



DESIGN REQUIREMENTS FOR OUTLINES OF SOLID STATE AND RELATED PRODUCTS

JEDEC PUBLICATION 95 (JEP95) DESIGN REGISTRATION 4.26

Micropillar Grid Array Package - Unencapsulated (MPGA)

JEDEC SOLID STATE TECHNOLOGY ASSOCIATION

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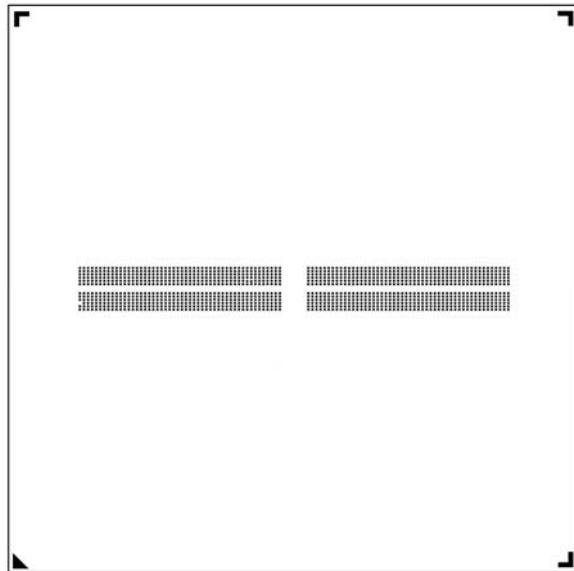
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MICROPILLAR GRID ARRAY DESIGN REQUIREMENTS

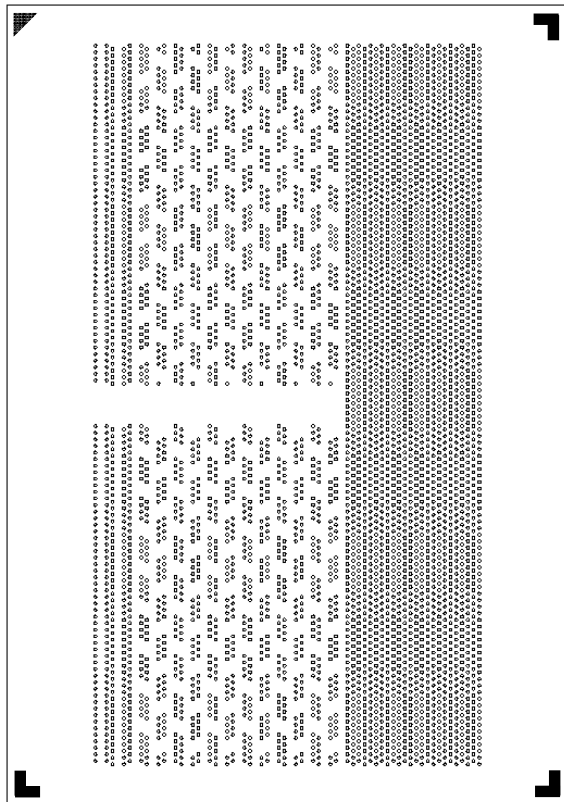
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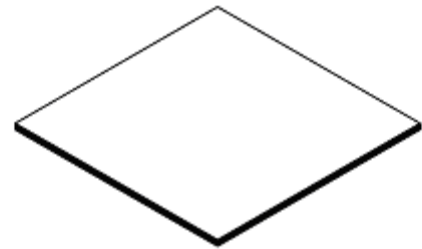
4.26 MICROPILLAR GRID ARRAY PACKAGE (MPGA)



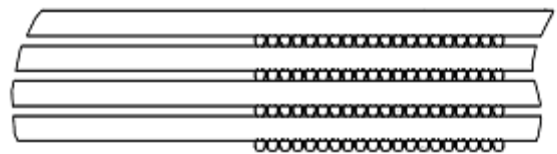
Bottom View
(Rectangular Array Example)



Bottom View
(Staggered Array Example)



Isometric view



Side view (a)



Side view (b)

FIGURE 4.26-1 — Micropillar Grid Array Package (MPGA)

4.26 MICROPILLAR GRID ARRAY PACKAGE (MPGA)

4.26.1 Introduction

A micropillar grid array package has an array of metallic pillars on the underside of the package. The substrate of the assembly (unencapsulated) is the semiconductor die with or without a redistribution layer that may have a orthogonal or rectangular shape with metallic pillars applied onto the circuit side of the die. The array pattern of metal pillars provides the mechanical and electrical connection from the assembly (unencapsulated) body to the next level component such as a printed circuit board or silicon substrate (i.e. wafer or die). The size of the assembly (unencapsulated) is generally equal to the die size.

