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Packaging of components for automatic handling – Part 5: Matrix trays

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FOREWORD

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This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

International Standard IEC 60286-5 has been prepared by IEC technical committee 40: Capacitors and resistors for electronic equipment.

This third edition cancels and replaces the second edition published in 2003 and Amendment 1:2009. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) The generic rules for the design of matrix trays are given in this document. Newly developed trays which follow these rules will not be listed individually. Only those trays which conform to the design rules set forth herein are classified as "standard trays" and are thus preferred for use.
b) An update of the matrix trays, which do not conform to the design rules set forth herein, are considered as "non-standard trays" and are not preferred for use, is listed in Annex A.

The text of this International Standard is based on the following documents:

CDV	Report on voting
40/2556/CDV	40/2597/RVC

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 60286 series, published under the general title *Packaging of components for automatic handling*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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PACKAGING OF COMPONENTS FOR AUTOMATIC HANDLING –

Part 5: Matrix trays

1 Scope

This part of IEC 60286 describes the common dimensions, tolerances and characteristics of the tray. It includes only those dimensions that are essential for the handling of the trays for the stated purpose and for placing or removing components from the trays.

Matrix trays are designed to facilitate the transport and handling of electronic components during their testing, baking, transport/storage, and final mounting by automatic placement equipment.

The generic rules for their design are given in this document. Newly developed trays that follow these rules will not be listed individually. Only those trays that conform to the design rules set forth herein are classified as "standard trays" and are thus preferred for use.

NOTE Matrix trays listed in Annex A that do not conform to the design rules set forth herein shall be considered as "non-standard trays" and are not preferred for use.

2 Normative references

There are no normative references in this document.

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.2 Abbreviated terms

The following are the abbreviated terms used in Table A.1 and Table A.3.

ball grid array (ball grid array type package)	**BGA**
ceramic quad flat package (ceramic quad flat type package)	**CQFP**
metric quad flat package (metric quad flat type package)	**MQFP**
plastic leaded chip carrier (plastic leaded type chip carrier)	**PLCC**
plastic quad flat package (plastic quad flat type package)	**PQFP**
thin quad flat package (thin quad flat type package)	**TQFP**
small outline j-leaded package (small outline j-leaded type package)	**SOJ**
type 1 thin small outline package (thin small outline type package1)	**TSOP (I)**
type 2 thin small outline package (thin small outline type package2)	**TSOP (II)**

4 Material

4.1 Electrostatic dissipative requirements

Trays shall be moulded from material that meets the ESD dissipative requirements ~~which are:~~ with surface resistance equal to or greater than 1,0 x 10^5 ohms/square but less than 1,0 x ~~10^{12}~~ 10^{-11} ohms/square.

4.2 Effect of properties

The tray material shall not adversely affect the mechanical, electrical characteristics, solder-ability, or marking of the component during or after transport, baking or storage in the tray.

4.3 Recycling and rigidity

The tray material shall be reusable or recyclable and shall be rigid enough to avoid damage to the components during handling, loading, baking, testing, shipping and placement operations.

There should be space for a recycle logo and material code or material declaration close to 'Detail B'.

5 Mechanical stability

5.1 Loaded tray

Mechanical stability of loaded trays shall be such that the components are adequately retained, without lead/terminal damage, and can be easily removed from the tray.

5.2 Empty tray

The empty tray shall withstand normal environmental conditions (including component baking temperatures, if required) without distorting, warping, expanding, shrinking or any other physical change outside the specified dimensions of the trays.

5.3 Outer edges

The outer edges of the tray shall be of sufficient thickness and strength to allow mechanical positioning and clamping.

6 Tray design, dimensions and other physical properties

6.1 Tray design

6.1.1 Number of pockets

All new tray proposals should maximize the number of pockets in each tray-family variation without violating the pocket-density design rules specified in 6.1.3.

6.1.2 Orientation of pockets

When designing a tray for a rectangular package, the longest dimension (D) of the package is oriented parallel to the length of the tray to maximize tray pocket density.

