IEC 61188-5-8

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INTERNATIONAL STANDARD

Printed boards and printed board assemblies – Design and use – Part 5-8: Attachment (land/joint) considerations – Area array components (BGA, FBGA, CGA, LGA)

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International Standard IEC 61188-5-8 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
91/705/FDIS	91/737/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 61188-5-8 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- withdrawn;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 publication may be issued at a later date.

INTRODUCTION

This part of IEC 61188 covers land patterns for area array components which include ball grid array (BGA) parts (rigid, flexible or ceramic substrate); fine pitch ball grid array (FBGA) parts (rigid or flexible substrate); column grid array (CGA) parts (ceramic substrates) and land grid array (LGA) parts (ceramic substrates). Each clause contains information in accordance with the area array family of components and their requirements for appropriate land patterns.

The proposed land pattern dimensions in this standard are based upon the fundamental tolerance calculation combined with the given land geometries 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 the reflow soldering process.

Although other standards in the IEC 61188-5 series define three levels of land pattern dimensioning, this standard will only define two levels. One level (level 2) is for non collapsing BGA balls; the other level (level 3) is for those BGA components where the ball does collapse around the land. All land descriptions are non-solder mask defined. 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 geometries, this standard should be used for checking the resulting ball to land relationship.

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. In addition, the size and shape of the proposed land pattern may vary according to the solder resist aperture, the size of the land pattern extension (dog bone), the via within the extension, or if the via is in the land pattern itself.

Dimensions of the components listed in this standard are of those available in the market, and regarded as reference only.

PRINTED BOARDS AND PRINTED BOARD ASSEMBLIES – DESIGN AND USE –

Part 5-8: Attachment (land/joint) considerations – Area array components (BGA, FBGA, CGA, LGA)

1 Scope

This part of IEC 61188 provides information on land pattern geometries used for the surface attachment of electronic components with area array terminations in the form of solder balls, solder columns or protective coated lands. 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 joint, 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 joint no matter which solder alloy is used to make that joint (lead-free, tin lead, etc.).

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

Area array land patterns do not use "land protrusion" concepts and attempt to match the characteristics of the physical and dimensional termination properties. There are several configurations available, as shown in Figure 1. However, the tables provided show only the optimum dimension across the outer construction of the land.

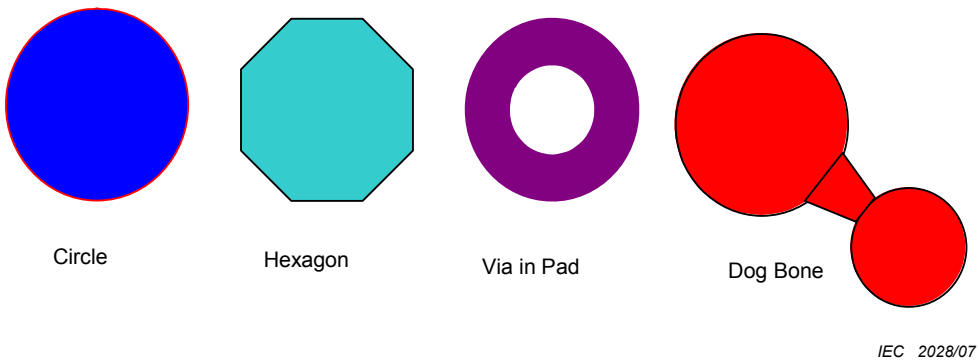


Figure 1 – Area array land pattern configuration

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 60068-2-58, *Environmental testing – Part 2-58: Tests: Test Td – Test methods for solderability, resistance to dissolution of metallization and to soldering heat of surface mounting devices (SMD)*

IEC 60191-2 (all parts), *Mechanical standardization of semiconductor devices – Part 2: Dimensions*

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

IEC 62090, *Product package labels for electronic components using bar code and two-dimensional symbologies*

3 General information

3.1 General component description

The area array family is characterized by terminations that are on a particular pitch and contain a number of rows and columns for the total IO termination pin count. The BGA family uses a solder ball as a termination and may have a square or rectangular package configuration. The family includes both moulded plastic and ceramic case styles. The acronyms PBGA (plastic ball grid array), CBGA (ceramic ball grid array), FBGA (fine pitch ball grid array), and TBGA (tape ball grid array) are also used to describe the family since they all use a ball termination in an array format. Other enhancements such as the addition of thermal heat distributors may be included in any of the package types described.

There are several ball pitch variations within the family; these range from 1,50 mm to 0,25 mm as shown in Table 1. The lower pitch items (below 0,40 mm) are predicted for future component configurations.

Table 1 – Ball diameter sizes

Pitch mm	**Solder bump nominal diameter** mm	**Solder bump diameter variation** mm
1,50; 1,27	0,75	0,90 – 0,65
1,00	0,60	0,70 – 0,50
1,00; 0,80	0,50	0,55 – 0,45
1,00; 0,80; 0,75	0,45	0,50 – 0,40
0,80; 0,75; 0.65	0,40	0,45 – 0,35
0,80; 0,75; 0,65; 0,50	0,30	0,35 – 0,25
0,40	0,25	0,28 – 0,22
0,30	0,20	0,22 – 0,18
0,25	0,15	0,17 – 0,13

3.2 Marking

The area array family 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 a pin 1 marking. Additional markings may include date-code manufacturing lot and/or manufacturing location. Bar code marking should be in accordance with IEC 62090.

3.3 Carrier packaging format

Carrier tray packaging format or tape and reel may be provided. Either format is acceptable and is usually specified by the component manufacturer or the assembler. Choice of format is usually dependent on size of component and volume to be assembled. Bulk packaging is not acceptable because of termination coplanarity issues and the requirements for placement and soldering.

3.4 Process considerations

Area array packages are normally processed by reflow solder operations. There is also a process difference between the solder application for those terminations that collapse slightly during soldering as defined in level 3 of this standard, and those terminations that do not collapse (level 2) where a significant amount of additional solder paste is required.

In conjunction with the right land size, the volume of the solder paste application is a fundamental parameter to keep under control in order to have a good reflow quality yield and reliable solder joint. Paste volume deposition may be a matter of SPC adoption at the print process step.

Fine pitch ball parts may require special processing outside the normal pick/place and reflow manufacturing operations. This requirement relates to the amount of solder paste, the precision of the placement machine and the soldering process profile, in order to permit all parts to become attached at the same time that the FBGA is reflowed.

4 BGA (square)

4.1 Field of application

This clause provides the component and land pattern dimensions for square type BGA (ball grid array) components. The basic construction of the BGA 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

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

4.2.1 Basic construction

The ball grid array has been developed for applications requiring low height and high density. The BGA components may take many forms, as illustrated in Figure 2. Variations include the method of die attach (wire bonding, flip chip, etc.), the substrate material (organic rigid or flexible material, ceramic, etc.) and the method of protecting the device from the environment (plastic encapsulation, hermetic sealing etc.). All variations can use the same land patterns defined in this clause, as all types may be used in many printed circuit board assemblies for device applications.

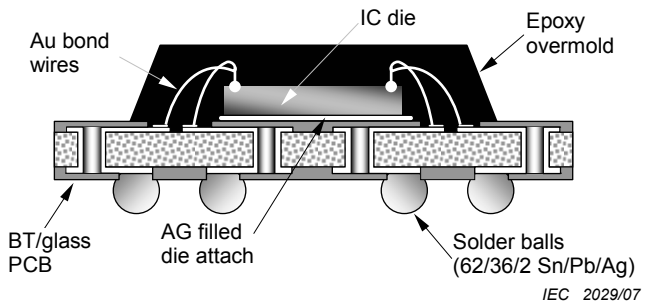
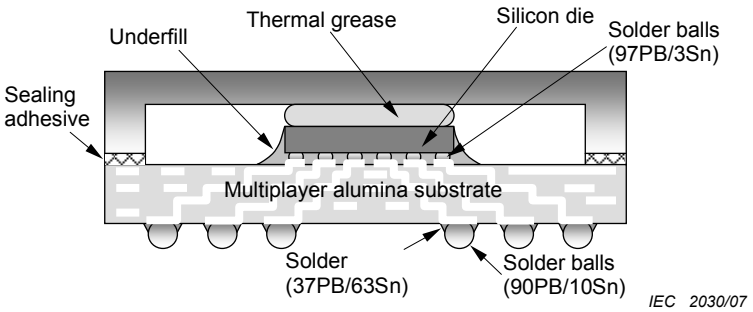
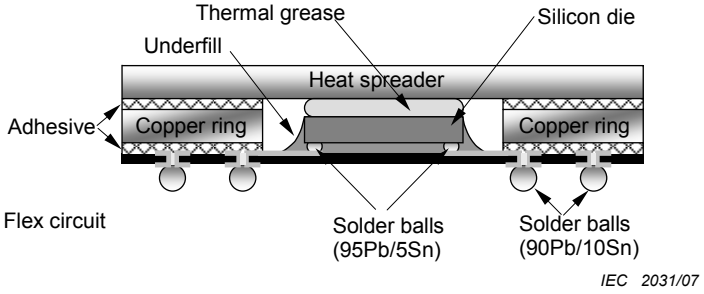
Plastic BGA with wire bond chip attach	
Ceramic BGA, hermetically sealed, with flip chip die attach	
Tape bonded grid array, with flip chip die attach and enhanced thermal heat spreader	

Figure 2 – BGA physical configuration examples

4.2.2 Termination materials

The BGA ball termination may consist of a variety of metal alloys. Some of these include balls with some lead content such as 37Pb63Sn, 90Pb10Sn, 95Pb5Sn, while others do not contain lead such as Sn96,5Ag3,0Cu0,5, Sn96,5Ag3,5, Sn-9Zn-0,003Al. It is a good recommendation to use the same alloy, in a paste form, to attach the BGA balls to the mounting substrate, however, some of the balls that do not collapse, as shown in Figure 3, require a paste that is more conducive to reflow temperatures.

