IEC 61188-6-4

Edition 1.0 2019-05

INTERNATIONAL STANDARD

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**Printed boards and printed board assemblies – Design and use –
Part 6-4: Land pattern design – Generic requirements for dimensional drawings of surface mounted components (SMD) from the viewpoint of land pattern design**

**Cartes imprimées et cartes imprimées équipées – Conception et utilisation –
Partie 6-4: Conception de la zone de report – Exigences génériques pour les dessins dimensionnels de composants montés en surface (CMS) du point de vue de la conception de la zone de report**

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International Standard IEC 61188-6-4 has been prepared by IEC technical committee 91: Electronics assembly technology.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
91/1561/FDIS	91/1572/RVD

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

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 61188 series, published under the general title *Printed boards and printed board assemblies – Design and use*, can be found on the IEC website.

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

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- withdrawn,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

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PRINTED BOARDS AND PRINTED BOARD ASSEMBLIES – DESIGN AND USE –

Part 6-4: Land pattern design – Generic requirements for dimensional drawings of surface mounted components (SMD) from the viewpoint of land pattern design

1 Scope

This part of IEC 61188 specifies generic requirements for dimensional drawings of SMD from the viewpoint of land pattern design.

The purpose of this document is to prevent land pattern design issues caused by lack of information and/or misuse of the information from SMD outline drawing as well as to improve the utilization of IEC 61188 series.

This document is applicable to the SMD of semiconductor devices and electrical components.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 60194, *Printed board design, manufacture and assembly – Terms and definitions*

IEC 60194-2, *Printed board design, manufacture and assembly – Vocabulary – Part 2: Common usage in electronic technologies as well as printed board and electronic assembly technologies*

3 Terms, definitions and symbols

For the purposes of this document, the terms and definitions given in IEC 60194 and IEC 60194-2 apply, and the reference symbols are shown in Table 1.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

Table 1 – Reference symbols used in this document

Reference symbol	Definition
A	SMD height (from the mounting surface to the package upper surface)
A_1	Stand-off height (distance from the mounting surface to the package bottom)
A_2	Package height
A_3	Standard heel height for terminal
A_4	Terminal height
A_5	Terminal height (thickness)
A_6	SMD height (from the mounting surface to the package upper surface, maximum)
A_7	SMD height from the mounting surface to the package top (excluding moving part)
A_8	SMD height from the mounting surface to the package top (at the lock lever open state)
A_9	SMD height from the mounting surface to the upper surface of cap
$Øb_1$	Terminal diameter for ball
$Øb_2$	Ball diameter
C, C_1, C_2	Row spacing. Distance between land centers
CY_1	Courtyard width
CY_2	Courtyard length
D	Package width
D'	Solder balls area width (distance between the centres of the ball of both ends)
E	Package length
E'	Solder balls area length (distance between the centres of the ball of both ends)
E_2	Position of auxiliary terminals
E_3	Upper surface cap width
F_1, F_2	Clearance between signal and center (GND) terminal
F_3	Distance from package-end to terminal-end of signal terminal
F_4	Distance between signal terminals at the package corners
G, G_1, G_2	Distance between lands. Measured from inside edges
H_D	SMD total width
H_E	SMD total length
H_T	Height from the tray stage to the package top
i	Terminal inflection point
J_b	Protrusion length of land over the component terminal
J_H	Heel protrusion length
J_S	Side protrusion length
J_T	Toe protrusion length
k_1, k_2, k_4	Land pattern length
k_3	Distance between land patterns
K_5, K_6	Terminal notch length (toe)
K_7, K_8	Terminal notch height (heel)
L	Terminal flat part length (mounting surface side)
L_0, L_1	Length from the package end to a terminal tip
L_3	Position of auxiliary terminals
L_4	Auxiliary terminal pitch
L_5	Package length at the lock lever open state