6.1.3 Design rules for pocket density

6.1.3.1 Formulas

DT is D_{max} + strengthening pocket rib width *W*

ET is E_{max}" + strengthening pocket rib width *W*

M is (135,9 mm − *M*3(*N*1 − 1))/2

*M*1 is (315,0 mm − *M*2(*N*2 − 1))/2

*M*2 is [(315,0 mm ~~– 6,4~~ − 2*P* mm) − *W*(*N*2 − 1)]/*N*2 + *W*

*M*3 is [(135,9 mm ~~– 6,4~~ − 2*P* mm) − *W*(*N*1 − 1)]/*N*1 + *W*

*N*1 is (135,9 mm ~~– 6,4~~ − 2*P* mm)/*ET* (rounded down to a whole number)

*N*2 is (315,0 mm ~~– 6,4~~ − 2*P* mm)/*DT* (rounded down to a whole number)

NOTE 1 After the maximum matrix has been established by the above calculation using a minimum *W* value, *N*1 and *N*2 may not have resulted in even numbers and may therefore have been rounded down to the nearest whole number. This means we may have fractions of millimetres extra that should be added back to *M*2 and *M*3 to maximize the pitch between the pockets while minimizing the edge of the tray to the centre line of the first pocket *M* and *M*1.

NOTE 2 For component sizes < (7 × 7) mm high density can cause difficulties for inspection and risks for handling.

NOTE 3 See Annex C for further information about tray design considerations.

The dimensions *P* and *W* are given in Table 1.

Table 1 – *P* and *W* dimension

Dimension	Thin tray		Thick tray
	Normal stacking tray mm	Low stacking tray mm	mm
P	3,2	5,0	5,0
W	2,0	2,5	2,0

6.1.3.2 Constituents of the design rules, formulas and drawings

D_{max} is determined by appropriate specification

DT is the max. length *D* + strengthening pocket rib width *W*

E_{max} is determined by appropriate specification

ET is the max. width *E* + strengthening pocket rib width *W*

M is the edge of the tray width to the centre line of the first pocket

*M*1 is the edge of the tray length to the centre line of the first pocket

*M*2 is the pitch of the tray pocket in the tray length

*M*3 is the pitch of the tray pocket in the tray width

N is the package ~~lead~~ pin counts supported

*N*1 is the number of columns in the tray

*N*2 is the number of rows in the tray

*N*3 is the total number of pockets in the tray (*N*1 × *N*2 = *N*3)

*N*4 is the package type accommodated

*N*5 is the end vacuum pick-up area(s)

*N*6 is the centre vacuum pick-up area(s)

P is the edge of the tray to the edge of the pocket

W is the strengthening pocket rib width

NOTE The tray ~~sponsor~~ manufacturer or tray user will determine *W* from the latest manufacturing capabilities and design feature needs at the time of the new tray-family design.

W should not exceed the target value of ~~2,00 mm~~ Table 1 in order to achieve the maximum tray density unless required by application.

6.2 Overall tray dimensions

Overall tray dimensions shall be 322,6 mm in length and 135,9 mm in width. Overall height *A*, stacking step height *A*1 and edge height *A*2 are given in Table 2.

Table 2 – Height dimensions

Dimension	Thin tray		Thick tray mm
	Normal stacking tray mm	Low stacking tray mm	
A	7,62	7,62	12,19
*A*1	6,35	5,62	10,16
*A*2	1,27 typically	2,00 typically	~~2,00~~ 2,03 typically

Measurement methodology of the tray outline dimensions, height, stacking feature dimensions and warpage is described in Annex B.

6.3 Cell dimensions

Cell dimensions are derived from package dimensions. The information given in this section is intended for reference only. Package types shown in Figures 1 and 2 are not intended in any way to limit types of present or future designs that may require matrix trays.

D and *E* dimensions represent the largest overall features of a package (lead/terminal or body).