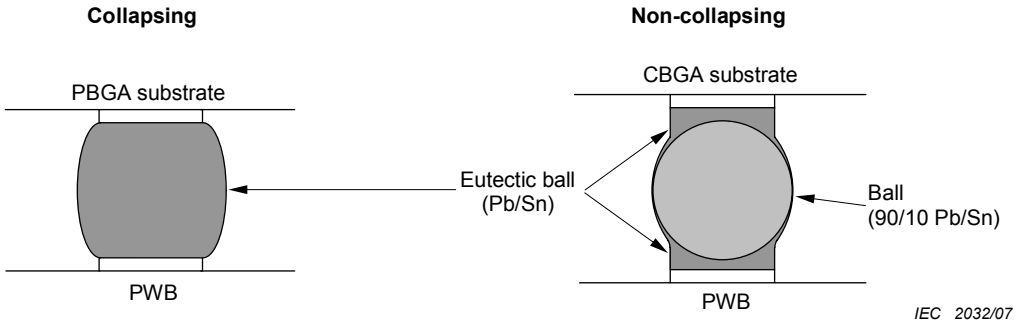


Figure 3 – High land and eutectic solder ball and joint comparison

4.2.3 Marking

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

4.2.4 Carrier package format

The carrier package format for BGAs may be tray or tape and reel format. In most instances, BGAs are delivered in a carrier tray.

4.2.5 Process considerations

BGAs are usually processed using standard reflow solder processes. Parts should be capable of withstanding three cycles through a standard reflow system operating within a range of 235 °C to 260 °C depending on the attachment alloy being used. Each cycle shall consist of a 60 s to 90 s exposure at the particular temperature selected. The construction of the BGA resin system used for encapsulation, as shown in Figure 4, shall be capable of withstanding the process temperature exposure. This capability may be verified through test methods indicated in IEC 60068-2-58, Method 2, for three cycles with an appropriate dwell time to allow the specimens to cool.

It is important to consider that plastic BGAs are moisture sensitive device/components. Precaution shall be taken during the printed board assembly process in order to avoid MSD damages (delamination, cracks, etc). Traceability for baking PBGA, might be required mainly when attached in a double sided/reflow printed board assembly.

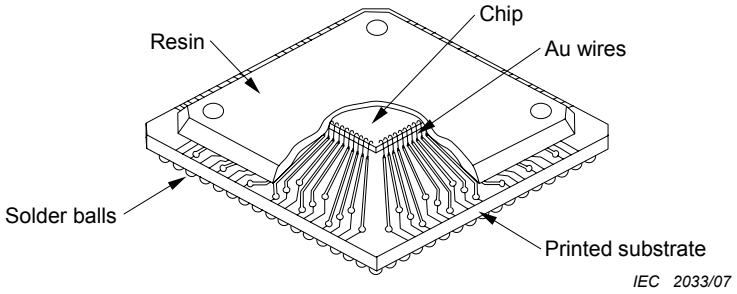


Figure 4 – BGA (square)

4.3 Component dimensions (square)

This subclause contains the physical dimensions of various PBGAs that have been standardized so that land pattern analysis can be performed. Figure 5 provides the general characteristic of the component and shows a depopulated version of the BGA device. Each manufacturer of a semiconductor may take the fully populated version and remove those terminations (balls), as appropriate, to establish the final configuration of the part.

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

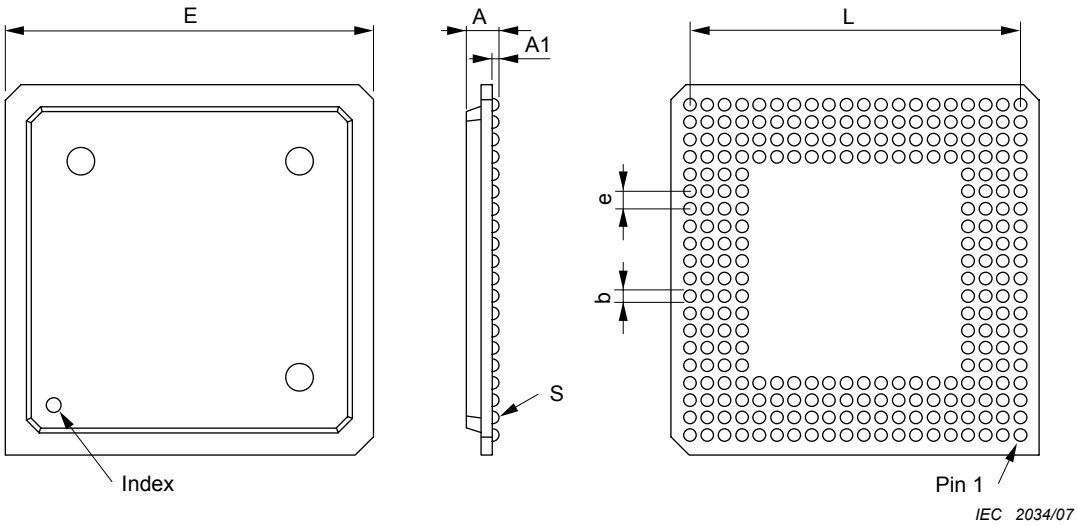


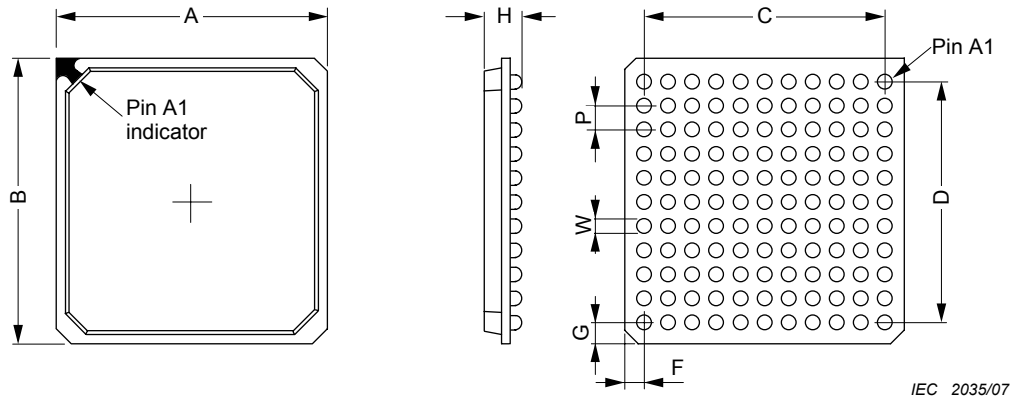
Figure 5 – General BGA dimensional characteristics

The following tables have been segmented according to the know pitch of those devices presently in use. The requirements are fully documented in IEC 60191-2. The information is provided for fully populated parts only, so that all the corresponding land patterns can be derived. Users of the information are cautioned to be sure that their land pattern version is identical to the part that they have purchased from the component supplier. It should also be known that not every supplier follows the same removal of termination pattern for a similar product. Thus, when looking for multiple sources, the user shall establish complete compliance with the design image in the computer library before making the commitment that the end use patterns may be used to mount different BGA component supplier parts.

4.3.1 PBGA 1,5 mm pitch component dimensions (square)

Table 2 defines the requirements for BGA components with a pitch of 1,5 mm.

