IEC 61188-5-3

Edition 1.0 2007-10

INTERNATIONAL STANDARD

**Printed boards and printed board assemblies – Design and use –
Part 5-3: Attachment (land/joint) considerations – Components with gull-wing leads on two sides**

IEC 61188-5-3:2007(E)

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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

PRICE CODE U

ICS 31.180

ISBN 2-8318-9340-2

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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PRINTED BOARDS AND PRINTED BOARD ASSEMBLIES – DESIGN AND USE –

Part 5-3: Attachment (land/joint) considerations – Components with gull-wing leads on two sides

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International Standard IEC 61188-5-3 has been prepared by IEC technical committee 91: Electronics assembly technology.

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

FDIS	Report on voting
91/702/FDIS	91/734/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.

IEC 61188-5-3 is to be read in conjunction with IEC 61188-5-1.

A list of all parts of the IEC 61188 series, 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 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- withdrawn;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 standard may be issued at a later date.

INTRODUCTION

This part of IEC 61188 covers land patterns for components with gull-wing leads on two sides. Each clause contains information in accordance with the following format:

The proposed land pattern dimensions in this standard are based upon the fundamental tolerance calculation combined with the given land protrusions and courtyard excesses (see IEC 61188-5-1, Generic requirements). The courtyard includes all issues of the normal manufacturing necessities.

The unaltered land pattern dimensions of this part are generally applicable for the solder paste application plus reflow soldering process. For application of the wave soldering process, the land pattern dimensions normally have to be modified. Orientation parallel to the wave direction is preferable and special, suitably dimensioned solder thieves should be added.

This standard offers a threefold land pattern dimensioning (levels 1, 2, and 3) on the basis of a threefold set of land protrusions and courtyard excesses: maximum (max.); median (mdn) and minimum (min.). Each land pattern has been assigned an identification number to indicate the characteristics of the specific robustness of the land patterns. Users also have the opportunity to organize the information so that it is most useful for their particular design.

If a user has good reason to use a concept different from that of IEC 61188-5-1 or if the user prefers unusual land protrusions, this standard should be used for checking the resulting solder fillet size.

It is the responsibility of the user to verify the SMD land patterns used for achieving an undisturbed mounting process including testing and an ensured reliability for the product stress conditions in use.

Component dimensions listed in this standard are those available on the market and regarded as for reference only.

PRINTED BOARDS AND PRINTED BOARD ASSEMBLIES – DESIGN AND USE –

Part 5-3: Attachment (land/joint) considerations – Components with gull-wing leads on two sides

1 Scope

This part of IEC 61188 provides information on land pattern geometries used for the surface attachment of electronic components with gull-wing leads on two sides. The intent of the information presented herein is to provide the appropriate size, shape and tolerances of surface mount land patterns to ensure sufficient area for the appropriate solder fillet, and also allow for inspection, testing and reworking of those solder joints.

Each clause contains a specific set of criteria such that the information presented is consistent, providing information on the component, the component dimensions, the solder joint design, and the land pattern dimensions.

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 61188-5-1, *Printed boards and printed board assemblies – Design and use – Part 5-1: Attachment (land/joint) considerations – Generic requirements*

3 General information

3.1 General component description

The acronyms TSOP (thin small outline package), SOP (small outline package) and SSOP (shrink small outline package) are also used to describe the family.

3.2 Marking

The TSOP, SOP and SSOP families of parts are generally marked with the manufacturer's part numbers, manufacturer's name or symbol, and a pin 1 indicator. Some parts may have a pin 1 feature in the case shape instead of pin 1 marking. Additional markings may include date-code manufacturing lot and/or manufacturing location.

3.3 Carrier packaging format

Carrier packaging format may be provided in a tray carrier, but tape and reel carriers are preferred for best handling and high volume applications. Bulk packaging is not acceptable because of lead co-planarity required for placement and soldering.

3.4 Process considerations

TSOP, SOP and SSOP packages are normally processed by reflow solder operations.

The land pattern dimensions are based on a mathematical model that establishes a platform for a solder joint attachment to the printed board. The existing models create a platform that is capable of establishing a reliable solder joint no matter what solder alloy is used to make that joint (lead-free, tin lead, etc.)

Process requirements for solder reflow are different based on the solder alloy and should be analyzed in order that the process is above the liquidus temperature of the alloy, and remains above that temperature a sufficient time to form a reliable metallurgical bond.

4 TSOP (Type 1)

4.1 Field of application

This clause provides the component and land pattern dimensions for TSOP (Type 1) components. Basic construction is also covered. Subclause 4.4 lists the tolerances and target solder joint dimensions used to arrive at the land pattern dimensions.

4.2 Component description

Figure 1 shows a typical construction example.

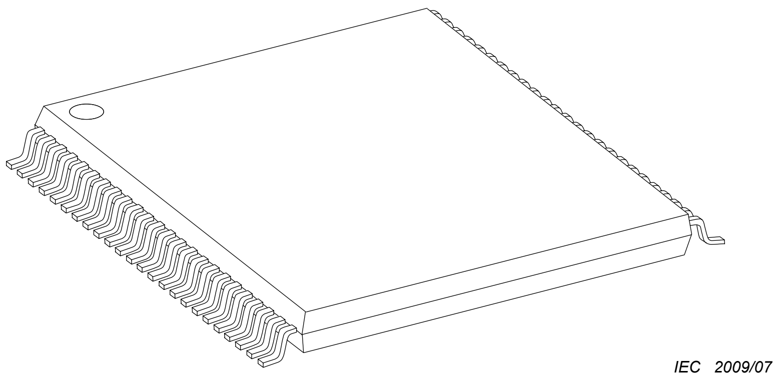
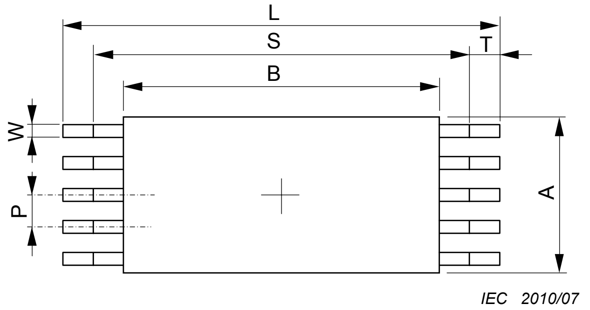


Figure 1 – TSOP (Type 1) construction

4.3 Component dimensions

Figure 2 shows the component dimensions for TSOP (Type 1) components.

Land pattern dimensional data may need to be adjusted if the component dimensional data does not match JEDEC and/or JEITA data sheets.



Dimensions in millimetres

Component identification	Pin count	L		W		T		S*		A		B		H	P
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Max.	Basic
TSOP 6x14	16	13,8	14,2	0,17	0,27	0,40	0,75	12,3	12,94	5,80	6,20	12,2	12,6	1,20	0,65
TSOP 6x16	24	15,8	16,2	0,17	0,23	0,40	0,75	14,3	14,94	5,80	6,20	14,2	14,6	1,20	0,5
TSOP 6x18	28	17,8	18,2	0,13	0,19	0,40	0,75	16,3	16,94	5,80	6,20	16,2	16,6	1,20	0,4
TSOP 6x20	36	19,8	20,2	0,09	0,15	0,40	0,75	18,3	18,94	5,80	6,20	18,2	18,6	1,20	0,3
TSOP 8x14	24	13,8	14,2	0,17	0,27	0,40	0,75	12,3	12,94	7,80	8,20	12,2	12,6	1,20	0,65
TSOP 8x16	32	15,8	16,2	0,17	0,23	0,40	0,75	14,3	14,94	7,80	8,20	14,2	14,6	1,20	0,5
TSOP 8x18	40	17,8	18,2	0,13	0,19	0,40	0,75	16,3	16,94	7,80	8,20	16,2	16,6	1,20	0,4
TSOP 8x20	52	19,8	20,2	0,09	0,15	0,40	0,75	18,3	18,94	7,80	8,20	18,2	18,6	1,20	0,3
TSOP 10x14	28	13,8	14,2	0,17	0,27	0,40	0,75	12,3	12,94	9,80	10,20	12,2	12,6	1,20	0,65
TSOP 10x16	40	15,8	16,2	0,17	0,23	0,40	0,75	14,3	14,94	9,80	10,20	14,2	14,6	1,20	0,5
TSOP 10x18	48	17,8	18,2	0,13	0,19	0,40	0,75	16,3	16,94	9,80	10,20	16,2	16,6	1,20	0,4
TSOP 10x20	64	19,8	20,2	0,09	0,15	0,40	0,75	18,3	18,94	9,80	10,20	18,2	18,6	1,20	0,3
TSOP 12x14	36	13,8	14,2	0,17	0,27	0,40	0,75	12,3	12,94	11,80	12,20	12,2	12,6	1,20	0,65
TSOP 12x16	48	15,8	16,2	0,17	0,23	0,40	0,75	14,3	14,94	11,80	12,20	14,2	14,6	1,20	0,5
TSOP 12x18	60	17,8	18,2	0,13	0,19	0,40	0,75	16,3	16,94	11,80	12,20	16,2	16,6	1,20	0,4
TSOP 12x20	76	19,8	20,2	0,09	0,15	0,40	0,75	18,3	18,94	11,80	12,20	18,2	18,6	1,20	0,3

* Calculated value.

