
  - either for general information as an actual nominal figure;
  - or to specify true geometrical position (by means of linear or angular dimensions). Such dimensions shall be indicated by an asterisk (*) after the numerical value, the asterisk in this sense meaning "true geometrical position"
(example: L_{nom} = 5,85 mm).

c) Single minimum, single maximum or single nominal (where not given for general information) dimensions should be stated in decimals to such a number of places as is considered adequate to express the degree of accuracy appropriate for that dimension; e.g. if measurement to the nearest 0,001 mm is considered appropriate, the dimension should be expressed to the third decimal place (for example 0,500 mm), but if the measurement to the nearest 0,01 mm is sufficient, the dimension should be expressed to the second decimal place (for example 0,50 mm) and so on. Similar consideration should be given to the number of decimal places necessary when an original dimension is expressed in millimetres.

d) Limiting values or nominal value and limits of a toleranced dimension should be stated with the same number of decimal places (e.g. 0,016 mm min. – 0,017 mm nom. – 0,019 mm max.).

e) The use of fractional mm dimensions is permitted to describe nominal hexagon sizes.

f) Numerical dimensions should not be shown directly on the figure(s). They should be shown in tabular form under the figure(s) and correspond to the reference letter symbols on the figure(s). The letter symbols on the figure(s) should be upright. Upper case letters should be used for device outline and case outline dimensions and lower case letters for base dimensions. If confusion could arise, upper case letters should preferably be used throughout.

g) In the case of a diameter, the symbol “Ø” should appear in front of the reference letter concerned both on the figure(s) and in the table. In cases where the cross-section is uncontrolled (not necessarily round), the “Ø” symbol should not be used.

h) The table shall give dimensions in millimetres. The basic dimensions and system (millimetres or inches) will be indicated immediately above the table.

NOTE Outline drawings published in IEC 60191-2 before this document came into effect may give dimensions in inches.

i) The dimensions and limits which should normally be given and their corresponding reference letter symbols are contained in Annex A. Some examples of drawings prepared in accordance with these rules are given in Annex E.

Where a particular reference letter is to be used for more than one dimension on the same drawing, use should be made of a suffix to identify the dimensions.

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Annex A cannot be expected to include all dimensions likely to be necessary for mechanical standardization, more particularly in the future. A distinction has been made between primary and secondary reference letter symbols, primary reference letter symbols being those which are used most frequently, secondary reference letter symbols being those which are used less frequently and which can, if necessary, be associated with dimensions other than those given in the table.

j) Where it is self-evident that several angles are equal, it is not necessary to show more than one angle on the figure(s).

k) Notes will be numbered and placed under the table of dimensions, which will have a “notes”' column on the right-hand side. The note reference will be placed opposite the dimension to which the note refers in the table or, when this dimension does not appear in the table, on the figure(s). The numerical sequence of the notes should follow the alphabetical sequence of the dimensional reference letters to which the notes refer. Notes referring to the figure(s) should follow notes referring to dimensions given in the table.

4.3 Methods for locating the datum

These methods are listed below in order of preference. When more than one of these methods is possible for a given device, the method appearing earliest in the list should be used. When none of the following methods is possible, the method best suited to the device should be used.

The datum is

a) the radial line through the centre of the mechanical or visual index;

b) the radial line midway between the two terminals which obviously comprise a gap in an otherwise equally spaced circular terminal array;

c) the radial line 180° from the locating radius of the most isolated terminal;

d) the radial line 180° from the mid-point of, in order of preference:
   - the two most widely spaced terminals;
   - the two most closely spaced terminals;

e) the radial line through the centre of the index terminal. In order of preference, the index terminal is defined as that having:
   - the smallest cross-sectional area at the point of emergence from the case;
   - the greatest axial length, when one terminal is noticeably longer than the others;
   - the smallest axial length, when one terminal is noticeably shorter than the others.

4.4 Numbering of terminals

4.4.1 General

Where possible, device terminals should be identified by numbers according to the system outlined in 4.4.2 to 4.4.7. In all instances terminals are considered as being viewed from their free ends.

4.4.2 Single-ended devices with terminals in a linear array

4.4.2.1 Symmetrical linear array

The terminal nearest the reference mark should be numbered as No.1, the other terminals should be numbered progressively from terminal No.1.

4.4.2.2 Asymmetrical linear array

The terminals should be numbered progressively from the end having the most terminals.

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4.4.3 Single-ended devices with terminals in a circular array

- The terminal, the centre of which is past the datum, should be numbered as No.1, the other terminals should be numbered progressively and in a clockwise sequence from No.1.
- Where a terminal is situated in the centre of the base, this should be known as the centre terminal and shall not be given a number.
- Where omission of one terminal in an otherwise equally spaced array identifies the datum, the position of the omitted terminal should not be numbered; but, in a fixed modular circular array, any location of omitted terminal which does not define a datum should be numbered.

4.4.4 Double-ended devices

Terminals on both end views should be numbered without duplication of numbers.

4.4.5 Devices with terminals disposed in a square or rectangular periphery

Visual identification of the top of the device should be provided. The means of identification of terminal position number one should also be provided. These identifications may be combined.

The terminal positions should be numbered progressively in an anti-clockwise direction around the periphery of the device as viewed from the top. The number one terminal position shall be the first position anti-clockwise from the means of identification.

Each terminal shall be identified by the number of its position. Terminals may not necessarily be present in all the numbered positions but those present shall have the number of the position.

4.4.6 Particular case of lozenge – shaped bases

Given two orthogonal axes, X'X and Y'Y, the device is oriented so that:

a) the greatest diagonal of the base coincides with the Y'Y axis, whereas the smallest diagonal coincides with the X'X axis;

b) the greatest number of terminals is in the upper half (Figure1A, 1B, 1C) or in the right-hand half (Figure 1D).

The numeration is clockwise, starting from the quadrant in the upper left-hand side.

If the terminals are disposed in a cross on the axis (Figure 1E), it is necessary to mark on the body with a visual index the terminal which shall be considered as the first in the clockwise numeration.

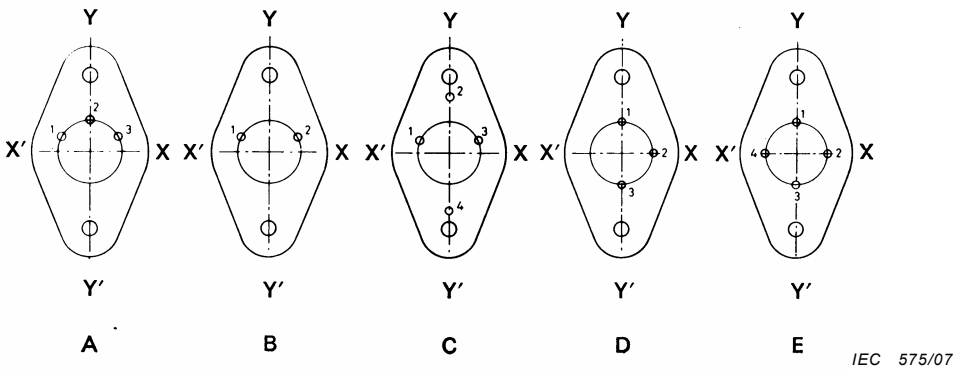

Figure 1 – Numbering of terminals of lozenge – shaped bases

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