Table 2 – BGA products with pitch of 1,5 mm



FE full even matrix
FO full odd matrix

Component identifier	Contact array rows x columns	A	B	C	D	W	P	H	F or G
		Max.	Max.	Max.	Max.	Nom.	Basic	Max.	Nom.
PBGA 7x7 FE16	4x4	7,00	7,00	4,50	4,50	0,75	1,50	3,50	1,25
PBGA 7x7 FO9	3x3	7,00	7,00	3,00	3,00	0,75	1,50	3,50	2,00
PBGA 8x8 FO25	5x5	8,00	8,00	6,00	6,00	0,75	1,50	3,50	1,00
PBGA 8x8 FE16	4x4	8,00	8,00	4,50	4,50	0,75	1,50	3,50	1,75
PBGA 9x9 FE36	6x6	9,00	9,00	7,50	7,50	0,75	1,50	3,50	0,75
PBGA 9x9 FO25	5x5	9,00	9,00	6,00	6,00	0,75	1,50	3,50	1,50
PBGA 10x10 FE36	6x6	10,00	10,00	7,50	7,50	0,75	1,50	3,50	1,25
PBGA 10x10 FO25	5x5	10,00	10,00	6,00	6,00	0,75	1,50	3,50	2,00
PBGA 11x11 FO49	7x7	11,00	11,00	9,00	9,00	0,75	1,50	3,50	1,00
PBGA 11x11 FE36	6x6	11,00	11,00	7,50	7,50	0,75	1,50	3,50	1,75
PBGA 12x12 FE64	8x8	12,00	12,00	10,50	10,50	0,75	1,50	3,50	0,75
PBGA 12x12 FO49	7x7	12,00	12,00	9,00	9,00	0,75	1,50	3,50	1,50
PBGA 13x13 FE64	8x8	13,00	13,00	10,50	10,50	0,75	1,50	3,50	1,25
PBGA 13x13 FO49	7x7	13,00	13,00	9,00	9,00	0,75	1,50	3,50	2,00
PBGA 14x14 FO81	9x9	14,00	14,00	12,00	12,00	0,75	1,50	3,50	1,00
PBGA 14x14 FE64	8x8	14,00	14,00	10,50	10,50	0,75	1,50	3,50	1,75
PBGA 15x15 FE100	10x10	15,00	15,00	13,50	13,50	0,75	1,50	3,50	0,75
PBGA 15x15 FO81	9x9	15,00	15,00	12,00	12,00	0,75	1,50	3,50	1,50
PBGA 17x17 FO121	11x11	17,00	17,00	15,00	15,00	0,75	1,50	3,50	1,00
PBGA 17x17 FE100	10x10	17,00	17,00	13,50	13,50	0,75	1,50	3,50	1,75
PBGA 19X19 FE144	12x12	19,00	19,00	16,50	16,50	0,75	1,50	3,50	1,25
PBGA 19X19 FO121	11x11	19,00	19,00	15,00	15,00	0,75	1,50	3,50	2,00
PBGA 21X21 FE196	14x14	21,00	21,00	19,50	19,50	0,75	1,50	3,50	0,75
PBGA 21X21 FO169	13x13	21,00	21,00	18,00	18,00	0,75	1,50	3,50	1,5
PBGA 23X23 FO225	15x15	23,00	23,00	21,00	21,00	0,75	1,50	3,50	1,00
PBGA 23X23 FE196	14x14	23,00	23,00	19,50	19,50	0,75	1,50	3,50	1,75
PBGA 25X25 FE256	16x16	25,00	25,00	22,50	22,50	0,75	1,50	3,50	1,25
PBGA 25X25 FO225	15x15	25,00	25,00	21,00	21,00	0,75	1,50	3,50	2,00
PBGA 27X27 FE324	18x18	27,00	27,00	25,50	25,50	0,75	1,50	3,50	0,75
PBGA 27X27 FO289	17x17	27,00	27,00	24,00	24,00	0,75	1,50	3,50	1,50
PBGA 29X29 FO361	19x19	29,00	29,00	27,00	27,00	0,75	1,50	3,50	1,00
PBGA 29X29 FE324	18x18	29,00	29,00	25,50	25,50	0,75	1,50	3,50	1,75
PBGA 31X31 FE400	20x20	31,00	31,00	28,50	28,50	0,75	1,50	3,50	1,25
PBGA 31X31 FO361	19x19	31,00	31,00	27,00	27,00	0,75	1,50	3,50	2,00
PBGA 33X33 FE484	22x22	33,00	33,00	31,50	31,50	0,75	1,50	3,50	0,75
PBGA 33X33 FO441	21x21	33,00	33,00	30,00	30,00	0,75	1,50	3,50	1,50
PBGA 35X35 FO529	23x23	35,00	35,00	33,00	33,00	0,75	1,50	3,50	1,00
PBGA 35X35 FE484	22x22	35,00	35,00	31,50	31,50	0,75	1,50	3,50	1,75

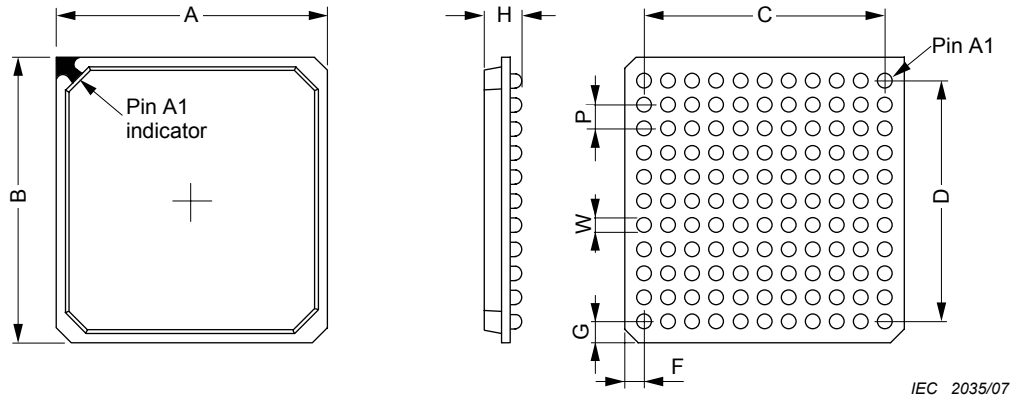
Table 2 *(continued)*

Component identifier	Contact array rows x columns	A	B	C	D	W	P	H	F or G
		Max.	Max.	Max.	Max.	Nom.	Basic	Max.	Nom.
PBGA 37,5X37,5 FO625	25x25	37,50	37,50	36,00	36,00	0,75	1,50	3,50	0,75
PBGA 37,5X37,5 FE576	24x24	37,50	37,50	34,50	34,50	0,75	1,50	3,50	1,50
PBGA 40X40 FE676	26x26	40,00	40,00	37,50	37,50	0,75	1,50	3,50	1,25
PBGA 40X40 FO625	25x25	40,00	40,00	36,00	36,00	0,75	1,50	3,50	2,00
PBGA 42,5X42,5 FE784	28x28	42,50	42,50	40,50	40,50	0,75	1,50	3,50	1,00
PBGA 42,5X42,5 FO729	27x27	42,50	42,50	39,00	39,00	0,75	1,50	3,50	1,75
PBGA 45X45 FE900	30x30	45,00	45,00	43,50	43,50	0,75	1,50	3,50	0,75
PBGA 45X45 FO841	29x29	45,00	45,00	42,00	42,00	0,75	1,50	3,50	1,50
PBGA 47,5X47,5 FO961	31x31	47,50	47,50	45,00	45,00	0,75	1,50	3,50	1,25
PBGA 47,5X47,5 FE900	30x30	47,50	47,50	43,50	43,50	0,75	1,50	3,50	2,00
PBGA 50X50 FO1089	33x33	50,00	50,00	48,00	48,00	0,75	1,50	3,50	1,00
PBGA 50X50 FE1024	32x32	50,00	50,00	46,50	46,50	0,75	1,50	3,50	1,75
Unit dimensions are in millimetres.									

4.3.2 PBGA 1,27 mm pitch component dimensions (square)

Table 3 defines the requirements for BGA components with a pitch of 1,27 mm.

Table 3 – BGA products with pitch of 1,27 mm



FE full even matrix
FO full odd matrix

Component identifier	Contact array rows x columns	A	B	C	D	W	P	H	F or G
		Max.	Max.	Max.	Max.	Nom.	Basic	Max.	Nom.
PBGA 7x7 FO25	5x5	7,00	7,00	5,08	5,08	0,75	1,27	3,50	0,96
PBGA 7x7 FE16	4x4	7,00	7,00	3,81	3,81	0,75	1,27	3,50	1,6
PBGA 8x8 FE36	6x6	8,00	8,00	6,35	6,35	0,75	1,27	3,50	0,82
PBGA 8x8 FO25	5x5	8,00	8,00	5,08	5,08	0,75	1,27	3,50	1,46
PBGA 9x9 FE36	6x6	9,00	9,00	6,35	6,35	0,75	1,27	3,50	1,32
PBGA 9x9 FO25	5x5	9,00	9,00	5,08	5,08	0,75	1,27	3,50	1,96
PBGA 10x10 FO49	7x7	10,00	10,00	7,62	7,62	0,75	1,27	3,50	1,19
PBGA 10x 10 FE36	6x6	10,00	10,00	6,35	6,35	0,75	1,27	3,50	1,82