Figure 2 – TSOP (Type 1) – Component dimensions

4.4 Solder joint fillet design

Figure 3 shows the dimensions of the solder fillet after the soldering process. The minimum, median and maximum dimensions of each of toe, heel and side fillet are determined by taking into consideration solder joint reliability and also quality and productivity in the mounting process of parts.

In designing land patterns, three accuracy factors need to be taken into consideration:

- parts dimensions accuracy (C);
- parts mount accuracy on PWBs (P);
- land shape accuracy of PWBs (F),

in addition to fillet dimensions. The formulae to obtain the tolerance resulting from these factors are basically as follows:

a) Design consideration when soldered without self-alignment effect (level 1)

In the flow soldering process, there is no self-alignment effect. Thus, the formulae cannot be simplified but remain the same, as follows:

$Zmax = Lmin + 2J_T\,max + T_T$ $T_T = \sqrt{F_{L1}^2 + P_{L1}^2 + C_L^2}$

$Gmin = Smax\,(rms) - 2J_H\,max - T_H$ $T_H = \sqrt{F_{L1}^2 + P_{L1}^2 + C_S^2}$

$Xmax = Wmin + 2J_S\,max + T_S$ $T_S = \sqrt{F_{L1}^2 + P_{L1}^2 + C_W^2}$

b) Design consideration when soldered without self-alignment effect (Level 2)

$Zmax = Lmin + 2J_T\,mdn + T_T$ $T_T = \sqrt{F_{L2}^2 + P_{L2}^2 + C_L^2}$

$Gmin = Smax(rms) - 2J_H\,mdn - T_H$ $T_H = \sqrt{F_{L2}^2 + P_{L2}^2 + C_S^2}$

$Xmax = Wmin + 2J_S\,mdn + T_S$ $T_S = \sqrt{F_{L2}^2 + P_{L2}^2 + C_W^2}$

c) Design consideration when soldered with self-alignment effect (Level 3)

$Zmax = Lmin + 2J_T\,min + T_T$ $T_T = \sqrt{F_{L3}^2 + P_{L3}^2 + C_L^2}$

$Gmin = Smax(rms) - 2J_H\,min - T_H$ $T_H = \sqrt{F_{L3}^2 + P_{L3}^2 + C_S^2}$

$Xmax = Wmin + 2\,J_S\,min + T_S$ $T_S = \sqrt{F_{L3}^2 + P_{L3}^2 + C_W^2}$

In the reflow soldering process, there is a self-alignment effect. In the surface mount process of reflow soldering, parts mount displacement when soldered can be cancelled by self-alignment effect (therefore factor P can be regarded as 0). In addition, the tolerance of the land shape accuracy of PWBs is about ±30 μm, and this is extremely small when compared with that of the parts dimensions accuracy (therefore factor F can be regarded also as 0). Thus, the formulae can be simplified as follows:

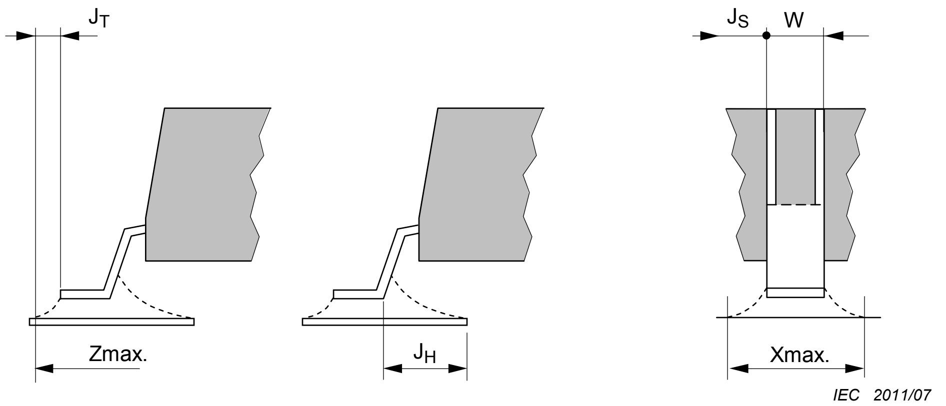
$T_T = C_L$, $Zmax = Lmin + 2J_Tmin + C_L = Lmax + 2J_Tmin$

$T_H = C_S$, $Gmin = Smax\,(rms) - 2J_Hmin - C_S$

$T_S = C_W$, $Xmax = Wmin + 2J_Smin + C_W = Wmax + 2J_Smin$

In addition, the value Gmin ≥ B is also necessary so that the land should not be hidden under the TSOP. The stand-off of the component mould is nearly zero. The land pattern design should be made to prevent the lead from floating caused by the solder under the component.

Any tolerance other than the above may be used depending on the soldering strength required, the capability of the production process used, and so on.



Dimensions in millimetres

Component	Tolerance assumptions		Solder joint											
			Toe				Heel				Side			
	F	P	J_T				J_H				J_S			
	L-1/L-2/L-3	L-1/L-2/L-3	C_L	Max.	Mdn	Min.	C_S	Max.	Mdn	Min.	C_W	Max.	Mdn	Min.
0,65	0,10	0,10	0,4	0,55	0,35	0,15	0,64	0,50	0,35	0,20	0,10	0,05	0,0	0,0
0,50	0,10	0,10	0,4	0,55	0,35	0,15	0,64	0,20	0,20	0,20	0,06	0,0	0,0	0,0
0,40	0,10	0,10	0,4	0,55	0,35	0,15	0,64	0,20	0,20	0,20	0,06	0,0	0,0	0,0
0,30	0,10	0,10	0,4	0,55	0,35	0,15	0,64	0,20	0,20	0,20	0,06	0,0	0,0	0,0

Figure 3 – Solder joint fillet design (see IEC 61188-5-1, Tables 2 and 3)

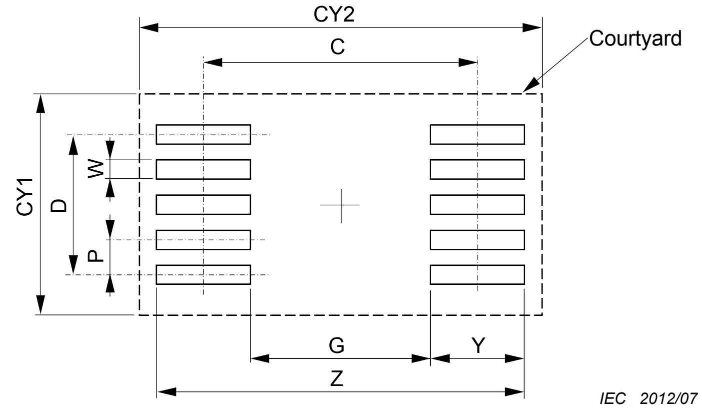
4.5 Land pattern dimensions

Figure 4 shows the land pattern dimensions for TSOP (Type 1) for reflow and flow soldering. These values are calculated based on the formula for the solder joint fillet design of 4.4.

The courtyard is calculated using the following formula and rounded up (round up factor is to the nearest 0,05 mm for minimum values and to the nearest 0,5 mm for maximum values).

$$CY_1 = (\text{Amin} + \sqrt{F^2 + P^2 + C_A{}^2}\,) + (\text{courtyard excess} \times 2)$$

$$CY_2 = \{\text{whichever larger } [\text{Lmin} + \sqrt{F^2 + P^2 + C_L{}^2}\,] \text{ or } [Z]\} + (\text{courtyard excess} \times 2)$$



Dimensions in millimetres

Level 1

Pattern identifier	Component identifier	Z	G	X	Y	C	D	P	CY1	CY2
3000M	TSOP 6x14	15,4	12,4	0,35	1,5	13,9	3,9	0,65	8,0	17,0
3001M	TSOP 6x16	17,4	14,4	0,33	1,5	15,9	3,5	0,50	8,0	19,0
3002M	TSOP 6x18	19,4	16,4	0,29	1,5	17,9	3,2	0,40	8,0	21,0
3004M	TSOP 8x14	15,4	12,4	0,35	1,5	13,9	3,9	0,65	10,0	17,0
3005M	TSOP 8x16	17,4	14,4	0,33	1,5	15,9	3,5	0,50	10,0	19,0
3006M	TSOP 8x18	19,4	16,4	0,29	1,5	17,9	3,2	0,40	10,0	21,0
3008M	TSOP 10x14	15,4	12,4	0,35	1,5	13,9	3,9	0,65	12,0	17,0
3009M	TSOP 10x16	17,4	14,4	0,33	1,5	15,9	3,5	0,50	12,0	19,0
3010M	TSOP 10x18	19,4	16,4	0,29	1,5	17,9	3,2	0,40	12,0	21,0
3012M	TSOP 12x14	15,4	12,4	0,35	1,5	13,9	3,9	0,65	14,0	17,0
3013M	TSOP 12x16	17,4	14,4	0,33	1,5	15,9	3,5	0,50	14,0	19,0
3014M	TSOP 12x18	19,4	16,4	0,29	1,5	17,9	3,2	0,40	14,0	21,0

