

Printed boards and printed board assemblies — Design and use —

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

The European Standard EN 61188-5-5:2007 has the status of a
British Standard

ICS 31.180

National foreword

This British Standard is the UK implementation of EN 61188-5-5:2007. It is identical to IEC 61188-5-5:2007.

The UK participation in its preparation was entrusted to Technical Committee EPL/501, Electronic assembly technology.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Design and use -
Part 5-5: Attachment (land/joint) considerations -
Components with gull-wing leads on four sides
(IEC 61188-5-5:2007)**

Cartes imprimées et
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Conception et utilisation -
Partie 5-5: Considérations
sur les liaisons pistes-soudures -
Composants à sorties
en aile de mouette sur quatre côtés
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Leiterplatten und Flachbaugruppen -
Konstruktion und Anwendung -
Teil 5-5: Betrachtungen zur Montage
(Anschlussfläche/Verbindung) -
Bauelemente mit
Gullwing-Anschlüssen
auf vier Seiten
(IEC 61188-5-5:2007)

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CENELEC

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Foreword

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This standard is to be used in conjunction with EN 61188-5-1.

The following dates were fixed:

- | | | |
|--|-------|------------|
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Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 61188-5-5:2007 was approved by CENELEC as a European Standard without any modification.

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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 from 1,0 mm to 0,30 mm. High lead-count 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

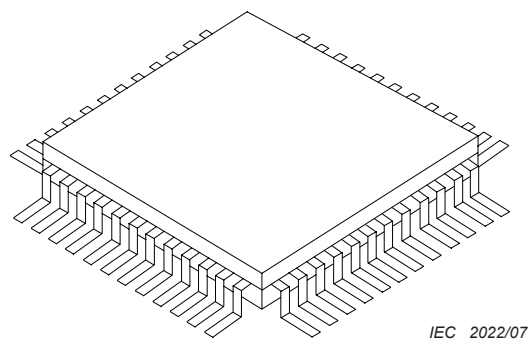
All parts shall be marked with a part number and an index area. The index area shall identify the location of pin 1.

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.



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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.

