IEC 61188-5-5

Edition 1.0 2007-10

INTERNATIONAL STANDARD

NORME INTERNATIONALE

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

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

IEC 61188-5-5:2007

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

**Cartes imprimées et cartes imprimées équipées – Conception et utilisation –
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PRINTED BOARDS AND PRINTED BOARD ASSEMBLIES – DESIGN AND USE –

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

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 61188-5-5 has been prepared by IEC technical committee 91: Electronics assembly technology.

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

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

FDIS	Report on voting
91/704/FDIS	91/736/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.

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

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

IEC 61188-5-5 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.

INTRODUCTION

This part of IEC 61188 covers land patterns for components with gull-wing leads on four sides. Each clause gives 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 should be regarded as for reference only.

PRINTED BOARDS AND PRINTED BOARD ASSEMBLIES – DESIGN AND USE –

Part 5-5: Attachment (land/joint) considerations – Components with gull-wing leads on four 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 four 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.

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 alloy 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 that temperature a sufficient time to form a reliable metallurgical bond.

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 four-sided gull wing family is characterized by gull-wing leads on four sides of a square or rectangular package. The family includes both molded plastic and ceramic case styles. The acronyms PQFP (plastic quad flat pack) and CQFP (ceramic quad flat pack) are also used to describe the family.

There are several lead pitches within the family form 1,0 mm to 0,30 mm. High lead-court packages are available in this family that accommodate complex, high lead-count chips.

3.2 Marking

The PQFP and CQFP 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 tube but packaging tray carries 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

PQFP and CQFP packages are normally processed by reflow solder operations.

High lead-count fine pitch parts may require special processing outside the normal pick/place and reflow manufacturing operations.

4 PQFP (square)

4.1 Field of application

This clause provides the component and land pattern dimensions for square PQFP (plastic quad flat pack) components. Basic construction of the PQFP device is also covered. At the end of this clause is a listing of the tolerances and target solder joint dimensions used to arrive at the land pattern dimensions.

4.2 Component descriptions

PQFPs are widely used in a variety of applications for commercial, industrial or military electronics.

4.2.1 Basic construction

The quad flat pack has been developed for applications requiring low height and high density. The PQFP, along with the LSOP components, are frequently used in memory card applications (see Figure 1).

4.2.1.1 Termination materials

Leads shall be solder-coated with a tin/lead alloy. The solder should contain between 58 % to 68 % tin. Solder may be applied to the leads by hot dipping or by plating from solution. Plated solder terminations should be subjected to post plating reflow operation to fuse the solder. The tin/lead finish should be at least 0,007 5 mm thick.

4.2.1.2 Marking

All parts shall be marked with a part number and an index area. The index area shall identify the location of pin 1.

4.2.1.3 Carrier package format

The carrier package format for flat packs may be tubular in shape but, in most instances, flat packs are delivered in a carrier tray.

4.2.1.4 Process considerations

PQFPs are usually processed using standard reflow solder processes. Parts should be capable of withstanding ten cycles through a standard reflow system operating at 235 °C. Each cycle shall consist of 60 s exposure at 235 °C.

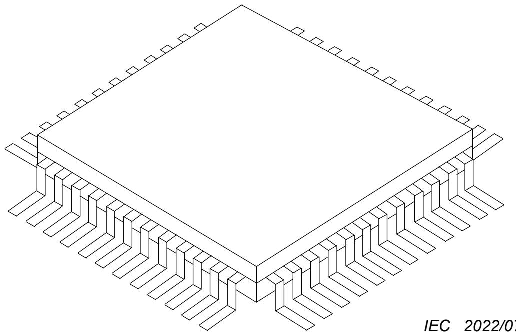
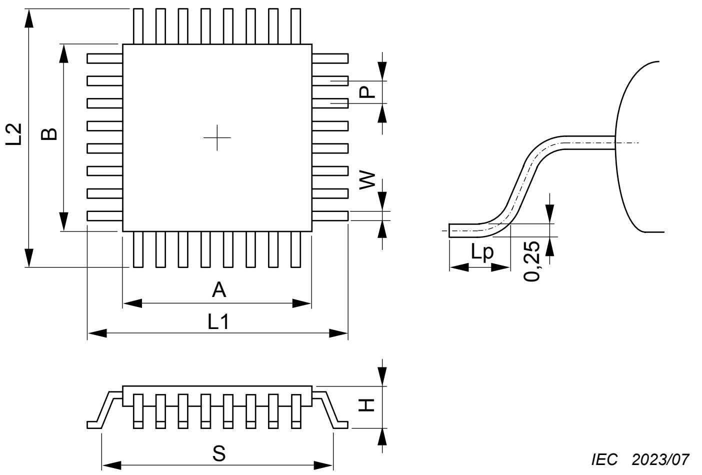


Figure 1 – PQFP (square)

4.3 Component dimensions

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

Figure 2 provides the component dimensions for PQFP (square) components.