Level 2

Pattern identifier	Component identifier	Z	G	X	Y	C	D	P	CY1	CY2
3000N	TSOP 6x14	15,0	12,4	0,35	1,3	13,7	3,9	0,65	7,0	15,5
3001N	TSOP 6x16	17,0	14,4	0,33	1,3	15,7	3,5	0,50	7,0	17,5
3002N	TSOP 6x18	19,0	16,4	0,29	1,3	17,7	3,2	0,40	7,0	19,5
3004N	TSOP 8x14	15,0	12,4	0,35	1,3	13,7	3,9	0,65	9,0	15,5
3005N	TSOP 8x16	17,0	14,4	0,33	1,3	15,7	3,5	0,50	9,0	17,5
3006N	TSOP 8x18	19,0	16,4	0,29	1,3	17,7	3,2	0,40	9,0	19,5
3008N	TSOP 10x14	15,0	12,4	0,35	1,3	13,7	3,9	0,65	11,0	15,5
3009N	TSOP 10x16	17,0	14,4	0,33	1,3	15,7	3,5	0,50	11,0	17,5
3010N	TSOP 10x18	19,0	16,4	0,29	1,3	17,7	3,2	0,40	11,0	19,5
3012N	TSOP 12x14	15,0	12,4	0,35	1,3	13,7	3,9	0,65	13,0	15,5
3013N	TSOP 12x16	17,0	14,4	0,33	1,3	15,7	3,5	0,50	13,0	17,5
3014N	TSOP 12x18	19,0	16,4	0,29	1,3	17,7	3,2	0,40	13,0	19,5

Level 3										
Pattern identifier	Component identifier	Z	G	X*	Y	C	D	P	CY1	CY2
3000L	TSOP 6x14	14,50	12,40	0,30	1,05	13,45	3,90	0,65	6,5	14,7
3001L	TSOP 6x16	16,50	14,40	0,25	1,05	15,45	3,50	0,50	6,5	16,7
3002L	TSOP 6x18	18,50	16,40	0,20	1,05	17,45	3,20	0,40	6,5	18,7
3003L	TSOP 6x20	20,50	18,40	0,15	1,05	19,45	2,70	0,30	6,5	20,7
3004L	TSOP 8x14	14,50	12,40	0,30	1,05	13,45	3,90	0,65	8,5	14,7
3005L	TSOP 8x16	16,50	14,40	0,25	1,05	15,45	3,50	0,50	8,5	16,7
3006L	TSOP 8x18	18,50	16,40	0,20	1,05	17,45	3,20	0,40	8,5	18,7
3007L	TSOP 8x20	20,50	18,40	0,15	1,05	19,45	2,70	0,30	8,5	20,7
3008L	TSOP 10x14	14,50	12,40	0,30	1,05	13,45	3,90	0,65	10,5	14,7
3009L	TSOP 10x16	16,50	14,40	0,25	1,05	15,45	3,50	0,50	10,5	16,7
3010L	TSOP 10x18	18,50	16,40	0,20	1,05	17,45	3,20	0,40	10,5	18,7
3011L	TSOP 10x20	20,50	18,40	0,15	1,05	19,45	2,70	0,30	10,5	20,7
3012L	TSOP 12x14	14,50	12,40	0,30	1,05	13,45	3,90	0,65	12,5	14,7
3013L	TSOP 12x16	16,50	14,40	0,25	1,05	15,45	3,50	0,50	12,5	16,7
3014L	TSOP 12x18	18,50	16,40	0,20	1,05	17,45	3,20	0,40	12,5	18,7
3015L	TSOP 12x20	20,50	18,40	0,15	1,05	19,45	2,70	0,30	12,5	20,7

* When the X dimension is used, it is necessary to confirm whether the space between adjacent land patterns is proper.

Figure 4 – TSOP (Type 1) – Land pattern dimensions

5 TSOP (Type 2)

5.1 Field of application

This clause provides the component and land pattern dimensions for TSOPs (Type 2). Basic construction of the TSOP device is also covered. Subclause 5.4 lists the tolerances and target solder joint dimensions used to arrive at the land pattern dimensions.

5.2 Component description

Figure 5 shows a typical construction example.

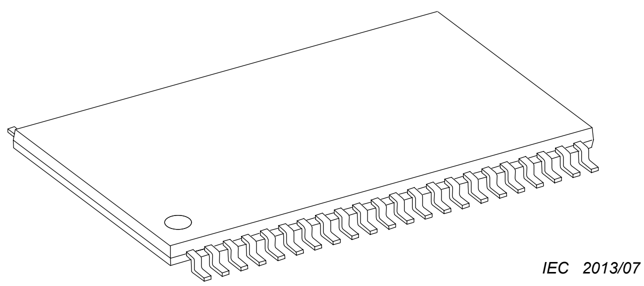
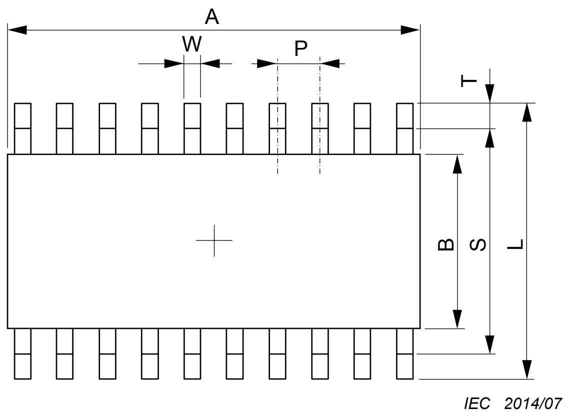


Figure 5 – TSOP (Type 2) construction

5.3 Component dimensions

Figure 6 shows the component dimensions for TSOP (Type 2) components.

Land pattern dimensional data may need to be adjusted if the component dimensional data does not match JEDEC and/or JEITA data sheets.



Dimensions in millimetres

Component identification	Pin count	L		W		T		S*		A		B		H	P
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Max.	Basic
TSOP 300mil	26	9,02	9,42	0,35	0,45	0,45	0,75	7,52	8,10	16,94	17,34	7,42	7,82	1,20	1,27
TSOP 300mil	44	9,02	9,42	0,25	0,35	0,45	0,75	7,52	8,10	18,21	18,61	7,42	7,82	1,20	0,80
TSOP 300mil	42	9,02	9,42	0,17	0,27	0,45	0,75	7,52	8,10	14,40	14,80	7,42	7,82	1,20	0,65
TSOP 350mil	26	10,29	10,69	0,35	0,45	0,45	0,75	8,79	9,37	16,94	17,34	8,69	9,09	1,20	1,27
TSOP 400mil	28	11,56	11,96	0,35	0,45	0,45	0,75	10,06	10,64	18,21	18,61	9,96	10,36	1,20	1,27
TSOP 400mil	44	11,56	11,96	0,25	0,35	0,45	0,75	10,06	10,64	18,21	18,61	9,96	10,36	1,20	0,80
TSOP 400mil	54	11,56	11,96	0,17	0,27	0,45	0,75	10,06	10,64	18,21	18,61	9,96	10,36	1,20	0,65
TSOP 400mil	70	11,56	11,96	0,17	0,23	0,45	0,75	10,06	10,64	18,21	18,61	9,96	10,36	1,20	0,50
TSOP 500mil	48	14,10	14,50	0,25	0,35	0,45	0,75	12,6	13,18	19,48	19,88	12,50	12,90	1,20	0,80
TSOP 0130	66	13,30	13,70	0,17	0,27	0,45	0,75	11,8	12,38	21,80	22,20	11,30	11,70	1,20	0,65
TSOP 0130	86	13,30	13,70	0,17	0,23	0,45	0,75	11,8	12,38	21,80	22,20	11,30	11,70	1,20	0,50
TSOP 0145	78	16,30	16,70	0,17	0,27	0,45	0,75	14,8	15,8	25,55	25,95	14,30	14,70	1,20	0,65
TSOP 0160	40	17,80	18,20	0,35	0,45	0,45	0,75	16,3	16,88	25,55	25,95	15,80	16,20	1,20	1,25
TSOP 0160	62	17,80	18,20	0,25	0,35	0,45	0,75	16,3	16,88	25,55	25,95	15,80	16,20	1,20	0,80
TSOP 0160	88	17,80	18,20	0,17	0,27	0,45	0,75	16,3	16,88	29,30	29,70	15,80	16,20	1,20	0,65

* Calculated value.