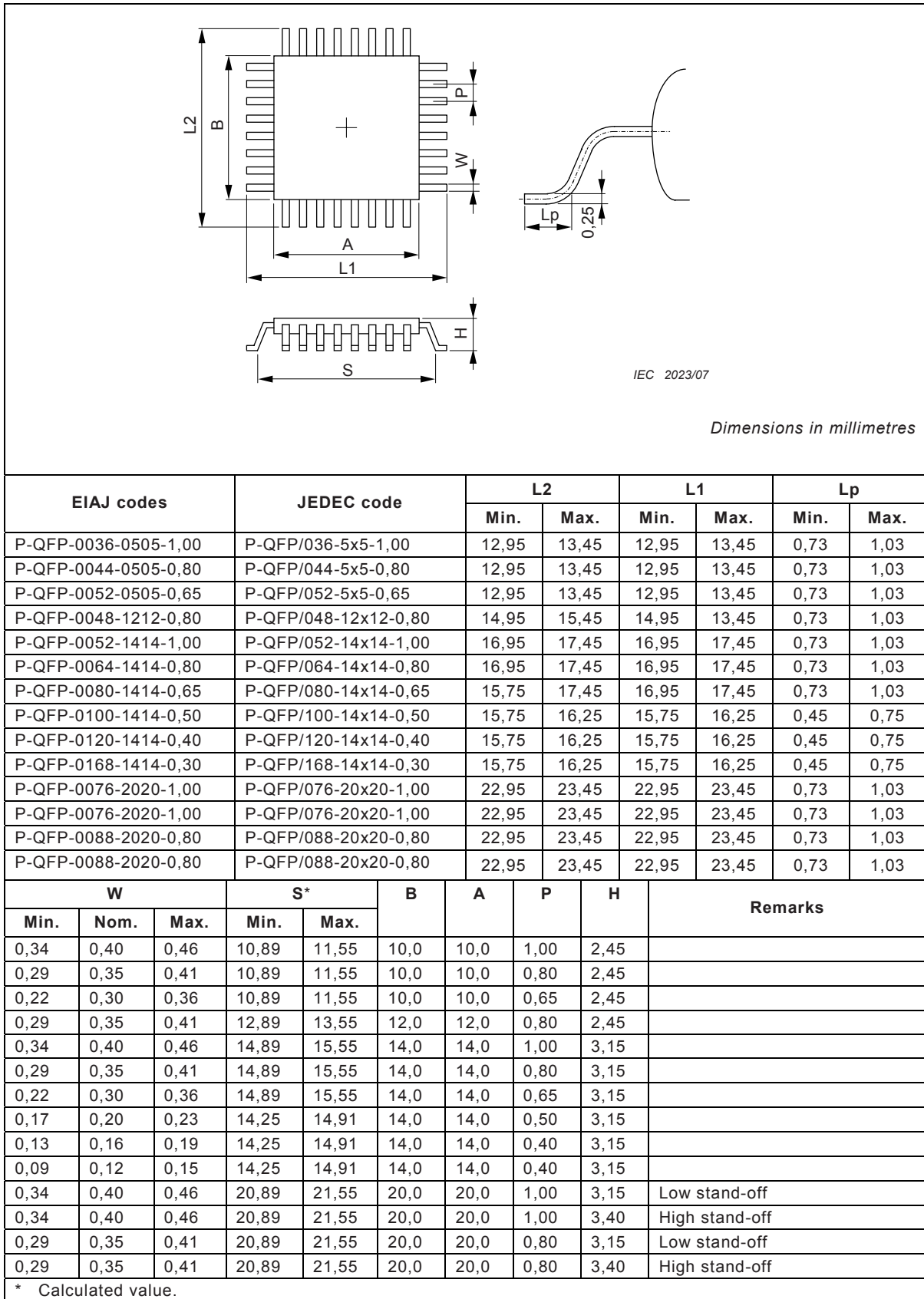


Figure 2 – PQFP (square) component