



DESIGN REQUIREMENTS FOR OUTLINES OF SOLID STATE AND RELATED PRODUCTS

JEDEC PUBLICATION 95 (JEP95) DESIGN GUIDE 4.14

Ball Grid Array Package (BGA)

JEDEC SOLID STATE TECHNOLOGY ASSOCIATION

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BALL GRID ARRAY PACKAGE DESIGN REQUIREMENTS

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4.14 BALL and COLUMN GRID ARRAY PACKAGES

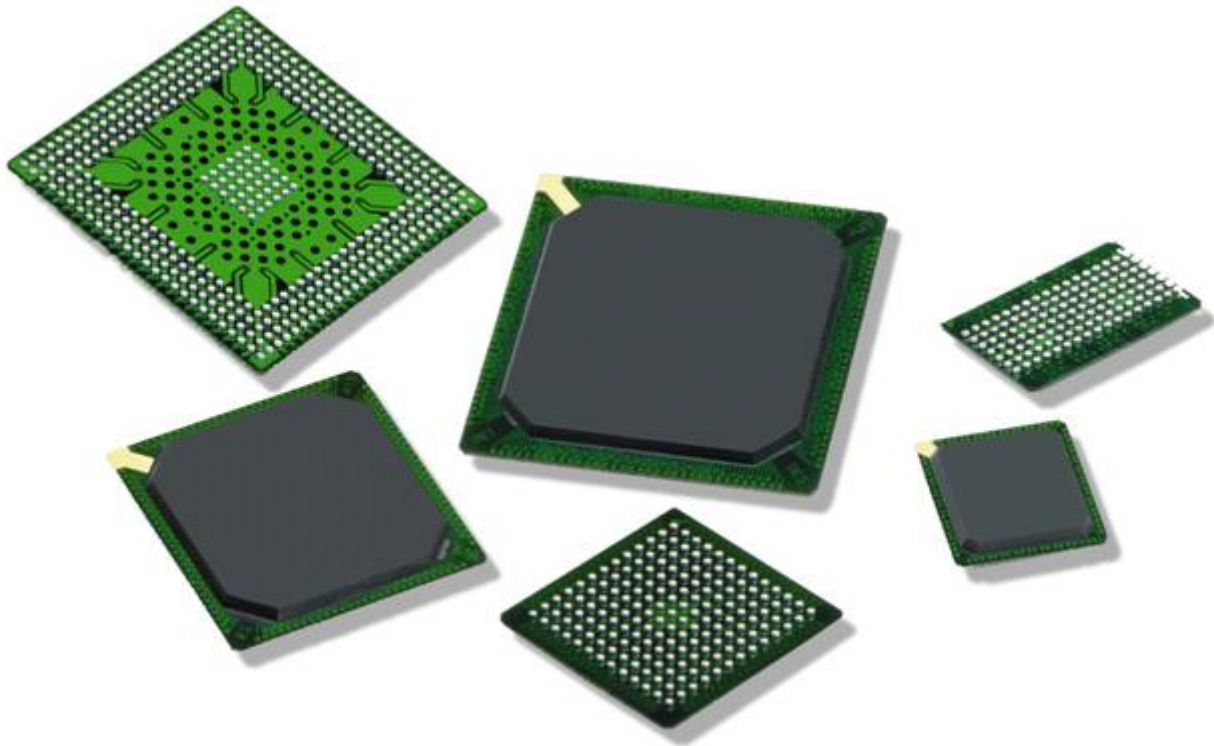


Figure 4.14-1 — Ball Grid Array Packages

4.14 BALL AND COLUMN GRID ARRAY PACKAGE

4.14.1 Introduction

A Ball Grid Array (BGA) or Column Grid Array (CGA) is a square or rectangular 1.50 mm, 1.27 mm, and 1.00 mm pitch package with an array of metallic balls or columns on the underside of the package. The main body of the package has a metallized circuit pattern applied to a dielectric structure. To this package body, the semiconductor die(s) is attached to either the top or bottom surface. On the underside of the dielectric is an array pattern of metallized balls/columns that form the mechanical and electrical connection from the package body to a mating feature such as a printed circuit board. The surface that contains the die may be encapsulated by various techniques to protect the semiconductor.