Reference symbol	Definition
L_6	Upper surface cap position
L_7	Upper surface cap length
L_P, L_{P1}, L_{P2}	Terminal length (mounting surface side), Projected terminal length (when part of the terminal is away from the mounting surface)
L_{P0}	Terminal length (upper side)
$ØM$	Diameter of auxiliary terminal
N	Coplanarity to mounting surface
$\boxed{P}$	Pitch
q	Land pattern design parameter
R	Terminal bend radius (inside)
R_2	Terminal bend radius (outside)
S	Distance between the terminals. Measured from inside edges
T_T	Tray height from the tray stage to the surface that supports SMD
u_1, u_2	Allowance for courtyard
$ØW$	SMD diameter (terminal)
W_1, W_2	Terminal width
W_3	Bottom centre (GND) terminal length
W_4	Bottom centre (GND) terminal width
W_G	Groove width
W_P	Position tolerance at terminal end
W_V	Variation range of terminal tip outer position
X	Land width
Y	Land length
$ØY$	Land diameter
Z, Z_1, Z_2	Distance between lands. Measured from outside edges
α, β	(Datum symbols)
η	Terminal horizontal angle formed by the groove centre line and the line form the egress to the tip of the terminal
θ	Terminal angle

4 Applicable SMDs

Applicable SMDs are as described below:

a) end-terminal type (components with rectangular or square terminal and cylindrical components with end cap terminal);

NOTE 1 In IEC 61191-2, "toe" solder fillet height is specified but "heel" solder fillet height is not specified for this type of SMD.

b) gull-wing terminals type (e.g. SOP, QFP), inward L-shaped ribbon terminals type and under-body L type (e.g. vertical form aluminium electrolytic capacitor, connector);

NOTE 2 In IEC 61191-2, "heel" solder fillet height is required but "toe" solder fillet height is not required for these SMD.

c) bottom surface terminal type (e.g. BGA, QFN and LGA) and flat lug terminals type.

NOTE 3 These SMDs have characteristics different from a) or b).

5 Requirements

5.1 Figures and dimensional symbols

The figures shown in this document are indicated as examples of typical SMDs. However, it is not the purpose to specify the rule of drawings (such as how to pull out a dimension line and dimensional symbols to be used).

The dimensional symbols in this document are used to show the various cases in order to indicate common requirements for land pattern designs. This document is not intended to integrate dimensional symbols.

NOTE The dimensional symbols used in this document are referring to existing International Standards and industry standards. It is difficult to integrate the dimensional symbols because the definitions of the dimensional symbols are different between these standards. For this reason, the dimensional symbols in this document can differ depending on the figure. The dimensional symbols in this document give priority to coordination with land pattern shape notation given by the IEC 61188-5 series. As a result, the notation for some SMDs can differ from the industry standards.

5.2 Common requirements

5.2.1 General

The common requirements for dimensional drawings of SMDs from the viewpoint of land pattern design are described in 5.2.2 to 5.2.10.

To explain a basic relation between dimensional drawings of SMDs and land pattern design, a representative case is shown in Figure 1 (gull-wing terminals type; 4-pin S-terminals). The quoted reference symbols in 5.2.2 to 5.2.10 are based on Figure 1.

5.2.2 Requirements for solder joint fillet design

To design a land that is a part of the land pattern and makes a solder joint to each terminal of the SMD, the dimensional drawing of the SMD shall have the terminal's dimensions (L_P and W_1 in Figure 1) and the dimensions that specify the location of the terminal (H_E and P in Figure 1). Each dimension should be indicated by a nominal value with its tolerances.

The reasons are as shown below:

a) As a principle, each terminal of the SMD will have its own land.

Land width (X) and land length (Y) are given by the following formulas:

$$X = W_1 + 2 \times J_S$$

$$Y = J_T + L_P + J_H$$

where

X is the land width [mm];

Y is the land length [mm];

W_1 is the terminal width [mm];

L_P is the terminal length [mm];

J_T is the toe protrusion length [mm];

J_H is the heel protrusion length [mm];

J_S is the side protrusion length [mm].

b) As a principle, the location of each land is decided based on the dimensions, such as H_E and P in Figure 1a), which indicate the physical relationship of the soldering terminals of the SMD.

5.2.3 Requirements for courtyard design

The outermost dimensions of the SMD shall be given (e.g. H_E, E, D and A in Figure 1). This is because the courtyard is designed by taking into account the outermost shape after mounting the SMD on the land pattern.

NOTE The courtyard, which is a monopolization area for the SMD on a PCB, is designed based on the shape of the mount state (when the SMD is located on the lands), to prevent mechanical interferences at the time of mounting or assembly. If solder paste openings are outside the maximum extent of the package outline, plus terminals plus lands, the courtyard can be designed based on the outermost shape including solder paste openings. In addition, the courtyard is sometimes designed in consideration of reworkability, electrical insulation, stability of optical inspection, and the like. Therefore, three-dimensional information is required for the courtyard design.