dimensions

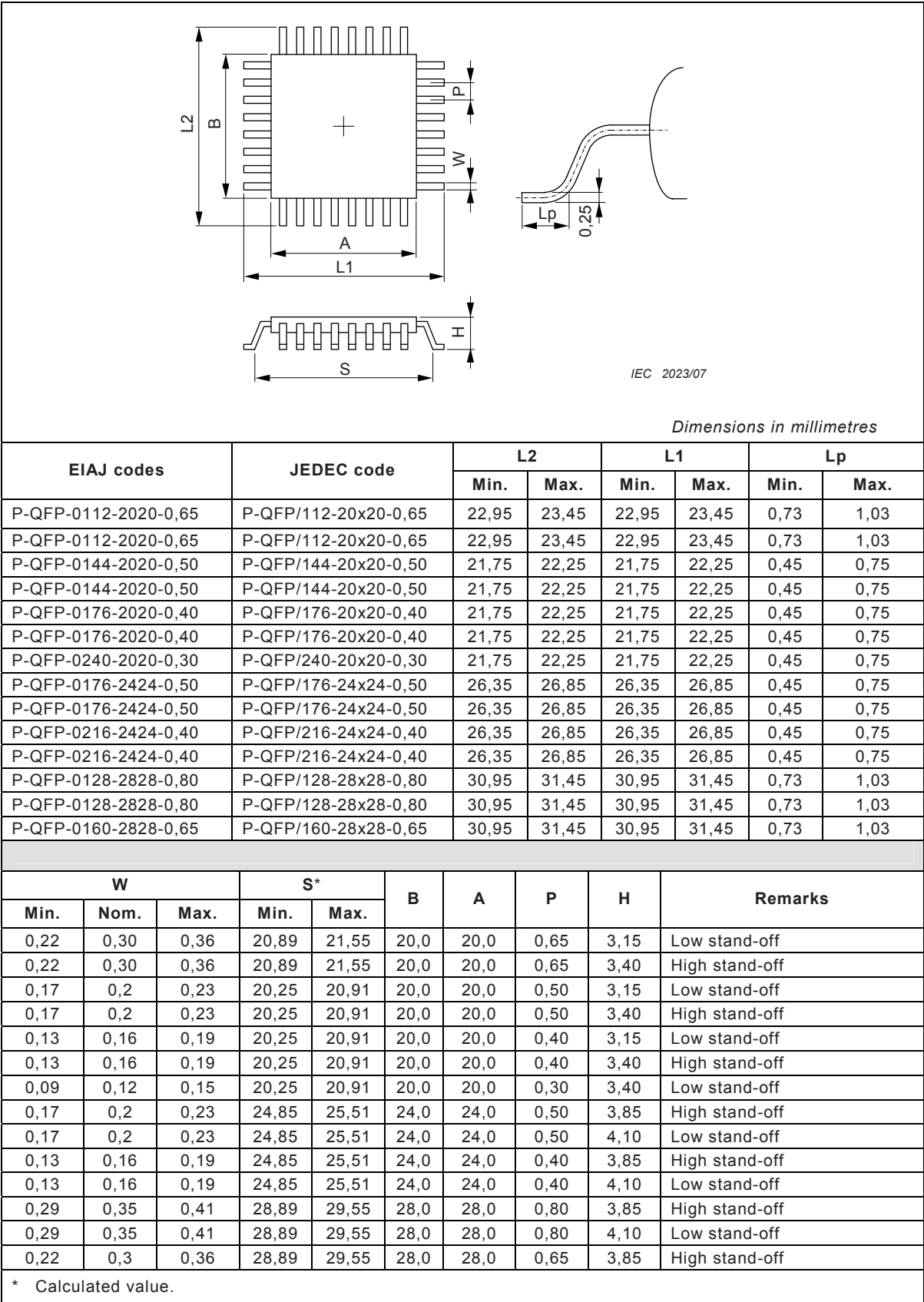


Figure 2 (continued)