Figure 6 – TSOP (Type 2) – Component dimensions

5.4 Solder joint fillet design

Figure 7 shows dimensions of the solder fillet after soldering process. The minimum, median, and maximum dimensions of each of toe, heel, and side fillet are determined by taking into consideration solder joint reliability, and also quality and productivity in the mounting process of parts.

In designing land patterns, three accuracy factors need to be taken into consideration:

– parts dimensions accuracy (C);
– parts mount accuracy on PWBs (P);
– land shape accuracy of PWBs (F);

in addition to fillet dimensions. The formulae to obtain the tolerance resulting from these factors are basically as follows:

a) Design consideration when soldered without self-alignment effect (level 1)

In the flow soldering process, there is no self-alignment effect. Thus, the formulae cannot be simplified but remain the same as follows:

$$Zmax = Lmin + 2J_T \max + T_T \qquad T_T = \sqrt{F_{L1}^2 + P_{L1}^2 + C_L^2}$$

$$Gmin = Smax\,(rms) - 2J_H \max - T_H \qquad T_H = \sqrt{F_{L1}^2 + P_{L1}^2 + C_S^2}$$

$$Xmax = Wmin + 2J_S \max + T_S \qquad T_S = \sqrt{F_{L1}^2 + P_{L1}^2 + C_W^2}$$

b) Design consideration when soldered without self-alignment effect (level 2)

$$Zmax = Lmin + 2J_T\, mdn + T_T \qquad T_T = \sqrt{F_{L2}^2 + P_{L2}^2 + C_L^2}$$

$$Gmin = Smax(rms) - 2J_H\, mdn - T_H \qquad T_H = \sqrt{F_{L2}^2 + P_{L2}^2 + C_S^2}$$

$$Xmax = Wmin + 2J_S\, mdn + T_S \qquad T_S = \sqrt{F_{L2}^2 + P_{L2}^2 + C_W^2}$$

c) Design consideration when soldered with self-alignment effect (level 3)

$$Zmax = Lmin + 2J_T \min + T_T \qquad T_T = \sqrt{F_{L3}^2 + P_{L3}^2 + C_L^2}$$

$$Gmin = Smax(rms) - 2J_H \min - T_H \qquad T_H = \sqrt{F_{L3}^2 + P_{L3}^2 + C_S^2}$$

$$Xmax = Wmin + 2\,J_S \min + T_S \qquad T_S = \sqrt{F_{L3}^2 + P_{L3}^2 + C_W^2}$$

In the reflow soldering process, there is a self-alignment effect. In the surface mount process of reflow soldering, parts mount displacement when soldered can be cancelled by self-alignment effect (therefore factor P can be regarded as 0). In addition, the tolerance of the land shape accuracy of PWBs is about ±30µm, and this is extremely small when compared with that of the parts dimensions accuracy (therefore factor F can be regarded also as 0). Thus, the formulae can be simplified as follows:

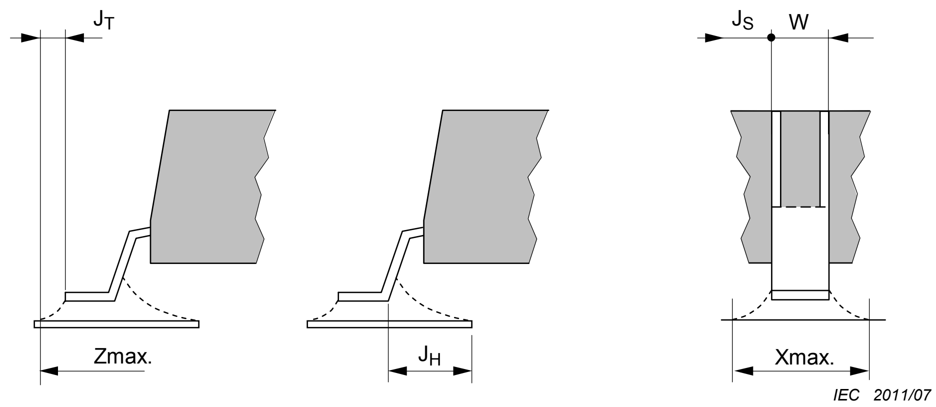
$T_T = C_{L,}$ $Zmax = Lmin + 2J_T min + C_L = Lmax + 2J_T min$

$T_H = C_{S,}$ $Gmin = Smax\ (rms) - 2J_H min - C_S$

$T_S = C_{W,}$ $Xmax = Wmin + 2J_S min + C_W = Wmax + 2J_S min$

In addition, the value Gmin ≥ B is also necessary so that the land should not be hidden under the TSOP. The stand-off of the component mould is nearly zero. The land pattern design should be made to prevent the lead from floating caused by the solder under the component.

Any tolerance other than the above may be used depending on the soldering strength required, the capability of the production process used, and so on.



Dimensions in millimetres

Component	Tolerance assumptions		Solder joint												
			Toe				Heel				Side			
	F	P	J_T				J_H				J_S			
	L-1/L-2/L-3	L-1/L-2/L-3	C_L	Max.	Mdn	Min.	C_S	Max.	Mdn	Min.	C_W	Max.	Mdn	Min.
1,27	0,10	0,10	0,4	0,55	0,35	0,15	0,58	0,50	0,35	0,20	0,10	0,05	0,0	0,0
1,25	0,10	0,10	0,4	0,55	0,35	0,15	0,58	0,50	0,35	0,20	0,10	0,05	0,0	0,0
0,80	0,10	0,10	0,4	0,55	0,35	0,15	0,58	0,50	0,35	0,20	0,10	0,05	0,0	0,0
0,65	0,10	0,10	0,4	0,55	0,35	0,15	0,58	0,50	0,35	0,20	0,10	0,05	0,0	0,0
0,50	0,10	0,10	0,4	0,55	0,35	0,15	0,58	0,20	0,20	0,20	0,06	0,0	0,0	0,0

Figure 7 – Solder joint fillet design (see IEC 61188-5-1, Tables 2 and 3)

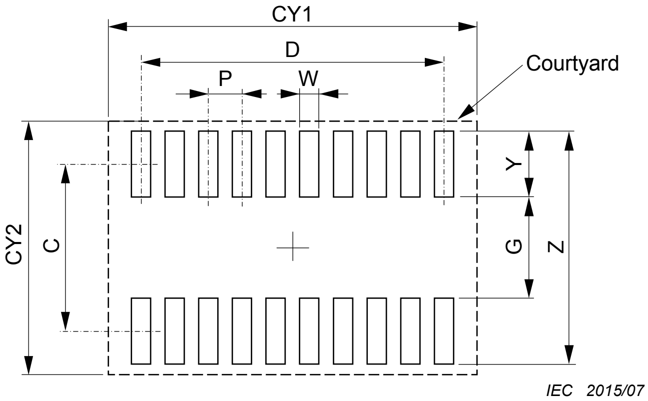
5.5 Land pattern dimensions

Figure 8 shows the land pattern dimensions for TSOP (Type 2) for reflow and flow soldering. These values are calculated based on the formulae for the solder joint fillet design of 5.4.

The courtyard is calculated using the following formula and rounded off (round off factor is to the nearest 0,05 mm for minimum values and to the nearest 0,5 mm for maximum values).

$$CY_1 = (A\text{min} + \sqrt{F^2 + P^2 + C_A^2}\ ) + (\text{courtyard excess} \times 2)$$

$$CY_2 = \{\text{whichever larger } [L\text{min} + \sqrt{F^2 + P^2 + C_L^2}\ ] \text{ or } [Z]\} + (\text{courtyard excess} \times 2)$$



Dimensions in millimetres

Level 1

Pattern identifier	Component identifier	Z	G	X	Y	C	D	P	CY1	CY2
3016M	TSOP 300mil	11,1	7,6	0,53	1,75	9,35	15,24	1,27	19	13
3017M	TSOP 300mil	11,1	7,6	0,43	1,75	9,35	16,80	0,80	20	13
3018M	TSOP 300mil	11,1	7,6	0,35	1,75	9,35	13,00	0,65	16	13
3019M	TSOP 350mil	12,4	8,9	0,53	1,75	10,65	15,24	1,27	19	14
3020M	TSOP 400mil	13,6	10,2	0,53	1,7	11,9	16,51	1,27	20	15
3021M	TSOP 400mil	13,6	10,2	0,43	1,7	11,9	16,80	0,80	20	15
3022M	TSOP 400mil	13,6	10,2	0,35	1,7	11,9	16,90	0,65	20	15
3023M	TSOP 400mil	13,6	10,2	0,33	1,7	11,9	16,90	0,50	20	15
3024M	TSOP 500mil	16,2	12,7	0,43	1,75	14,45	18,40	0,80	21	18
3025M	TSOP 0130	15,4	11,5	0,35	1,95	13,45	20,80	0,65	24	17
3026M	TSOP 0130	15,4	11,5	0,33	1,95	13,45	20,80	0,50	24	17
3027M	TSOP 0145	18,4	14,5	0,35	1,95	16,45	24,70	0,65	27	20
3028M	TSOP 0160	19,9	16,0	0,53	1,95	17,95	23,75	1,25	27	21
3029M	TSOP 0160	19,9	16,0	0,43	1,95	17,95	24,00	0,80	27	21
3030M	TSOP 0160	19,9	16,0	0,35	1,95	17,95	27,95	0,65	31	21

