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INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Circuit boards and circuit board assemblies – Design and use –
Part 6-2: Land pattern design – Description of land pattern for the most common surface mounted components (SMD)**

**Cartes imprimées et cartes imprimées équipées – Conception et utilisation –
Partie 6-2: Conception de la zone de report – Description de la zone de report pour les composants montés en surface (CMS) les plus courants**

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CIRCUIT BOARDS AND CIRCUIT BOARD ASSEMBLIES – DESIGN AND USE –

Part 6-2: Land pattern design – Description of land pattern for the most common surface mounted components (SMD)

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

Draft	Report on voting
91/1637/CDV	91/1657/RVC

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

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

Future documents in this series will carry the new general title as cited above. Titles of existing documents in this series will be updated at the time of the next edition.

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CIRCUIT BOARDS AND CIRCUIT BOARD ASSEMBLIES – DESIGN AND USE –

Part 6-2: Land pattern design – Description of land pattern for the most common surface mounted components (SMD)

1 Scope

This part of IEC 61188 describes the requirements of design and use for soldering surfaces of land pattern on circuit boards. This document includes land pattern for surface mounted components. These requirements are based on the solder joint requirements of IEC 61191-2:2017.

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

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IEC 61188-6-1, *Circuit boards and circuit board assemblies – Design and use – Part 6-1: Land pattern design – Generic requirements for land pattern on circuit boards*

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IEC 61188-6-4, *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*

IEC 61191-2:2017, *Printed board assemblies – Part 2: Sectional specification – Requirements for surface mount soldered assemblies*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60194-2 and IEC 61188-6-1 apply.

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

- IEC Electropedia: available at http://www.electropedia.org/
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4 Kinds of target solder process

Typical soldering methods used in surface mount technology include, but are not limited to:

a) reflow soldering for all process types;

b) wave soldering of surface mounted component.

5 Land pattern determination

This standard discusses the following method of providing information on land patterns.

For each typical termination type, one land pattern for one termination will be determined by formulas based on the termination dimensions (nominal value).

The assumption is that the following dimensions have the necessary and sufficient accuracy:

a) component tolerance;

c) printed board fabrication tolerance;

d) placement tolerance.

NOTE Further information on the effect of the above dimensional tolerance on the land pattern can be found in Annex A of IEC 61188-6-1:2021.

There are two classes of land pattern relating to the assembly limitations of components and the intended soldering process:

- land pattern for wave soldering – For low density product applications, land patterns are designed to accommodate several types of wave soldering applicable to surface mounted components.
- land pattern for reflow soldering – The land patterns generated for all device families shall provide a robust solder attachment condition for reflow soldering.

6 Requirements

6.1 General requirements

The calculated land pattern geometry for an electronic component can be different depending upon the type of soldering process to be used. Wherever possible, land patterns should be defined in such a manner that are transparent to the attachment process being used. Land pattern designers can use the information contained herein to establish standard configurations not only for manual designs but also for computer-aided design systems.

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Whether parts are mounted on one side or both sides of the board, subjected to wave soldering, reflow soldering, or other type of soldering, the land pattern and part dimensions should be optimized to insure proper solder joint and inspection criteria.

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Although patterns are dimensionally defined and since they are a part of the circuit board geometry, they are subject to the reducibility levels and tolerances associated with plating, etching, assembly or other conditioning process. The producibility aspects also pertain to the use of solder mask and the registration required between the solder mask and the conductor patterns.

A correctly designed land pattern is essential to satisfy quality standards such as IEC 61191-2:2017, which specifies generic requirements for the concept of land pattern design. The land pattern designer should design in accordance with the concept in this document, and they could adopt appropriate numeric values that were suitable for their purpose. The numeric values described in this document are the parameters that were selected as references to show the concept of land-pattern design.

6.2 The proposed land pattern dimension system

6.2.1 Land pattern design

Distance between lands measured from outside edges (Z) and distance between lands measured from inside edges (G) are given by the following Formula (1) and Formula (2).