4.26.2 Scope

This Design Requirement standard defines the symbols, definitions, algorithms, and specified dimensions and tolerances for a micropillar grid array package. The specification uses metric dimensioning per JEDEC PUBLICATION 95, SECTION 4.3, SPP-003C, and adheres to geometric dimensioning and tolerance methods defined in ASME Y14.5-2009. This design guide does not attempt to document all micropillar grid array package designs being produced. It establishes the design requirements that shall be followed for future micropillar grid array assembly (unencapsulated) outlines included in JEDEC Publication 95 (JEP95).

4.26.3 Terms and Definitions

4.26.3.1 Micropillar Grid Array Assembly

A package consisting of either one die or two or more stacked dice; reference Figure 4.26-1 Side Views (a and b). The single or bottom die (with or without a redistribution layer) has micropillar terminals on its bottom surface in a matrix of at least three rows and three columns.

NOTE 1 The controlling factors for the standardization of micropillar grid array assemblies are the size and aspect ratio of the micropillar grid array on the bottom die, not the assembly size.

NOTE 2 Body dimensions will change as a result of future changes in die size.

NOTE 3 The format of the package may be orthogonal or rectangular, but this aspect ratio may also change as a given device is redesigned to conform to a new die size.

NOTE 4 The aspect ratio will likely differ for devices of the same functionality from multiple suppliers.

4.26.3.2 Descriptive Designator

The common designator for micropillar grid array assemblies (unencapsulated) takes the form <profile><aspect> SCDS (S : Silicon, C : column, DS : Die-Size Array).

NOTE 1 The <profile> entry takes values as specified in JESD30.

NOTE 2 The <aspect> entry takes the value R (for Rectangular) for assemblies (unencapsulated) with rectangular aspect ratios.

NOTE 3 For official Descriptive Designators, see JESD30.

4.26.3.3 Micropillar

A protruding terminal consisting of a columnar structure made of a high-melting-point metal (e.g., copper) terminating with a cap that is either compatible with a mechanical and electrical joining technique such as a solderable surface or a low-melting-point metal (e.g. Cu-Cu bonding, Ni/Au finish, or a solder).

NOTE 1 The terms “micropillar” and “pillar” are used interchangeably in this document.

NOTE 2 Typically the solder caps are Pb-free.

4.26.3.4 Seating Plane

The plane formed by the three terminal apexes that exhibit the greatest perpendicular distance from the assembly (unencapsulated) substrate, provided that the triangle formed by those three apexes encompasses the projection of the center of gravity (CoG) of the component.

NOTE 1 This plane is the basis for all measurements with respect to Datum C.

NOTE 2 If multiple seating planes exist, then the seating plane resulting in the worst coplanarity condition is used for all measurements.

NOTE 3 Refer to JESD22-B108 for specific information on coplanarity definitions and measurement techniques.

4.26.3.5 Profile Height (Dimension A)

The perpendicular distance from the seating plane to the highest point on the assembly (unencapsulated) body.

4.26.3.6 Alignment Mark (Optional)

Specific pattern for fine position alignment on bottom of micropillar grid array.

4.26.4 Design Requirements

4.26.4.1 Body Size

The body size for a micropillar grid array package is defined by the D and E dimensions. For package with a rectangular or staggered pillar matrix, the orientation of these dimensions is determined by the matrix. Dimension D is the body size measured parallel to the major axis of the pillar matrix, and Dimension E is the body size measured parallel to the minor axis of the pillar matrix. The values of D and E for a specific micropillar grid array assembly (unencapsulated) may be more than the minimum permitted value (4.26.4.4). Dimensions D and E are defined in JEDEC Publication 95 outlines as maximum values on 0.010 mm increments. The values are determined by rounding the actual micropillar grid array assemblies (unencapsulated) body size upward to the next 0.010 mm boundary. Thus, D and E values have the form x.yz0 following this procedure. Maximum body size includes profile tolerance.