5.2.4 Height parameters

The height of the soldering terminal, A_5 in Figure 1a), shall be given in dimensional drawings of the SMD to determine the land pattern design.

NOTE Generally, the height of soldering terminal is used for the solder joint fillet design to estimate the necessary amount of solder. The height of the SMD is used for spatial design of the PCB assembly, and also used for defining the mounting machine parameters, such as the floating height of the vacuum adsorption nozzle.

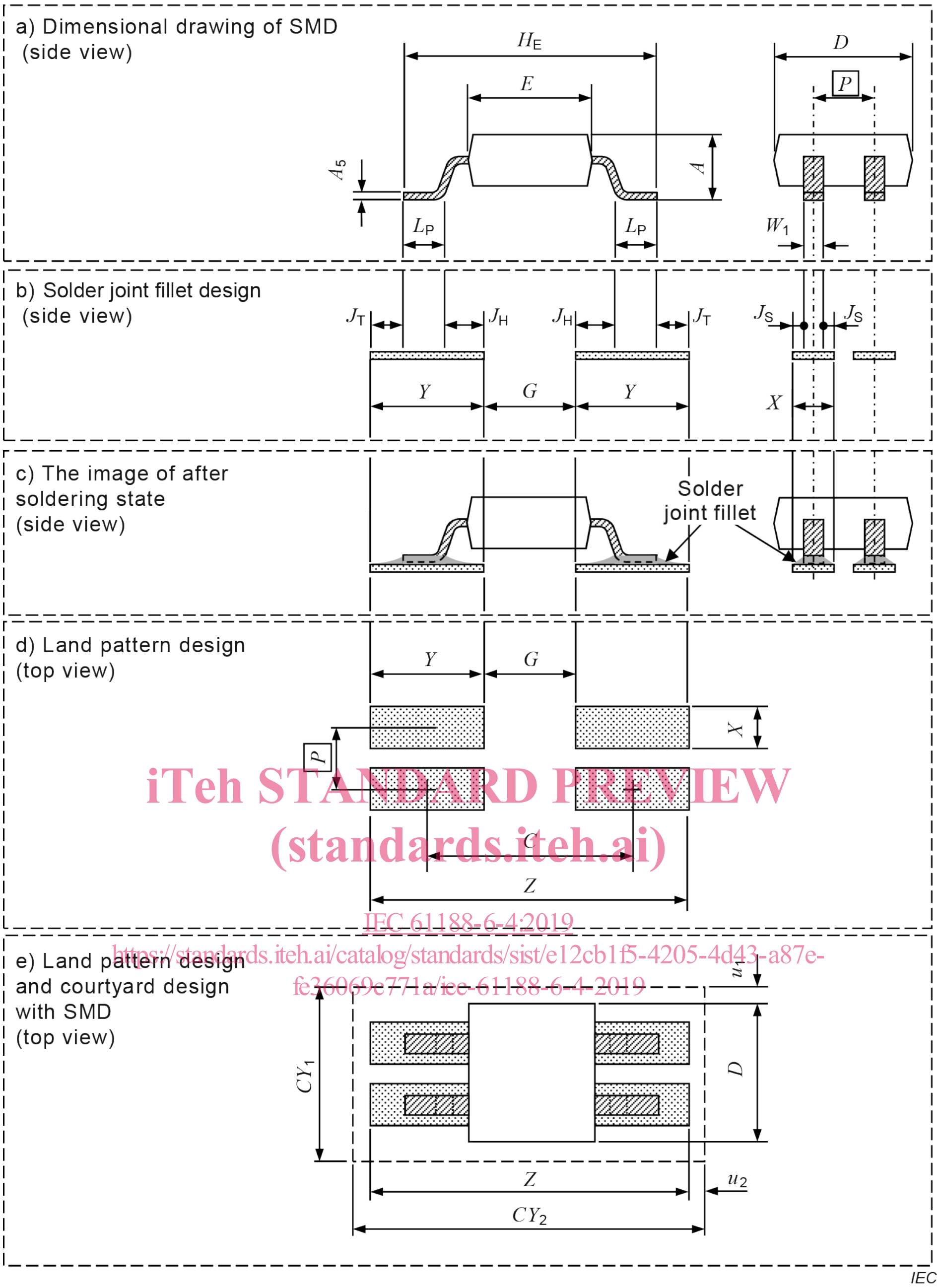


Figure 1 *(1 of 2)*

Key

H_E	SMD total length
E	Package length
D	Package width
W_1	Terminal width
$\boxed{P}$	Pitch
A	SMD height (from the mounting surface to the package upper surface)
A_5	Terminal height (thickness)
L_P	Terminal length
J_T	Toe protrusion length
J_H	Heel protrusion length
J_S	Side protrusion length
X	Land width
Y	Land length
G	Distance between lands. Measured from inside edges
C	Row spacing. Distance between land centers
Z	Distance between lands. Measured from outside edges
CY_1	Courtyard width
CY_2	Courtyard length
u_1, u_2	Allowance for courtyard

Sample image: gull-wing terminals type; 4-pin S-terminals.

NOTE In Figure 1e), the area enclosed by dashed lines is the courtyard.

Figure 1 – Example of the dimensional relationship to the drawings of SMDs, the land pattern design and the after soldering state *(2 of 2)*

5.2.5 Bottom view

In the case of a 2D drawing, a figure of the bottom (attachment side) view should be given in addition to a top view, a side view, and a front view based on trigonometry. If the shape of the SMD can be recognized from the figure of the top view and the side view only, the figures of the front view and the bottom view may be omitted.

NOTE The examples of SMDs shown in Figure 6 and Figure 9 omit the figures of their front and bottom (attachment side) views.

5.2.6 Detail view

If an SMD has a terminal with complicated shape, an additional detail view should be given. If the SMD shape is asymmetrical, the figure showing the relation of the position of the body and terminals shall be given.

5.2.7 Distinguish between metal and resin

In any 2D drawing or 3D data, the conductive metal part and the insulated resin part shall be clearly distinguished, at least for the bottom and the side of the SMD.