Presently there are 7 major families of BGA being manufactured:

Ceramic Ball Grid Array (CBGA)	Square and Rectangular
Ceramic Column Grid Array (CCGA)	Square and Rectangular
Plastic Ball Grid Array (PBGA)	Square and Rectangular
Tape Ball Grid Array (TBGA)	Square
Low-Profile Ball Grid Array (LBGA)	Square and Rectangular
Thin-Profile Ball Grid Array (TBGA)	Square and Rectangular
Very-Thin-Profile Ball Grid Array (VBGA)	Square and Rectangular

4.14.2 Scope

This Design Guide defines the symbology, definitions, algorithms, recommended dimensions and tolerances for the various Ball Grid Array packages. The guidelines defined are based on hard metric dimensioning and adhere to the geometric dimensioning and tolerancing principles defined in ASME Y14.5-2009.

This Design Guide does not attempt to document all of the BGA designs presently being produced. It establishes the design practices that shall be followed for designing future BGA standard outlines.

4.14.3 Recommended Outline

Refer to Figure 4.14-2 through Figure 4.14-6 for the recommended outline format and symbology for a BGA package.

4.14.4 Terms and Definitions

4.14.4.1 Matrix Size

Matrix Size is defined by MD and ME which represent the maximum matrix size corresponding to body dimensions D and E respectively as determined in 4.14.4.2. An allowed standard option reduces the MD X ME array size by 1 row and 1 column. This option is identified in the appropriate tables of this standard by use of the MD-1 x ME-1 designation

The allowed values for MD and ME (and MD-1 and ME-1) are shown in Table 4.14-6, Table 4.14-7 and Table 4.14-8.

When selecting the matrix size, the designer should consider issues related to handling and shipping systems and socketing. Use of the MD-1 x ME-1 option provides a wider ball keep out zone for support in shipping and clearance in handling.

4.14.4.2 Maximum Matrix Size Calculation

The maximum matrix size is defined by MD and ME and represents the Maximum Ball/Column Matrix Size corresponding to body direction D and E, respectively. The Maximum Matrix Size permissible is determined by the following algorithms:

$$MD = \frac{[(D - aaa) - (bMAX + eee)] - (2 \times 0.15)}{e} + 1 \quad \text{Truncated to an integer}$$

$$ME = \frac{[(E - aaa) - (bMAX + eee)] - (2 \times 0.15)}{e} + 1 \quad \text{Truncated to an integer}$$

NOTE The minimum clearance between the edge of the outermost row or column of balls and the edge of the body shall be 0.15 mm per side when D or E are at their minimum value and b is at its maximum value (as used in the above formulas). Odd or even matrices for a given body size are allowable by depopulation (see 4.14.4.2). The maximum ball counts (N) are determined by: $N = MD \times ME$

Refer to Table 4.14-1. Symbols, recommended dimensions and tolerance for Ball or Column Grid Array packages for the definition of D, E, b, e, aaa and eee.

4.14.4.3 Depopulation

Depopulation is the omission of balls or columns from a full matrix. Any depopulation method is allowed, provided the pattern of balls or columns is not shifted from its original center.

The following illustrations are some possible depopulated matrix patterns:

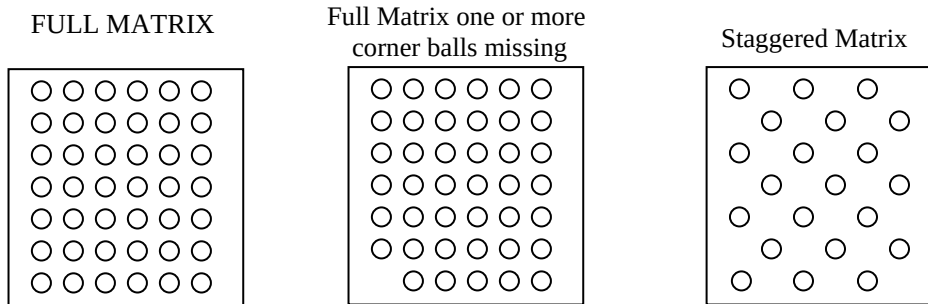


Figure 4.14-2A — Examples of depopulated matrix patterns

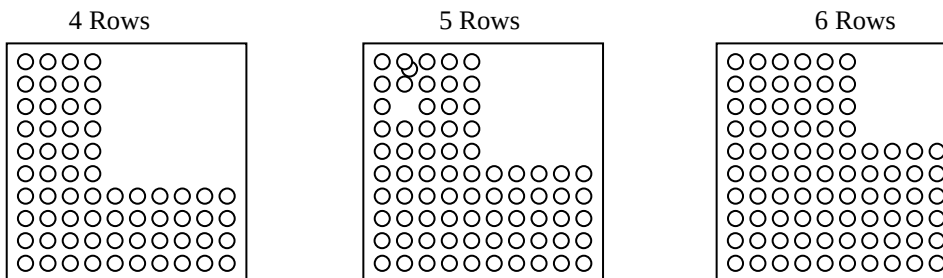


Figure 4.14-2B — Examples of depopulated matrix patterns

4.14.4.4 Low-Melt Solder ball

Low-Melt Solder ball: A solder ball whose metallurgical composition allows it to go into the liquidus state when subjected to the applicable standard industry surface mount reflow profile as defined in IPC/JEDEC Joint Standard, J-STD-020.

4.14.4.5 High-Melt Solder ball

High-Melt Solder ball: A solder ball whose metallurgical composition allows it to remain in a solid state when subjected to the applicable standard industry surface mount reflow profile as defined in IPC/JEDEC Joint Standard, J-STD-020.

4.14.4.6 Seating Plane

The plane formed by the three terminal apexes that exhibit the greatest perpendicular distance from the package substrate, provided that the triangle formed by those three apexes encompasses the projection of the center of gravity (COG) of the component. Refer to JEDEC Standard, JESD22-B108A.

4.14.5 Recommended Values and Tolerances

The following tables define the symbology to be used on Ball or Column Grid Array outlines, and provide algorithms and recommended dimensions and tolerances that shall be used when preparing a BGA outline.

The Design Guide addresses square variations only at this time. The definition of Rectangular variations may be added at a later date.

Table 4.14-1 — Symbols, Recommended Dimensions and Tolerances for Ball and Column Grid Array Packages

A	Include attached features such as external heat sinks or chip capacitors. An integral heatslug is not considered an attached feature.	For A (max) definitions where xBGA = CBGA, CCGA, PBGA, TBGA																																																
A2	The thickness of the package body, exclusive of the lid or encapsulation height and ball/column height.	For CBGA A2 = Design Specified CCGA A2 = Design Specified PBGA A2 = Design Specified TBGA A2 = Design Specified																																																
A3	The distance from the top of the package body to the top of the lid or encapsulation.	Design specified for cavity up configurations																																																
A4	The distance from the seating plane to the lid surface on cavity down configurations	0.10 Minimum																																																
D	The length of the body measured at the outermost extremes of the body. In the case of rectangular packages, D is the longest side of the package. D is a BASIC dimension.	<table><tr><td></td><td>= 4.00</td><td>= 16.00</td><td>= 35.00</td></tr><tr><td></td><td>= 5.00</td><td>= 17.00</td><td>= 37.50</td></tr><tr><td></td><td>= 6.00</td><td>= 18.00</td><td>= 40.00</td></tr><tr><td></td><td>= 7.00</td><td>= 19.00</td><td>= 42.50</td></tr><tr><td></td><td>= 8.00</td><td>= 20.00</td><td>= 45.00</td></tr><tr><td>D, E</td><td>= 9.00</td><td>= 21.00</td><td>= 47.50</td></tr><tr><td></td><td>= 10.00</td><td>= 23.00</td><td>= 50.00</td></tr><tr><td></td><td>= 11.00</td><td>= 25.00</td><td>= 52.50</td></tr><tr><td></td><td>= 12.00</td><td>= 27.00</td><td>= 55.00</td></tr><tr><td></td><td>= 13.00</td><td>= 29.00</td><td></td></tr><tr><td></td><td>= 14.00</td><td>= 31.00</td><td></td></tr><tr><td></td><td>= 15.00</td><td>= 33.00</td><td></td></tr></table>		= 4.00	= 16.00	= 35.00		= 5.00	= 17.00	= 37.50		= 6.00	= 18.00	= 40.00		= 7.00	= 19.00	= 42.50		= 8.00	= 20.00	= 45.00	D, E	= 9.00	= 21.00	= 47.50		= 10.00	= 23.00	= 50.00		= 11.00	= 25.00	= 52.50		= 12.00	= 27.00	= 55.00		= 13.00	= 29.00			= 14.00	= 31.00			= 15.00	= 33.00	
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	= 15.00	= 33.00																																																
E	The width of the body measured at the outermost extremes of the body. In the case of rectangular packages, E is the shortest side of the package. E is a BASIC dimension.																																																	
D1	The distance between the centerlines of the first and last balls/columns on the long axis of the package.	D1 = (MD -1) e BASIC																																																