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PRE-STANDARD

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Mechanical standardization of semiconductor devices – Part 6-19: Measurement methods of package warpage at elevated temperature and the maximum permissible warpage

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IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland
Email: inmail@iec.ch
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MECHANICAL STANDARDIZATION OF SEMICONDUCTOR DEVICES –

Part 6-19: Measurement methods of package warpage at elevated temperature and the maximum permissible warpage

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IEC-PAS 60191-6-19 was submitted by the JEITA (Japan Electronics and Information Technology Industries Association) and has been processed by IEC subcommittee SC47D: Mechanical standardization for semiconductor devices.

The text of this PAS is based on the following documents	This PAS was approved for publication by the P-members of the committee concerned as indicated in the following document:
Draft PAS	Report on voting
47D/691/NP	47D/707/RVN

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MECHANICAL STANDARDIZATION OF SEMICONDUCTOR DEVICES –

Part 6-19: Measurement methods of package warpage at elevated temperature and the maximum permissible warpage

1 Scope

This PAS stipulates the package warpage criteria and the package warpage measurement methods at elevated temperature for BGA, FBGA, and FLGA

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 applies.

JEITA EDR-4701/301, *Resistance to soldering heat for surface mounting devices (SMD)*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
measuring zone
area to be measured to determine the package warpage

NOTE 1 For the packages whose stand-off height is more than 0,1 mm, such as BGA and FBGA, the measuring zone is the area where terminals are located. This area is bordered by the lines connecting the centers of the outermost neighboring solder balls (see Figure 1 and Figure 2). If there are thermal balls at the package centre, their area is also considered as a part of the measuring zone

NOTE 2 For the packages whose stand-off height is 0,1 mm or less, such as FLGA, the measuring area is the substrate surface except certain edge margin (see Figure 3, dimension *L*). The width of this margin *L* depends on the capability of each measuring instrument (0,2 mm recommended).

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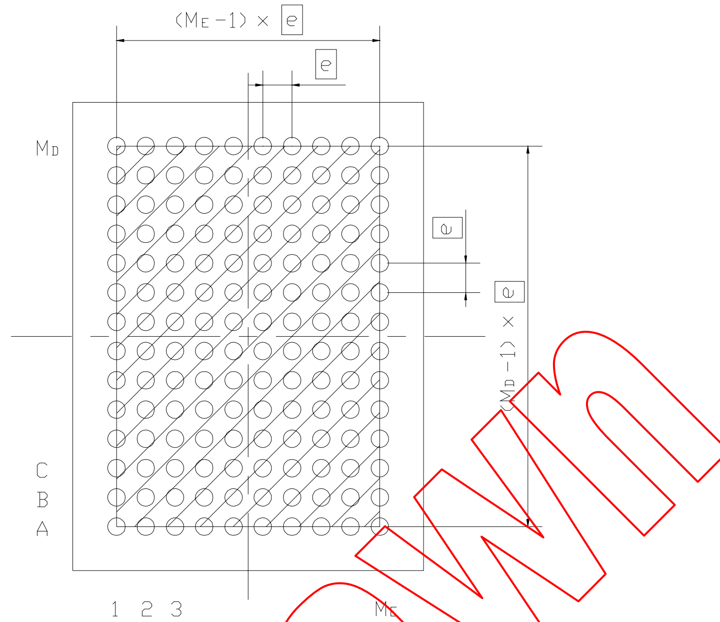

NOTE The hatched area indicates the measuring zone.