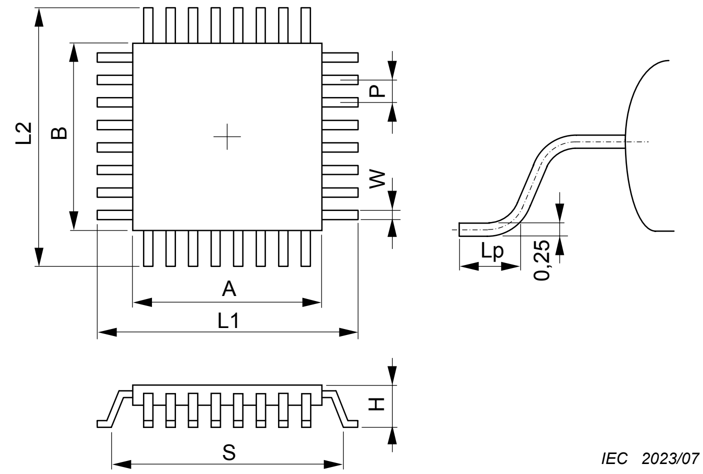
Dimensions in millimetres

EIAJ codes	JEDEC code	L2		L1		Lp	
		Min.	Max.	Min.	Max.	Min.	Max.
P-QFP-0036-0505-1,00	P-QFP/036-5x5-1,00	12,95	13,45	12,95	13,45	0,73	1,03
P-QFP-0044-0505-0,80	P-QFP/044-5x5-0,80	12,95	13,45	12,95	13,45	0,73	1,03
P-QFP-0052-0505-0,65	P-QFP/052-5x5-0,65	12,95	13,45	12,95	13,45	0,73	1,03
P-QFP-0048-1212-0,80	P-QFP/048-12x12-0,80	14,95	15,45	14,95	13,45	0,73	1,03
P-QFP-0052-1414-1,00	P-QFP/052-14x14-1,00	16,95	17,45	16,95	17,45	0,73	1,03
P-QFP-0064-1414-0,80	P-QFP/064-14x14-0,80	16,95	17,45	16,95	17,45	0,73	1,03
P-QFP-0080-1414-0,65	P-QFP/080-14x14-0,65	15,75	17,45	16,95	17,45	0,73	1,03
P-QFP-0100-1414-0,50	P-QFP/100-14x14-0,50	15,75	16,25	15,75	16,25	0,45	0,75
P-QFP-0120-1414-0,40	P-QFP/120-14x14-0,40	15,75	16,25	15,75	16,25	0,45	0,75
P-QFP-0168-1414-0,30	P-QFP/168-14x14-0,30	15,75	16,25	15,75	16,25	0,45	0,75
P-QFP-0076-2020-1,00	P-QFP/076-20x20-1,00	22,95	23,45	22,95	23,45	0,73	1,03
P-QFP-0076-2020-1,00	P-QFP/076-20x20-1,00	22,95	23,45	22,95	23,45	0,73	1,03
P-QFP-0088-2020-0,80	P-QFP/088-20x20-0,80	22,95	23,45	22,95	23,45	0,73	1,03
P-QFP-0088-2020-0,80	P-QFP/088-20x20-0,80	22,95	23,45	22,95	23,45	0,73	1,03

W			S*		B	A	P	H	Remarks
Min.	Nom.	Max.	Min.	Max.					
0,34	0,40	0,46	10,89	11,55	10,0	10,0	1,00	2,45	
0,29	0,35	0,41	10,89	11,55	10,0	10,0	0,80	2,45	
0,22	0,30	0,36	10,89	11,55	10,0	10,0	0,65	2,45	
0,29	0,35	0,41	12,89	13,55	12,0	12,0	0,80	2,45	
0,34	0,40	0,46	14,89	15,55	14,0	14,0	1,00	3,15	
0,29	0,35	0,41	14,89	15,55	14,0	14,0	0,80	3,15	
0,22	0,30	0,36	14,89	15,55	14,0	14,0	0,65	3,15	
0,17	0,20	0,23	14,25	14,91	14,0	14,0	0,50	3,15	
0,13	0,16	0,19	14,25	14,91	14,0	14,0	0,40	3,15	
0,09	0,12	0,15	14,25	14,91	14,0	14,0	0,40	3,15	
0,34	0,40	0,46	20,89	21,55	20,0	20,0	1,00	3,15	Low stand-off
0,34	0,40	0,46	20,89	21,55	20,0	20,0	1,00	3,40	High stand-off
0,29	0,35	0,41	20,89	21,55	20,0	20,0	0,80	3,15	Low stand-off
0,29	0,35	0,41	20,89	21,55	20,0	20,0	0,80	3,40	High stand-off

* Calculated value.

