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

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PACKAGING OF COMPONENTS FOR AUTOMATIC HANDLING –

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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- withdrawn,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 $1,0 \times 10^5$ ohms/square but less than $1,0 \times$ ~~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 − $M3(N1 - 1)$)/2

$M1$ is (315,0 mm − $M2(N2 - 1)$)/2

$M2$ is [(315,0 mm ~~− 6,4~~ − $2P$ mm) − $W(N2 - 1)$]/$N2$ + W

$M3$ is [(135,9 mm ~~− 6,4~~ − $2P$ mm) − $W(N1 - 1)$]/$N1$ + W

$N1$ is (135,9 mm ~~− 6,4~~ − $2P$ mm)/ET (rounded down to a whole number)

$N2$ is (315,0 mm ~~− 6,4~~ − $2P$ 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, $N1$ and $N2$ 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 $M2$ and $M3$ to maximize the pitch between the pockets while minimizing the edge of the tray to the centre line of the first pocket M and $M1$.

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	Low stacking tray	
	mm	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

$M1$ is the edge of the tray length to the centre line of the first pocket

$M2$ is the pitch of the tray pocket in the tray length

$M3$ is the pitch of the tray pocket in the tray width

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

$N1$ is the number of columns in the tray

$N2$ is the number of rows in the tray

$N3$ is the total number of pockets in the tray ($N1$ × $N2$ = $N3$)

$N4$ is the package type accommodated

$N5$ is the end vacuum pick-up area(s)

$N6$ 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 $A1$ and edge height $A2$ are given in Table 2.

Table 2 – Height dimensions

Dimension	Thin tray		Thick tray
	Normal stacking tray mm	Low stacking tray mm	mm
A	7,62	7,62	12,19
$A1$	6,35	5,62	10,16
$A2$	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).

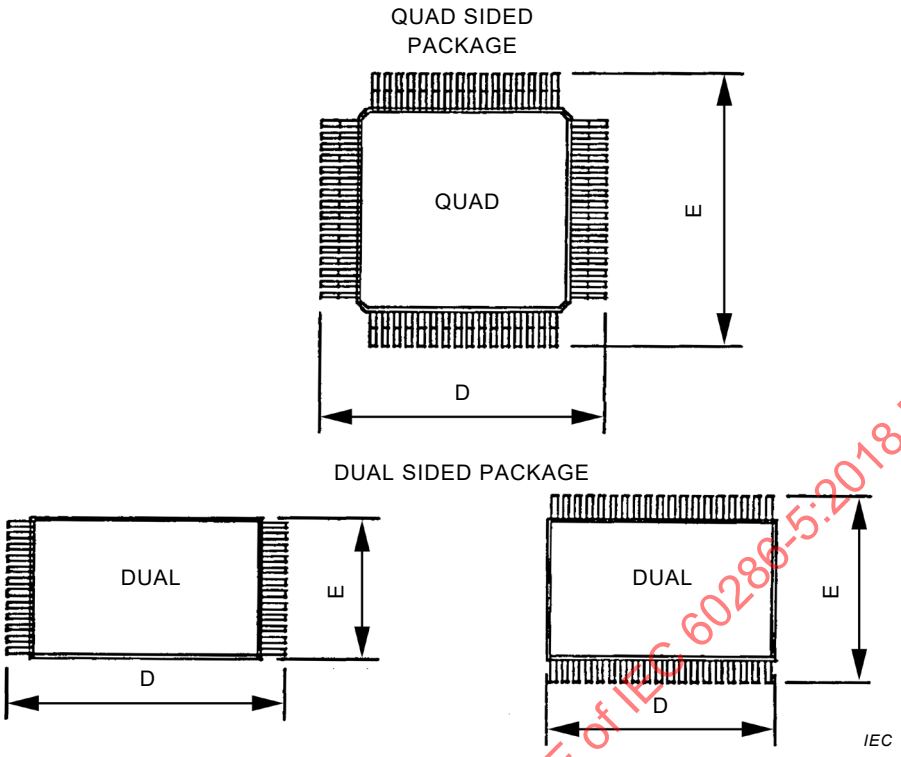


Figure 1 – Sample of leaded packages

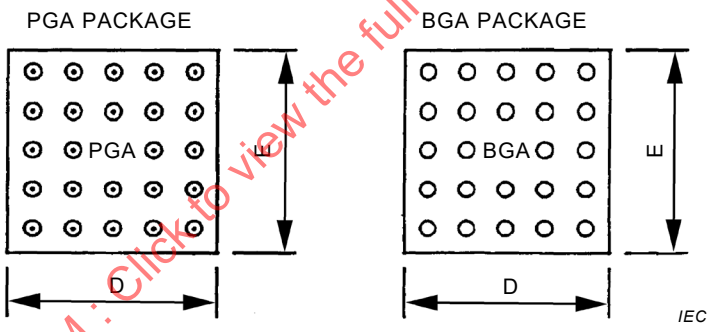


Figure 2 – Sample of grid array packages

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).

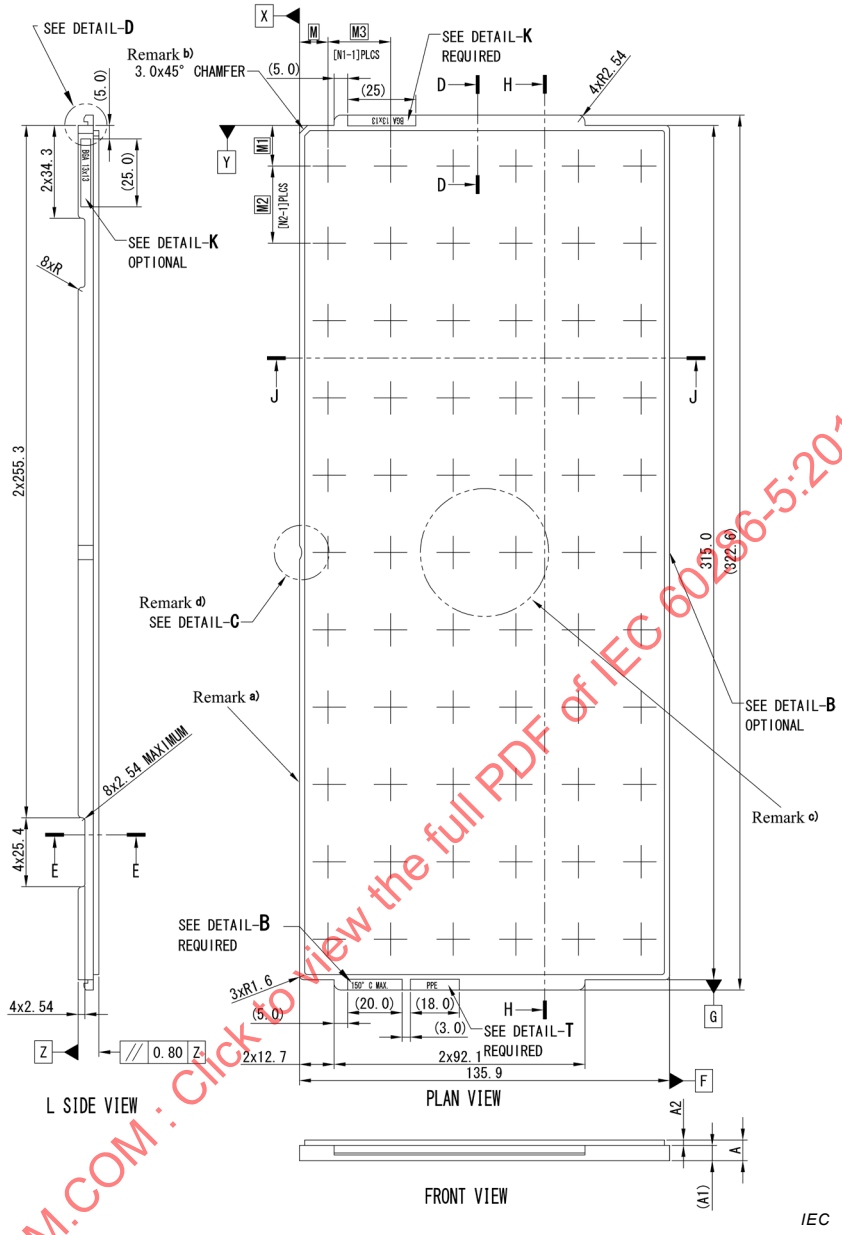
For packages ≥ 7mm × 7 mm: rotation < 5°

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.

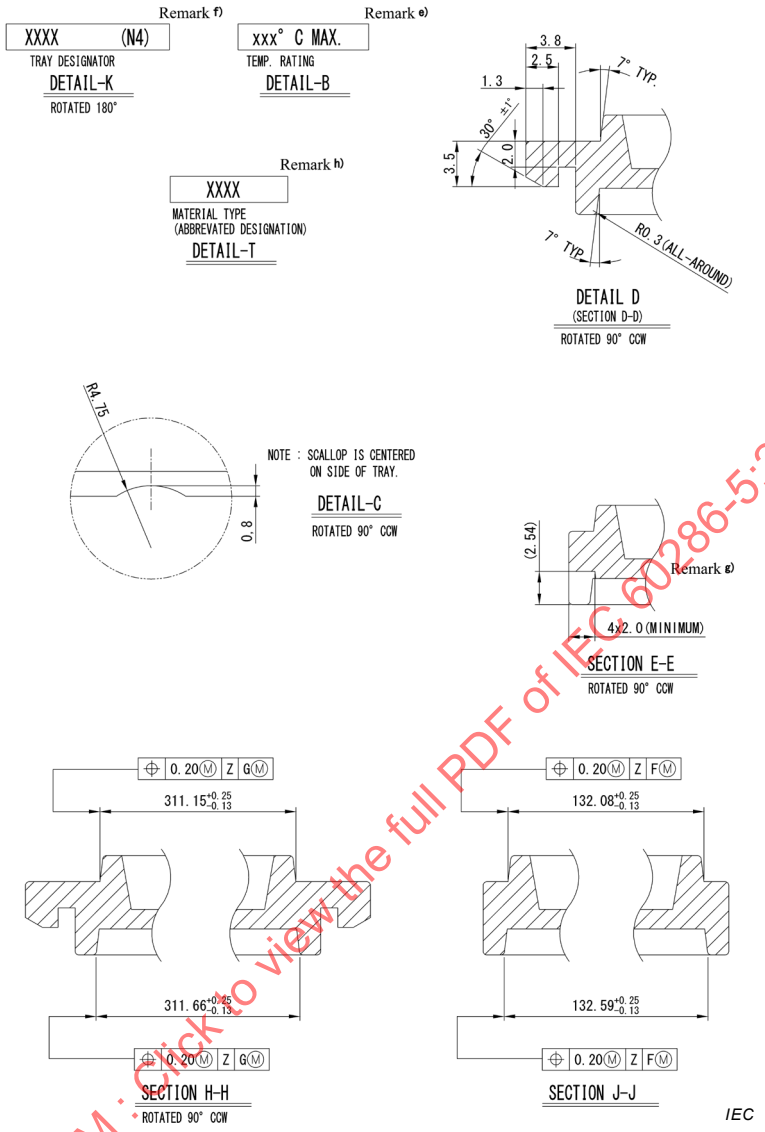
Dimensions in millimetres



NOTE For notes, see Table 3.

Figure 3 – Tray main view

Dimensions in millimetres



NOTE For notes, see Table 3.

Figure 4 – Tray stacking details

Dimensions in millimetres

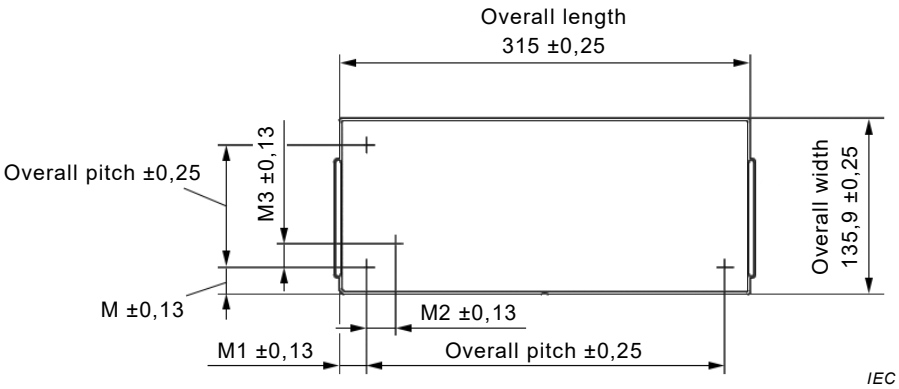


Figure 5 – Tray tolerances

Table 3 – Notes related to Figures 3 and 4

1	These surfaces should be free of seams.
2	Chamfer denotes general package pin 1 orientation.
3	The tray vacuum pick-up method requires two separate pick-up areas represented by bottom closed cells. Optional vacuum pick-up cell locations are $N5$.
4	The tray vacuum pick-up method requires a minimum walled pick-up area of 28 mm × 28 mm, located as close to the centre of the tray as is practical. Centre vacuum pick-up cell locations are $N6$.
5	This scallop is centred on the side of the tray and allows the use of a pin to bias mechanically the tray orientation.
6	The symbol N refers to package lead count supported, where applicable.
7	Total usable cells $N3 = N1 \times N2$ (columns × rows). Columns run top to bottom along the length of the tray. Rows run left to right across the width of the tray.
8	Dimensions M, $M1$, $M2$ and $M3$ define the centre lines for the cell sites. Package interface is controlled by package design and lead form.
9	Non-tabulated dimensions have a tolerance of
	X = ± 0,25;
	XX = ± 0,13; angles = ± 0,5°.
10	Dimensions are in millimetres.
11	Interpret dimensioning and tolerancing in accordance with ANSI Y14.5M-1982.
12	XXX °C is the maximum temperature to which the empty tray can be subjected to for 48 continuous hours without violating the dimensional tolerance of the tray.
13	$N4$ indicates the package type accommodated.
14	Bottom side-wall notches require a minimum depth of 2 mm to facilitate auto handling equipment.
15	All tray measurements are to be made with the tray unrestrained. All tray measurements except height measurement should be done with the tray unrestrained.
16	Sharp edges that could cause damage to dry-pack bags or other packaging material should be avoided regardless of whether or not an edge or corner radius is specified.
17	~~There should be space for a recycle logo and material code or material declaration close to Detail B.~~ Detail T" indicates material, recycle logo and material code.