Figure 1 – Measuring zone of BGA and FBGA in full grid layout

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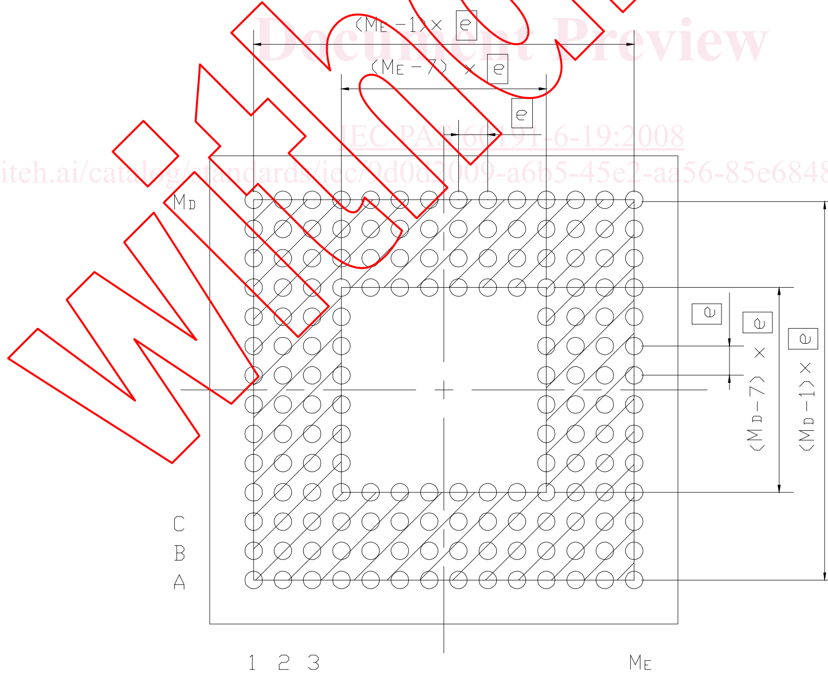
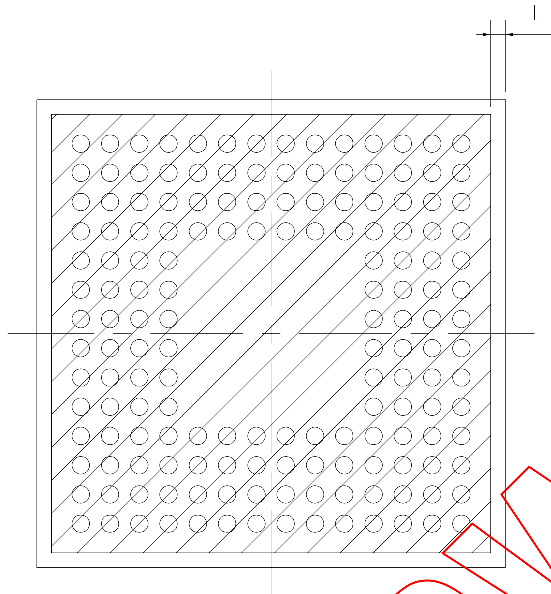


Figure 2 – Measuring zone of BGA and FBGA perimeter layout with 4 rows and 4 columns



NOTE The edge margin *L* indicates the exempt area from measurement to avoid measurement noise depending on the instrument capability. Recommended edge margin *L* = 0,2 mm.

Figure 3 – Measuring zone of FLGA perimeter layout with 4 rows and 4 columns

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3.2
convex warpage
arched top surface (not interconnect side) of package being mounted on PWB

NOTE The sign of the convex warpage is defined as plus.

3.3
concave warpage
inward-curving top surface (not interconnect side) of package being mounted on PWB

NOTE The sign of the concave warpage is defined as minus.

3.4
package warpage sign
plus or minus sign of package warpage determined by the sign of the sum of the largest positive displacement and the largest negative displacement of the package profile on both measurement zone diagonals

NOTE These diagonals are regarded as base lines connecting the outermost opposite corners of the measuring zone. The sign of the package warpage is defined as the sign of:

$$(AB_{MAX}+AB_{MIN}+CD_{MAX}+CD_{MIN})$$

AB_{MAX} is the largest positive displacement and AB_{MIN} is the largest negative displacement of the package profile on the diagonal AB; (The sign of AB_{MAX} is plus and AB_{MIN} is zero in Figure 4.)

CD_{MAX} is the largest positive displacement and CD_{MIN} is the largest negative displacement of the package profile on the diagonal CD; (The sign of CD_{MAX} is plus and that of CD_{MIN} is minus in Figure 4.)