5.2.8 Consistency of various dimensions

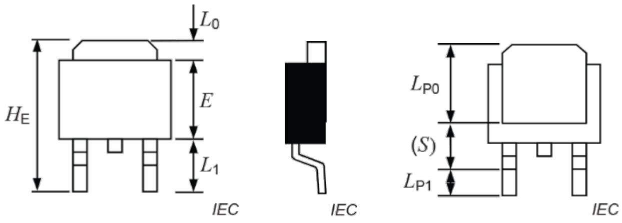
The nominal dimension for any part shall be fixed in one value for land pattern design. For this purpose, the following conditions shall be met:

a) In a 2D drawing and 3D data, the dimension of the SMD shall be given by the nominal value and its tolerances. However, in the case of a 2D drawing, when the nominal value can be considered as the centre value of the maximum value and the minimum value, the nominal value may be omitted.

b) In a 2D drawing for the SMD that has two or more soldering terminals, the dimension of soldering terminals, other metal parts and each soldering terminal distance shall be given in addition to an SMD outline. However, such distance can be given as a reference value.

c) The sum of each part's dimensions shall be consistent with the nominal value of the total width or the total length of the SMD.

With these conditions, even if an asymmetrical SMD, the arrangement of the spatial relationship of all the parts is possible. The example of a case where the sum of each part's dimensions is consistent with the nominal value of the total length H_E is shown in Figure 2.



Top view **Side view** **Bottom view**

EXAMPLE:

The total length of the SMD is equal to the sum of the length of the parts in the top view and in the bottom view.

$$H_E = L_0 + E + L_1 = L_{P0} + S + L_{P1}$$

where

H_E is the SMD total length [mm];

E is the package length [mm];

L_0 is the length from the package end to a terminal tip [mm];

L_1 is the length from the package end to a terminal tip [mm];

L_{P0} is the terminal length [mm];

L_{P1} is the terminal length [mm];

S is the distance between the terminals measured from inside edges [mm].

Figure 2 – Example of dimensional consistency for an asymmetrical SMD

5.2.9 The relation between a land pattern and an element-placement position

When a recommended land pattern along with the outline drawing of an SMD is shown, the information that shows the geometrical relation between a recommended land pattern and the position of the mounted SMD shall be given.

For an asymmetric SMD, draw the common centre line for the outline drawing of the SMD and the recommended land pattern so that the SMD's position on the land pattern can be clearly recognized (refer to Figure 3).