Level 2

Pattern identifier	Component identifier	Z	G	X	Y	C	D	P	CY1	CY2
3016N	TSOP 300mil	10,5	7,6	0,53	1,45	9,1	15,24	1,27	18	11
3017N	TSOP 300mil	10,5	7,6	0,43	1,45	9,1	16,80	0,80	20	11
3018N	TSOP 300mil	10,5	7,6	0,35	1,45	9,1	13,00	0,65	16	11
3019N	TSOP 350mil	11,8	8,9	0,53	1,45	10,35	15,24	1,27	18	13
3020N	TSOP 400mil	13,05	10,2	0,53	1,45	11,65	16,51	1,27	20	14
3021N	TSOP 400mil	13,05	10,2	0,43	1,45	11,65	16,80	0,80	20	14
3022N	TSOP 400mil	13,05	10,2	0,35	1,45	11,65	16,90	0,65	20	14
3023N	TSOP 400mil	13,05	10,2	0,33	1,45	11,65	16,90	0,50	20	14
3024N	TSOP 500mil	15,6	12,7	0,43	1,45	14,15	18,40	0,80	21	17
3025N	TSOP 0130	14,8	11,5	0,35	1,65	13,15	20,80	0,65	23	16
3026N	TSOP 0130	14,8	11,5	0,33	1,65	13,15	20,80	0,50	23	16
3027N	TSOP 0145	17,8	14,5	0,35	1,65	16,15	24,70	0,65	27	19
3028N	TSOP 0160	19,3	16,0	0,53	1,65	17,65	23,75	1,25	27	20

3029N	TSOP 0160	19,3	16,0	0,43	1,65	17,65	24,00	0,80	27	20
3030N	TSOP 0160	19,3	16,0	0,35	1,65	17,65	27,95	0,65	31	20
Level 3										
Pattern identifier	**Component identifier**	**Z**	**G**	**X***	**Y**	**C**	**D**	**P**	**CY1**	**CY2**
3016L	TSOP 300mil	9,85	7,65	0,45	1,10	8,75	15,24	1,27	17,6	10,1
3017L	TSOP 300mil	9,85	7,65	0,35	1,10	8,75	16,80	0,80	18,9	10,1
3018L	TSOP 300mil	9,85	7,65	0,30	1,10	8,75	13,00	0,65	15,1	10,1
3019L	TSOP 350mil	11,10	8,90	0,45	1,10	10,00	15,24	1,27	17,6	11,3
3020L	TSOP 400mil	12,40	10,20	0,45	1,10	11,30	16,51	1,27	18,9	12,6
3021L	TSOP 400mil	12,40	10,20	0,35	1,10	11,30	16,80	0,80	18,9	12,6
3022L	TSOP 400mil	12,40	10,20	0,30	1,10	11,30	16,90	0,65	18,9	12,6
3023L	TSOP 400mil	12,40	10,20	0,25	1,10	11,30	17,00	0,50	18,9	12,6
3024L	TSOP 500mil	14,90	12,70	0,35	1,10	13,80	18,40	0,80	20,1	15,1
3025L	TSOP 0130	14,10	11,50	0,30	1,30	12,80	20,80	0,65	22,5	14,3
3026L	TSOP 0130	14,10	11,50	0,25	1,30	12,80	21,00	0,50	22,5	14,3
3027L	TSOP 0145	17,10	14,50	0,30	1,30	15,80	24,70	0,65	26,2	17,3
3028L	TSOP 0160	18,60	16,00	0,45	1,30	17,30	23,75	1,25	26,2	18,8
3029L	TSOP 0160	18,60	16,00	0,35	1,30	17,30	24,00	0,80	26,2	18,8
3030L	TSOP 0160	18,60	16,00	0,30	1,30	17,30	27,95	0,65	30,0	18,8
* When the X dimension is used, it is necessary to confirm whether the space between adjacent land patterns is proper.										

Figure 8 – TSOP (Type 2) – Land pattern dimensions

6 SOP

6.1 Field of application

This clause provides the component and land pattern dimensions for the SOPs. Basic construction of the SOP device is also covered. Subclause 6.4 lists the tolerances and target solder joint dimensions used to arrive at the land pattern dimensions.

6.2 Component description

Figure 9 shows a typical construction example.

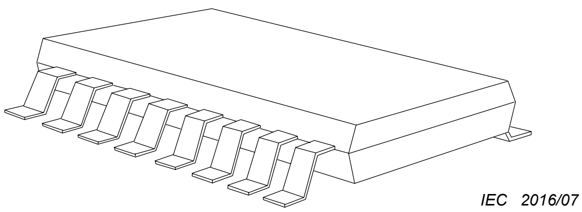


Figure 9 – SOPIC construction

6.3 Component dimensions

Figure 10 shows the component dimensions for SOP components.

Land pattern dimensional data may need to be adjusted if the component dimensional data does not match JEDEC and/or JEITA data sheets.

Dimensions in millimetres

Component identification	Pin count	L		W		T		S*		A		B		H	P
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Max.	Basic
P-SOP8-4,4x5-1,27	8	6,02	6,42	0,35	0,47	0,45	0,75	4,52	5,10	4,88	5,28	4,02	4,42	1,20	1,27
P-SOP14 -4,4x10-1,27	14	6,02	6,42	0,35	0,47	0,45	0,75	4,52	5,10	9,96	10,36	4,02	4,42	1,20	1,27
P-SOP14-5,3x10,3-1,27	14	8,22	8,62	0,35	0,47	0,73	1,03	6,16	7,16	9,96	10,36	5,02	5,42	1,20	1,27
P-SOP16 -4,4x10-1,27	16	6,02	6,42	0,35	0,47	0,45	0,75	4,52	5,52	9,96	10,36	4,02	4,42	1,20	1,27
P-SOP16-5,3x10,3-1,27	16	8,22	8,62	0,35	0,47	0,73	1,03	6,16	7,16	9,96	10,36	5,02	5,42	1,20	1,27
P-SOP20-12,6x5,5-1,27	20	15,84	16,24	0,35	0,47	0,73	1,03	13,78	14,78	12,50	12,90	12,64	13,04	1,20	1,27
P-SOP24-8x15,4 -1,27	24	10,13	10,53	0,35	0,47	0,73	1,03	8,07	9,07	15,04	15,44	6,93	7,33	1,20	1,27
P-SOP28–8,6x18 -1,27	28	12,03	12,43	0,35	0,47	0,73	1,03	9,97	10,97	17,58	17,98	8,83	9,23	1,20	1,27
P-SOP32-10,7x20,6-1,27	32	13,94	14,34	0,35	0,47	0,73	1,03	11,88	12,88	20,12	20,52	10,74	11,14	1,20	1,27
P-SOP40-10,7x26-1,27	40	13,94	14,34	0,35	0,47	0,73	1,03	11,88	12,88	26,47	26,87	10,74	11,14	1,20	1,27
P-SOP44-13x28,2-1,27	44	15,84	16,24	0,35	0,47	0,73	1,03	13,78	14,78	27,74	28,14	12,64	13,04	1,20	1,27

* Calculated value.

Figure 10 – SOP component dimensions

6.4 Solder joint fillet design

Figure 11 shows dimensions of the solder fillet after soldering process. The minimum, median and maximum dimensions of each of toe, heel, and side fillets are determined by taking into consideration solder joint reliability and also quality and productivity in parts mount process.