7 Polarity and orientation of components in the tray

7.1 Pin one

Pin 1 of the component shall be orientated towards the tray chamfer corner or the side of the tray with the centre scallop.

7.2 Loading

Components shall be loaded into the tray starting at the lower right corner diagonally opposite the chamfered corner of the tray. Proceeding from bottom to top and right to left, the columns shall be completely filled from bottom to top before placing a component in the next column.

8 Tray stacking

8.1 Bundling

Trays may be bundled in stacks providing the stacks contain only components of the same part number and the same manufacturer.

8.2 Top protection

The top tray containing components shall be protected by an empty tray or a suitable equivalent lid.

8.3 Partial filling

A stack of trays shall not contain more than one partially filled tray. Except for the protective cover tray (lid), any partially filled tray shall be the top tray of the stack as received from the supplier.

8.4 Protrusion of components

The component shall not protrude above the top surface profile of the tray. A heat-sink, attached to the top of a component, may protrude above the top surface of the tray. When such a heat-sink is used, suitable "spacer" trays shall be used in the stack.

8.5 Stack-up

Trays shall be stackable without interference and shall not stick together during unstacking operations.

8.6 Damaging of components

Trays shall be stackable without damaging contained components.

8.7 Warpage

Maximum warpage for trays shall be 0,8 mm.

NOTE The maximum warpage of 0,80 mm may have to be reduced when designing trays for thinner packages.

9 Missing components

Missing components are not allowed, except for an intentionally partially filled tray as described in 8.3.

10 Marking

The tray shall be marked with the following:

a) The type of component the tray is intended to obtain.

b) The temperature in degrees Celsius, which the empty tray will withstand for 48 continuous hours, without violating the dimensional tolerance of the tray.

c) When required, a label with information in normal script or in code form (for example, OCR bar code, magnetic~~, etc.~~) for automatic reading shall be placed on the right side of the tray (opposite side from the scallop).

- In the case of bar codes, it is recommended to use ~~bar~~ Code 39.
- For optical character recognition, OCR B should be used.

Annex A
(informative)

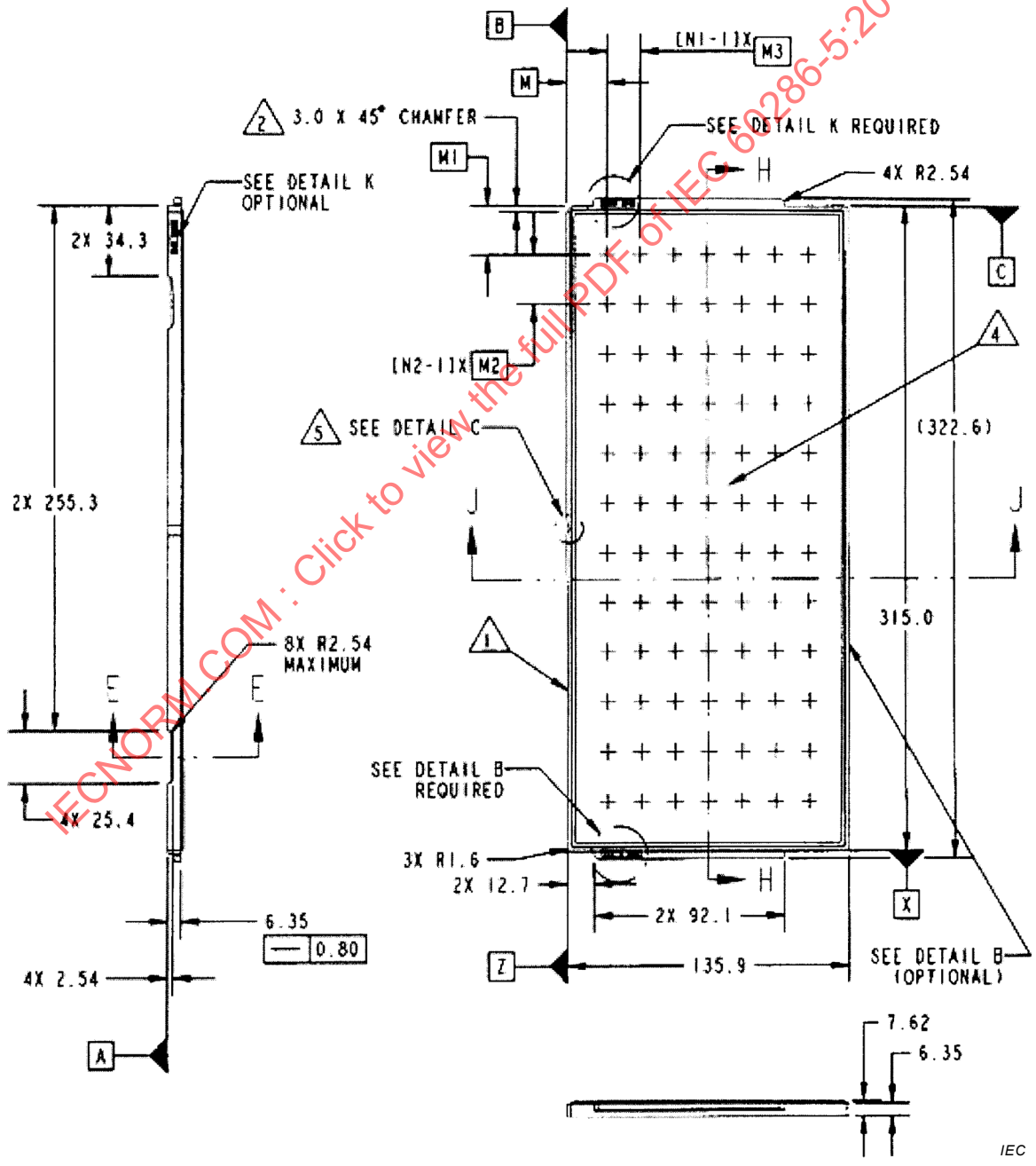
List of existing matrix trays with wide anticipated use in the electronic industries

A.1 Matrix trays (for different packages)

~~A.1.1 Dimensional information~~

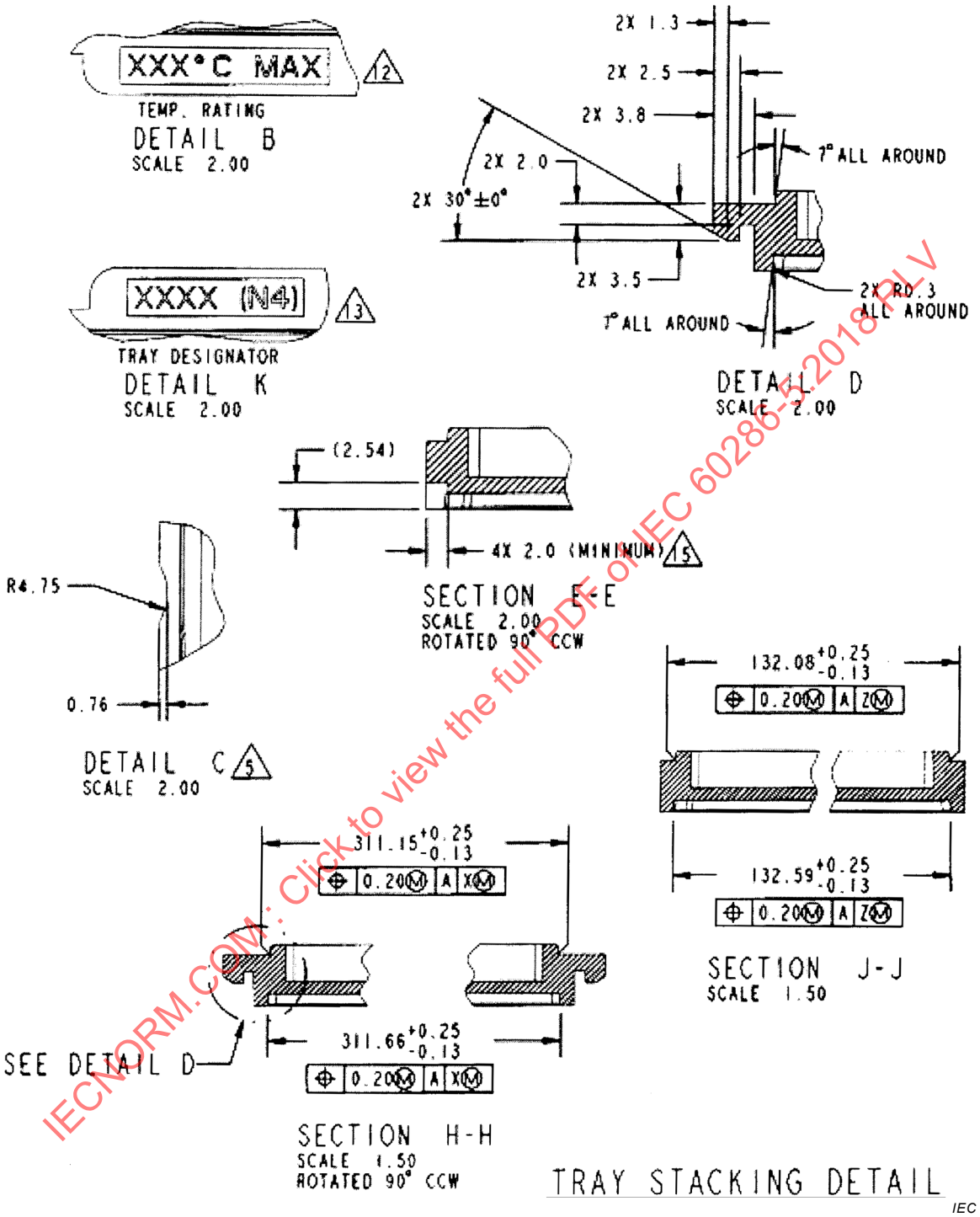
See Table 1, column "Thin ~~magazine~~ tray", and Figure A.1.

Dimensions in millimetres



a) Main view

Dimensions in millimetres



b) Stacking details

NOTE For notes, see Table A.2.

Figure A.1 – Thin tray

A.1.2 Variation sheets

The following are the abbreviations used in Tables A.1 and A.2.

BGA (Ball Grid Array)
CQFP (Ceramic Quad Flat Pack)
MQFP (Metric Quad Flat Pack)
PLCC (Plastic Leaded Chip Carrier)
PQFP (Plastic Quad Flat Pack)
TQFP (Thin Quad Flat Pack)
SOJ (Small Outline J-Leaded Package)
TSOP (I) (type 1 Thin Small Outline Package)
TSOP (II) (type 2 Thin Small Outline Package)

Table A.1 – Variations

Tray			*M*	*M*1	*M*2	*M*3	*N*	*N*1	*N*2	*N*3	*N*4	*N*5	*N*6	Origin	
Type	Component Type	Fig	Basic Dim.	Basic Dim.	Basic Dim.	Basic Dim.	Pin count	Columns	Rows	Pockets	Form	Row/Column	Row/Column	Standard	Var
A1.B1	BGA	2	26,70	20,00	27,50	27,50	256; 361; 576	4	11	44	25 × 25	2/2; 10/3	6/2-3	CO-028: B	AA
A1.B2	BGA	2	24,15	26,10	29,20	29,20	324; 441; 676	4	10	40	27 × 27	2/2; 9/3	5/3; 6/2	CO-028: B	AB
A1.B3	BGA	2	20,85	31,10	31,60	31,40	361; 484; 784	4	9	36	29 × 29	2/2; 8/3	5/2-3	CO-028: B	AC
A1.B4	BGA	2	25,05	21,90	33,90	42,90	400; 576; 900	3	9	27	31 × 31	2/2; 8/2	5/2	CO-028: B	AD
A1.B5	BGA	2	32,45	33,25	35,50	35,50	441; 484; 625; 676; 1024	3	8	24	32,5 × 32,5; 33 × 33	2/2; 7/2	4/2; 5/2	CO-028: B	AE
A1.B6	BGA	2	29,95	24,50	38,00	38,00	529; 729; 1156	3	8	24	35 × 35	2/2; 7/2	4/2; 5/2	CO-028: B	AF
A1.B7	BGA	2	27,95	37,50	40,00	40,00	625; 841; 1369	3	7	21	37,5 × 37,5	2/2; 6/2	4/2	CO-028: B	AG
A1.B8	BGA	2	25,65	30,60	42,30	42,30	676; 961; 1521	3	7	21	40 × 40	2/2; 6/2	4/2	CO-028: B	AH
A1.B9	BGA	2	26,70	43,75	45,50	82,50	784; 1089; 1764	2	6	12	42,5 × 42,5	not applicable	not applicable	CO-028: B	AJ
A1.B10	BGA	2	30,00	30,00	51,00	75,90	900; 1225; 1936	2	6	12	45 × 45	1/1; 6/2	3/2; 4/1	CO-028: B	AK
A1.B11	BGA	2	30,00	31,25	50,50	75,90	961; 1369; 2209	2	6	12	47,5 × 47,5	1/1; 6/2	3/2; 4/1	CO-028: B	AL
A1.B12	BGA	2	41,45	51,50	53,00	53,00	1089; 1521; 2401	2	5	10	50 × 50	1/1; 5/2	3/1; 3/2	CO-028: B	AM
A1.B13	BGA	2	20,95	20,00	27,50	23,50	224; 304; 480	5	11	55	25 × 21	2/2; 10/4	6/2-4	CO-028: B	BA
A1.B14	BGA	2	26,70	33,25	35,50	27,50	336; 475; 744	4	8	32	32,5 × 25	2/2; 7/3	4/2-3; 5/2-3	CO-028: B	BB
A1.B15	BGA	2	11,55	11,80	9,40	9,40	16; 25; 36	13	32	416	7 × 7	4/7; 29/7	15-18/6-7	CO-029: A	AA
A1.B16	BGA	2	16,65	15,00	11,40	11,40	36; 49; 64	10	26	260	9 × 9	3/5; 24/6	12-15/4-7	CO-029: A	AB
A1.B17	BGA	2	17,20	16,80	13,40	14,50	49; 64; 100	8	22	176	11 × 11	3/4; 20/5	11-12/4-5	CO-029: A	AC
A1.B18	BGA	2	15,45	15,00	15,00	15,00	64; 100; 144	8	20	160	13 × 13	3/4; 18/5	10-11/4-5	CO-029: A	AD
A1.B19	BGA	2	16,35	11,30	17,20	17,20	100; 121; 196	7	18	126	15 × 15	2/4; 17/4	9-10/3-5	CO-029: A	AE
A1.B20	BGA	2	19,20	21,00	19,50	19,50	121; 169; 256	6	15	90	17 × 17	2/3; 14/4	7-9/3-4	CO-029: A	AF
A1.B21	BGA	2	14,60	18,79	21,34	21,34	144; 196; 225; 289; 324	6	14	84	19 × 19; 18,5 × 18,5	2/3;13/4	7-8/3-4	CO-029: A	AG
A1.B22	BGA	2	20,15	26,05	23,90	23,90	196; 256; 400	5	12	60	21 × 21	2/2; 11/4	6-7/2-4	CO-029: A	AH
A1.B23	BGA	2	16,95	17,25	25,50	25,50	225; 324; 484	5	12	60	23 × 23	2/2; 11/4	6-7/3	CO-029: A	AJ
A1.B24	BGA	2	26,70	20,00	27,50	27,50	256; 361; 576	4	11	44	25 × 25	2/2; 10/3	6/2-3	CO-029: A	AK
A1.B25	BGA	2	25,40	29,70	28,40	28,40	—	4	10	40	26 × 26	2/2; 9/3	5-6/2-3	ED-7613	—
A1.B26	BGA	2	24,15	26,10	29,20	29,20	324; 441; 676	4	10	40	27 × 27	2/2; 9/3	5/3; 6/2	CO-029: A	AL

