

INTERNATIONAL STANDARD

NORME INTERNATIONALE

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

**Cartes imprimées et cartes imprimées équipées – Conception et utilisation –
Partie 5-3: Considérations sur les liaisons pistes-soudures – Composants à
sorties en aile de mouette sur deux côtés**





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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 bilingual version, published in 2009-09, corresponds to the English version.

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.

The French version of this standard has not been voted upon.

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

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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.

[IEC 61188-5-3:2007](https://standards.iteh.ai/catalog/standards/sist/a85a9537-fc33-4f92-b91a-8795c967a4c2/iec-61188-5-3-2007)

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 61188-5-3:2007](#)

IEC 61188-5-1:2002, *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.

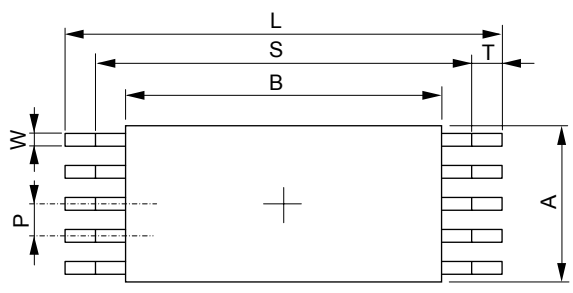


Figure 1 – TSOP (Type 1) construction

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.



IEC 2010/07
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:

$$Z_{\max} = L_{\min} + 2J_T \max + T_T \quad T_T = \sqrt{F_{L1}^2 + P_{L1}^2 + C_L^2}$$

$$G_{\min} = S_{\max}(\text{rms}) - 2J_H \max - T_H \quad T_H = \sqrt{F_{L1}^2 + P_{L1}^2 + C_S^2}$$

$$X_{\max} = W_{\min} + 2J_S \max + T_S \quad T_S = \sqrt{F_{L1}^2 + P_{L1}^2 + C_W^2}$$

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

$$Z_{\max} = L_{\min} + 2J_T \text{mdn} + T_T \quad T_T = \sqrt{F_{L2}^2 + P_{L2}^2 + C_L^2}$$

$$G_{\min} = S_{\max}(\text{rms}) - 2J_H \text{mdn} - T_H \quad T_H = \sqrt{F_{L2}^2 + P_{L2}^2 + C_S^2}$$

$$X_{\max} = W_{\min} + 2J_S \text{mdn} + T_S \quad T_S = \sqrt{F_{L2}^2 + P_{L2}^2 + C_W^2}$$

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

$$Z_{\max} = L_{\min} + 2J_T \min + T_T \quad T_T = \sqrt{F_{L3}^2 + P_{L3}^2 + C_L^2}$$

$$G_{\min} = S_{\max}(\text{rms}) - 2J_H \min - T_H \quad T_H = \sqrt{F_{L3}^2 + P_{L3}^2 + C_S^2}$$

$$X_{\max} = W_{\min} + 2J_S \min + T_S \quad T_S = \sqrt{F_{L3}^2 + P_{L3}^2 + C_W^2}$$

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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 $\pm 30 \mu\text{m}$ 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:

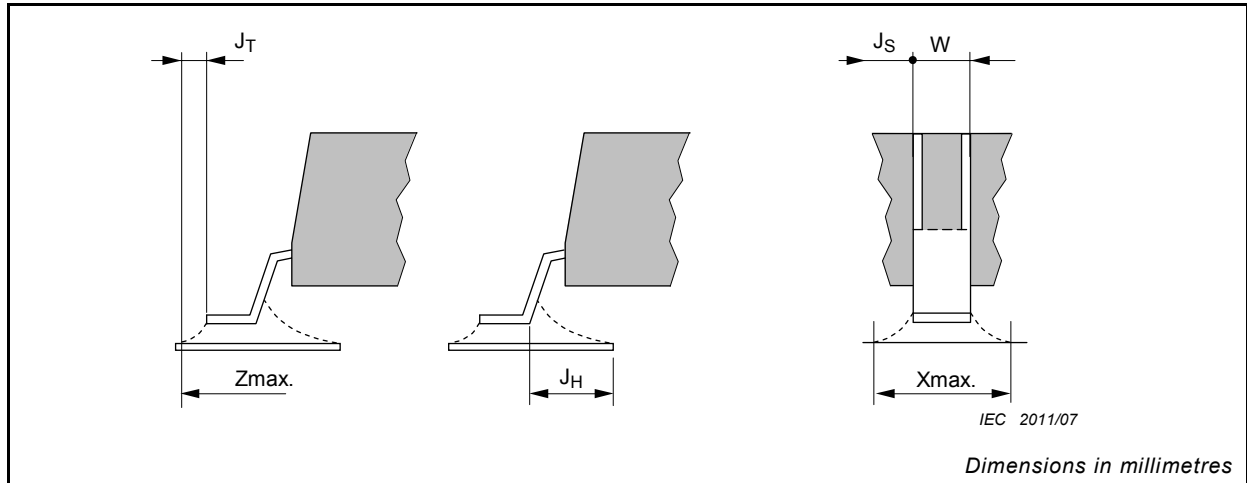
$$T_T = C_L, Z_{\max} = L_{\min} + 2J_T \min + C_L = L_{\max} + 2J_T \min$$