In designing land patterns, three accuracy factors need to be taken into consideration:

– parts dimensions accuracy (C);
– parts mount accuracy on PWBs (P);
– land shape accuracy of PWBs (F),

in addition to fillet dimensions. The formulae to obtain the tolerance resulted from these factors are basically as follows:

a) Design consideration when soldered without self-alignment effect (Level 1)

In the flow soldering process, there is no self-alignment effect. Thus, the formulae cannot be simplified but remain the same, as follows:

$$Zmax = Lmin + 2J_T\ max + T_T \qquad T_T = \sqrt{F_{L1}^2 + P_{L1}^2 + C_L^2}$$

$$Gmin = Smax\ (rms) - 2J_H\ max - T_H \qquad T_H = \sqrt{F_{L1}^2 + P_{L1}^2 + C_S^2}$$

$$Xmax = Wmin + 2J_S\ max + T_S \qquad T_S = \sqrt{F_{L1}^2 + P_{L1}^2 + C_W^2}$$

b) Design consideration when soldered without self-alignment effect (Level 2)

$$Zmax = Lmin + 2J_T\ mdn + T_T \qquad T_T = \sqrt{F_{L2}^2 + P_{L2}^2 + C_L^2}$$

$$Gmin = Smax(rms) - 2J_H\ mdn - T_H \qquad T_H = \sqrt{F_{L2}^2 + P_{L2}^2 + C_S^2}$$

$$Xmax = Wmin + 2J_S\ mdn + T_S \qquad T_S = \sqrt{F_{L2}^2 + P_{L2}^2 + C_W^2}$$

c) Design consideration when soldered with self-alignment effect (Level 3)

$$Zmax = Lmin + 2J_T\ min + T_T \qquad T_T = \sqrt{F_{L3}^2 + P_{L3}^2 + C_L^2}$$

$$Gmin = Smax(rms) - 2J_H\ min - T_H \qquad T_H = \sqrt{F_{L3}^2 + P_{L3}^2 + C_S^2}$$

$$Xmax = Wmin + 2\ J_S\ min + T_S \qquad T_S = \sqrt{F_{L3}^2 + P_{L3}^2 + C_W^2}$$

In the reflow soldering process, there is a self-alignment effect. In the surface mount process of reflow soldering, parts mount displacement when soldered can be cancelled by self-alignment effect (therefore factor P can be regarded as 0). In addition, the tolerance of the land shape accuracy of PWBs is about ±30μm, and this is extremely small when compared with that of the parts dimensions accuracy (therefore factor F can be regarded also as 0). Thus, the formulae can be simplified as follows:

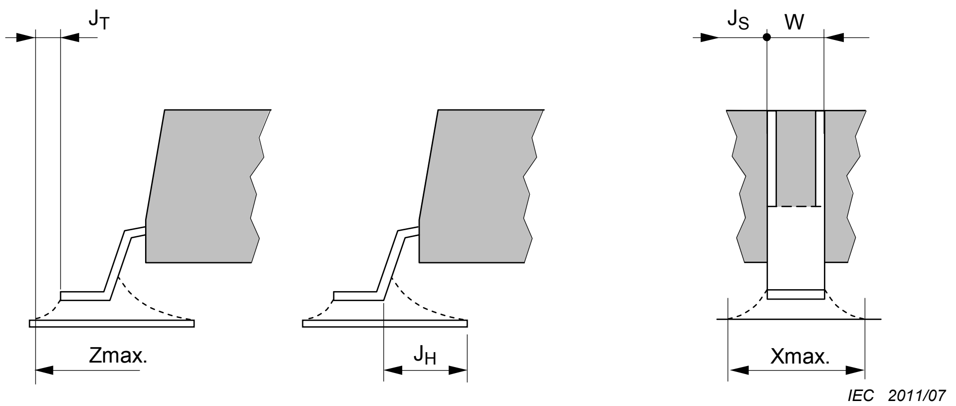
$T_T = C_{L,}$ $Zmax = Lmin + 2J_Tmin + C_L = Lmax + 2J_Tmin$

$T_H = C_{S,}$ $Gmin = Smax\ (rms) - 2J_Hmin - C_S$

$T_S = C_{W,}$ $Xmax = Wmin + 2J_Smin + C_W = Wmax + 2J_Smin$

In addition, the value Gmin ≥ B is also necessary so that the land should not be hidden under the SOP. The standoff of the component mould is nearly zero. The land pattern design should be made to prevent the lead from floating caused by the solder under the component.

Any tolerance other than the above may be used depernding on the soldering strength required, the capability of the production process used, and so on.



Unit: mm

Dimensions in millimetres

Component	Tolerance assumptions		Solder joint											
			Toe				Heel				Side			
	F	P	JT				JH				JS			
	L-1/L-2/L-3	L-1/L-2/L-3	CL	Max.	Mdn	Min.	CS	Max.	Mdn	Min.	CW	Max.	Mdn	Min.
1,27	0,10	0,10	0,4	0,55	0,35	0,15	0,58	0,50	0,35	0,20	0,10	0,05	0,0	0,0

Figure 11 – Solder joint fillet design (see IEC 61188-5-1, Table 2)

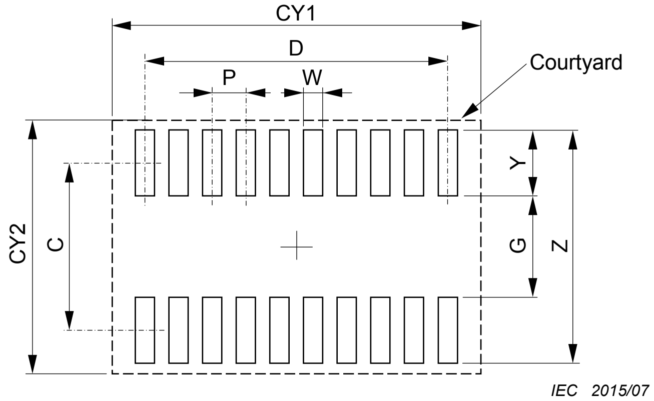
6.5 Land pattern dimensions

Figure 12 shows the land pattern dimensions for SOP for reflow and flow soldering. These values are calculated based on the formula for the solder joint fillet design of 6.4.

The courtyard is calculated using the following formula and rounded off (round off factor is to the nearest 0,05 mm for minimum values and to the nearest 0,5 mm for maximum values).

$$CY_1 = (Amin + \sqrt{F^2 + P^2 + C_A{}^2}\ ) + (\text{courtyard excess} \times 2)$$

$$CY_2 = \{\text{whichever larger } [Lmin + \sqrt{F^2 + P^2 + C_L{}^2}\ ] \text{ or } [Z]\} + (\text{courtyard excess} \times 2)$$



Dimensions in millimetres

Pattern identifier	Component identifier	Z	G	X	Y	C	D	P	CY1	CY2
Level 1										
3031M	P-SOP8-4,4x5-1,27	8,1	4,25	0,54	2,0	6,25	3,81	1,27	7	10
3032M	P-SOP14-4,4x10-1,27	8,1	4,25	0,54	2,0	6,25	7,62	1,27	12	10
3033M	P-SOP14-5,3x10,3-1,27	10,3	5,25	0,54	2,6	7,85	7,62	1,27	12	12
3034M	P-SOP16-4,4x10-1,27	8,1	4,25	0,54	2,0	6,25	8,89	1,27	12	10
3035M	P-SOP16-5,3x10,3-1,27	10,3	5,25	0,54	2,6	7,85	8,89	1,27	12	12
3036M	P-SOP20-12,6x5,5-1,27	17,9	12,85	0,54	2,6	15,45	11,43	1,27	14	19
3037M	P-SOP24-8x15,4-1,27	12,2	7,15	0,54	2,6	9,75	13,97	1,27	17	14
3038M	P-SOP28-8,6x18-1,27	14,1	9,05	0,54	2,6	11,65	16,51	1,27	19	16
3039M	P-SOP32-10,7x20,6-1,27	16,0	9,05	0,54	2,6	13,55	19,05	1,27	22	18
3040M	P-SOP40-10,7x26-1,27	16,0	9,05	0,54	2,6	13,55	24,13	1,27	28	18
3041M	P-SOP44-13x28,2-1,27	17,9	9,05	0,54	2,6	15,45	26,67	1,27	30	19
Level 2										
Pattern identifier	**Component identifier**	**Z**	**G**	**X**	**Y**	**C**	**D**	**P**	**CY1**	**CY2**
3031N	P-SOP8-4,4x5-1,27	7,5	4,25	0,54	1,65	5,9	3,81	1,27	6	8
3032N	P-SOP14-4,4x10-1,27	7,5	4,25	0,54	1,65	5,9	7,62	1,27	11	8
3033N	P-SOP14-5,3x10,3-1,27	9,7	5,25	0,54	2,25	7,5	7,62	1,27	11	11
3034N	P-SOP16-4,4x10-1,27	7,5	4,25	0,54	1,65	5,9	8,89	1,27	11	8
3035N	P-SOP16-5,3x10,3-1,27	9,7	5,25	0,54	2,25	7,5	8,89	1,27	11	11
3036N	P-SOP20-12,6x5,5-1,27	17,3	12,85	0,54	2,25	15,1	11,43	1,27	14	18
3037N	P-SOP24-8x15,4-1,27	11,6	7,15	0,54	2,25	9,4	13,97	1,27	16	13
3038N	P-SOP28-8,6x18-1,27	13,5	9,05	0,54	2,25	11,3	16,51	1,27	19	14
3039N	P-SOP32-10,7x20,6-1,27	15,4	10,95	0,54	2,25	13,2	19,05	1,27	22	16
3040N	P-SOP40-10,7x26-1,27	15,4	10,95	0,54	2,25	13,2	24,13	1,27	28	16
3041N	P-SOP44-13x28,2-1,27	17,3	12,85	0,54	2,25	15,1	26,67	1,27	29	18