4.26.4.2 Matrix Size

MD and ME represent the matrix size corresponding to body dimensions D and E respectively. The full matrix represented by MD x ME must be located symmetrically on the package body with respect to Datums A and B (4.26.4.7). When selecting the matrix size, the designer should consider issues relating to handling and shipping systems and to socket selection. For example, if pillar contact during shipping is undesirable, then the matrix size should be chosen so that the package allows use of a support feature in the shipping medium.

4.26.4.3 Matrix Pitch

The array pitch for a micropillar grid array package will not necessarily be equal for the MD and ME matrix dimensions. In such cases, eD and eE represent the pitches corresponding to MD and ME respectively. When the pitches are not equal, pillar dimensions and tolerances for the smaller of the two pitches will govern the definition of related package dimensions and tolerances. When eD and eE are equal, the symbol 'e' may be used for both.

4.26.4.4 Smallest Nominal Body Size per Matrix Size

The smallest permitted nominal values for D or E for any values of MD or ME are determined by the following formulas:

Rectangular Array

$$D_{nom} = (MD - 1) \times eD + b_{max} + eee + aaa + (2 \times \text{keepout}) \text{ Rounded up to } x.yz0$$
$$E_{nom} = (ME - 1) \times eE + b_{max} + eee + aaa + (2 \times \text{keepout}) \text{ Rounded up to } x.yz0$$

Staggered Array

$$D_{nom} = (MD - 1) \times (eD/2) + b_{max} + eee + aaa + (2 \times \text{keepout}) \text{ Rounded up to } x.yz0$$
$$E_{nom} = (ME - 1) \times (eE/2) + b_{max} + eee + aaa + (2 \times \text{keepout}) \text{ Rounded up to } x.yz0$$

NOTE 1 Tolerance values (aaa, eee etc.) are process capability dependent. To determine minimum die size possible for a given number of pillars, please use actual tolerance values based on process capability.

NOTE 2 Keep Out Zone is zero for most micropillar grid array package. Requirement to have a Keep Out Zone may limit the number of pillars possible for a given die size. The Keep Out Zone within a micropillar grid array assembly (unencapsulated) is defined by the tolerance of the saw street and side mold dimensions. Most tolerances in wafer fabrication are at submicron levels.

NOTE 3 When the array pitch is constant, e would be substituted for eD and eE.

NOTE 4 The maximum permitted pillar count (Nmax) is determined by $N_{max} = MD(\text{max}) \times ME(\text{max})$. MD and ME (max) values are truncated to the integer value.

NOTE 5 See tables 4.26-1 and 4.26-2 for symbol definitions.

NOTE 6 For pitch and pillar size combinations listed in this design guide, the edge of the pillar will always maintain a minimum distance greater than or equal to zero mm from the package edge.

4.26.4.5 Depopulation

Depopulation is the omission of pillars from a full matrix defined by MD and ME. Any depopulated pattern is allowed. Figure 4.26-2 illustrates some possible depopulated matrix patterns.