Figure 2 – PQFP (square) component dimensions



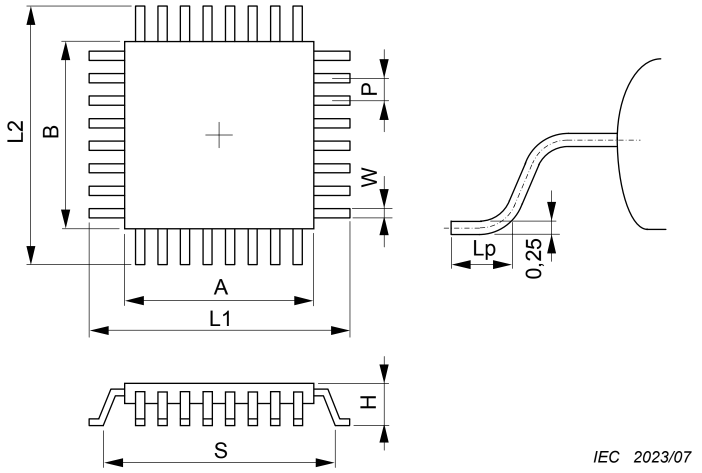
Dimensions in millimetres

EIAJ codes	JEDEC code	L2		L1		Lp	
		Min.	Max.	Min.	Max.	Min.	Max.
P-QFP-0112-2020-0,65	P-QFP/112-20x20-0,65	22,95	23,45	22,95	23,45	0,73	1,03
P-QFP-0112-2020-0,65	P-QFP/112-20x20-0,65	22,95	23,45	22,95	23,45	0,73	1,03
P-QFP-0144-2020-0,50	P-QFP/144-20x20-0,50	21,75	22,25	21,75	22,25	0,45	0,75
P-QFP-0144-2020-0,50	P-QFP/144-20x20-0,50	21,75	22,25	21,75	22,25	0,45	0,75
P-QFP-0176-2020-0,40	P-QFP/176-20x20-0,40	21,75	22,25	21,75	22,25	0,45	0,75
P-QFP-0176-2020-0,40	P-QFP/176-20x20-0,40	21,75	22,25	21,75	22,25	0,45	0,75
P-QFP-0240-2020-0,30	P-QFP/240-20x20-0,30	21,75	22,25	21,75	22,25	0,45	0,75
P-QFP-0176-2424-0,50	P-QFP/176-24x24-0,50	26,35	26,85	26,35	26,85	0,45	0,75
P-QFP-0176-2424-0,50	P-QFP/176-24x24-0,50	26,35	26,85	26,35	26,85	0,45	0,75
P-QFP-0216-2424-0,40	P-QFP/216-24x24-0,40	26,35	26,85	26,35	26,85	0,45	0,75
P-QFP-0216-2424-0,40	P-QFP/216-24x24-0,40	26,35	26,85	26,35	26,85	0,45	0,75
P-QFP-0128-2828-0,80	P-QFP/128-28x28-0,80	30,95	31,45	30,95	31,45	0,73	1,03
P-QFP-0128-2828-0,80	P-QFP/128-28x28-0,80	30,95	31,45	30,95	31,45	0,73	1,03
P-QFP-0160-2828-0,65	P-QFP/160-28x28-0,65	30,95	31,45	30,95	31,45	0,73	1,03

W			S*		B	A	P	H	Remarks
Min.	Nom.	Max.	Min.	Max.					
0,22	0,30	0,36	20,89	21,55	20,0	20,0	0,65	3,15	Low stand-off
0,22	0,30	0,36	20,89	21,55	20,0	20,0	0,65	3,40	High stand-off
0,17	0,2	0,23	20,25	20,91	20,0	20,0	0,50	3,15	Low stand-off
0,17	0,2	0,23	20,25	20,91	20,0	20,0	0,50	3,40	High stand-off
0,13	0,16	0,19	20,25	20,91	20,0	20,0	0,40	3,15	Low stand-off
0,13	0,16	0,19	20,25	20,91	20,0	20,0	0,40	3,40	High stand-off
0,09	0,12	0,15	20,25	20,91	20,0	20,0	0,30	3,40	Low stand-off
0,17	0,2	0,23	24,85	25,51	24,0	24,0	0,50	3,85	High stand-off
0,17	0,2	0,23	24,85	25,51	24,0	24,0	0,50	4,10	Low stand-off
0,13	0,16	0,19	24,85	25,51	24,0	24,0	0,40	3,85	High stand-off
0,13	0,16	0,19	24,85	25,51	24,0	24,0	0,40	4,10	Low stand-off
0,29	0,35	0,41	28,89	29,55	28,0	28,0	0,80	3,85	High stand-off
0,29	0,35	0,41	28,89	29,55	28,0	28,0	0,80	4,10	Low stand-off
0,22	0,3	0,36	28,89	29,55	28,0	28,0	0,65	3,85	High stand-off