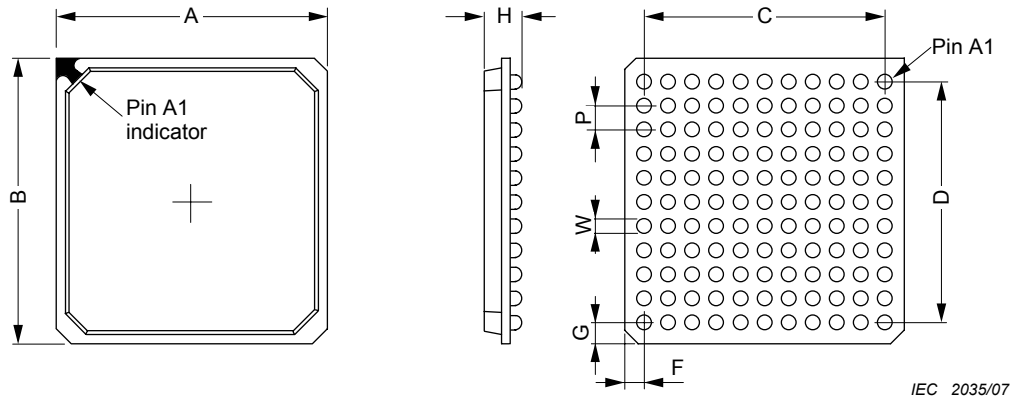
Table 3 *(continued)*

PBGA 11x11 FE64	8x8	11,00	11,00	8,89	8,89	0,75	1,27	3,50	1,05
PBGA 11x11 FO49	7x7	11,00	11,00	7,62	7,62	0,75	1,27	3,50	1,69
Component identifier	**Contact array rows x columns**	**A**	**B**	**C**	**D**	**W**	**P**	**H**	**F or G**
		Max.	**Max.**	**Max.**	**Max.**	**Nom.**	**Basic**	**Max.**	**Nom.**
PBGA 12x12 FO81	9x9	12,00	12,00	10,16	10,16	0,75	1,27	3,50	0,92
PBGA 12x12 FE64	8x8	12,00	12,00	8,89	8,89	0,75	1,27	3,50	1,56
PBGA 13x13 FE100	10x10	13,00	13,00	11,43	11,43	0,75	1,27	3,50	0,78
PBGA 13x13 FO81	9x9	13,00	13,00	10,16	10,16	0,75	1,27	3,50	1,42
PBGA 14x14 FE100	10x10	14,00	14,00	11,43	11,43	0,75	1,27	3,50	1,28
PBGA 14x14 FO81	9x9	14,00	14,00	10,16	10,16	0,75	1,27	3,50	1,92
PBGA 15x15 FO121	11x11	15,00	15,00	12,70	12,70	0,75	1,27	3,50	1,15
PBGA 15x15 FE100	10x10	15,00	15,00	11,43	11,43	0,75	1,27	3,50	1,78
PBGA 17x17 FO169	13x13	17,00	17,00	15,24	15,24	0,75	1,27	3,50	0,88
PBGA 17x17 FE144	12x12	17,00	17,00	13,97	13,97	0,75	1,27	3,50	1,51
PBGA 19X19 FE196	14x14	19,00	19,00	16,51	16,51	0,75	1,27	3,50	1,24
PBGA 19X19 FO169	13x13	19,00	19,00	15,24	15,24	0,75	1,27	3,50	1,88
PBGA 21X21 FE256	16x16	21,00	21,00	19,05	19,05	0,75	1,27	3,50	0,971
PBGA 21X21 FO225	15x15	21,00	21,00	17,78	17,78	0,75	1,27	3,50	1,6
PBGA 23X23 FE324	18x18	23,00	23,00	21,59	21,59	0,75	1,27	3,50	0,70
PBGA 23X23 FO289	17x17	23,00	23,00	20,32	20,32	0,75	1,27	3,50	1,34
PBGA 25X25 FO361	19x19	25,00	25,00	22,86	22,86	0,75	1,27	3,50	1,07
PBGA 25X25 FE324	18x18	25,00	25,00	21,59	21,59	0,75	1,27	3,50	1,70
PBGA 27X27 FO441	21x21	27,00	27,00	25,40	25,40	0,75	1,27	3,50	0,80
PBGA 27X27 FE400	20x20	27,00	27,00	24,13	24,13	0,75	1,27	3,50	1,43
PBGA 29X29 FE484	22x22	29,00	29,00	26,67	26,67	0,75	1,27	3,50	1,16
PBGA 29X29 FO441	21x21	29,00	29,00	25,40	25,40	0,75	1,27	3,50	1,80
PBGA 31X31 FE576	24x24	31,00	31,00	29,21	29,21	0,75	1,27	3,50	0,89
PBGA 31X31 FO529	23x23	31,00	31,00	27,94	27,94	0,75	1,27	3,50	1,53
PBGA 33X33 FO625	25x25	33,00	33,00	30,48	30,48	0,75	1,27	3,50	1,26
PBGA 33X33 FE576	24x24	33,00	33,00	29,21	29,21	0,75	1,27	3,50	1,89
PBGA 35X35 FO729	27x27	35,00	35,00	33,02	33,02	0,75	1,27	3,50	0,99
PBGA 35X35 FE676	26x26	35,00	35,00	31,75	31,75	0,75	1,27	3,50	1,62
PBGA 37,5X37,5 FO841	29x29	37,50	37,50	35,56	35,56	0,75	1,27	3,50	0,97
PBGA 37,5X37,5 FE784	28x28	37,50	37,50	34,29	34,29	0,75	1,27	3,50	1,60
PBGA 40X40 FO961	31x31	40,00	40,00	38,10	38,10	0,75	1,27	3,50	0,95
PBGA 40X40 FE900	30x30	40,00	40,00	36,83	36,83	0,75	1,27	3,50	1,58
PBGA 42,5X42,5 FO1089	33x33	42,50	42,50	40,64	40,64	0,75	1,27	3,50	0,93
PBGA 42,5X42,5 FE1024	32x32	42,50	42,50	39,37	39,37	0,75	1,27	3,50	1,56
PBGA 45X45 FO1225	35x35	45,00	45,00	43,18	43,18	0,75	1,27	3,50	0,91
PBGA 45X45 FO1156	34x34	45,00	45,00	41,91	41,91	0,75	1,27	3,50	1,54
PBGA 47,5X47,5 FO1369	37x37	47,50	47,50	45,72	45,72	0,75	1,27	3,50	0,89
PBGA 47,5X47,5 FE1296	36x36	47,50	47,50	44,45	44,45	0,75	1,27	3,50	1,52
PBGA 50X50 FO1521	39x39	50,00	50,00	48,26	48,26	0,75	1,27	3,50	0,87
PBGA 50X50 FE1444	38x38	50,00	50,00	46,99	46,99	0,75	1,27	3,50	1,50
Unit dimensions are in millimetres.									

4.3.3 PBGA 1,00 mm pitch component dimensions (square)

Table 4 defines the requirements for BGA components with a pitch of 1,00 mm.

Table 4 – BGA products with pitch of 1,0 mm



FE full even matrix
FO full odd matrix

Component identifier	Contact array rows x columns	A	B	C	D	W	P	H	F or G
		Max.	Max.	Max.	Max.	Nom.	Basic	Max.	Nom.
PBGA 7x7 FE36	6x6	7,00	7,00	5,00	5,00	0,60	1,00	3,50	1,00
PBGA 7x7 FO25	5x5	7,00	7,00	4,00	4,00	0,60	1,00	3,50	1,50
PBGA 8x8 F049	7x7	8,00	8,00	6,00	6,00	0,60	1,00	3,50	1,00
PBGA 8x8 FE36	6x6	8,00	8,00	5,00	5,00	0,60	1,00	3,50	1,50
PBGA 9x9 FE64	8x8	9,00	9,00	7,00	7,00	0,60	1,00	3,50	1,00
PBGA 9x9 FO49	7x7	9,00	9,00	6,00	6,00	0,60	1,00	3,50	1,50
PBGA 10x10 FO81	9x9	10,00	10,00	8,00	8,00	0,60	1,00	3,50	1,00
PBGA 10x10 FE64	8x8	10,00	10,00	7,00	7,00	0,60	1,00	3,50	1,50
PBGA 11x11 FE100	10x10	11,00	11,00	9,00	9,00	0,60	1,00	3,50	1,00
PBGA 11x11 FO81	9x9	11,00	11,00	8,00	8,00	0,60	1,00	3,50	1,50
PBGA 12x12 FO121	11x11	12,00	12,00	10,00	10,00	0,60	1,00	3,50	1,00
PBGA 12x12 FE100	10x10	12,00	12,00	9,00	9,00	0,60	1,00	3,50	1,50
PBGA 13x13 FE144	12x12	13,00	13,00	11,00	11,00	0,60	1,00	3,50	1,00
PBGA 13x13 FO121	11x11	13,00	13,00	10,00	10,00	0,60	1,00	3,50	1,50
PBGA 14x14 FO169	13x13	14,00	14,00	12,00	12,00	0,60	1,00	3,50	1,00
PBGA 14x14 FE144	12x12	14,00	14,00	11,00	11,00	0,60	1,00	3,50	1,50
PBGA 15x15 FE196	14x14	15,00	15,00	13,00	13,00	0,60	1,00	3,50	1,00
PBGA 15x15 FO169	13x13	15,00	15,00	12,00	12,00	0,60	1,00	3,50	1,50
PBGA 17x17 FE256	16x16	17,00	17,00	15,00	15,00	0,60	1,00	3,50	1,00
PGBA 17x17 FO225	15x15	17,00	17,00	14,00	14,00	0,60	1,00	3,50	1,50
PBGA 19X19 FE324	18X18	19,00	19,00	17,00	17,00	0,60	1,00	3,50	1,00
PBGA 19x19 FO289	17x17	19,00	19,00	16,00	16,00	0,60	1,00	3,50	1,50
PBGA 21X21 FE400	20X20	21,00	21,00	19,00	19,00	0,60	1,00	3,50	1,00
PBGA 21x21 FO361	19x19	21,00	21,00	18,00	18,00	0,60	1,00	3,50	1,50
PBGA 23X23 FE484	22X22	23,00	23,00	21,00	21,00	0,60	1,00	3,50	1,00
PBGA 23x23 FO441	21x21	23,00	23,00	20,00	20,00	0,60	1,00	3,50	1,50
PBGA 25X25 FE576	24X24	25,00	25,00	23,00	23,00	0,60	1,00	3,50	1,00
PBGA 25x25 FO529	23x23	25,00	25,00	22,00	22,00	0,60	1,00	3,50	1,50
PBGA 27X27 FE676	26X26	27,00	27,00	25,00	25,00	0,60	1,00	3,50	1,00
PBGA 27X27 FO625	25x25	27,00	27,00	24,00	24,00	0,60	1,00	3,50	1,50
PBGA 29X29 FE784	28X28	29,00	29,00	27,00	27,00	0,60	1,00	3,50	1,00
PBGA 29X29 FO729	27x27	29,00	29,00	26,00	26,00	0,60	1,00	3,50	1,50
PBGA 31X31 FE900	30X30	31,00	31,00	29,00	29,00	0,60	1,00	3,50	1,00
PBGA 31X31 FO841	29x29	31,00	31,00	28,00	28,00	0,60	1,00	3,50	1,50
PBGA 33X33 FE1024	32X32	33,00	33,00	31,00	31,00	0,60	1,00	3,50	1,00
PBGA 33X33 FO961	31x31	33,00	33,00	30,00	30,00	0,60	1,00	3,50	1,50
PBGA 35X35 FE1156	34X34	35,00	35,00	33,00	33,00	0,60	1,00	3,50	1,00
PBGA 35X35 FO1089	33x33	35,00	35,00	32,00	32,00	0,60	1,00	3,50	1,50