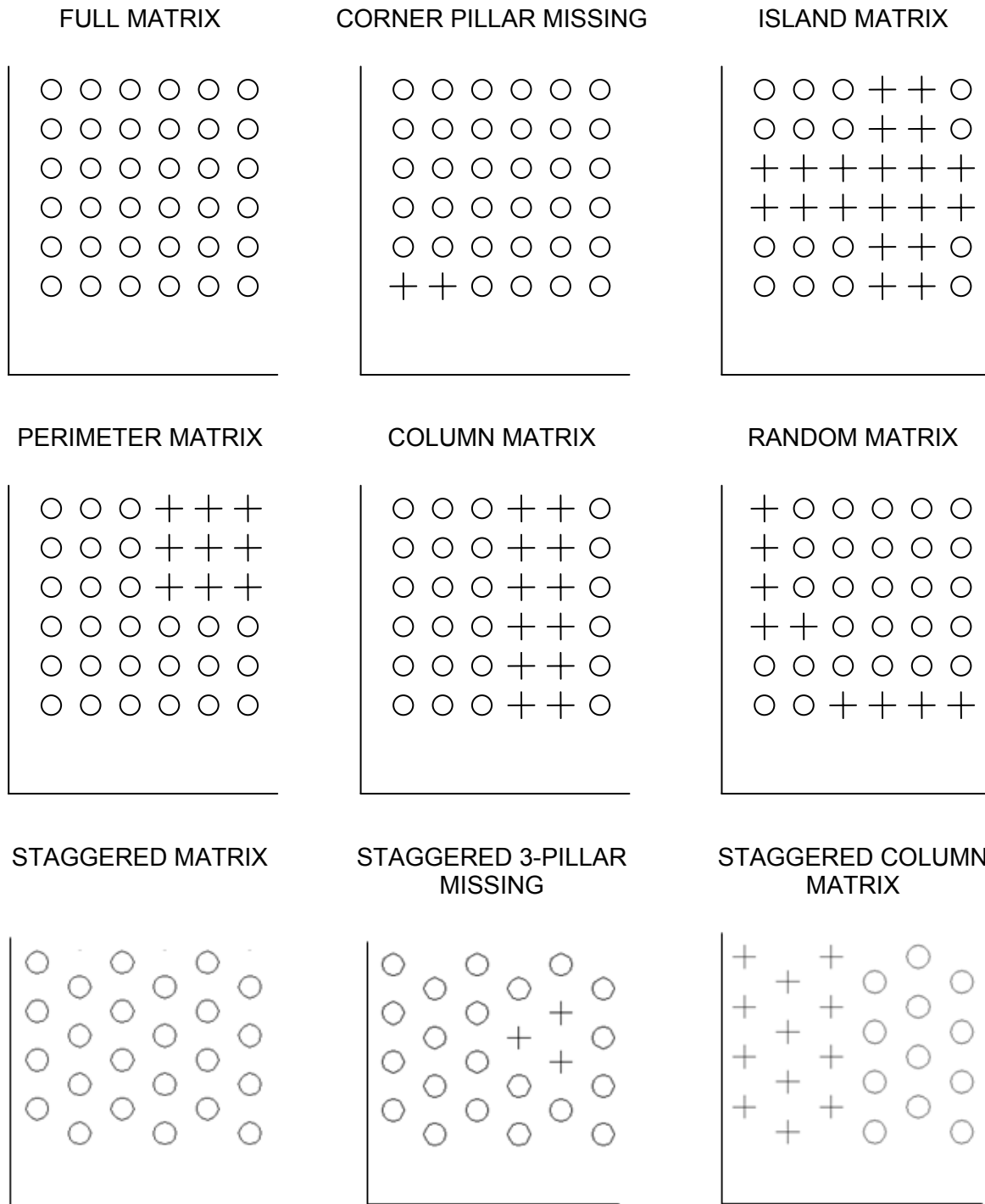


FIGURE 4.26-2 — Examples of Depopulated Matrix Patterns
(+ = Depopulated Ball Locations)

4.26.4.6 Depopulated Pillar Patterns

Micropillar grid array package may be defined with standardized depopulation patterns. This is especially true for memory device package. In these cases, the depopulation pattern shall be illustrated in the outline. For ISLAND MATRIX patterns, center depopulated sites do not necessarily fall within row and column numbering. See Figure 4.26-4 (Page31) for an example.

4.26.4.7 Datums

Datum A is the axis of the feature that is defined by Dimension D. Datum B is the axis of the feature that is defined by Dimension E. Datums A and B are used for defining the true position of the pillar matrix. Datum C is the seating plane per 4.26.3.4. See Figure 4.26-3 for outline drawing format.