Level 3										
Pattern identifier	Component identifier	Z	G	X	Y	C	D	P	CY1	CY2
3031L	P-SOP8-4,4x5-127	6,85	4,25	0,50	1,30	5,55	3,81	1,27	5,5	7,1
3032L	P-SOP14-4,4x10-1,27	6,85	4,25	0,50	1,30	5,55	7,62	1,27	10,6	7,1
3033L	P-SOP14-5,3x10,3-1,27	9,05	5,25	0,50	1,90	7,15	7,62	1,27	10,6	9,3
3034L	P-SOP16-4,4x10-1,27	6,85	4,25	0,50	1,30	5,55	8,89	1,27	10,6	7,1
3035L	P-SOP16-5,3x10,3-1,27	9,05	5,25	0,50	1,90	7,15	8,89	1,27	10,6	9,3
3036L	P-SOP20-12,6x5,5-1,27	16,65	12,85	0,50	1,90	14,75	11,43	1,27	13,2	16,9
3037L	P-SOP24-8x15,4-1,27	10,95	7,15	0,50	1,90	9,05	13,97	1,27	15,7	11,2
3038L	P-SOP28-8,6x18-1,27	12,85	9,05	0,50	1,90	10,95	16,51	1,27	18,2	13,1
3039L	P-SOP32-10,7x20,6-1,27	14,75	10,95	0,50	1,90	12,85	19,05	1,27	20,8	15,0
3040L	P-SOP40-10,7x26-1,27	14,75	10,95	0,50	1,90	12,85	24,13	1,27	27,1	15,0
3041L	P-SOP44-3x28,2-1,27	16,65	12,85	0,50	1,90	14,75	26,67	1,27	28,4	16,9
* When the X dimension is used, it is necessary to confirm whether the space between adjacent land patterns is proper.										

Figure 12 – SOP Land pattern dimensions

7 SSOP

7.1 Field of application

This clause provides the component and land pattern dimensions for the SSOPs. Basic construction of the SSOP device is also covered. Subclause 7.4 lists the tolerances and target solder joint dimensions used to arrive at the land pattern dimensions.

7.2 Component description

Figure 13 shows a typical construction example.

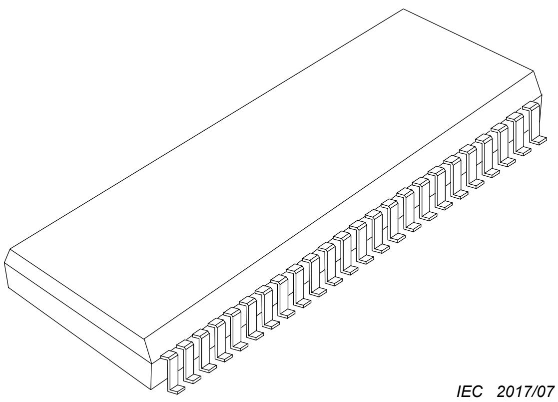
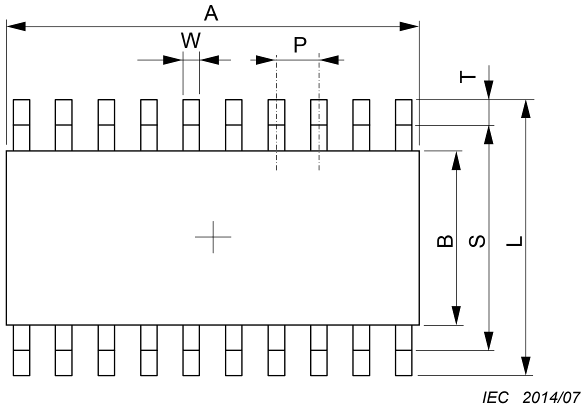


Figure 13 – SSOP construction

7.3 Component dimensions

Figure 14 shows the component dimensions for SSOP components.

Land pattern dimensional data may need to be adjusted if the component dimensional data does not match JEDEC and/or JEITA data sheets.



Dimensions in millimetres

Component identification	Pin count	L		W		T		S*		A		B		H	P
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Max.	Basic
P-SSOP8-4,4x3,0-0,65	8	6,20	6,60	0,16	0,28	0,45	0,75	4,7	5,28	2,80	3,20	4,20	4,60	1,20	0,65
P-SSOP16-4,4x5,0-0,65	16	6,20	6,60	0,16	0,28	0,45	0,75	4,7	5,28	4,80	5,20	4,20	4,60	1,20	0,65
P-SSOP20-4,4x6,5-0,65	20	6,20	6,60	0,16	0,28	0,45	0,75	4,7	5,28	6,30	6,70	4,20	4,60	1,45	0,65
P-SSOP24-5,6x7,8-0,65	24	7,40	7,80	0,16	0,28	0,45	0,75	5,9	6,48	7,60	8,00	5,40	5,80	1,45	0,65
P-SSOP24-5,6x9,7-0,8	24	7,40	7,80	0,24	0,36	0,45	0,75	5,9	6,48	9,50	9,90	5,40	5,80	1,45	0,80
P-SSOP30-5,6x9,7-0,65	30	7,40	7,80	0,16	0,28	0,45	0,75	5,9	6,48	9,50	9,90	5,40	5,80	1,45	0,65
P-SSOP34-6,1x11,0-0,65	34	7,90	8,30	0,16	0,28	0,45	0,75	6,4	6,98	10,80	11,20	5,90	6,30	1,75	0,65
P-SSOP36-5,6x15,8-0,65	36	7,40	7,80	0,16	0,28	0,45	0,75	5,9	6,48	15,60	16,00	5,40	5,80	1,75	0,65
P-SSOP36-8,0x12,5-0,65	36	9,80	10,20	0,16	0,28	0,45	0,75	8,3	8,88	12,30	12,70	7,80	8,20	1,75	0,65
P-SSOP40-6,1x14,0-0,65	40	7,90	8,30	0,16	0,28	0,45	0,75	6,4	6,98	13,80	14,20	5,90	6,30	1,95	0,65

* Calculated value.

Figure 14 – Component dimensions

7.4 Solder joint fillet design

Figure 15 shows dimensions of the solder fillet after soldering process. The minimum, median and maximum dimensions of each of toe, heel, and side fillets are determined by taking into consideration solder joint reliability and also quality and productivity in the mounting process of parts.

In designing land patterns, three accuracy factors need to be taken into consideration:

– parts dimensions accuracy (C);
– parts mount accuracy on PWBs (P);
– land shape accuracy of PWBs (F).

in addition to fillet dimensions. The formulae to obtain the tolerance resulted from these factors are basically as follows:

a) Design consideration when soldered without self-alignment effect (Level 1)

In the flow soldering process, there is no self-alignment effect. Thus, the formulae cannot be simplified but remain the same, as follows:

$$Zmax = Lmin + 2J_T\ max + T_T \qquad T_T = \sqrt{F_{L1}^2 + P_{L1}^2 + C_L^2}$$

$$Gmin = Smax\ (rms) - 2J_H\ max - T_H \qquad T_H = \sqrt{F_{L1}^2 + P_{L1}^2 + C_S^2}$$

$$Xmax = Wmin + 2J_S\ max + T_S \qquad T_S = \sqrt{F_{L1}^2 + P_{L1}^2 + C_W^2}$$

b) Design consideration when soldered without self-alignment effect (Level 2)

$$Zmax = Lmin + 2J_T\ mdn + T_T \qquad T_T = \sqrt{F_{L2}^2 + P_{L2}^2 + C_L^2}$$

$$Gmin = Smax(rms) - 2J_H\ mdn - T_H \qquad T_H = \sqrt{F_{L2}^2 + P_{L2}^2 + C_S^2}$$

$$Xmax = Wmin + 2J_S\ mdn + T_S \qquad T_S = \sqrt{F_{L2}^2 + P_{L2}^2 + C_W^2}$$

c) Design consideration when soldered with self-alignment effect (Level 3)

$$Zmax = Lmin + 2J_T\ min + T_T \qquad T_T = \sqrt{F_{L3}^2 + P_{L3}^2 + C_L^2}$$

$$Gmin = Smax(rms) - 2J_H\ min - T_H \qquad T_H = \sqrt{F_{L3}^2 + P_{L3}^2 + C_S^2}$$

$$Xmax = Wmin + 2\ J_S\ min + T_S \qquad T_S = \sqrt{F_{L3}^2 + P_{L3}^2 + C_W^2}$$

In the reflow soldering process, there is a self-alignment effect. In the surface mount process of reflow soldering, parts mount displacement when soldered can be cancelled by self-alignment effect (therefore factor P can be regarded as 0). In addition, the tolerance of the land shape accuracy of PWBs is about ±30μm, and this is extremely small when compared with that of the parts dimensions accuracy (therefore factor F can be regarded also as 0). Thus, the formulae can be simplified as follows:

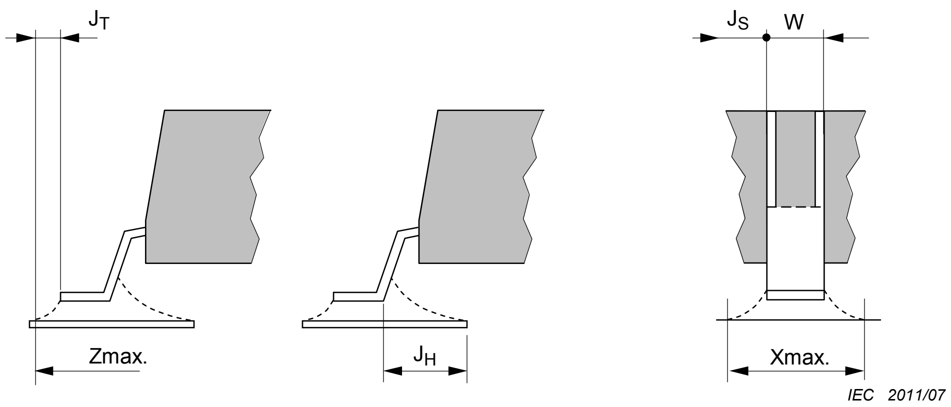
$T_T = C_L$, $Zmax = Lmin + 2J_T min + C_L = Lmax + 2J_T min$

$T_H = C_S$, $Gmin = Smax\ (rms) - 2J_H min - C_S$

$T_S = C_W$, $Xmax = Wmin + 2J_S min + C_W = Wmax + 2J_S min$

In addition, the value Gmin ≥ B is also necessary so that the land should not be hidden under the SSOP. The stand-off of the component mould is nearly zero. The land pattern design should be made to prevent the lead from floating caused by the solder under the component.

Any tolerance other than the above may be used depending on the soldering strength required, the capability of the production process used, and so on.



Dimensions in millimetres

Component	Tolerance assumptions		Solder joint											
			Toe				Heel				Side			
	F	P	J_T				J_H				J_S			
	L-1/L-2/L-3	L-1/L-2/L-3	C_L	Max.	Mdn	min.	C_S	Max.	mdn	Min.	C_W	Max.	Mdn	Min.
0,80	0,10	0,10	0,4	0,55	0,35	0,15	0,58	0,50	0,35	0,20	0,10	0,05	0,0	0,0
0,65	0,10	0,10	0,4	0,55	0,35	0,15	0,58	0,50	0,35	0,20	0,10	0,05	0,0	0,0

Figure 15 – Solder joint fillet design (see IEC 61188-5-1, Table 2)

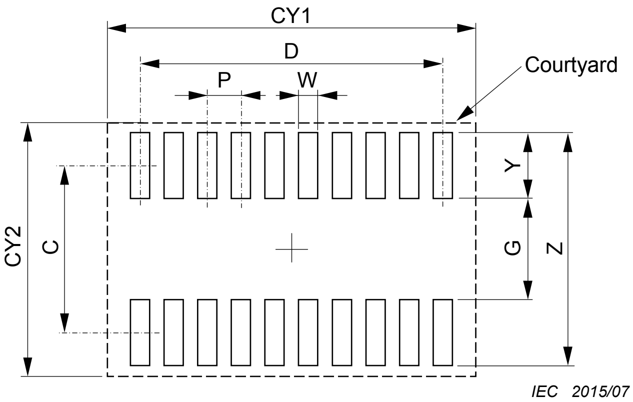
7.5 Land pattern dimensions

Figure 16 shows the land pattern dimensions for SSOP for reflow and flow soldering. These values are calculated based on the formula for the solder joint fillet design of 7.4.

The courtyard is calculated using the following formula and rounded off (round-off factor is to the nearest 0,05 mm for minimum values and to the nearest 0,5 mm for maximum values).

$$CY_1 = (A\text{min} + \sqrt{F^2 + P^2 + C_A{}^2}\ ) + (\text{courtyard excess} \times 2)$$

$$CY_2 = \{\text{whichever larger } [L\text{min} + \sqrt{F^2 + P^2 + C_L{}^2}\ ] \text{ or } [Z]\} + (\text{courtyard excess} \times 2)$$



Level 1										
Pattern identifier	**Component identifier**	**Z**	**G**	**X**	**Y**	**C**	**D**	**P**	**CY1**	**CY2**
3042N	P-SSOP8-4,4x3,0-0,65	8,3	4,4	0,35	1,95	6,35	1,95	0,65	5	10
3043N	P-SSOP16-4,4x5,0-0,65	8,3	4,4	0,35	1,95	6,35	4,55	0,65	7	10
3044N	P-SSOP20-4,4x6,5-0,65	8,3	4,4	0,35	1,95	6,35	5,85	0,65	8	10
3045N	P-SSOP24-5,6x7,8-0,65	9,5	5,6	0,35	1,95	7,55	7,15	0,65	10	11
3046N	P-SSOP24-5,6x9,7-0,8	9,5	5,6	0,35	1,95	7,55	8,80	0,80	11	11
3047N	P-SSOP30-5,6x9,7-0,65	9,5	5,6	0,35	1,95	7,55	9,10	0,65	11	11
3048N	P-SSOP34-6,1x11,0-0,65	10,0	6,1	0,35	1,95	8,05	10,40	0,65	13	11
3049N	P-SSOP36-5,6x15,8-0,65	9,5	5,6	0,35	1,95	7,55	11,05	0,65	18	11
3050N	P-SSOP36-8,0x12,5-0,65	11,9	8,0	0,35	1,95	9,95	11,05	0,65	14	13
3051N	P-SSOP40-6,1x14,0-0,65	10,0	6,1	0,35	1,95	8,05	12,35	0,65	16	11
Level 2										
Pattern identifier	**Component identifier**	**Z**	**G**	**X**	**Y**	**C**	**D**	**P**	**CY1**	**CY2**
3042N	P-SSOP8-4,4x3,0-0,65	7,7	4,4	0,35	1,65	6,05	1,95	0,65	4	9
3043N	P-SSOP16-4,4x5,0-0,65	7,7	4,4	0,35	1,65	6,05	4,55	0,65	6	9
3044N	P-SSOP20-4,4x6,5-0,65	7,7	4,4	0,35	1,65	6,05	5,85	0,65	8	9
3045N	P-SSOP24-5,6x7,8-0,65	8,9	5,6	0,35	1,65	7,25	7,15	0,65	9	10
3046N	P-SSOP24-5,6x9,7-0,8	8,9	5,6	0,35	1,65	7,25	8,80	0,80	11	10
3047N	P-SSOP30-5,6x9,7-0,65	8,9	5,6	0,35	1,65	7,25	9,10	0,65	11	10
3048N	P-SSOP34-6,1x11,0-0,65	8,4	6,1	0,35	1,65	7,75	10,40	0,65	12	9
3049N	P-SSOP36-5,6x15,8-0,65	8,9	5,6	0,35	1,65	7,25	11,05	0,65	17	10
3050N	P-SSOP36-8,0x12,5-0,65	11,3	8,0	0,35	1,65	9,65	11,05	0,65	14	12
3051N	P-SSOP40-6,1x14,0-0,65	9,4	6,1	0,35	1,65	7,75	12,35	0,65	15	10

Level 3										
Pattern identifier	**Component Identifier**	**Z**	**G**	**X***	**Y**	**C**	**D**	**P**	**CY1**	**CY2**
3042L	P-SSOP8-4,4x3,0-0,65	7,00	4,40	0,3	1,30	5,70	1,95	0,65	3,5	7,2
3043L	P-SSOP16-4,4x5.0-0,65	7,00	4,40	0,3	1,30	5,70	4,55	0,65	5,5	7,2
3044L	P-SSOP20-4,4x6,5-0,65	7,00	4,40	0,3	1,30	5,70	5,85	0,65	7,0	7,2
3045L	P-SSOP24-5,6x7,8-0,65	8,20	5,60	0,3	1,30	6,90	7,15	0,65	8,3	8,4
3046L	P-SSOP24-5,6x9,7-0,8	8,20	5,60	0,4	1,30	6,90	8,80	0,80	10,2	8,4
3047L	P-SSOP30-5,6x9,7-0,65	8,20	5,60	0,3	1,30	6,90	9,10	0,65	10,2	8,4
3048L	P-SSOP34-6,1x11,0-0,65	8,70	6,10	0,3	1,30	7,40	10,40	0,65	11,5	8,9
3049L	P-SSOP36-5,6x15,8-0,65	8,20	5,60	0,3	1,30	6,90	11,05	0,65	16,3	8,4
3050L	P-SSOP36-8,0x12,5-0,65	10,60	8,00	0,3	1,30	9,30	11,05	0,65	13,0	10,8
3051L	P-SSOP40-6,1x14,0-0,65	8,70	6,10	0,3	1,30	7,40	12,35	0,65	14,5	8,9

* When the X dimension is used, it is necessary to confirm whether the space between adjacent land patterns is proper.

Figure 16 – Land pattern dimensions

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