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

Figure 1 shows a typical example of the relationship between the land pattern design and the component dimensions. The requirements contained in IEC 61188-6-4 about the relationship between dimensions shall apply.

$$Z = H_{\mathrm{E}} + 2 \times J_{\mathrm{T}} \quad (1)$$

$$G = S - 2 \times J_{\mathrm{H}} \quad (2)$$

where:

Z is the distance between lands, expressed in mm. Measured from outside edges;

G is the distance between lands, expressed in mm. Measured from inside edges;

H_E is the SMD total length (nominal), expressed in mm;

S is the distance between the solder terminals measured from inside edges, expressed in mm;

J_T is the toe protrusion length, expressed in mm;

J_H is the heel protrusion length, expressed in mm.

6.2.2 Solder joint fillet design

Land width (X) and land length (Y) are given by the following Formula (3) and Formula (4).

$$X = W_1 + 2 \times J_S \quad (3)$$

$$Y = J_T + L_P + J_H \quad (4)$$

where

X is the land width (nominal), expressed in mm;

Y is the land length (nominal), expressed in mm;

W_1 is the terminal width (nominal), expressed in mm;

L_P is the solder terminal length (nominal), expressed in mm;

J_T is the toe protrusion length, expressed in mm;

J_H is the heel protrusion length, expressed in mm;

J_S is the side protrusion length, expressed in mm.

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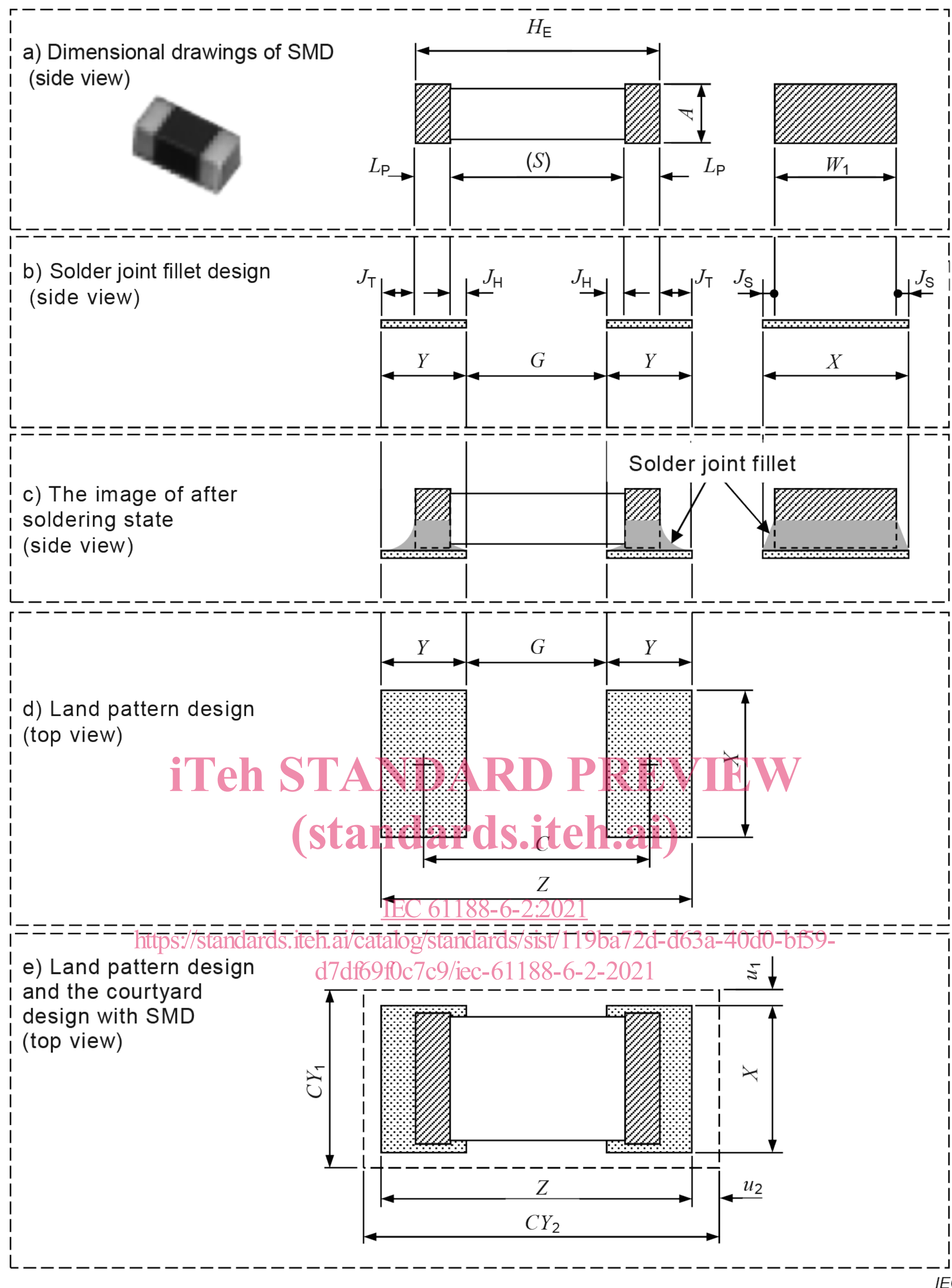