Tray			*M*	*M*1	*M*2	*M*3	*N*	*N*1	*N*2	*N*3	*N*4	*N*5	*N*6	Origin	
Type	Component Type	Fig	Basic Dim.	Basic Dim.	Basic Dim.	Basic Dim.	Pin count	Columns	Rows	Pockets	Form	Row/Column	Row/Column	Standard	Var
A1.B27	BGA	2	20,85	31,10	31,60	31,40	361; 484; 784	4	9	36	29 × 29	2/2; 8/3	5/2-3	CO-029: A	AM
A1.B28	BGA	2	25,05	21,90	33,90	42,90	400; 576; 900	3	9	27	31 × 31	2/2; 8/2	5/2	CO-029: A	AN
A1.B29	BGA	2	32,45	33,25	35,50	35,50	441; 484; 625; 676; 1024	3	8	24	33 × 33; 32,5 × 32,5	2/2; 7/2	4-5/2	CO-029: A	AP
A1.B30	BGA	2	29,95	24,50	38,00	38,00	529; 729; 1156	3	8	24	35 × 35	2/2; 7/2	4-5/2	CO-029: A	AR
A1.B31	BGA	2	27,95	37,50	40,00	40,00	625; 841; 1369	3	7	21	37,5 × 37,5	2/2; 6/2	4/2	CO-029: A	AS
A1.B32	BGA	2	26,65	30,60	42,30	42,30	676; 961; 1521	3	7	21	40 × 40	2/2; 6/2	4/2	CO-029: A	AT
A1.B33	BGA	2	26,70	43,75	45,50	82,50	784; 1089; 1764	2	6	12	42,5 × 42,5	not applicable	not applicable	CO-029: A	AU
A1.B34	BGA	2	30,00	30,00	51,00	75,90	900; 1225; 1936	2	6	12	45 × 45	1/1; 6/2	3/2; 4/1	CO-029: A	AV
A1.B35	BGA	2	30,00	31,25	50,50	75,90	961; 1369; 2209	2	6	12	47,5 × 47,5	1/1; 6/2	3/2; 4/1	CO-029: A	AW
A1.B36	BGA	2	41,45	51,50	53,00	53,00	1089; 1521; 2401	2	5	10	50 × 50	1/1; 5/2	3/1-2	CO-029: A	AX
A1.B37	BGA	2	9,00	9,15	12,90	13,10	25; 36; 49; 64; 81	10	24	240	10 × 10	2/5; 23/6	11-14/4-6	CO-029: D	AY
A1.B38	BGA	2	9,55	10,00	14,75	14,60	49; 64; 81; 100; 121	9	21	189	12 × 12	2/5; 20/5	10-12/4-6	CO-029: D	AZ
A1.B39	BGA	2	12,75	23,30	24,40	18,40	119; 153	7	12	84	22 × 14	2/4; 11/4	6-7/3-5	CO-029: A	BA
A1.B40	BGA	2	14,60	16,50	23,50	21,34	168; 224; 340	6	13	78	21 × 18,5	2/3; 12/4	7/3-4	CO-029: A	BB
A1.B41	BGA	2	20,95	20,00	27,50	23,50	224; 304; 480	5	11	55	25 × 21	2/2; 10/4	6/2-4	CO-029: A	BC
A1.B42	BGA	2	26,70	33,25	35,50	27,50	336; 475; 744	4	8	32	32,5 × 25	2/2; 7/3	4-5/2-3	CO-029: A	BD
A1.B43	BGA	2	11,60	24,95	24,10	16,10	119; 153	8	12	96	22 × 14	2/4; 11/5	6-7/4-5	CO-029: B	BE
A1.B44	BGA	2	8,20	12,60	20,70	11,95	60	11	15	165	16 × 8	6/2; 6/14	5-7/7-9	CO-029: D	BF
A1.C1	CQFP	1	17,81	17,93	25,37	25,07	28; 52	5	12	60	-	3/3; 10/3	6-7/3	CO-011: B	AA
A1.C2	CQFP	1	20,93	23,98	33,38	31,34	68	4	9	36	-	2/2; 8/3	5/2	CO-011: B	AB
A1.C3	CQFP	1	29,49	29,49	38,05	38,46	44; 84	3	8	24	-	2/2; 7/2	5/2	CO-011: B	AC
A1.C4	CQFP	1	20,93	23,98	33,38	31,34	52; 100	4	9	36	-	2/2; 8/3	5/2	CO-011: B	AD
A1.C5	CQFP	1	20,93	23,98	33,38	31,34	68; 132	4	9	36	-	2/2; 8/3	5/2	CO-011: B	AE
A1.C6	CQFP	1	29,49	29,49	38,05	38,46	84; 164	3	8	24	-	2/2; 7/2	5/2	CO-011: B	AF
A1.D1	MQFP	1	18,30	17,25	18,70	19,86	36; 44; 52;64; 80	6	16	96	10 × 10	3/3; 14/4	8-9/3-4	CS-004: A	AA
A1.D2	MQFP	1	15,45	17,75	21,50	21,00	52; 64; 80; 100; 120	6	14	84	14 × 14	3/3; 12/4	7-8/3-4	CS-004: A	AB
A1.D3	MQFP	1	15,45	22,50	27,00	21,00	64; 80; 100; 128	6	11	66	14 × 20	2/3; 10/4	6/3-4	CS-004: A	AC

Tray			*M*	*M*1	*M*2	*M*3	*N*	*N*1	*N*2	*N*3	*N*4	*N*5	*N*6	Origin	
Type	Component Type	Fig	Basic Dim.	Basic Dim.	Basic Dim.	Basic Dim.	Pin count	Columns	Rows	Pockets	Form	Row/Column	Row/Column	Standard	Var
A1.D4	MQFP	1	30,93	27,93	37,02	37,02	120; 128; 144; 160; 208; 256	3	8	24	28 × 28	2/2; 7/2	4-5/2	CS-004: A	AD
A1.D5	MQFP	1	26,57	25,13	37,82	41,38	184; 240; 296	3	8	24	32 × 32	2/2; 7/2	4-5/2	CS-004: A	AE
A1.D6	MQFP	1	29,22	31,10	50,56	77,46	232; 304; 376	2	6	12	40 × 40	not applicable	not applicable	CS-004: A	AF
A1.D7	MQFP	1	10,20	11,05	10,10	10,50	32; 40	12	30	360	5 × 5	2/6; 29/7	14-17/5-8	CS-004: B	AG
A1.D8	MQFP	1	11,25	11,10	12,20	12,60	32; 40; 48; 64	10	25	250	7 × 7	2/5; 24/6	12-14/4-7	CS-004: B	AH
A1.D9	MQFP	1	13,95	14,30	17,90	18,00	48; 64; 80; 100	7	17	119	12 × 12	2/4; 16/4	8-10/3-5	CS-004: B	AJ
A1.D10	MQFP	1	17,55	17,80	25,40	25,20	128; 144; 176	5	12	60	20 × 20	2/3; 11/3	6-7/2-4	CS-004: B	AK
A1.D11	MQFP	1	20,70	20,70	30,40	31,50	160; 176; 216	4	10	40	24 × 24	2/2; 9/3	5-6/2-3	CS-004: B	AL
A1.D12	MQFP	1	26,40	32,70	41,60	41,60	—	3	7	21	36 × 36	2/2; 6/2	4/2	ED-7614	—
A1.E1	MQFP-HD	1	13,00	13,10	15,20	15,70	44; 52; 64; 80	8	20	160	10 × 10	2/4; 19/5	10-11/4-5	CO-027: B	AC
A1.E2	MQFP-HD	1	15,45	15,40	20,30	21,00	52; 64; 80; 100; 120	6	15	90	14 × 14	2/3; 14/4	7-9/3-4	CO-027: B	AE
A1.E3	MQFP-HD	1	15,45	17,80	25,40	21,00	80; 100; 128	6	12	72	14 × 20	2/3; 11/4	6-7/3-4	CO-027: B	AF
A1.F1	PLCC	1	11,80	17,09	14,78	11,23	18	11	20	220	rectangular	3/6; 18/6	10-11/5-7	CS-003: A	AA
A1.F2	PLCC	1	10,80	17,25	16,50	11,43	22	11	18	198	rectangular	3/6; 16/6	9-10/5-7	CS-003: A	AB
A1.F3	PLCC	1	16,11	22,20	18,04	12,96	28	9	16	144	rectangular	2/5; 15/5	8-9/4-6	CS-003: A	AC
A1.F4	PLCC	1	13,70	22,20	18,04	15,50	32	8	16	128	rectangular	2/4; 15/5	8-9/4-5	CS-003: A	AD
A1.F5	PLCC	1	16,11	14,94	12,96	12,96	20	9	23	207	square	4/5; 20/5	11-13/4-6	CS-003: A	AE
A1.F6	PLCC	1	13,70	18,00	15,50	15,50	28	8	19	152	square	3/4; 17/5	9-11/4-5	CS-003: A	AF
A1.F7	PLCC	1	16,50	23,73	20,58	20,58	44	6	14	84	square	2/3; 13/4	7-8/3-4	CS-003: A	AG
A1.F8	PLCC	1	21,71	18,78	23,12	23,12	52	5	13	65	square	2/3; 12/3	6-8/2-4	CS-003: A	AH
A1.F9	PLCC	1	25,65	30,60	28,20	28,20	68	4	10	40	square	2/2; 9/3	5-6/2-3	CS-003: A	AJ
A1.F10	PLCC	1	34,67	24,38	33,28	33,28	84	3	9	27	square	2/2; 8/2	5/2	CS-003: A	AK
A1.F11	PLCC	1	29,59	23,24	38,36	38,36	100	3	8	24	square	2/2; 7/2	4-5/2	CS-003: A	AL
A1.G1	PQFP	1	15,70	18,24	23,21	20,90	68	6	13	78	-	3/3; 11/4	6-8/3-4	CS-002: A	AA
A1.G2	PQFP	1	17,81	17,91	25,38	25,07	84	5	12	60	-	3/3; 10/3	6-7/2-4	CS-002: A	AB
A1.G3	PQFP	1	17,81	19,05	27,69	25,07	100	5	11	55	-	3/3; 9/3	6/2-4	CS-002: A	AC
A1.G4	PQFP	1	20,94	23,98	33,38	31,34	132	4	9	36	-	2/2; 8/3	5/2-3	CS-002: A	AD