Table 4 *(continued)*

Component identifier	Contact array rows x columns	A	B	C	D	W	P	H	F or G
		Max.	Max.	Max.	Max.	Nom.	Basic	Max.	Nom.
PBGA 37,5X37,5 FO1369	37X37	37,50	37,50	36,00	36,00	0,60	1,00	3,50	0,75
PBGA 37,5X37,5 FE1296	36x36	37,50	37,50	35,00	35,00	0,60	1,00	3,50	1,25
PBGA 40X40 FO1521	39X39	40,00	40,00	38,00	38,00	0,60	1,00	3,50	1,00
PBGA 40X40 FE1444	38x38	40,00	40,00	37,00	37,00	0,60	1,00	3,50	1,50
PBGA 42,5X42,5 FE1764	42X42	42,50	42,50	41,00	41,00	0,60	1,00	3,50	0,75
PBGA 42,5X42,5 FO1681	41x41	42,50	42,50	40,00	40,00	0,60	1,00	3,50	1,25
PBGA 45X45 FE1936	44X44	45,00	45,00	43,00	43,00	0,60	1,00	3,50	1,00
PBGA 45X45 FO1849	43x43	45,00	45,00	42,00	42,00	0,60	1,00	3,50	1,50
PBGA 47,5X47,5 FO2209	47X47	47,50	47,50	46,00	46,00	0,60	1,00	3,50	0,75
PBGA 47,5X47,5 FE2116	46x46	47,50	47,50	45,00	45,00	0,60	1,00	3,50	1,25
PBGA 50X50 FO2401	49X49	50,00	50,00	48,00	48,00	0,60	1,00	3,50	1,00
PBGA 50X50 FE2304	48x48	50,00	50,00	47,00	47,00	0,60	1,00	3,50	1,50
Unit dimensions are in millimetres.									

4.4 Solder joint fillet design

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:

Design consideration when soldered with self-alignment effect:

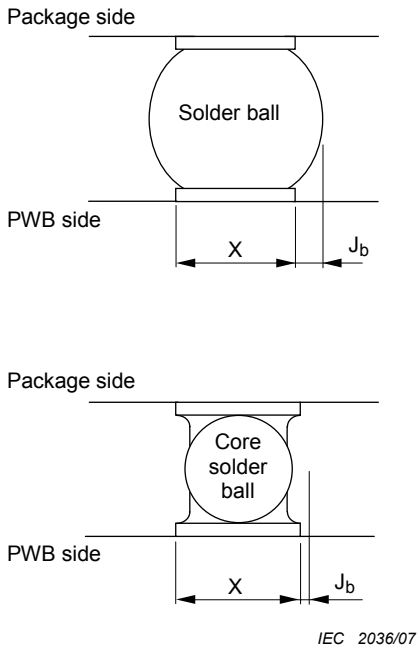
$$Xmax = b\ min + 2\ J_b\ min + T_S \qquad T_S = \sqrt{F_{L3}{}^2 + P_{L3}{}^2 + C_b{}^2}$$

In the reflow soldering process, there is a self-alignment effect because adhesives are not used to hold components. In the surface mount process of reflow soldering, parts mount displacement when soldered can be cancelled by a self-alignment effect (therefore factor P can be regarded as 0). In addition, the tolerance of the land shape accuracy of PWBs 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:

$$T_S = C_{b,}\ Xmax = b\ min + 2J_b min + C_b = b\ max + 2J_b min$$

4.4.1 Solder joint fillet design – Non-collapsing, collapsing (level 3)

Figure 6 shows the shape and dimensions of the solder fillet after the soldering process. This configuration is for both the collapsing and non-collapsing solder ball. The minimum dimensions of fillet are determined by taking into consideration solder joint reliability and also quality and productivity in the parts mount process.



Dimensions in millimetres

Component pitch	Tolerance assumptions		Solder joint	
	F	P	J_b	
Basic	L-2	L-2	C_b	Min
1,50	0,1	0,1	0,35	-0,100
1,27	0,1	0,1	0,3	-0,100
1,00	0,1	0,1	0,3	-0,100
0,80	0,1	0,1	0,2	-0,050
0,75	0,1	0,1	0,2	-0,050
0,65	0,1	0,1	0,2	-0,050
0,50	0,1	0,1	0,2	-0,050
0,40	0,1	0,1	0,15	-0,050

Figure 6 – Solder joint fillet design

4.5 Land pattern dimensions

Figure 7 shows land pattern dimensions for BGA (square) for reflow soldering. These values are calculated based on the formula for the solder joint fillet design shown in IEC 61188-5-1.

The courtyard is calculated using the following formula and rounded off (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= [Dmin + $\sqrt{F^2 + P^2 + C_D{}^2}$] + (courtyard excess × 2);

CY_2= [Emin + $\sqrt{F^2 + P^2 + C_E{}^2}$] + (courtyard excess × 2).

The area is that between the rectangle circumscribing the land pattern and the component and the outer boundary of the courtyard. Therefore, the courtyard excess for BGA components is the same as QFP 0,05 mm.

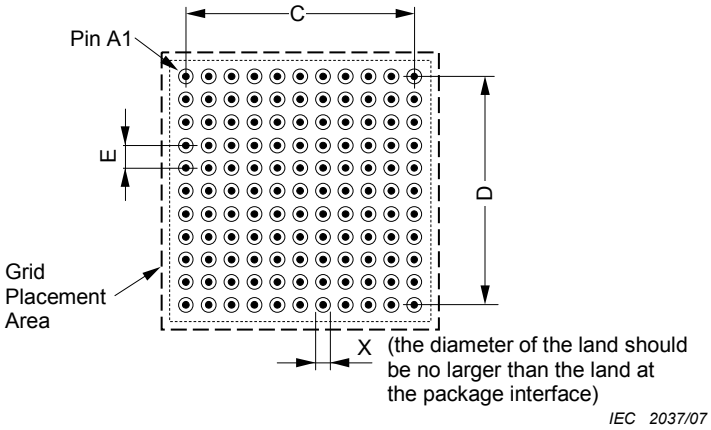
Pattern identifier	BGA Description	X	e	CY_1	CY_2
8000L	P-BGA-256P-2727-1,27	0,70	1,27	27,3	27,3
8001L	P-BGA-352P-3535-1,27	0,70	1,27	35,3	35,3
8002L	P-BGA-420P-3535-1,27	0,70	1,27	35,3	35,3
8003L	P-BGA-576P-4040-1,27	0,75	1,27	40,2	40,2
8004L	P-BGA-672P-4545-1,27	0,75	1,27	45,2	45,2
8005L	T-BGA-256P-2727-1,27	0,55	1,27	27,3	27,3
8006L	T-BGA-272P-2929-1,27	0,55	1,27	29,3	29,3
8007L	E-BGA-660P-4037-1,00	0,55	1,00	40,2	40,2
8008L	E-BGA-792P-4038-1,00	0,55	1,00	40,2	40,2
8009L	E-BGA-896P-4039-1,00	0,55	1,00	40,2	40,2

Figure 7 – BGA (square) land pattern dimensions

4.5.1 PBGA 1,5 mm pitch land pattern dimensions (square)

Table 5 defines the requirements for BGA land patterns with a pitch of 1,50 mm

Table 5 – BGA product land patterns with pitch of 1,50 mm



For land pattern tolerance analysis, see 4.5.