The concave or convex impression of the package warpage can differ from the above defined sign, in critical cases.

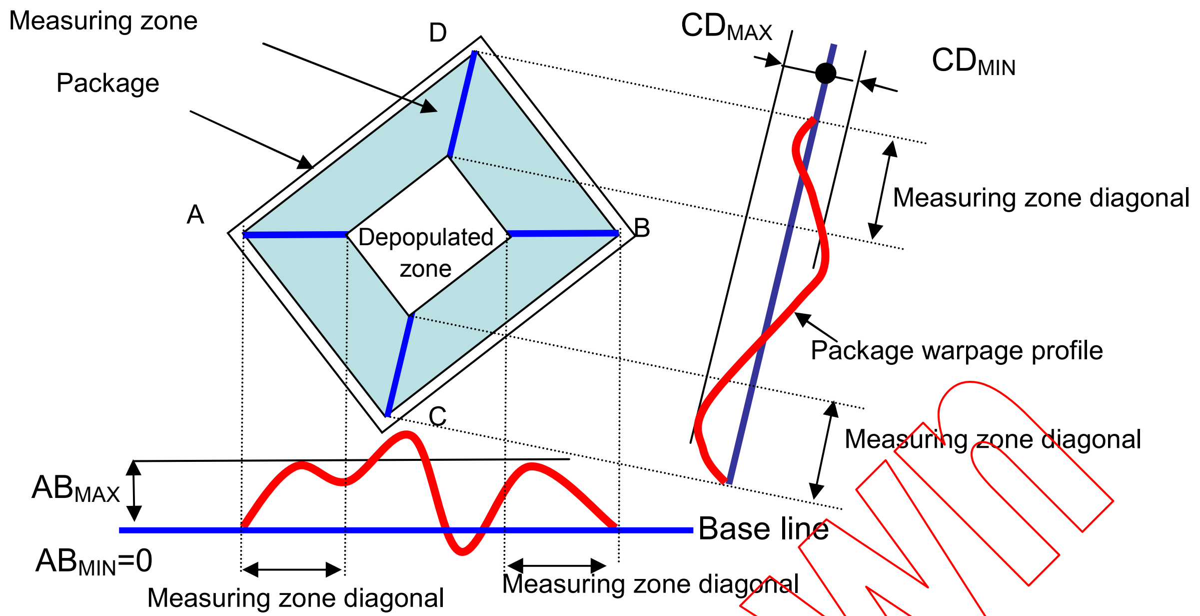

Figure 4 – Calculation of the sign of package warpage

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3.5
package warpage
difference of the largest positive and the largest negative displacements of the package warpage in the measuring zone with respect to the reference plane, preceded by package warpage sign

NOTE This reference plane is derived using the least square method with the measuring zone data. For example, the absolute value of the package warpage |C| is obtained by the sum of the absolute value of the largest positive displacement |A| and that of the largest negative displacement |B|. This is in respect to the reference plane which is derived by using the least square method, as shown in Figure 5. Package warpage sign precedes |C|.

$$|C| = |A| + |B|$$

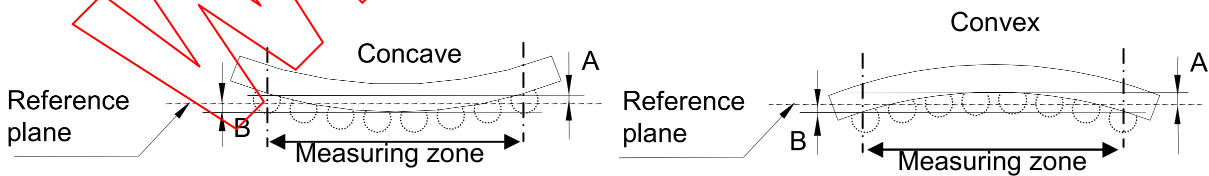

Figure 5 – Package warpage

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