Tray			*M*	*M*1	*M*2	*M*3	*N*	*N*1	*N*2	*N*3	*N*4	*N*5	*N*6	Origin	
Type	Component Type	Fig	Basic Dim.	Basic Dim.	Basic Dim.	Basic Dim.	Pin count	Columns	Rows	Pockets	Form	Row/Column	Row/Column	Standard	Var
A1.G5	PQFP	1	29,49	24,29	38,06	38,46	164	3	8	24	-	2/2; 7/2	4-5/2	CS-002: A	AE
A1.G6	PQFP	1	26,17	27,03	43,49	41,78	196	3	7	21	-	2/2; 6/2	4/2	CS-002: A	AF
A1.G7	PQFP	1	42,37	30,60	50,76	51,16	244	2	6	12	-	2/1; 5/2	3-4/1-2	CS-002: A	AG
A1.H1	SOJ	1	10,20	14,30	17,90	10,50	24	12	17	204	7,62 × 15,87	2/6; 16/7	8-10/5-8	CO-032: A	AA
A1.H2	SOJ	1	10,20	13,50	19,20	10,50	20; 24	12	16	192	7,62 × 17,14	2/6; 15/7	8-9/5-8	CO-032: A	AB
A1.H3	SOJ	1	10,20	14,70	20,40	10,50	28	12	15	180	7,62 × 18,14	2/6; 14/7	7-9/5-8	CO-032: A	AC
A1.H4	SOJ	1	10,20	19,80	22,95	10,50	32	12	13	156	7,62 × 20,95	2/6; 12/7	6-8/5-8	CO-032: A	AD
A1.H5	SOJ	1	10,20	25,65	29,30	10,50	42	12	10	120	7,62 × 27,30	2/6; 9/7	5-6/5-8	CO-032: A	AE
A1.H6	SOJ	1	15,15	14,70	20,40	13,20	24; 24	9	15	135	10,16 × 18,14	2/5; 14/5	7-9/4-5	CO-032: A	BA
A1.H7	SOJ	1	15,15	19,80	22,95	13,20	32	9	13	117	10,16 × 20,95	2/5; 12/5	6-8/4-6	CO-032: A	BB
A1.H8	SOJ	1	15,15	23,85	24,30	13,20	34	9	12	108	10,16 × 22,22	2/5; 11/5	6-7/4-5	CO-032: A	BC
A1.H9	SOJ	1	15,15	17,25	25,50	13,20	36	9	12	108	10,16 × 23,49	2/5; 11/5	6-7/4-6	CO-032: A	BD
A1.H10	SOJ	1	15,15	17,50	28,00	13,20	40	9	11	99	10,16 × 26,03	2/5; 10/5	6/4-6	CO-032: A	BE
A1.H11	SOJ	1	14,75	24,75	29,50	13,30	42	9	10	90	10,16 × 27,30	2/5; 9/5	5-6/4-6	CO-032: A	BF
A1.H12	SOJ	1	15,15	19,80	30,60	13,20	44	9	10	90	10,16 × 28,57	2/5; 9/5	5-6/4-6	CO-032: A	BG
A1.K1	TQFP	1	10,20	11,05	10,10	10,50	32; 40	12	30	360	5 × 5	2/6;27/7	14-17/5-8	CS-007: A	AA
A1.K2	TQFP	1	11,25	11,10	12,20	12,60	32; 40; 48; 64	10	25	250	7 × 7	2/5;24/6	12-14/4-7	CS-007: A	AB
A1.K3	TQFP	1	13,00	13,10	15,20	15,70	36; 44; 52; 64; 80	8	20	160	10 × 10	2/4;19/5	10-11/4-5	CS-007: A	AC
A1.K4	TQFP	1	13,95	14,30	17,90	18,00	44; 52; 64; 80; 100	7	17	119	12 × 12	2/4;16/4	8-10/3-5	CS-007: A	AD
A1.K5	TQFP	1	15,45	15,40	20,30	21,00	52; 64; 80; 100; 120	6	15	90	14 × 14	2/3;14/4	7-9/3-4	CS-007: A	AE
A1.K6	TQFP	1	15,45	17,80	25,40	21,00	100; 128	6	12	72	14 × 20	2/3;11/4	6-7/3-4	CS-007: A	AF
A1.K7	TQFP	1	17,55	17,80	25,40	25,20	144; 176	5	12	60	20 × 20	2/3;11/3	6-7/2-4	CS-007: A	AG
A1.K8	TQFP	1	20,70	20,70	30,40	31,50	176; 216	4	10	40	24 × 24	2/2;9/3	5-6/2-3	CS-007: A	AH
A1.K9	TQFP	1	19,65	28,70	32,20	32,20	160; 208; 256	4	9	36	28 × 28	2/2-3;8/2-3	5/2-3	CS-007: A	AJ
A1.L1	TSOP(I)	1	8,70	15,00	19,00	7,90	24	16	16	256	6 × 14	3/3-4;14/13-14	8-9/7-10	CS-008: A	AA
A1.L2	TSOP(I)	1	8,70	14,00	20,50	7,90	24	16	15	240	6 × 16	3/3-4; 13/3-4	7/7-10; 9/7-10	CS-008: A	AB
A1.L3	TSOP(I)	1	8,70	16,50	23,50	7,90	24	16	13	208	6 × 18	2/3-4; 12/3-4	6-8/7-10	CS-008: A	AC

Tray			*M*	*M*1	*M*2	*M*3	*N*	*N*1	*N*2	*N*3	*N*4	*N*5	*N*6	Origin	
Type	Component Type	Fig	Basic Dim.	Basic Dim.	Basic Dim.	Basic Dim.	Pin count	Columns	Rows	Pockets	Form	Row/Column	Row/Column	Standard	Var
A1.L4	TSOP(I)	1	8,70	17,25	25,50	7,90	24	16	12	192	6 × 20	2/3-4; 11/3-4	6/7-10; 7/7-10	CS-008: A	AD
A1.L5	TSOP(I)	1	8,85	15,00	19,00	9,85	32	13	16	208	8 × 14	3/3-4; 14/10-11	8-9/6-8	CS-008: A	BA
A1.L6	TSOP(I)	1	8,85	14,00	20,50	9,85	32	13	15	195	8 × 16	2/3-4; 14/10-11	7-9/6-8	CS-008: A	BB
A1.L7	TSOP(I)	1	8,85	16,50	23,50	9,85	32	13	13	169	8 × 18	2/3-4; 12/10-11	6-8/6-8	CS-008: A	BC
A1.L8	TSOP(I)	1	8,85	14,50	26,00	9,85	32	13	12	156	8 × 20	2/3-4; 11/10-11	6-7/6-8	CS-008: A	BD
A1.L9	TSOP(I)	1	14,40	15,00	19,00	11,90	40	10	16	160	10 × 14	3/2-3; 14/8-9	8-9/4-7	CS-008: A	CA
A1.L10	TSOP(I)	1	14,40	14,00	20,50	11,90	40	10	15	150	10 × 16	2/2-3; 14/8-9	7-9/4-7	CS-008: A	CB
A1.L11	TSOP(I)	1	14,40	16,5	23,50	11,90	40	10	13	130	10 × 18	2/2-3; 12/8-9	6-8/4-7	CS-008: A	CC
A1.L12	TSOP(I)	1	14,40	17,25	25,50	11,90	40	10	12	120	10 × 20	2/2-3; 11/8-9	6-7/4-7	CS-008: A	CD
A1.L13	TSOP(I)	1	15,80	15,00	19,00	14,90	48	8	16	128	12 × 14	3/2-3; 14/6-7	8-9/4-5	CS-008: A	DA
A1.L14	TSOP(I)	1	15,80	14,00	20,50	14,90	48	8	15	120	12 × 16	2/2-3; 14/6-7	7-9/4-5	CS-008: A	DB
A1.L15	TSOP(I)	1	15,80	16,50	23,50	14,90	48	8	13	104	12 × 18	2/2-3; 12/6-7	6-8/4-5	CS-008: A	DC
A1.L16	TSOP(I)	1	15,80	17,25	25,50	14,90	48	8	12	96	12 × 20	2/2-3; 11/6-7	6-7/4-5	CS-008: A	DD
A1.L17	TSOP(I)	1	18,15	15,75	18,90	16,60	—	7	16	112	14 × 16	2/2-3; 15/5-6	8-9/3-5	CS-008: A	EA
A1.L18	TSOP(I)	1	18,15	21,65	20,90	16,60	—	7	14	98	14 × 18	2/2-3; 13/5-6	7-8/3-5	CS-008: A	EB
A1.L19	TSOP(I)	1	18,15	20,10	22,90	16,60	—	7	13	91	14 × 20	2/2-3; 12/5-6	6-8/3-5	CS-008: A	EC
A1.M1	TSOP(II)	1	12,30	13,95	19,14	11,13	20; 24; 26	11	16	176	7,62 × 17,14	3/3-4; 14/8-9	8-9/5-7	CS-005: A	AA
A1.M2	TSOP(II)	1	13,27	14,56	20,42	13,67	28; 40; 44/40	9	15	135	10,16 × 18,41	3/3-4; 13/6-7	7-9/4-6	CS-005: A	AB
A1.M3	TSOP(II)	1	13,27	19,74	22,96	13,67	32; 50/44; 50; 80	9	13	117	10,16 × 20,95	2/3-4; 12/6-7	6-8/4-6	CS-005: A	AC
A1.M4	TSOP(II)	1	19,32	24,18	24,24	16,21	34; 36; 54	7	12	84	12,70 × 22,25	2/2-3; 11/5-6	6-7/3-5	CS-005: A	AD
A1.M5	TSOP(II)	1	12,30	14,56	20,42	11,13	28; 44	11	15	165	7,62 × 18,41	3/3-4; 13/8-9	7-9/5-7	CS-005: B	AE
A1.M6	TSOP(II)	1	13,27	15,60	25,80	13,67	36; 64; 70; 86	9	12	108	10,16 × 22,22 10,16 × 23,49	2/3-4; 11/6-7	6-7/4-6	CS-005: B	AF
A1.M7	TSOP(II)	1	13,27	16,50	28,20	13,67	40	9	11	99	10,16 × 26,03	2/3-4; 10/6-7	6/4-6	CS-005: B	AG
A1.M8	TSOP(II)	1	13,27	18,00	31,00	13,67	70	9	10	90	10,16 × 28,57	2/3-4; 9/6-7	5-6/4-6	CS-005: B	AH
A1.M9	TSOP(II)	1	19,32	14,40	23,85	16,21	32; 50; 62	7	13	91	12,70 × 21,00	2/2-3; 12/5-6	6-8/3-5	CS-005: B	AJ
A1.M10	TSOP(II)	1	19,32	15,60	25,80	16,21	36	7	12	84	12,70 × 23,49	2/2-3; 11/5-6	6-7/3-5	CS-005: B	AK
A1.M11	TSOP(II)	1	19,32	16,50	28,20	16,21	40	7	11	77	12,70 × 26,03	2/2-3; 10/5-6	6/3-5	CS-005: B	AL

Tray			*M*	*M*1	*M*2	*M*3	*N*	*N*1	*N*2	*N*3	*N*4	*N*5	*N*6	Origin	
Type	Component Type	Fig	Basic Dim.	Basic Dim.	Basic Dim.	Basic Dim.	Pin count	Columns	Rows	Pockets	Form	Row/Column	Row/Column	Standard	Var
A1.M12	TSOP(II)	1	19,32	18,00	31,00	16,21	70	7	10	70	12,70 × 28,57	2/2-3; 9/5-6	5-6/3-5	CS-005: B	AM
A1.M13	TSOP(II)	1	12,00	21,70	24,70	14,00	—	9	12	108	10,16 × 22,22	2/3-4, 11/6-7	6-7/4-6	ED-7611	—

~~NOTE~~ The tray vacuum pick-up method requires a minimum walled pick up area of 28 mm × 28 mm, located as close to the centre of the tray as is practical. Centre vacuum pick-up cell locations are N6.

NOTE 1 Dimensions M, M1, M2 and M3 define the centre lines for the cell sites. Package interface is controlled by package design and lead form.

NOTE 2 Symbol N refers to package lead-count supported, where applicable.

NOTE 3 Total usable cells N3 = N1 × N2 (columns × rows). Columns run top to bottom along the length of the trays. Rows run left to right across the width of the trays.

NOTE 4 N4 indicates package type accommodated.

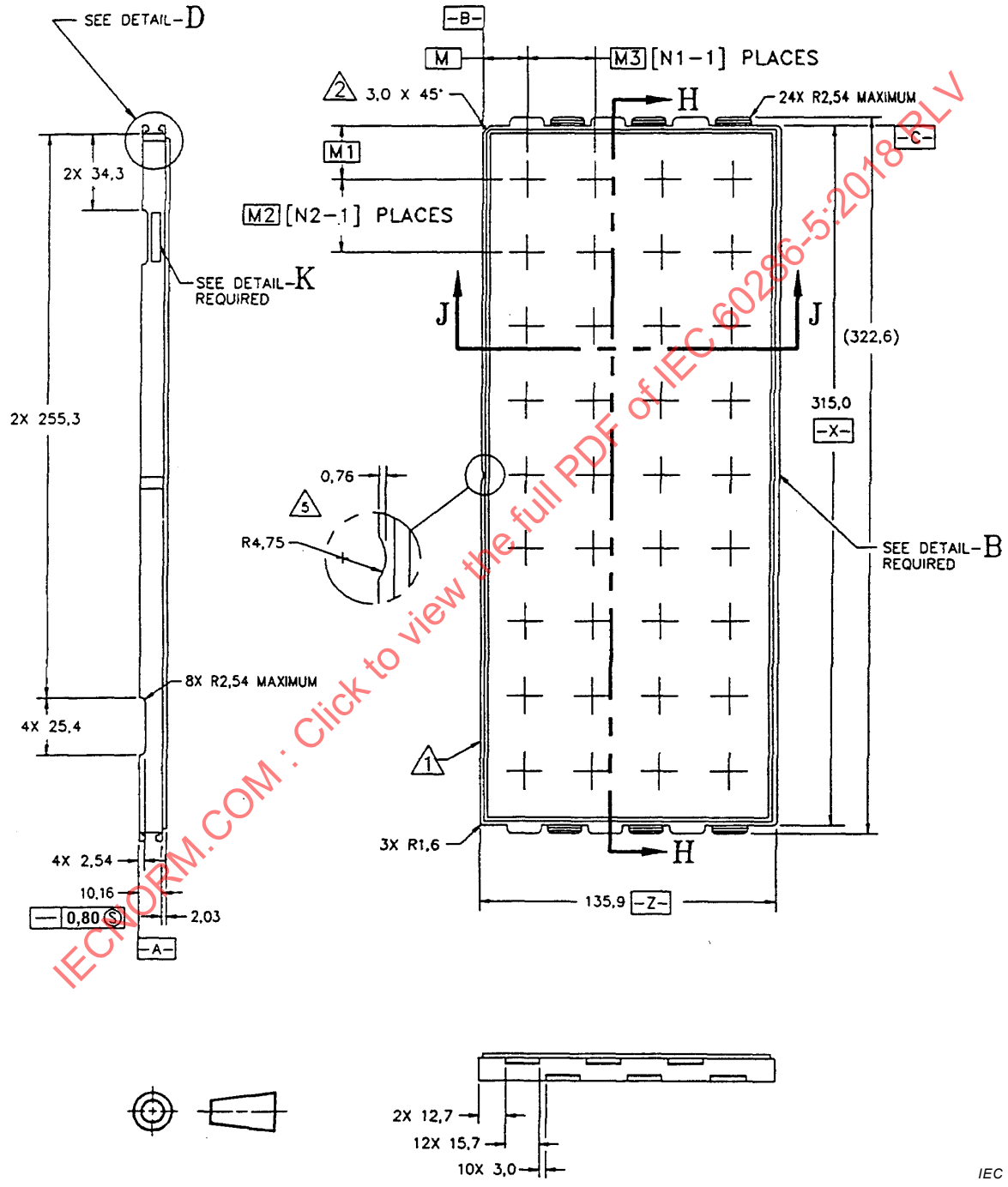
NOTE 5 The tray vacuum pick-up method allows two separate pick-up areas resulting in four closed cells per tray. Optical vacuum pick-up cell locations are N5.