FE full even matrix
FO full odd matrix

RLP	Component identifier	Contact array rows x columns	Max. contact count	C	D	X	E	Placement grid
1020	PBGA 7x7 FE16	4x4	16	4,50	4,50	0,60	1,50	16X16
1021	PBGA 7x7 FO9	3x3	9	3,00	3,00	0,60	1,50	16X16
1022	PBGA 8x8 FO25	5x5	25	6,00	6,00	0,60	1,50	18X18
1023	PBGA 8x8 FE16	4x4	16	4,50	4,50	0,60	1,50	18X18
1024	PBGA 9x9 FE36	6x6	36	7,50	7,50	0,60	1,50	20X20
1025	PBGA 9x9 FO25	5x5	25	6,00	6,00	0,60	1,50	20X20
1026	PBGA 10x10 FE36	6x6	36	7,50	7,50	0,60	1,50	22X22
1027	PBGA 10x10 FO25	5x5	25	6,00	6,00	0,60	1,50	22X22
1028	PBGA 11x11 FO49	7x7	49	9,00	9,00	0,60	1,50	24X24
1029	PBGA 11x11 FE36	6x6	36	7,50	7,50	0,60	1,50	24X24
1030	PBGA 12x12 FE64	8x8	64	10,50	10,50	0,60	1,50	26X26
1031	PBGA 12x12 FO49	7x7	49	9,00	9,00	0,60	1,50	26X26
1032	PBGA 13x13 FE64	8x8	64	10,50	10,50	0,60	1,50	28X28
1033	PBGA 13x13 FO49	7x7	49	9,00	9,00	0,60	1,50	28X28
1034	PBGA 14x14 FO81	9x9	81	12,00	12,00	0,60	1,50	30X30
1035	PBGA 14x14 FE64	8x8	64	10,50	10,50	0,60	1,50	30X30
1036	PBGA 15x15 FE100	10x10	100	13,50	13,50	0,60	1,50	32X32
1037	PBGA 15x15 FO81	9x9	81	12,00	12,00	0,60	1,50	32X32
1038	PBGA 17x17 FO121	11x11	121	15,00	15,00	0,60	1,50	36X36
1039	PBGA 17x17 FE100	10x10	100	13,50	13,50	0,60	1,50	36X36
1040	PBGA 19X19 FE144	12x12	144	16,50	16,50	0,60	1,50	40X40
1041	PBGA 19X19 FO121	11x11	121	15,00	15,00	0,60	1,50	40X40
1042	PBGA 21X21 FE196	14x14	196	19,50	19,50	0,60	1,50	44X44
1043	PBGA 21X21 FO169	13x13	196	18,00	18,00	0,60	1,50	44X44
1044	PBGA 23X23 FO225	15x15	225	21,00	21,00	0,60	1,50	48X48
1045	PBGA 23X23 FE196	14x14	196	19,50	19,50	0,60	1,50	48X48
1046	PBGA 25X25 FE256	16x16	256	22,50	22,50	0,60	1,50	52X52
1047	PBGA 25X25 FO225	15x15	225	21,00	21,00	0,60	1,50	52X52
1048	PBGA 27X27 FE324	18x18	324	25,50	25,50	0,60	1,50	56X56
1049	PBGA 27X27 FO289	17x17	289	24,00	24,00	0,60	1,50	56X56
1050	PBGA 29X29 FO361	19x19	361	27,00	27,00	0,60	1,50	60X60
1051	PBGA 29X29 FE324	18x18	324	25,50	25,50	0,60	1,50	60X60
1052	PBGA 31X31 FE400	20x20	400	28,50	28,50	0,60	1,50	64X64
1053	PBGA 31X31 FO361	19x19	361	27,00	27,00	0,60	1,50	64X64
1054	PBGA 33X33 FE484	22x22	484	31,50	31,50	0,60	1,50	68X68
1055	PBGA 33X33 FO441	21x21	441	30,00	30,00	0,60	1,50	68X68
1056	PBGA 35X35 FO529	23x23	529	33,00	33,00	0,60	1,50	72X72
1057	PBGA 35X35 FE484	22x22	484	31,50	31,50	0,60	1,50	72X72

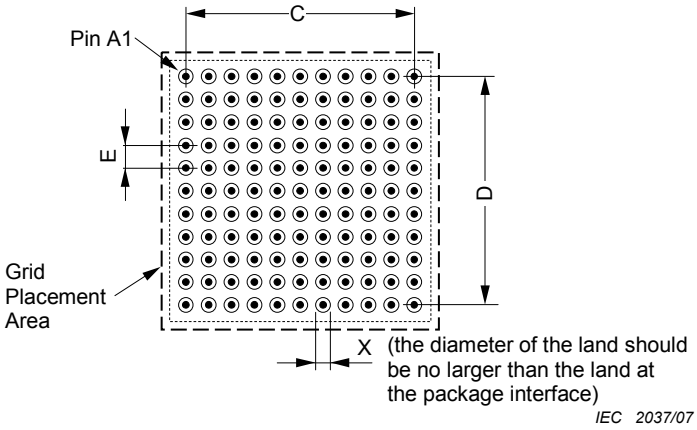
Table 5 *(continued)*

RLP	Component identifier	Contact array rows x columns	Max. contact count	C	D	X	E	Placement grid
1058	PBGA 37,5X37,5 FO625	25x25	625	36,00	36,00	0,60	1,50	78X78
1059	PBGA 37,5X37,5 FE576	24x24	576	34,50	34,50	0,60	1,50	78X78
1060	PBGA 40X40 FE676	26x26	676	37,50	37,50	0,60	1,50	82X82
1061	PBGA 40X40 FO625	25x25	625	36,00	36,00	0,60	1,50	82X82
1062	PBGA 42,5X42,5 FE784	28x28	784	40,50	40,50	0,60	1,50	88X88
1063	PBGA 42,5X42,5 FO729	27x27	729	39,00	39,00	0,60	1,50	88X88
1064	PBGA 45X45 FE900	30x30	900	43,50	43,50	0,60	1,50	92X92
1065	PBGA 45X45 FO841	29x29	841	42,00	42,00	0,60	1,50	92X92
1066	PBGA 47,5X47,5 FO961	31x31	961	45,00	45,00	0,60	1,50	98X98
1067	PBGA 47,5X47,5 FE900	30x30	900	43,50	43,50	0,60	1,50	98X98
1068	PBGA 50X50 FO1089	33x33	1089	48,00	48,00	0,60	1,50	102X102
1069	PBGA 50X50 FE1024	32x32	1024	46,50	46,50	0,60	1,50	102X102
Unit dimensions are in millimetres.								

4.5.2 PBGA 1,27 mm pitch land pattern dimensions (square)

Table 6 defines the requirements for BGA land patterns with a pitch of 1,27 mm

Table 6 – BGA product land patterns with pitch of 1,27 mm



For land pattern tolerance analysis, see 4.4.

FE full even matrix
FO full odd matrix

RLP	Component identifier	Contact array rows x columns	Max. contact count	C	D	X	E	Placement grid
960	PBGA 7x7 FO25	5x5	25	5,08	5,08	0,60	1,27	16X16
961	PBGA 7x7 FE16	4x4	16	3,81	3,81	0,60	1,27	16X16
962	PBGA 8x8 FE36	6x6	36	6,35	6,35	0,60	1,27	18X18
963	PBGA 8X8 FO25	5x5	25	5,08	5,08	0,60	1,27	18X18
964	PBGA 9x9 FE36	6x6	36	6,35	6,35	0,60	1,27	20X20
965	PBGA 9x9 FO25	5x5	25	5,08	5,08	0,60	1,27	20X20
966	PBGA 10x10 FO49	7x7	49	7,62	7,62	0,60	1,27	22X22
967	PBGA 10x10 FE36	6x6	36	6,35	6,35	0,60	1,27	22X22
968	PBGA 11x11 FE64	8x8	64	8,89	8,89	0,60	1,27	24X24
969	PBGA 11x11 FO49	7x7	49	7,62	7,62	0,60	1,27	24X24
970	PBGA 12x12 FO81	9x9	81	10,16	10,16	0,60	1,27	26X26
971	PBGA 12x12 FE64	8x8	64	8,89	8,89	0,60	1,27	26X26
972	PBGA 13x13 FE100	10x10	100	11,43	11,43	0,60	1,27	28X28
973	PBGA 13x13 FO81	9x9	81	10,16	10,16	0,60	1,27	28X28
974	PBGA 14x14 FE100	10x10	100	11,43	11,43	0,60	1,27	30X30
975	PBGA 14x14 FO81	9x9	81	10,16	10,16	0,60	1,27	30X30
976	PBGA 15x15 FO121	11x11	121	12,70	12,70	0,60	1,27	32X32
977	PBGA 15x15 FE100	10x10	100	11,43	11,43	0,60	1,27	32X32
978	PBGA 17x17 FO169	13x13	169	15,24	15,24	0,60	1,27	36X36
979	PBGA 17x17 FE144	12x12	144	13,97	13,97	0,60	1,27	36X36
980	PBGA 19X19 FE196	14x14	196	16,51	16,51	0,60	1,27	40X40
981	PBGA 19X19 FO169	13x13	169	15,24	15,24	0,60	1,27	40X40
982	PBGA 21X21 FE256	16x16	256	19,05	19,05	0,60	1,27	44X44
983	PBGA 21X21 FO225	15x15	225	17,78	17,78	0,60	1,27	44X44
984	PBGA 23X23 FE324	18x18	324	21,59	21,59	0,60	1,27	48X48
985	PBGA 23X23 FO289	17x17	289	20,32	20,32	0,60	1,27	48X48
986	PBGA 25X25 FO361	19x19	361	22,86	22,86	0,60	1,27	52X52
987	PBGA 25X25 FE324	18x18	324	21,59	21,59	0,60	1,27	52X52
988	PBGA 27X27 FO441	21x21	441	25,40	25,40	0,60	1,27	56X56
989	PBGA 27X27 FE400	20x20	400	24,13	24,13	0,60	1,27	56X56
990	PBGA 29X29 FE484	22x22	484	26,67	26,67	0,60	1,27	60X60
991	PBGA 29X29 FO441	21x21	441	25,40	25,40	0,60	1,27	60X60
992	PBGA 31X31 FE576	24x24	576	29,21	29,21	0,60	1,27	64X64
993	PBGA 31X31 FO529	23x23	529	27,94	27,94	0,60	1,27	64X64
994	PBGA 33X33 FO625	25x25	625	30,48	30,48	0,60	1,27	68X68
995	PBGA 33X33 FE576	24x24	576	29,21	29,21	0,60	1,27	68X68
996	PBGA 35X35 FO729	27x27	729	33,02	33,02	0,60	1,27	72X72
997	PBGA 35X35 FE676	26x26	676	31,75	31,75	0,60	1,27	72X72