4.26.4.8 Pillar Location

The pillar location on a micropillar grid array package is defined by the matrix pitch and the offset of the central row(s) or column(s) of pillars from Datum A or B. The pillar offset is specified by Dimensions SD or SE that correspond to MD or ME, and D or E, respectively. SD and SE represent the distance from the respective datum to the centerline of the first row or column of pillars in a fully populated matrix, MD x ME. If the values of MD or ME are odd numbers, then the axes of the center row or column of pillars lies on the respective datum. If the values of MD or ME are even numbers, then the central pair of rows or columns of pillars will straddle the respective datum. If the central rows or columns of the matrix are depopulated, then the offset from the appropriate datum to the first actual pillars in the matrix may be specified as SD1 and SE1 to aid the user. See Figure 4.26.-6 for an example using a rectangular array, and Figure 4.26-9 for an example using a staggered array.

4.26.5 Outline Format

Refer to Figure 4.26-3 through Figure 4.26-9 for the outline format of a micropillar grid array package using rectangular and staggered arrays.

4.26.6 Symbols, Dimensional Values and Tolerances

Table 4.26-1 and Table 4.26-2 define the symbols, algorithms, and specified dimensions and tolerances that shall be used when preparing micropillar grid array outlines.

Refer to Table 4.26-1 (SYMBOLS, DIMENSIONS, AND TOLERANCES FOR MICROPILLAR GRID ARRAY ASSEMBLIES (Unencapsulated)) for definitions of A, A2, D, E, D1, E1, D2, E2, eD, eE, e, MD, ME, mD, mE, n, ND, NE, SD, SE, SD1, SD2 and aaa, ccc.

Refer to Table 4.26-2 (SYMBOLS, DIMENSIONS, AND TOLERANCES RELATED TO PILLAR DIAMETERS) for definitions of A1, b, ddd, eee and fff.

This design standard defines micropillar grid array package outlines only.

4.26.7 Design Availability

The physical outlines of micropillar grid array package are dynamic since those depend on actual die size. Therefore, users of devices in these packages must exercise greater care in utilization than with more standardized packages. Devices supplied in packages designed per this section of JEDEC PUBLICATION 95 should be available for a period of one year following introduction, however, details of availability and future package) size changes and footprint migration must be coordinated between user and supplier. The pillar configuration or footprint for devices in micropillar grid array packages or assemblies should comply with relevant standards such as JEDEC standard JESD21.

TABLE 4.26-1— Symbols, Dimensions, and Tolerances for MPGA Packages

Symbol	Definition	Values
A	The distance from the seating plane to the highest point of the assembly (unencapsulated). This dimension includes the total Body Thickness (A2) and Pillar Height (A1) (see Table 4.26-2).	JESD30
A2	The thickness of the assembly (unencapsulated) body, excluding the Pillar Height (A1).	A2 = Design Specific
D	The distance between the body edges measured parallel to the major or minor axis of the micropillar matrix. D is specified as a maximum value (4.26.4.1).	Range: 2.500 mm to 26.000 mm (Recommended) Increment: 0.010 mm
E	The distance between the body edges measured parallel to the minor or major axis of the micropillar matrix. E is specified as a maximum value (4.26.4.1).	Range: 2.500 mm to 26.000 mm (Recommended) Increment: 0.010 mm
D1	The distance between the centerlines of the two outermost rows of pillars same direction with D axis of the pillar matrix. D1 is a BASIC dimension.	Rectangular Array $D1 = (MD-1) \times eD$
		Staggered Array $D1 = (MD-1) \times eD/2$
E1	The distance between the centerlines of the two outermost rows of pillars same direction with E axis of the pillar matrix. E1 is a BASIC dimension.	Rectangular Array $E1 = (ME-1) \times eE$
		Staggered Array $E1 = (ME-1) \times eE/2$
D2	The distance between the centerlines of the two innermost rows of pillars same direction with D axis of the pillar matrix. D2 is a BASIC dimension.	$D2 = \text{Design Specific}$ Note: $D2$ is multiple of eD
E2	The distance between the centerlines of the two innermost rows of pillars same direction with E axis of the pillar matrix. E2 is a BASIC dimension.	$E2 = \text{Design Specific}$ Note: $E2$ is multiple of eE
e	The distance between the centerlines of any two adjacent rows of pillars when $eD = eE$. e is a BASIC dimension	Use e when $eE = eD$