A.2 Matrix trays for PGA packages

A.2.1 Dimensional information

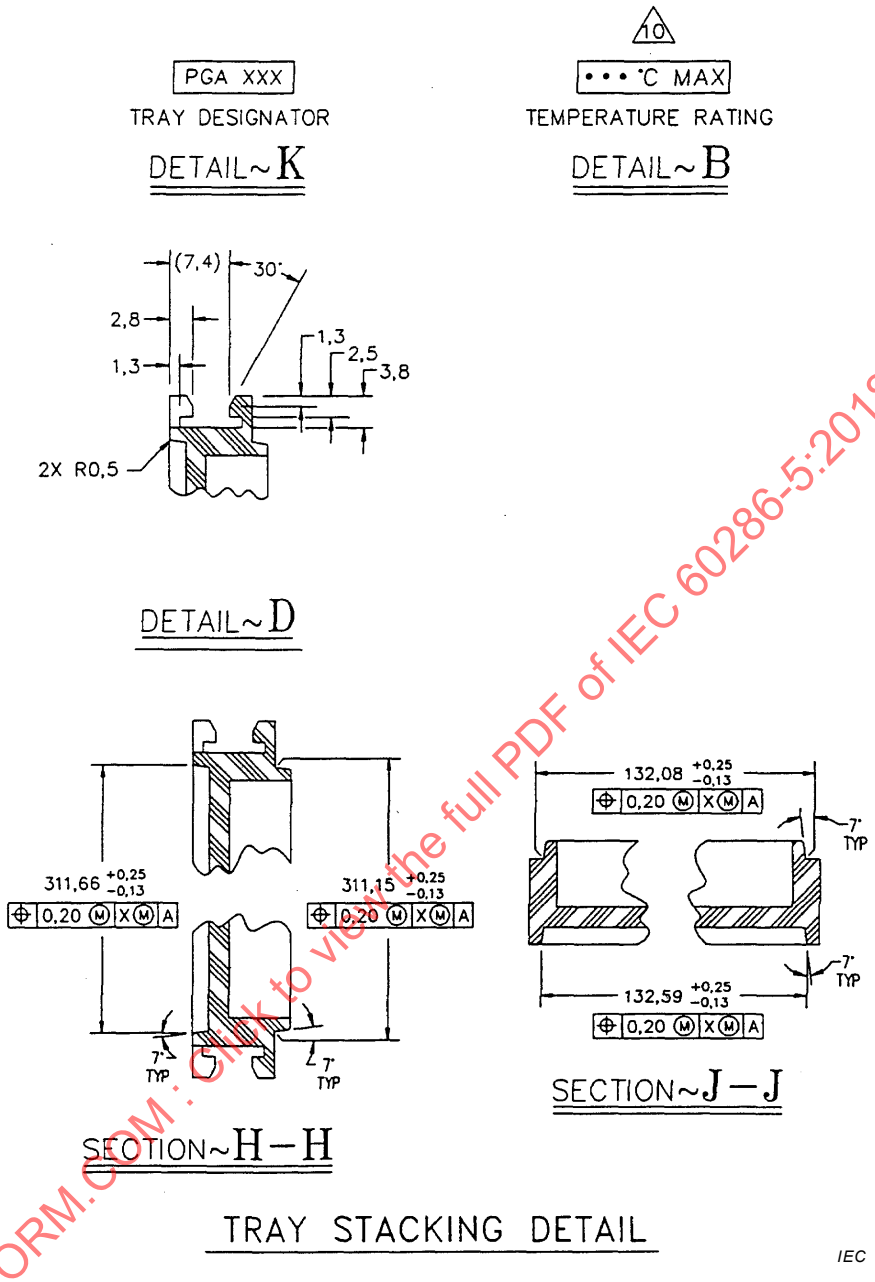
See Table 1, column "Thick tray", and Figure A.2.

Dimensions in millimetres



a) Tray outline for PGA packages

Dimensions in millimetres



b) Outline for PGA packages (details)

NOTE For notes, see Table A.2.

Figure A.2 – Thick matrix

Table A.2 – Notes related to Figures A.1 and A.2

	These surfaces should be free of seams.
	Chamfer denotes package pin 1 orientation.
3	The tray vacuum pick-up method allows two separate pick-up areas resulting in four closed cells per tray. Optional vacuum pick-up cell locations are $N5$.
	The tray vacuum pick-up method requires a minimum walled pick-up area of 28 mm × 28 mm, located as close to the centre of the tray as is practical. Centre vacuum pick-up cell locations are $N6$.
	This scallop is centred on the side of the tray and allows the use of a pin to bias mechanically the tray orientation.
6	The symbol N refers to package lead count supported, where applicable.
7	Total usable cells $N3 = N1 \times N2$ (columns × rows). Columns run top to bottom along the length of the tray. Rows run left to right across the width of the tray.
8	Dimensions M, $M1$, $M2$ and $M3$ define the centre lines for the cell sites. Package interface is controlled by package design and lead form.
9	Non-tabulated dimensions have a tolerance of .X = ± 0,25; .XX = ± 0,13; angles = ± 0,5°.
10	Dimensions are in millimetres.
11	Interpret dimensions and tolerances in accordance with ANSI Y14.5M-1994.
	XXX °C is the maximum temperature to which the empty tray can be subjected to for 48 continuous hours without violating the dimensional tolerance of the tray.
	$N4$ indicates the package type accommodated.
	Bottom side-wall notches require a minimum depth of 2 mm to facilitate auto handling equipment.
	All tray measurements are to be made with the tray unrestrained.
16	Sharp edges that could cause damage to dry-pack bags or other packaging material should be avoided regardless of whether or not an edge or corner radius is specified.
17	There should be space for a recycle logo and material code or material declaration close to Detail B.

A.2.2 Variation sheet PGA (pin grid array package)

Table A.3 – PGA variations

Tray			*M*	*M*1	*M*2	*M*3	*N*	*N*1	*N*2	*N*3	*N*4	*N*5	*N*6	Origin	
Type	Component Type	Fig	Basic Dim,	Basic Dim,	Basic Dim,	Basic Dim,	Pin count	Columns	Rows	Pockets	Form	Row/Column	Row/Column	Standard	Var
A2.A1	PGA	2	27,23	29,26	42,75	40,72	10 × 10 × 2,54	3	7	21	-	Not applicable	Not applicable	CO-010: A	AA
A2.A2	PGA	2	27,23	29,26	42,75	40,72	11 × 11 × 2,54	3	7	21	-	Not applicable	Not applicable	CO-010: A	AB
A2.A3	PGA	2	26,59	28,30	43,05	41,35	12 × 12 × 2,54	3	7	21	-	Not applicable	Not applicable	CO-010: A	AC
A2.A4	PGA	2	39,95	27,36	43,38	55,98	13 × 13 × 2,54	2	7	14	-	Not applicable	Not applicable	CO-010: A	AD
A2.A5	PGA	2	39,52	32,64	49,94	56,82	14 × 14 × 2,54	2	6	12	-	Not applicable	Not applicable	CO-010: A	AE
A2.A6	PGA	2	39,12	31,72	50,29	57,68	15 × 15 × 2,54	2	6	12	-	Not applicable	Not applicable	CO-010: A	AF
A2.A7	PGA	2	38,68	30,84	50,67	58,52	16 × 16 × 2,54	2	6	12	-	Not applicable	Not applicable	CO-010: A	AG
A2.A8	PGA	2	38,25	38,43	59,54	59,36	17 × 17 × 2,54	2	5	10	-	Not applicable	Not applicable	CO-010: A	AH
A2.A9	PGA	2	37,85	37,57	59,94	60,22	18 × 18 × 2,54	2	5	10	-	Not applicable	Not applicable	CO-010: A	AI
A2.A10	PGA	2	37,41	36,73	60,38	61,06	19 × 19 × 2,54	2	5	10	-	Not applicable	Not applicable	CO-010: A	AJ
A2.A11	PGA	2	36,98	35,89	60,81	61,90	20 × 20 × 2,54	2	5	10	-	Not applicable	Not applicable	CO-010: A	AK
A2.A12	PGA	2	67,95	47,27	73,46	not applicable	21 × 21 × 2,54	1	4	4	-	Not applicable	Not applicable	CO-010: A	AL
A2.A13	PGA	2	34,93	47,37	73,41	66,04	22 × 22 × (2,54)	2	4	8	-	Not applicable	Not applicable	CO-010: A	AM
A2.A14	PGA	2	34,93	47,37	73,41	66,04	23 × 23 × (2,54)	2	4	8	-	Not applicable	Not applicable	CO-010: A	AN
A2.A15	PGA	2	34,93	47,37	73,41	66,04	24 × 24 × (2,54)	2	4	8	-	Not applicable	Not applicable	CO-010: A	AO

~~NOTE~~ The tray vacuum pick-up method requires a minimum walled pick up area of 28 mm × 28 mm, located as close to the center of the tray as is practical. Centre vacuum pick-up cell locations are *N*6.

NOTE 1 Dimensions *M*, *M*1, *M*2 and *M*3 define the centre lines for the cell sites. Package interface is controlled by package design and lead form.

NOTE 2 Symbol *N* refers to package lead-count supported, where applicable.

NOTE 3 Total usable cells *N*3 = *N*1 × *N*2 (columns × rows). Columns run top to bottom along the length of the trays. Rows run left to right across the width of the trays.

NOTE 4 *N*4 indicates package type accommodated.

NOTE 5 The tray vacuum pick-up method allows two separate pick-up areas resulting in four closed cells per tray. Optical vacuum pick-up cell locations are *N*5.

Annex B
(normative)

Measurement methodology of the tray dimensions

B.1 General

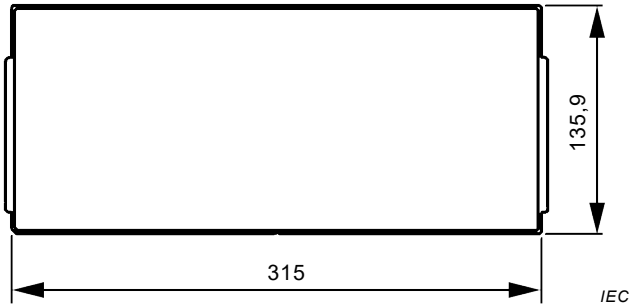
This annex describes the definitions of terms and the measurement methodology of the specified tray dimensions.

B.2 Definition of the dimensions

B.2.1 Outline dimensions

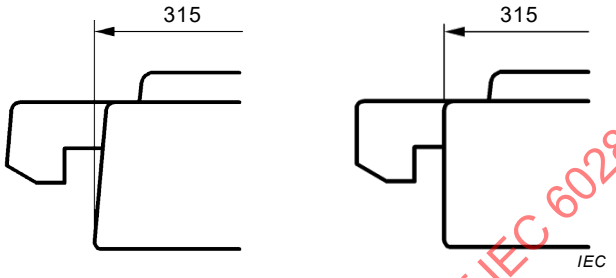
The outline dimensions are the maximum dimensions of length (315,0 mm) and width (135,9 mm), which are measured in the cross sections of the indicated locations in Figure B.1.

NOTE See Figure 3.



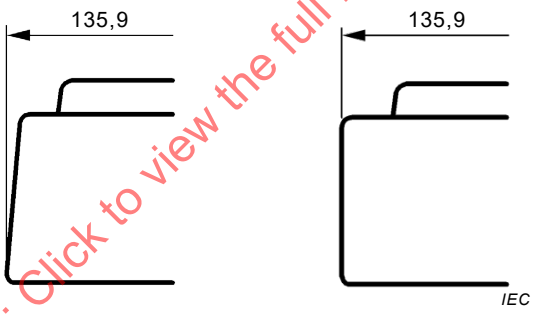
a) Dimensions 315,0 mm and 135,9 mm

Dimensions in millimetres



b) Dimension 315,0 mm

Dimensions in millimetres



c) Dimension 135,9 mm

Figure B.1 – Cross-sections of the outline dimensions

B.2.2 Tray thickness (*A*)

The tray thickness is the maximum dimension, but does not include any tray deformations such as peripheral warpage (refer to Figure B.2).