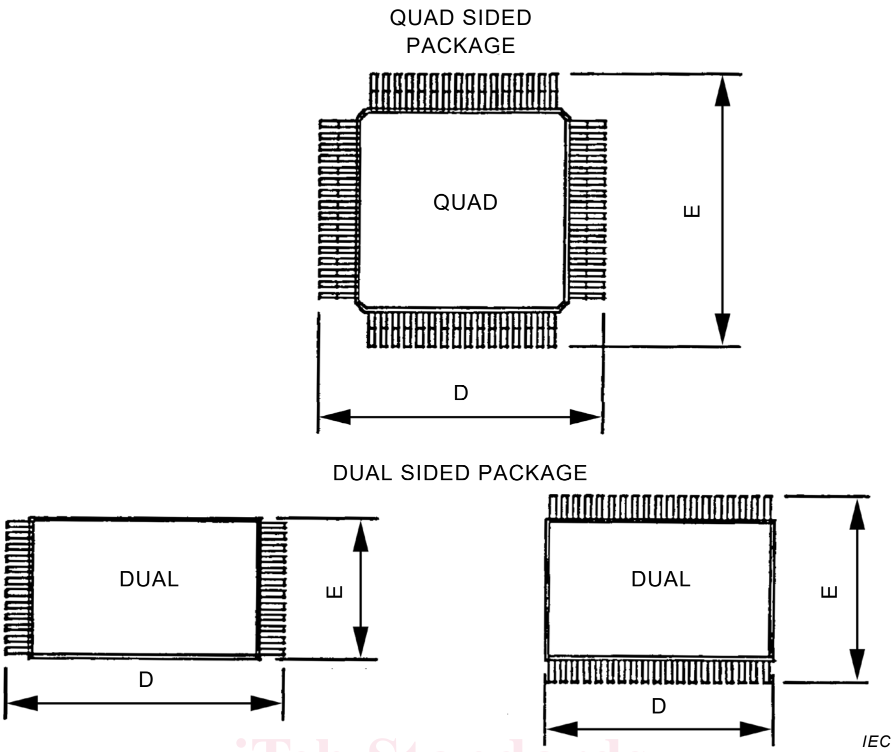

Figure 1 – Sample of leaded packages

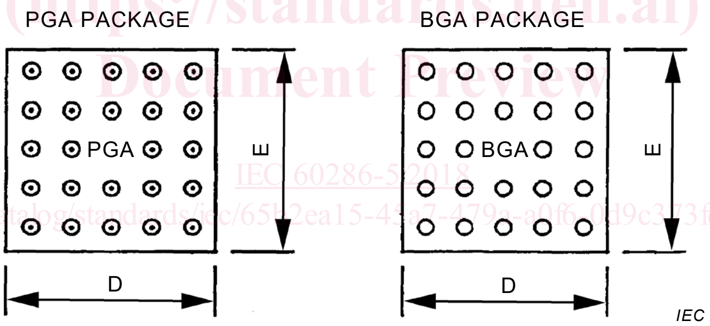

Figure 2 – Sample of grid array packages

6.4 Tray vacuum pick-up sites

6.4.1 Size

The closed walled vacuum pick-up area should be at least 28 mm × 28 mm.

6.4.2 Centre

A minimum of one walled vacuum pick-up area should be located as close to the centre as possible.

6.4.3 Perimeter

A minimum of one perimeter vacuum pick-up area should be located at each end of the tray.

6.5 Detail features

~~All cavity detail features must begin at a minimum distance of 3,2 mm from the external end of the tray (see Figures 3 and 4).~~

All cavity detail features shall begin at a minimum distance of P = 3,2 mm [thin tray (normal stacking tray)] or P = 5,0 mm [thin tray (low stacking tray) and thick tray)].

NOTE The straightness call-out of 0,80 mm may have to be reduced when designing trays for thinner packages.

6.6 Weight

The empty tray weight shall not exceed 300 g.

6.7 Movement of components

The tray cell design shall minimize the component movement. ~~The component shall not rotate more than 2,5° in any direction.~~

To calculate the maximum angle of rotation, the worst-case combination of dimensions should be used (minimum package size, maximum cavity size).

For packages ≥ 7mm × 7 mm: rotation < 5°

For packages < 7mm × 7mm: rotation < 10° (design value)

6.8 Dimensional information

Figures 3, 4 and 5 state dimensions for the tray main view and for the tray stacking details.