$$T_H = C_S, G_{\min} = S_{\max}(\text{rms}) - 2J_H \min - C_S$$

$$T_S = C_W, X_{\max} = W_{\min} + 2J_S \min + C_W = W_{\max} + 2J_S \min$$

In addition, the value $G_{\min} \geq B$ 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.



Component	Tolerance assumptions		Solder joint											
	F	P	Toe				Heel				Side			
			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)

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4.5 Land pattern dimensions

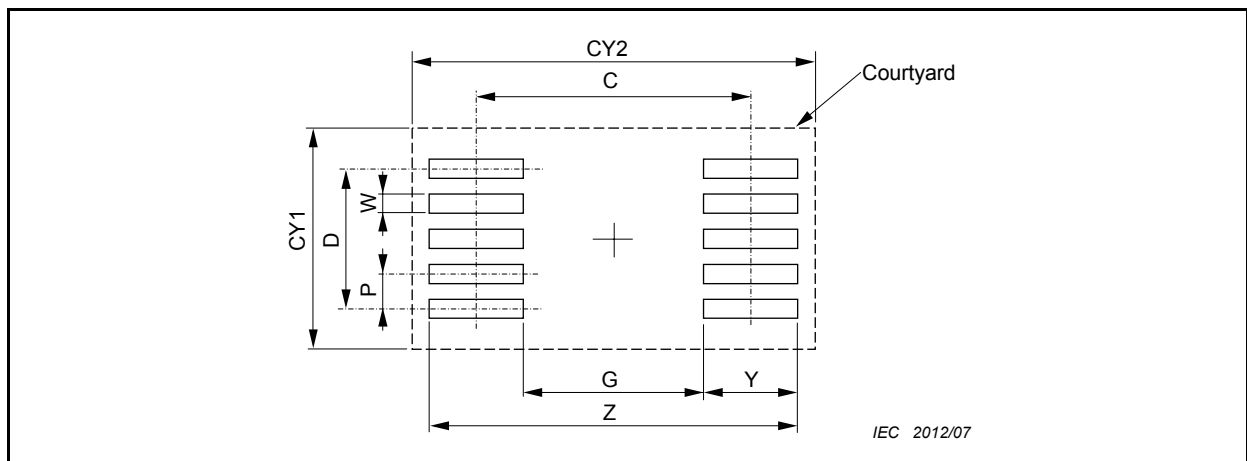
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Figure 4 shows the land pattern dimensions for TSOP (Type 1) for reflow and flow soldering. These values are calculated based on the formula for the solder joint fillet design of 4.4.

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).

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

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



<i>Dimensions in millimetres</i>										
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.

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 Figure 4 – TSOP (Type 1) – Land pattern dimensions
<https://standards.iteh.ai/catalog/standards/sist/a85a9537-1c53-4b92-b91a-8795c967a4c2/iec-61188-5-3-2007>

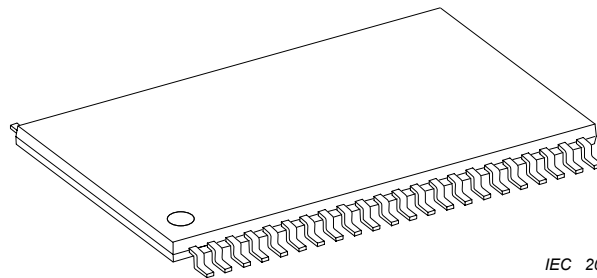
5 TSOP (Type 2)

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.



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Figure 5 – TSOP (Type 2) construction

5.3 Component dimensions

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