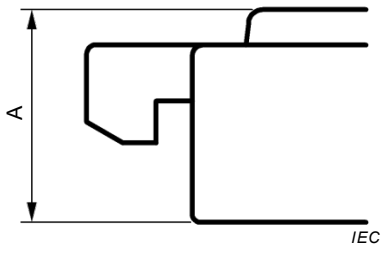


Figure B.2 – Tray thickness

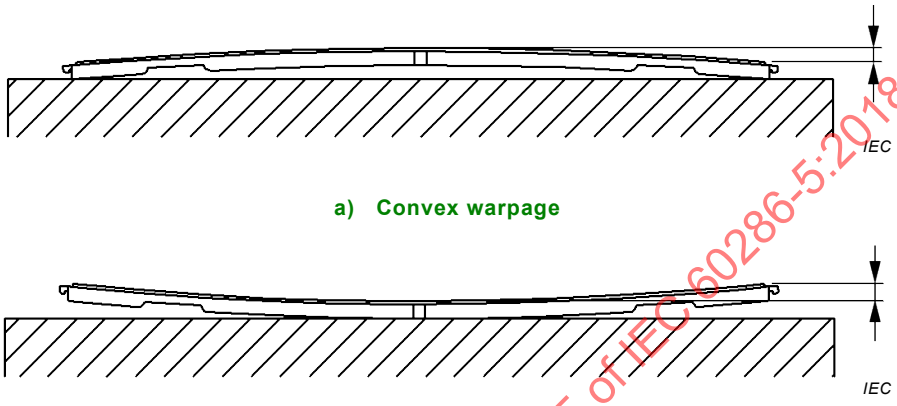
B.2.3 Dimensions of the stacking feature

Dimensions of the stacking feature are the length (top side 311,15 mm and bottom side311,66 mm) and the width (top side 132,08 mm and bottom side 132,59 mm) of the particular features that fit in each other when the same type of tray is stacked.

NOTE See Figure 4, section H-H, section J-J

B.2.4 Warpage

The warpage is the maximum lift from the reference plane (refer to Figure B.3).



a) Convex warpage

b) Concave warpage

Figure B.3 – Examples of tray warpage

B.3 Measuring instrument

Measuring instrument shall have a suitable measuring range and accuracy for measurement.

B.4 Measurement conditions

Measurement conditions shall be as follows:

Temperature: 23 °C ± 2 °C

Humidity: 35 % to 75 % R.H.

B.5 Measurement methodology

B.5.1 Outline dimensions

The tray length 315,0 mm shall be the maximum dimension among the measurements taken in the vicinity of section a-a or b-b in Figure B.4. The tray width 135,9 mm shall be the maximum dimension among the measurement taken in the vicinity of section d-d, e-e or f-f in Figure B.4.

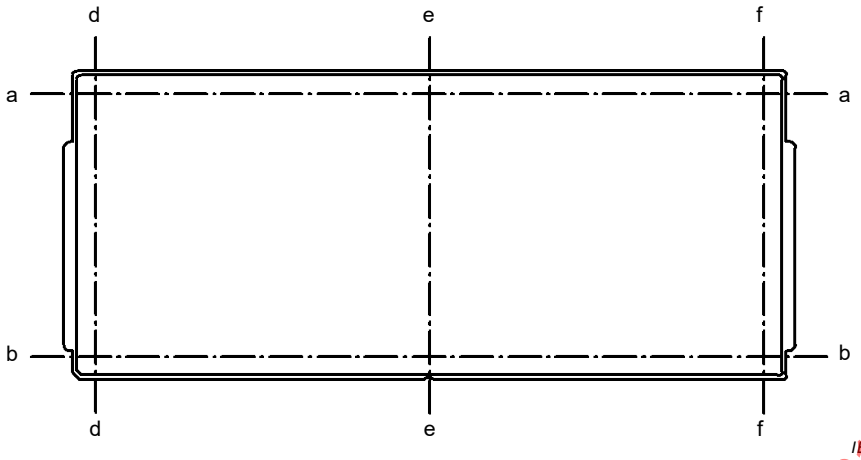


Figure B.4 – Top view of a tray showing the measurement locations for the outline dimensions

B.5.2 Tray thickness (*A*)

There are two measurement methods as given below.

a) Measurement method using a vernier caliper

Tray thickness shall be measured for all four corners of the tray by placing tray corner between the two jaws of the calliper (refer to Figure B.5 and Figure B.6).

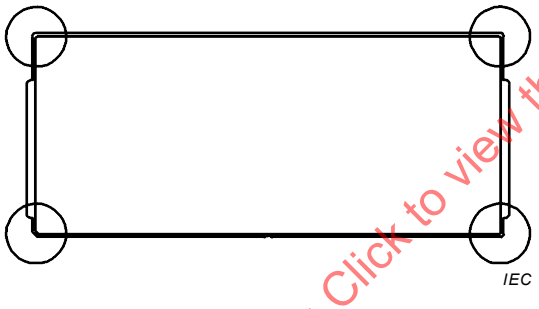


Figure B.5 – Measurement locations for tray thickness

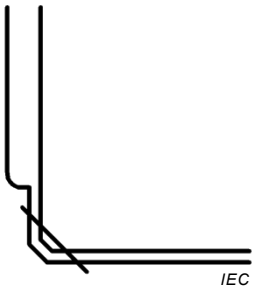


Figure B.6 – Holding position in calliper jaws for measurement

b) Measurement method using height gauge

Any measuring instrument such as optical distance meter, dial gauge or similar may be used for the measurement.

Any lift of the tray from the reference plane shall be corrected for measurement. Example of correction is shown in Figure B.7.

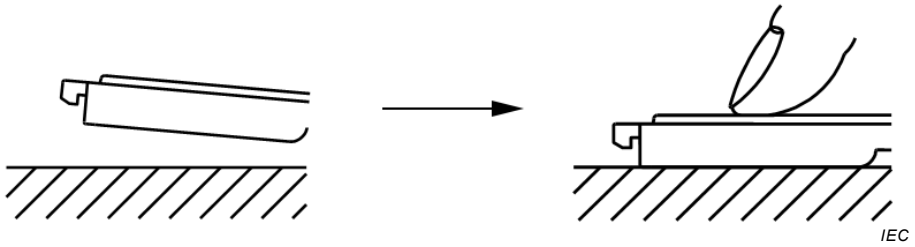


Figure B.7 – Correction of a lift of the tray at the measurement point

B.5.3 Dimensions of the stacking feature

Length (311,15 mm) shall be the maximum dimension among the measurements taken in the vicinity of a-a, b-b or c-c, while width (132,08 mm) shall be the maximum one in the vicinity of d-d, e-e and f-f.

Length (311,66 mm) shall be the minimum dimension among the measurements taken in the vicinity of a-a, b-b or c-c, while width (132,59 mm) shall be the minimum one in the vicinity of d-d, e-e and f-f.

The lines of a-a, b-b, d-d and f-f are located approximately 10 mm inward from the external tray edge. The lines of c-c and e-e are the centre lines of the tray (refer to Figure B.8).

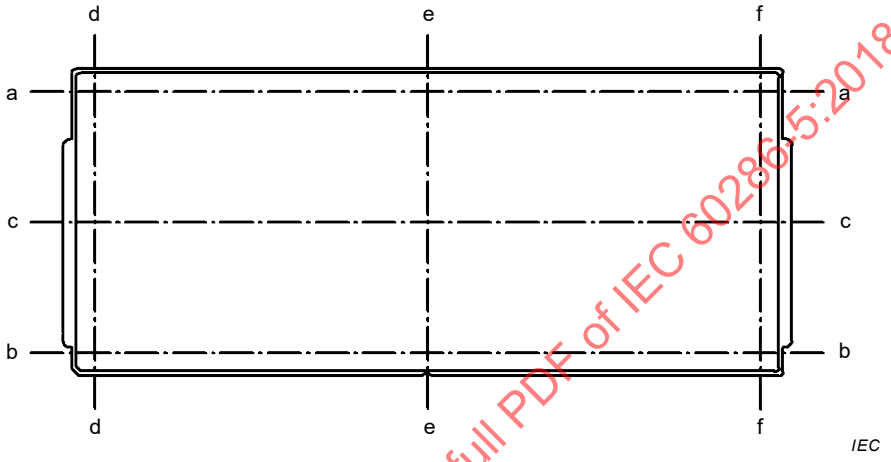


Figure B.8 – Measurement locations for the stackable design

B.5.4 Warpage

The warpage shall be the distance between the highest and the lowest heights from the reference plane, among nine measurement points which are indicated "O" in Figure B.9.

NOTE Non-contact measurement instruments are preferred. However contact-type measurement instruments may be employed with the least contact pressure.

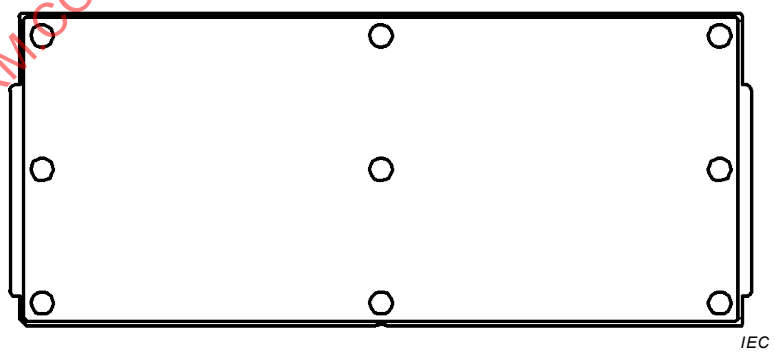


Figure B.9 – Measurement points for warpage

Annex C
(normative)

Matrix trays – General considerations for design (design value)

C.1 Lateral movement of leaded devices

To prevent unit stick, bent leads or unit damage, the minimum check points (see Figure C.1) indicated shall be greater than 0 in the worst-case scenario (max device <-> min cavity).

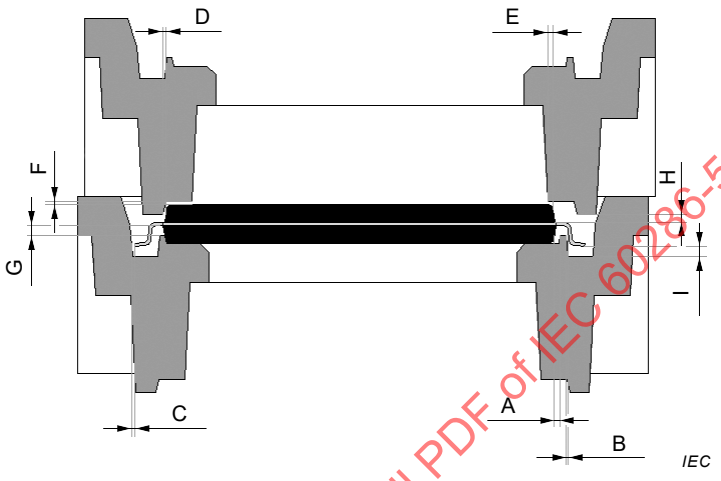


Figure C.1 – Lateral movement of leaded devices A to I

C.2 Lateral movement of un-leaded devices

To prevent unit stick, bent leads or unit damage, the minimum check points (see Figure C.2 and Figure C.3) indicated shall be greater than 0 in the worst-case scenario (max device <-> min cavity).

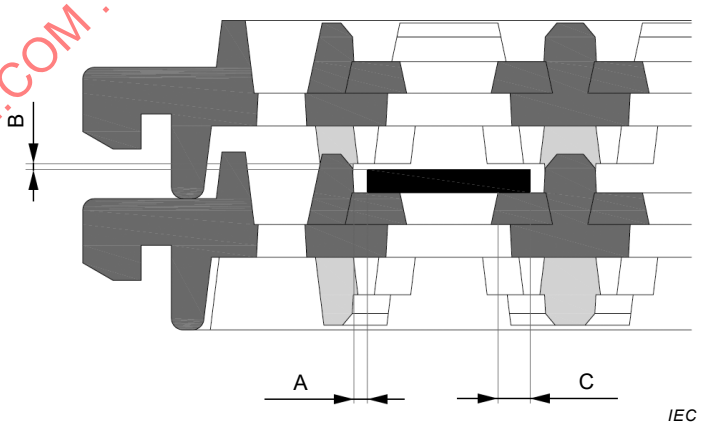


Figure C.2 – Lateral movement of un-leaded devices check points A to C

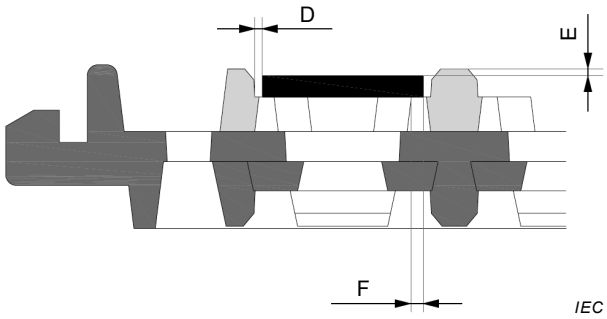


Figure C.3 – Lateral movement of un-leaded devices check points D to F

C.3 Lead protection

To prevent the unit from jumping out from its pocket during transportation, a gap between the tray's pocket bottom and the package's top, and a fence are needed for all leaded packages (see Figure C.4).

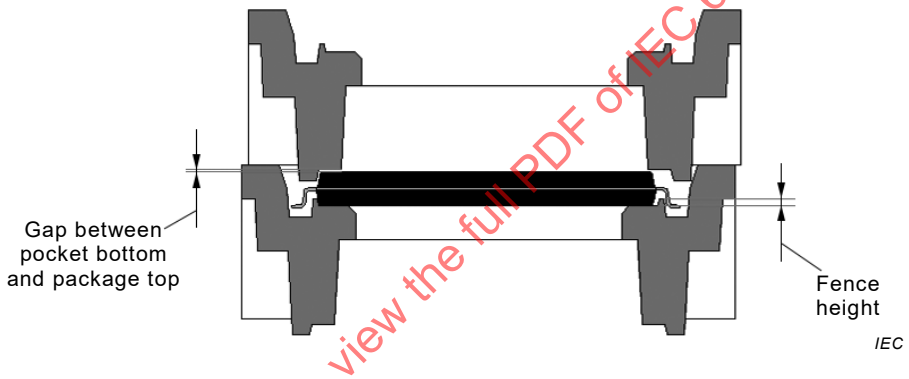


Figure C.4 – Lead protection gap

IEC 60286-5

Edition 3.0 2018-04

INTERNATIONAL STANDARD

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

IEC 60286-5:2018-04(en)

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

PACKAGING OF COMPONENTS FOR AUTOMATIC HANDLING –

Part 5: Matrix trays

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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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.