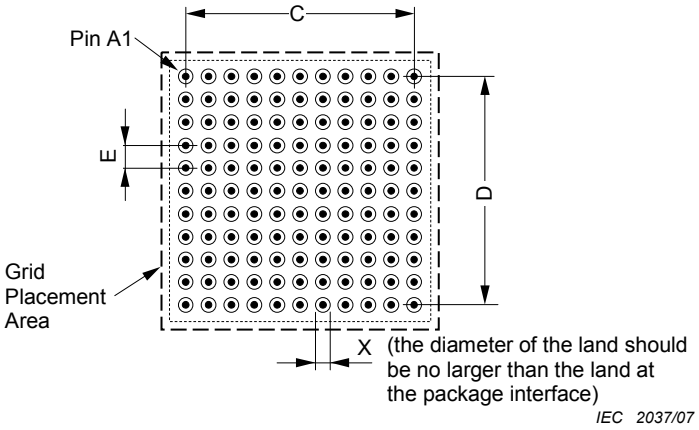
Table 6 *(continued)*

RLP	Component identifier	Contact array rows x columns	Max. contact count	C	D	X	E	Placement grid
998	PBGA 37,5X37,5 FO841	29x29	841	35,56	35,56	0,60	1,27	78X78
999	PBGA 37,5X37,5 FE784	28x28	784	34,29	34,29	0,60	1,27	78X78
1000	PBGA 40X40 FO961	31x31	961	38,10	38,10	0,60	1,27	82X82
1001	PBGA 40X40 FE900	30x30	900	36,83	36,83	0,60	1,27	82X82
1002	PBGA 42,5X42,5 FO1089	33x33	1089	40,64	40,64	0,60	1,27	88X88
1003	PBGA 42,5X42,5 FE1024	32x32	1024	39,37	39,37	0,60	1,27	88X88
1004	PBGA 45X45 FO1225	35x35	1225	43,18	43,18	0,60	1,27	92X92
1005	PBGA 45X45 FO1156	34x34	1156	41,91	41,91	0,60	1,27	92X92
1006	PBGA 47,5X47,5 FO1369	37x37	1369	45,72	45,72	0,60	1,27	98X98
1007	PBGA 47,5X47,5 FE1296	36x36	1296	44,45	44,45	0,60	1,27	98X98
1008	PBGA 50X50 FO1521	39x39	1521	48,26	48,26	0,60	1,27	102X102
1009	PBGA 50X50 FE1444	38x38	1444	46,99	46,99	0,60	1,27	102X102
Unit dimensions are in millimetres.								

4.5.3 PBGA 1,00 mm pitch land pattern dimensions (square)

Table 7 defines the requirements for BGA land patterns with a pitch of 1,00 mm

Table 7 – BGA product land patterns with pitch of 1,00 mm



For land pattern tolerance analysis, see 4.4.

FE full even matrix
FO full odd matrix

RLP	Component identifier	Contact array rows x columns	Max. contact count	C	D	X	E	Placement grid
900	PBGA 7x7 FE36	6x6	36	5,00	5,00	0,50	1,00	16X16
901	PBGA 7x7 FO25	5x5	25	4,00	4,00	0,50	1,00	16X16
902	PBGA 8x8 F049	7x7	49	6,00	6,00	0,50	1,00	18X18
903	PBGA 8x8 FE36	6x6	36	5,00	5,00	0,50	1,00	18X18
904	PBGA 9x9 FE64	8x8	64	7,00	7,00	0,50	1,00	20X20
905	PBGA 9x9 FO49	7x7	49	6,00	6,00	0,50	1,00	20X20
906	PBGA 10x10 FO81	9x9	81	8,00	8,00	0,50	1,00	22X22
907	PBGA 10x10 FE64	8x8	64	7,00	7,00	0,50	1,00	22X22
908	PBGA 11x11 FE100	10x10	100	9,00	9,00	0,50	1,00	24X24
909	PBGA 11x11 FO81	9x9	81	8,00	8,00	0,50	1,00	24X24
910	PBGA 12x12 FO121	11x11	121	10,00	10,00	0,50	1,00	26X26
911	PBGA 12x12 FE100	10x10	100	9,00	9,00	0,50	1,00	26X26
912	PBGA 13x13 FE144	12x12	144	11,00	11,00	0,50	1,00	28X28
913	PBGA 13x13 FO121	11x11	121	10,00	10,00	0,50	1,00	28X28
914	PBGA 14x14 FO169	13x13	169	12,00	12,00	0,50	1,00	30X30
915	PBGA 14x14 FE144	12x12	144	11,00	11,00	0,50	1,00	30X30
916	PBGA 15x15 FE196	14x14	196	13,00	13,00	0,50	1,00	32X32
917	PBGA 15x15 FO169	13x13	169	12,00	12,00	0,50	1,00	32X32
918	PBGA 17x17 FE256	16x16	256	15,00	15,00	0,50	1,00	36X36
919	PGBA 17x17 FO225	15x15	225	14,00	14,00	0,50	1,00	36X36
920	PBGA 19X19 FE324	18X18	324	17,00	17,00	0,50	1,00	40X40
921	PBGA 19x19 FO289	17x17	289	16,00	16,00	0,50	1,00	40X40
922	PBGA 21X21 FE400	20X20	400	19,00	19,00	0,50	1,00	44X44
923	PBGA 21x21 FO361	19x19	361	18,00	18,00	0,50	1,00	44X44
924	PBGA 23X23 FE484	22X22	484	21,00	21,00	0,50	1,00	48X48
925	PBGA 23x23 FO441	21x21	441	20,00	20,00	0,50	1,00	48X48
926	PBGA 25X25 FE576	24X24	576	23,00	23,00	0,50	1,00	52X52
927	PBGA 25x25 FO529	23x23	529	22,00	22,00	0,50	1,00	52X52
928	PBGA 27X27 FE676	26X26	676	25,00	25,00	0,50	1,00	56X56
929	PBGA 27X27 FO625	25x25	625	24,00	24,00	0,50	1,00	56X56
930	PBGA 29X29 FE784	28X28	784	27,00	27,00	0,50	1,00	60X60
931	PBGA 29X29 FO729	27x27	729	26,00	26,00	0,50	1,00	60X60
932	PBGA 31X31 FE900	30X30	900	29,00	29,00	0,50	1,00	64X64
933	PBGA 31X31 FO841	29x29	841	28,00	28,00	0,50	1,00	64X64
934	PBGA 33X33 FE1024	32X32	1024	31,00	31,00	0,50	1,00	68X68
935	PBGA 33X33 FO961	31x31	961	30,00	30,00	0,50	1,00	68X68
936	PBGA 35X35 FE1156	34X34	1156	33,00	33,00	0,50	1,00	72X72

Table 7 *(continued)*

RLP	Component identifier	Contact array rows x columns	Max. contact count	C	D	X	E	Placement grid
937	PBGA 35X35 FO1089	33x33	1089	32,00	32,00	0,50	1,00	72X72
938	PBGA 37.5X37.5 FO1369	37X37	1369	36,00	36,00	0,50	1,00	78X78
939	PBGA 37.5X37.5 FE1296	36x36	1296	35,00	35,00	0,50	1,00	78X78
940	PBGA 40X40 FO1521	39X39	1521	38,00	38,00	0,50	1,00	82X82
941	PBGA 40X40 FE1444	38x38	1444	37,00	37,00	0,50	1,00	82X82
942	PBGA 42.5X42.5 FE1764	42X42	1764	41,00	41,00	0,50	1,00	88X88
943	PBGA 42.5X42.5 FO1681	41x41	1681	40,00	40,00	0,50	1,00	88X88
945	PBGA 45X45 FE1936	44X44	1936	43,00	43,00	0,50	1,00	92X92
946	PBGA 45X45 FO1849	43x43	1849	42,00	42,00	0,50	1,00	92X92
947	PBGA 47.5X47.5 FO2209	47X47	2209	46,00	46,00	0,50	1,00	98X98
948	PBGA 47.5X47.5 FE2116	46x46	2116	45,00	45,00	0,50	1,00	98X98
949	PBGA 50X50 FO2401	49X49	2401	48,00	48,00	0,50	1,00	102X102
950	PBGA 50X50 FE2304	48x48	2304	47,00	47,00	0,50	1,00	102X102
Unit dimensions are in millimetres.								

5 FBGA (square)

Under consideration.

6 BGA (rectangular)

6.1 Field of application

This clause provides the component and land pattern dimensions for rectangular type BGA (ball grid array) components. Basic construction of the BGA device is also covered. At the end of this subclause is a listing of the tolerances and target solder joint dimensions used to arrive at the land pattern dimensions.

6.2 Component descriptions

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

6.2.1 Basic construction

The ball grid array has been developed for applications requiring low height and high density. The BGA components may take many forms. Variations include the method of die attach (wire bonding, flip chip etc.), the substrate material (organic rigid or flexible material, ceramic etc.) and the method of protecting the device from the environment (Plastic encapsulation, hermetic sealing, etc.). All variations can use the same land patterns defined in this clause as all types may be used in many printed circuit board assemblies for device applications.