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Key

H_E	SMD total length (nominal)	X	Land width
W_1	Terminal width (nominal)	Y	Land length
A	SMD height (from the mounting surface to the package upper surface) (nominal)	G	Distance between lands. Measured from inside edges
L_P	Solder terminal length (mounting surface side) (nominal)	C	Row spacing. Distance between land centers
S	Distance between the solder terminals. Measured from inside edges	Z	Distance between lands. Measured from outside edges
J_T	Toe protrusion length	CY_1	Courtyard width
J_H	Heel protrusion length	CY_2	Courtyard length
J_S	Side protrusion length	u_1, u_2	Allowance for courtyard

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

Figure 1 – Example of the dimensional relationship between the drawings of components with rectangular terminals and the land pattern design

6.2.3 Courtyard excess

Since courtyard excess is influenced by equipment performance, part size accuracy, provision for rework, etc., it should be desirable for the user to decide it. Therefore, in this document, courtyard excess is indicated as a reference value in Annex C.

6.2.4 Rounding factor

The rounding factor of the land pattern dimension should be 0,01 mm in general. However, if the rounding factor exceeds 10 % of the dimension, the rounding factor can be decreased to 0,005 mm.

6.2.5 Relationship between terminal classifications and class of land pattern

Relationship between terminal classifications and class of land pattern are given in Table 1.

For the relationship between each terminal type contained in the terminal classifications and component classifications, see Annex A.

Table 1 – Relationship between terminal classifications and class of land pattern

Terminal classification	Class of land pattern	
	For wave soldering	For reflow soldering
Flat bottom terminals	**6.3.2** (The basic design rule is not defined)	**6.4.1** The basic design rule is shown in Table 3
Flat bottom and vertical side terminals	**6.3.3** Available termination types are shown in Table 2 (The basic design rule is not defined)	**6.4.2** The basic design rule is shown in Table 4

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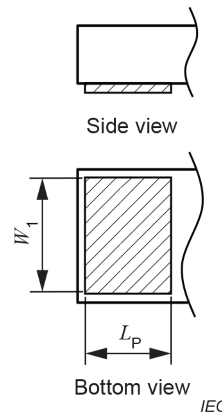
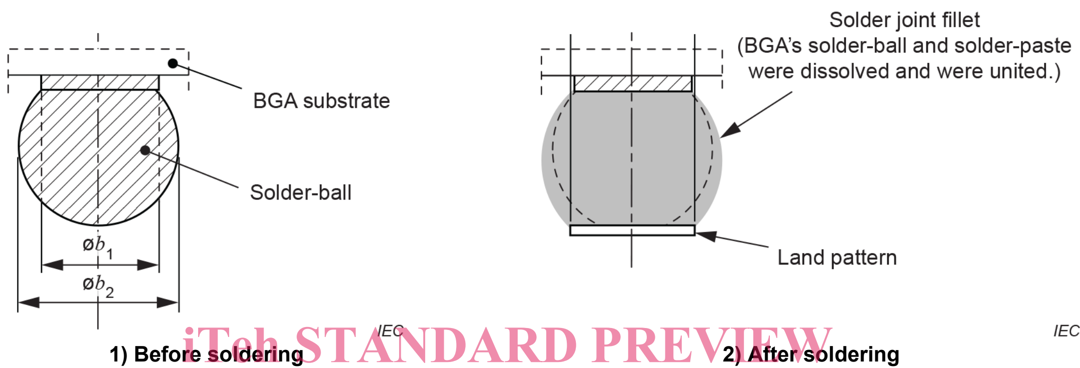
6.2.6 Terminal types