A bilingual version of this publication may be issued at a later date.

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 with surface resistance equal to or greater than $1,0 \times 10^{5}$ ohms/square but less than $1,0 \times 10^{-11}$ 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 − $M3(N1 - 1)$)/2

$M1$ is (315,0 mm − $M2(N2 - 1)$)/2

$M2$ is [(315,0 mm − 2P mm) − $W(N2 - 1)$]/$N2$ + W

$M3$ is [(135,9 mm − 2P mm) − $W(N1 - 1)$]/$N1$ + W

$N1$ is (135,9 mm − 2P mm)/ET (rounded down to a whole number)

$N2$ is (315,0 mm − 2P 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, $N1$ and $N2$ 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 $M2$ and $M3$ to maximize the pitch between the pockets while minimizing the edge of the tray to the centre line of the first pocket M and $M1$.

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	Low stacking tray	
	mm	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

$M1$ is the edge of the tray length to the centre line of the first pocket

$M2$ is the pitch of the tray pocket in the tray length

$M3$ is the pitch of the tray pocket in the tray width

N is the package pin counts supported

$N1$ is the number of columns in the tray

$N2$ is the number of rows in the tray

$N3$ is the total number of pockets in the tray ($N1$ × $N2$ = $N3$)

$N4$ is the package type accommodated

$N5$ is the end vacuum pick-up area(s)

$N6$ 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 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 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 $A1$ and edge height $A2$ are given in Table 2.

Table 2 – Height dimensions

Dimension	Thin tray		Thick tray
	Normal stacking tray	Low stacking tray	
	mm	mm	mm
A	7,62	7,62	12,19
$A1$	6,35	5,62	10,16
$A2$	1,27 typically	2,00 typically	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).

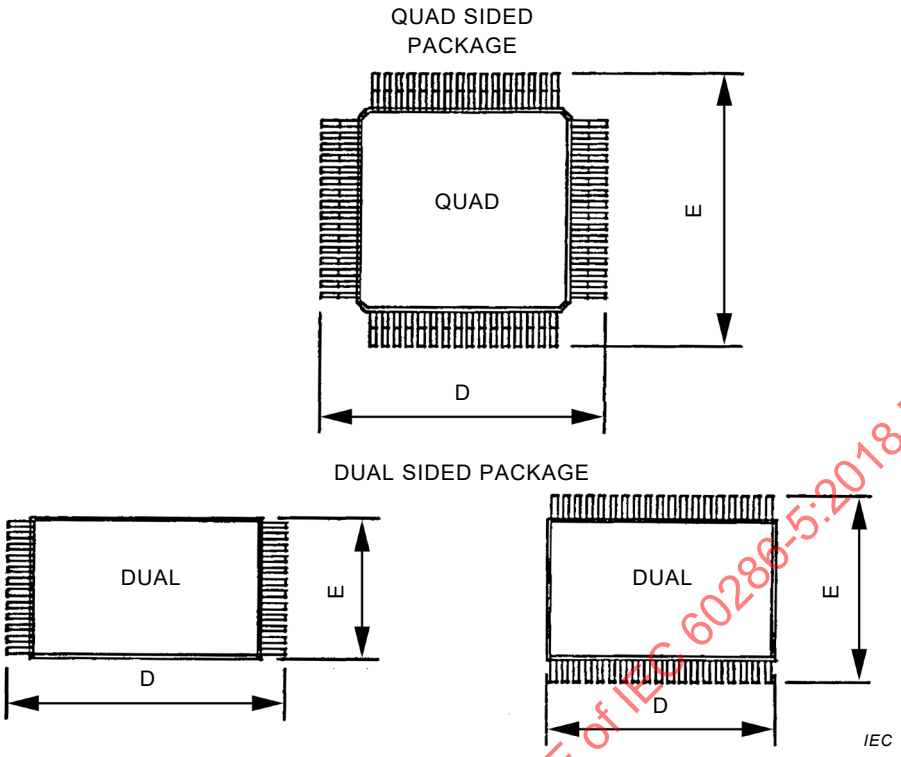


Figure 1 – Sample of leaded packages

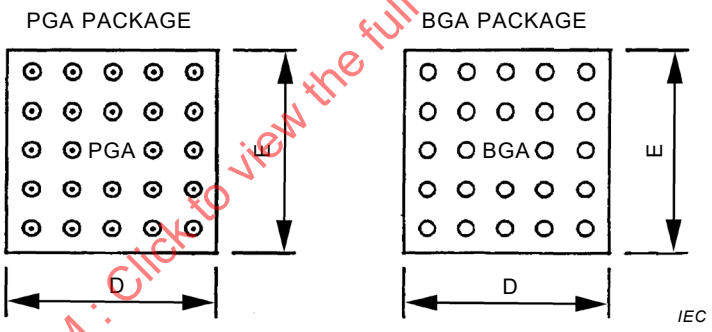


Figure 2 – Sample of grid array packages

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

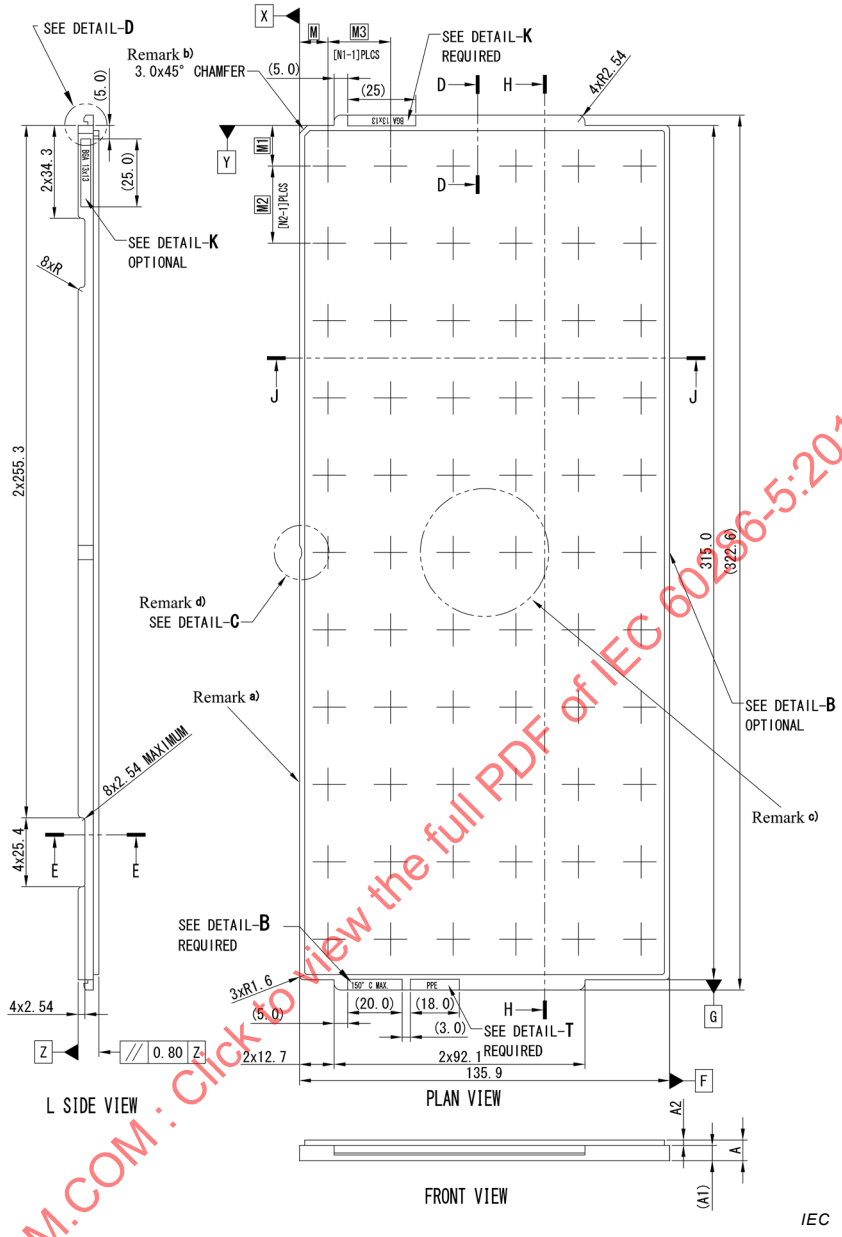
For packages ≥ 7mm × 7 mm: rotation < 5°

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.

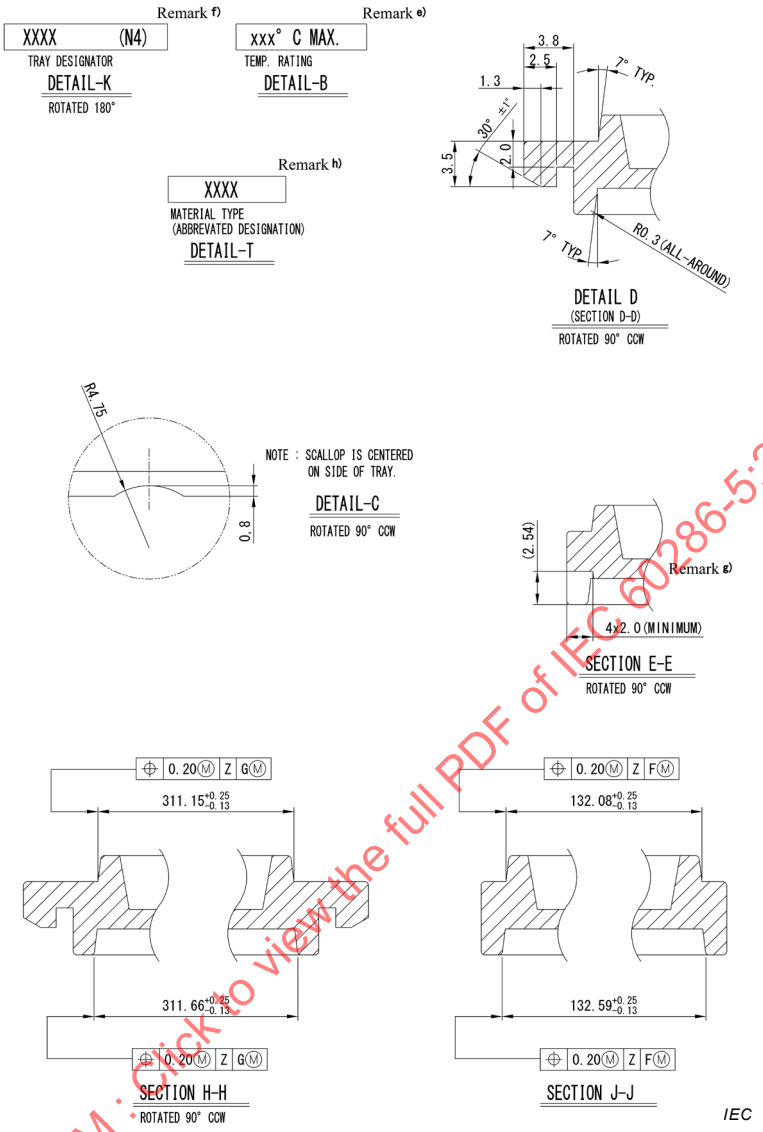
Dimensions in millimetres



NOTE For notes, see Table 3.

Figure 3 – Tray main view

Dimensions in millimetres



NOTE For notes, see Table 3.

Figure 4 – Tray stacking details

Dimensions in millimetres

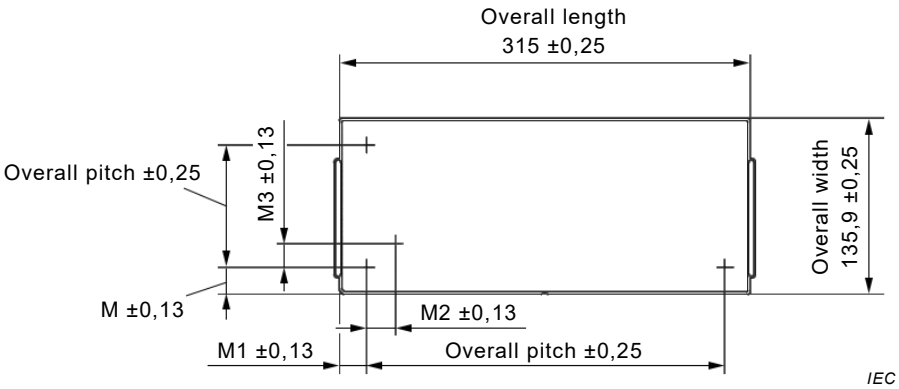


Figure 5 – Tray tolerances

Table 3 – Notes related to Figures 3 and 4

1	These surfaces should be free of seams.
2	Chamfer denotes general package pin 1 orientation.
3	The tray vacuum pick-up method requires two separate pick-up areas represented by bottom closed cells. Optional vacuum pick-up cell locations are $N5$.
4	The tray vacuum pick-up method requires a minimum walled pick-up area of 28 mm × 28 mm, located as close to the centre of the tray as is practical. Centre vacuum pick-up cell locations are $N6$.
5	This scallop is centred on the side of the tray and allows the use of a pin to bias mechanically the tray orientation.
6	The symbol N refers to package lead count supported, where applicable.
7	Total usable cells $N3 = N1 \times N2$ (columns × rows). Columns run top to bottom along the length of the tray. Rows run left to right across the width of the tray.
8	Dimensions M, $M1$, $M2$ and $M3$ define the centre lines for the cell sites. Package interface is controlled by package design and lead form.
9	Non-tabulated dimensions have a tolerance of
	X = ± 0,25;
	XX = ± 0,13; angles = ± 0,5°.
10	Dimensions are in millimetres.
11	Interpret dimensioning and tolerancing in accordance with ANSI Y14.5M-1982.
12	XXX °C is the maximum temperature to which the empty tray can be subjected to for 48 continuous hours without violating the dimensional tolerance of the tray.
13	$N4$ indicates the package type accommodated.
14	Bottom side-wall notches require a minimum depth of 2 mm to facilitate auto handling equipment.
15	All tray measurements are to be made with the tray unrestrained. All tray measurements except height measurement should be done with the tray unrestrained.
16	Sharp edges that could cause damage to dry-pack bags or other packaging material should be avoided regardless of whether or not an edge or corner radius is specified.
17	Detail T" indicates material, recycle logo and material code.