* Calculated value.

Figure 2 *(continued)*



Dimensions in millimetres

EIAJ codes	JEDEC code	L2		L1		Lp	
		Min.	**Max.**	**Min.**	**Max.**	**Min.**	**Max.**
P-QFP-0160-2828-0,65	P-QFP/160-28x28-0,65	30,95	31,45	30,95	31,45	0,73	1,03
P-QFP-0208-2828-0,50	P-QFP/208-28x28-0,50	30,35	30,85	30,35	30,85	0,45	0,75
P-QFP-0208-2828-0,50	P-QFP/208-28x28-0,50	30,35	30,85	30,35	30,85	0,45	0,75
P-QFP-0256-2828-0,40	P-QFP/256-28x28-0,40	30,35	30,85	30,35	30,85	0,45	0,75
P-QFP-0256-2828-0,40	P-QFP/256-28x28-0,40	30,35	30,85	30,35	30,85	0,45	0,75
P-QFP-0184-3232-0,65	P-QFP/184-32x32-0,65	34,95	35,45	34,95	35,45	0,73	1,03
P-QFP-0240-3232-0,50	P-QFP/240-32x32-0,50	34,95	34,85	34,95	34,85	0,45	0,75
P-QFP-0296-3232-0,40	P-QFP/296-32x32-0,40	34,95	34,85	34,95	34,85	0,45	0,75
P-QFP-0272-3636-0,50	P-QFP/272-36x36-0,50	38,35	38,85	38,35	38,85	0,45	0,75
P-QFP-0336-3636-0,40	P-QFP/336-36x36-0,40	38,35	38,85	38,35	38,85	0,45	0,75
P-QFP-0232-4040-0,65	P-QFP/232-40x40-0,65	42,95	43,45	42,95	43,45	0,73	1,03
P-QFP-0304-4040-0,50	P-QFP/304-40x40-0,50	42,35	42,85	42,35	42,85	0,45	0,75
P-QFP-0376-4040-0,40	P-QFP/376-40x40-0,40	42,35	42,85	42,35	42,85	0,45	0,75

W			S*		B	A	P	H	Remarks
Min.	**Nom.**	**Max.**	**Max.**	**Max.**					
0,22	0,3	0,36	28,89	29,55	28,0	28,0	0,65	4,10	Low stand-off
0,17	0,2	0,23	28,85	29,51	28,0	28,0	0,50	3,85	High stand-off
0,17	0,2	0,23	28,85	29,51	28,0	28,0	0,50	4,10	High stand-off
0,13	0,16	0,19	28,85	29,51	28,0	28,0	0,40	3,85	High stand-off
0,13	0,16	0,19	28,85	29,51	28,0	28,0	0,40	4,10	High stand-off
0,22	0,3	0,36	32,89	29,51	32,0	32,0	0,65	4,10	High stand-off
0,17	0,2	0,23	33,45	33,89	32,0	32,0	0,50	4,10	High stand-off
0,13	0,16	0,19	33,45	33,89	32,0	32,0	0,40	4,10	High stand-off
0,17	0,2	0,23	36,85	37,51	36,0	36,0	0,50	4,50	High stand-off
0,13	0,16	0,19	36,85	37,51	36,0	36,0	0,40	4,50	High stand-off
0,22	0,3	0,36	40,89	41,55	40,0	40,0	0,65	4,50	High stand-off
0,17	0,2	0,23	40,85	41,51	40,0	40,0	0,50	4,50	High stand-off
0,13	0,16	0,19	40,85	41,51	40,0	40,0	0,40	4,50	High stand-off

* Calculated value.

Figure 2 *(continued)*

4.4 Solder joint fillet design

Figure 3 shows the shape and 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 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 ±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:

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

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

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

In addition, the following value Gmin ≥ A, B is also necessary so that the land should not be hidden under the QFP. 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.