Figure 2 shows the flat bottom terminal types, and Figure 3 shows the Flat bottom and vertical side terminal types with dimension symbols used in this document.



a) **Bottom only chip terminal**



1) Before soldering   2) After soldering

b) **BGA terminal**

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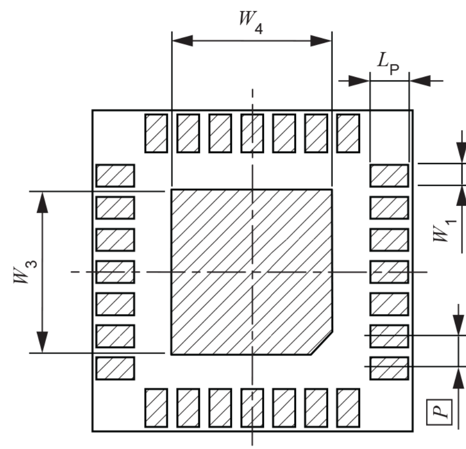


c) **BTC (QFN) terminal**

Key

$\varnothing b_1$ Terminal diameter for ball

$\varnothing b_2$ Ball diameter

L_P Solder terminal length (mounting surface side)

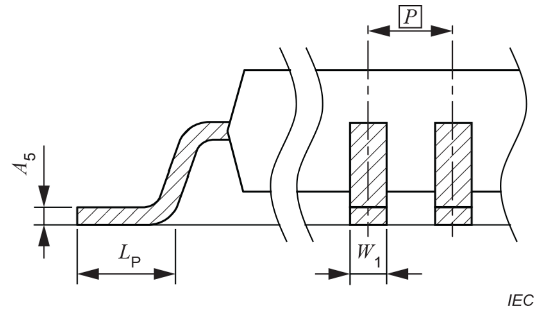
P Pitch

W_1 Terminal width

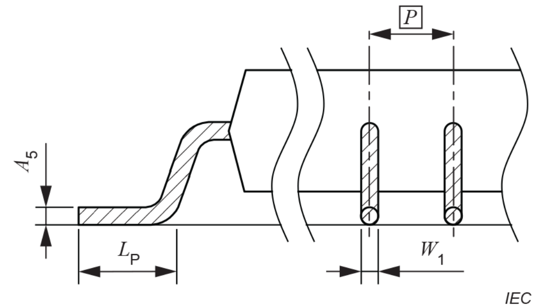
W_3 Bottom centre (GND) terminal length

W_4 Bottom centre (GND) terminal width

Figure 2 – Definitions of dimensions of the flat bottom terminal types



a) Flat ribbon L and gull-wing terminal