6.2.2 Termination materials

The BGA ball termination may consist of a variety of metal alloys. Some of these include balls with some lead content such as 37Pb63Sn, 90Pb10Sn, 95Pb5Sn, while others do not contain lead such as Sn96,5Ag3,0Cu0,5, Sn96,5Ag3,5, Sn-9Zn-0,003Al. It is a good recommendation to use the same alloy, in a paste form, to attach the BGA balls to the mounting substrate. However, some of the balls that do not collapse require a paste that is more conducive to reflow temperatures.

6.2.3 Marking

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

6.2.4 Carrier package format

The carrier package format for BGAs may be tray or tape and reel format. In most instances, BGAs are delivered in a carrier tray.

6.2.5 Process considerations

BGAs are usually processed using standard reflow solder processes. Parts should be capable of withstanding three cycles through a standard reflow system operating within a range of 235 °C to 260 °C, depending on the attachment alloy being used. Each cycle shall consist of 60 s to 90 s exposure at the particular temperature selected. The construction of the BGA resin system used for encapsulation shall be capable of withstanding the process temperature exposure. This capability may be verified through test methods indicated in IEC 60068-2-58, Method 2 for three cycles with an appropriate dwell time to allow the specimens to cool.

It is important to consider that plastic BGAs, are moisture sensitive device/components. Precaution shall be taken during the printed board assembly process in order to avoid MSD damages (delamination, cracks, etc). Traceability for baking PBGA, may be required mainly when attached in a double sided/reflow printed board assembly.

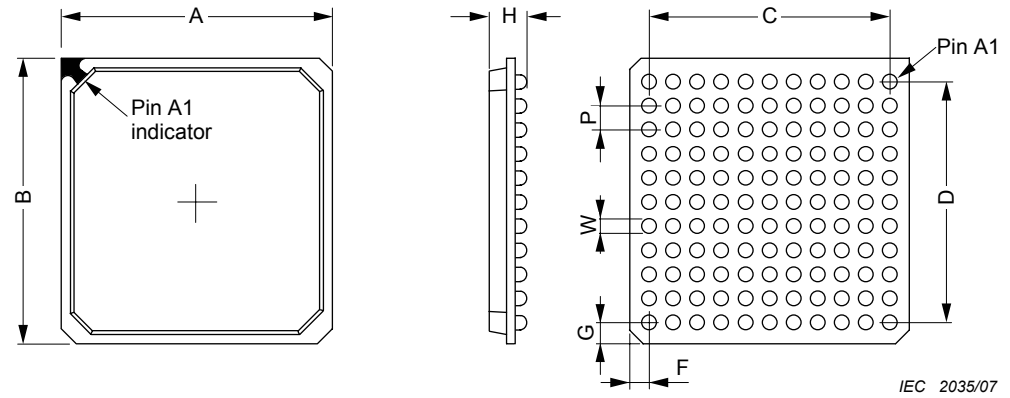
6.3 Component dimensions (rectangular)

This subclause contains the physical dimensions of various PBGAs that have been standardized so that land pattern analysis can be performed. Table 8 provides the general characteristic of the component with a fully populated version. Component manufacturers can remove those terminations (balls), as appropriate, to establish the final configuration of the part.

The information provided in Table 8 is for fully populated parts only, so that all the corresponding land patterns can be derived. The requirements are fully documented in IEC 60191-2. Users of the information are cautioned to be sure that their land pattern version is identical to the part that they have purchased from the component supplier. It should also be emphasized that not every supplier follows the same removal of the termination pattern for a similar product. Thus, when looking for multiple sources, the user shall establish complete compliance with the design image in the computer library before making the commitment that the end use patterns may be used to mount different BGA component supplier parts.

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

Table 8 – Rectangular BGA products with pitch of 1,27 mm



FE full even matrix
FO full odd matrix

Component identifier	Contact array rows x columns	A	B	C	D	W	P	H	F or G
		Max.	Max.	Max.	Max.	Nom.	Basic	Max.	Nom.
R-PBGA 22x14	14,00	22,00	7,62	20,32	0,75	1,27	3,50	3,19	0,84
R-PBGA 22x14	14,00	22,00	10,16	20,32	0,75	1,27	3,50	1,92	0,84
R-PBGA 25x21	21,00	25,00	12,70	22,86	0,75	1,27	3,50	4,15	1,07

6.4 Solder joint fillet design

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:

Design consideration when soldered with self-alignment effect:

$$Xmax = b\ min + 2\ J_b\ min + T_S \qquad T_S = \sqrt{F_{L3}{}^2 + P_{L3}{}^2 + C_b{}^2}$$

In the reflow soldering process, there is a self-alignment effect, because adhesives are not used to hold components. In the surface mount process of reflow soldering, parts mount displacement when soldered can be cancelled by a self-alignment effect (therefore, factor P can be regarded as 0). In addition, the tolerance of the land shape accuracy of PWBs 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:

$$T_S = C_{b,}\ Xmax = b\ min + 2J_b min + C_b = b\ max + 2J_b min$$

6.4.1 Solder joint fillet design – Collapsing (level 3)

Solder joints made using solder balls that collapse slightly during reflow require an understanding of the total properties of the joint construction. The variations that exist in determining these land patterns include the diameter of the individual ball, the positional accuracy of the ball in relationship to a true position on the component and the board, and the manufacturing allowance that can be held for the land on the substrate that mount the particular ball. The land pattern of the component (where the ball is attached) and the land pattern of the substrate mounting structure (printed board) should be as similar as possible.

6.4.2 Land approximation

In each instance, component manufacturers and board designers are encouraged to reduce the land size by some percentage of the nominal ball diameter. The amount of reduction is based on the original ball size, which is used to determine the average land. In determining the relationship between nominal characteristics, a manufacturing allowance for land size has been determined to be 0,1 mm between the maximum material condition (MMC) and least material condition (LMC).

6.4.3 Total variation

The total variation of the system considers three major issues: positioning, ball tolerance, and substrate tolerance. All three attributes added together result in a worst case analysis. However, as with other land patterns in the standard, a statistical average is determined by using the RMS (root mean square) value. It should be noted that the target value for lands on the substrate of the component or the board should be at maximum material condition. The variation from the maximum material condition indicates that ball-to-land misalignment is achieved by taking the maximum land size and subtracting the variation. The resulting dimension would indicate the amount of attachment area that would result from a system where all conditions are at a negative instance. For lands that are solder mask defined, the land size should be increased by the amount of encroachment of the solder mask.

6.5 Land pattern dimensions

Table 9 shows land pattern dimensions for BGA (rectangular) for reflow soldering. These values are calculated based on the formula for the solder joint fillet design shown in IEC 61188-5-1.

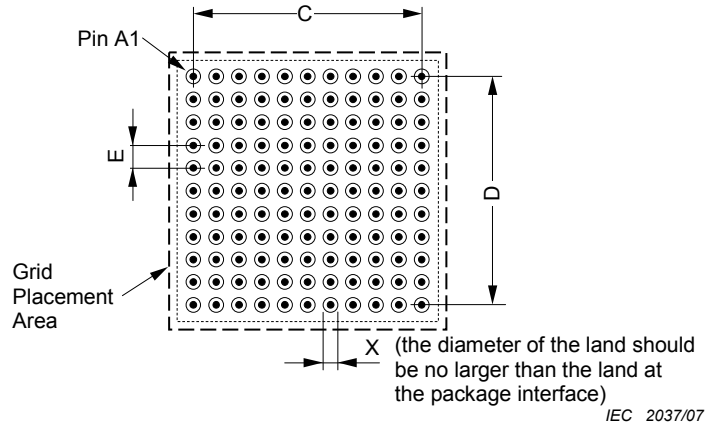
The courtyard is calculated using the following formula and rounded off (round up factor is to the nearest 0,05 mm for minimum values, and to the nearest 0,5 mm for maximum values).

$$CY_1 = [Dmin + \sqrt{F^2 + P^2 + C_D{}^2}\,] + (\text{courtyard excess} \times 2)$$

$$CY_2 = [Emin + \sqrt{F^2 + P^2 + C_E{}^2}\,] + (\text{courtyard excess} \times 2)$$

The area is that between the rectangle circumscribing the land pattern and the component and the outer boundary of the courtyard. Therefore, the courtyard excess for BGA components is the same as QFP 0,05 mm.

Table 9 – Rectangular BGA product land patterns with pitch of 1,27 mm



For land pattern tolerance analysis, see 6.5.

FE full even matrix
FO full odd matrix

RLP	Component identifier	Contact array rows x columns	Max. contact count	C	D	X	E	Placement grid
1080	R-PBGA 22x14	17x7	119	7,62	20,32	0,60	1,27	46X30
1081	R-PBGA 22x14	17x9	153	10,16	20,32	0,60	1,27	46X30
1082	R-PBGA 25x21	19x11	209	12,70	22,86	0,60	1,27	52X44

7 FBGA (rectangular)

Under consideration.

8 CGA

Under consideration.

9 LGA

Under consideration.

Bibliography

IEC 61191-1, *Printed board assemblies – Part 1*: *General specification – Requirements for soldered electrical and electronic assemblies using surface mount and related assembly technologies*

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