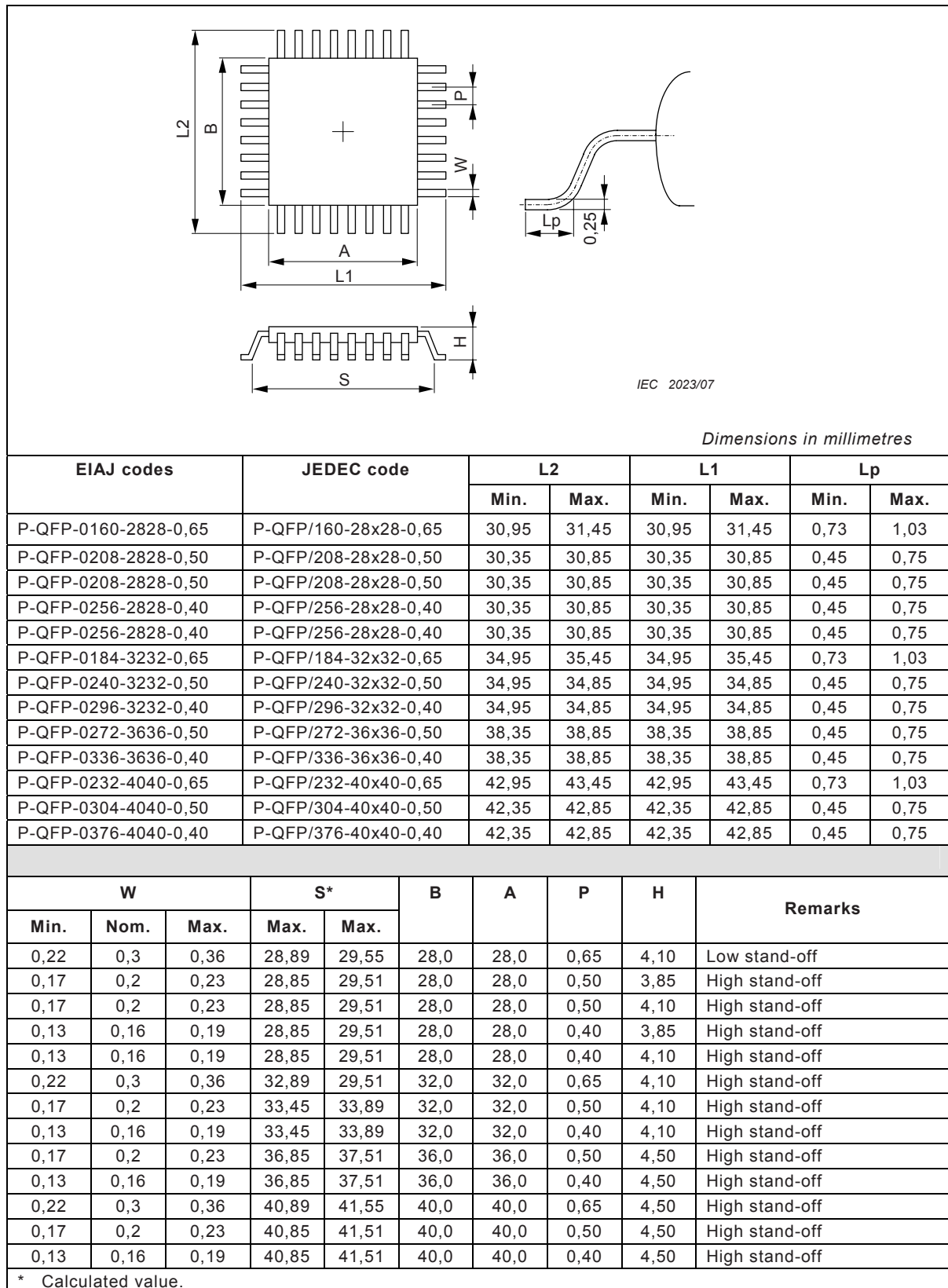


Figure 2 (continued)

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:

$$\begin{aligned} Z_{\max} &= L_{\min} + 2J_T \max + T_T & T_T &= \sqrt{F_{L1}^2 + P_{L1}^2 + C_L^2} \\ G_{\min} &= S_{\max}(\text{rms}) - 2J_H \max - T_H & T_H &= \sqrt{F_{L1}^2 + P_{L1}^2 + C_S^2} \\ X_{\max} &= W_{\min} + 2J_S \max + T_S & T_S &= \sqrt{F_{L1}^2 + P_{L1}^2 + C_W^2} \end{aligned}$$

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

$$\begin{aligned} Z_{\max} &= L_{\min} + 2J_T \text{mdn} + T_T & T_T &= \sqrt{F_{L2}^2 + P_{L2}^2 + C_L^2} \\ G_{\min} &= S_{\max}(\text{rms}) - 2J_H \text{mdn} - T_H & T_H &= \sqrt{F_{L2}^2 + P_{L2}^2 + C_S^2} \\ X_{\max} &= W_{\min} + 2J_S \text{mdn} + T_S & T_S &= \sqrt{F_{L2}^2 + P_{L2}^2 + C_W^2} \end{aligned}$$

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

$$\begin{aligned} Z_{\max} &= L_{\min} + 2J_T \min + T_T & T_T &= \sqrt{F_{L3}^2 + P_{L3}^2 + C_L^2} \\ G_{\min} &= S_{\max}(\text{rms}) - 2J_H \min - T_H & T_H &= \sqrt{F_{L3}^2 + P_{L3}^2 + C_S^2} \\ X_{\max} &= W_{\min} + 2J_S \min + T_S & T_S &= \sqrt{F_{L3}^2 + P_{L3}^2 + C_W^2} \end{aligned}$$

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:

$$\begin{aligned} T_T &= C_L, Z_{\max} = L_{\min} + 2J_T \min + C_L = L_{\max} + 2J_T \min \\ T_H &= C_S, G_{\min} = S_{\max}(\text{rms}) - 2J_H \min - C_S \\ T_S &= C_W, X_{\max} = W_{\min} + 2J_S \min + C_W = W_{\max} + 2J_S \min \end{aligned}$$

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