b) Round or flattened (coined) terminal

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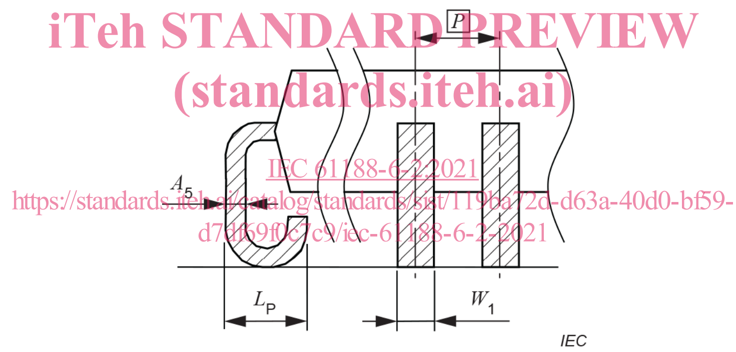
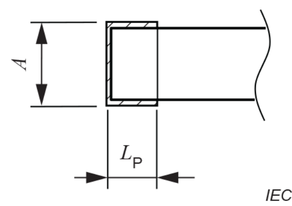
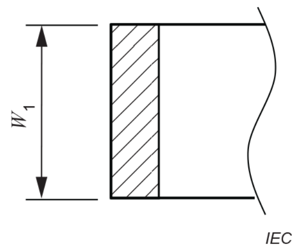


c) J terminal

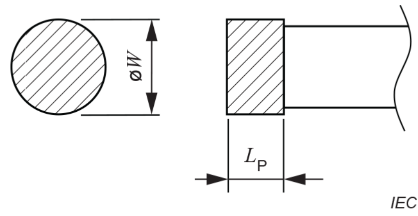


Side view

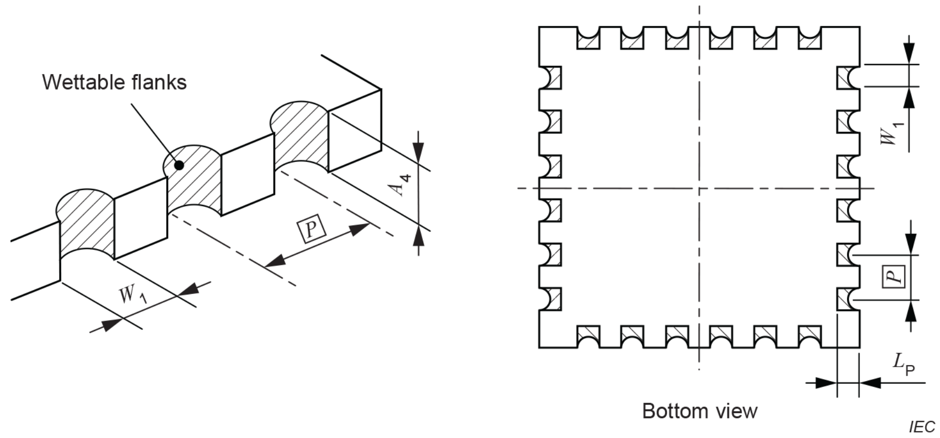


Bottom view

d) Rectangular or square end terminal



e) **Cylindrical End Cap terminal**



f) **Castellated terminal**

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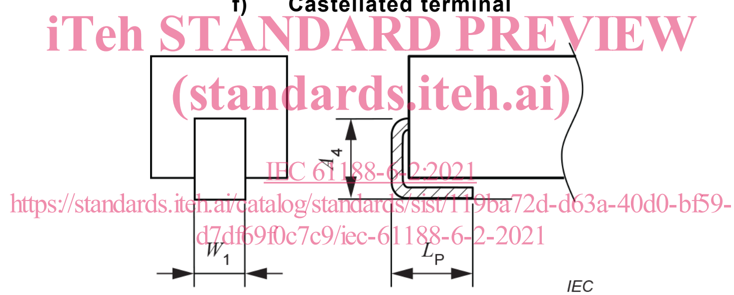
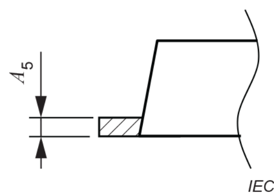
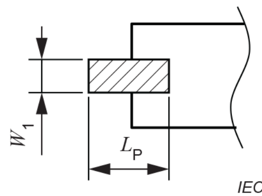
https://standards.iteh.ai/catalog/standards/sist/119ba72d-d63a-40d0-bf59-d7df69f0c7c9/iec-61188-6-2-2021



g) **Inward L-shaped ribbon terminal**



Side View



Bottom View

h) **Flat lug terminal**