7 Polarity and orientation of components in the tray

7.1 Pin one

Pin 1 of the component shall be orientated towards the tray chamfer corner or the side of the tray with the centre scallop.

7.2 Loading

Components shall be loaded into the tray starting at the lower right corner diagonally opposite the chamfered corner of the tray. Proceeding from bottom to top and right to left, the columns shall be completely filled from bottom to top before placing a component in the next column.

8 Tray stacking

8.1 Bundling

Trays may be bundled in stacks providing the stacks contain only components of the same part number and the same manufacturer.

8.2 Top protection

The top tray containing components shall be protected by an empty tray or a suitable equivalent lid.

8.3 Partial filling

A stack of trays shall not contain more than one partially filled tray. Except for the protective cover tray (lid), any partially filled tray shall be the top tray of the stack as received from the supplier.

8.4 Protrusion of components

The component shall not protrude above the top surface profile of the tray. A heat-sink, attached to the top of a component, may protrude above the top surface of the tray. When such a heat-sink is used, suitable "spacer" trays shall be used in the stack.

8.5 Stack-up

Trays shall be stackable without interference and shall not stick together during unstacking operations.

8.6 Damaging of components

Trays shall be stackable without damaging contained components.

8.7 Warpage

Maximum warpage for trays shall be 0,8 mm.

NOTE The maximum warpage of 0,80 mm may have to be reduced when designing trays for thinner packages.

9 Missing components

Missing components are not allowed, except for an intentionally partially filled tray as described in 8.3.

10 Marking

The tray shall be marked with the following:

a) The type of component the tray is intended to obtain.

b) The temperature in degrees Celsius, which the empty tray will withstand for 48 continuous hours, without violating the dimensional tolerance of the tray.

c) When required, a label with information in normal script or in code form (for example, OCR bar code, magnetic) for automatic reading shall be placed on the right side of the tray (opposite side from the scallop).

- In the case of bar codes, it is recommended to use Code 39.
- For optical character recognition, OCR B should be used.

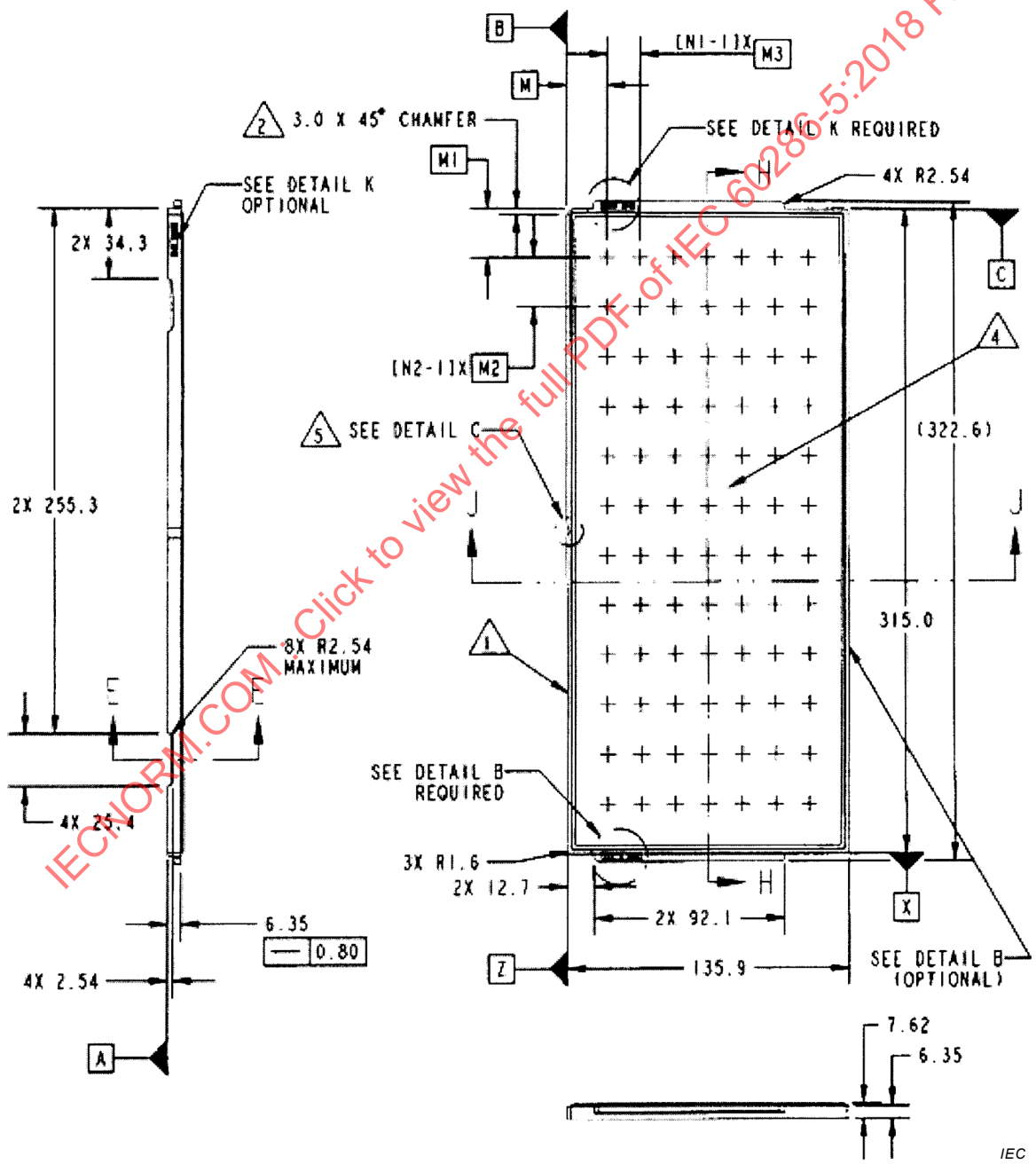
Annex A
(informative)

List of existing matrix trays with wide anticipated use in the electronic industries

A.1 Matrix trays (for different packages)

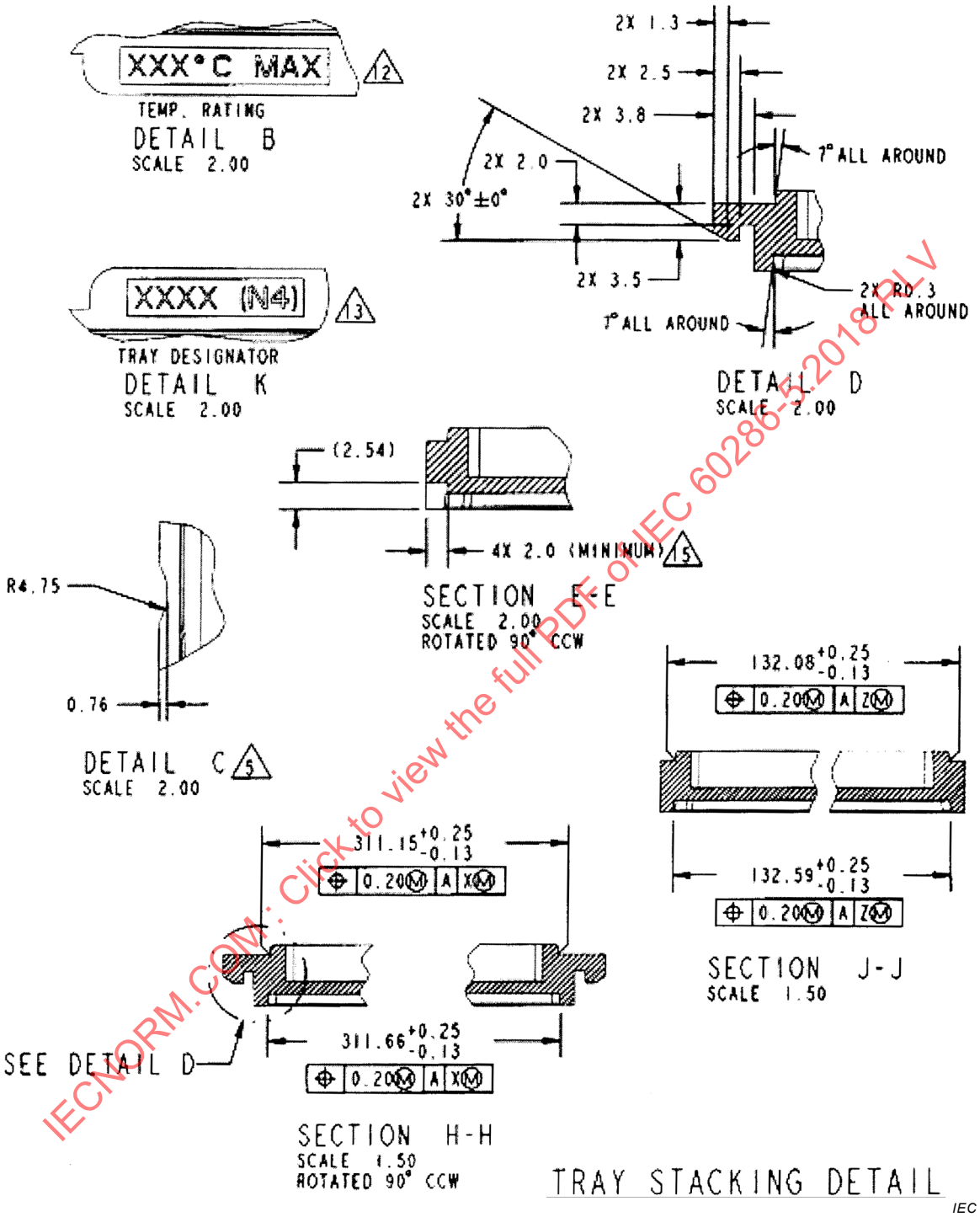
See Table 1, column "Thin tray", and Figure A.1.

Dimensions in millimetres



a) Main view

Dimensions in millimetres



b) Stacking details

NOTE For notes, see Table A.2.

Figure A.1 – Thin tray

Table A.1 – Variations

Tray			*M*	*M*1	*M*2	*M*3	*N*	*N*1	*N*2	*N*3	*N*4	*N*5	*N*6	Origin	
Type	Component Type	Fig	Basic Dim.	Basic Dim.	Basic Dim.	Basic Dim.	Pin count	Columns	Rows	Pockets	Form	Row/Column	Row/Column	Standard	Var
A1.B1	BGA	2	26,70	20,00	27,50	27,50	256; 361; 576	4	11	44	25 × 25	2/2; 10/3	6/2-3	CO-028: B	AA
A1.B2	BGA	2	24,15	26,10	29,20	29,20	324; 441; 676	4	10	40	27 × 27	2/2; 9/3	5/3; 6/2	CO-028: B	AB
A1.B3	BGA	2	20,85	31,10	31,60	31,40	361; 484; 784	4	9	36	29 × 29	2/2; 8/3	5/2-3	CO-028: B	AC
A1.B4	BGA	2	25,05	21,90	33,90	42,90	400; 576; 900	3	9	27	31 × 31	2/2; 8/2	5/2	CO-028: B	AD
A1.B5	BGA	2	32,45	33,25	35,50	35,50	441; 484; 625; 676; 1024	3	8	24	32,5 × 32,5; 33 × 33	2/2; 7/2	4/2; 5/2	CO-028: B	AE
A1.B6	BGA	2	29,95	24,50	38,00	38,00	529; 729; 1156	3	8	24	35 × 35	2/2; 7/2	4/2; 5/2	CO-028: B	AF
A1.B7	BGA	2	27,95	37,50	40,00	40,00	625; 841; 1369	3	7	21	37,5 × 37,5	2/2; 6/2	4/2	CO-028: B	AG
A1.B8	BGA	2	25,65	30,60	42,30	42,30	676; 961; 1521	3	7	21	40 × 40	2/2; 6/2	4/2	CO-028: B	AH
A1.B9	BGA	2	26,70	43,75	45,50	82,50	784; 1089; 1764	2	6	12	42,5 × 42,5	not applicable	not applicable	CO-028: B	AJ
A1.B10	BGA	2	30,00	30,00	51,00	75,90	900; 1225; 1936	2	6	12	45 × 45	1/1; 6/2	3/2; 4/1	CO-028: B	AK
A1.B11	BGA	2	30,00	31,25	50,50	75,90	961; 1369; 2209	2	6	12	47,5 × 47,5	1/1; 6/2	3/2; 4/1	CO-028: B	AL
A1.B12	BGA	2	41,45	51,50	53,00	53,00	1089; 1521; 2401	2	5	10	50 × 50	1/1; 5/2	3/1; 3/2	CO-028: B	AM
A1.B13	BGA	2	20,95	20,00	27,50	23,50	224; 304; 480	5	11	55	25 × 21	2/2; 10/4	6/2-4	CO-028: B	BA
A1.B14	BGA	2	26,70	33,25	35,50	27,50	336; 475; 744	4	8	32	32,5 × 25	2/2; 7/3	4/2-3; 5/2-3	CO-028: B	BB
A1.B15	BGA	2	11,55	11,80	9,40	9,40	16; 25; 36	13	32	416	7 × 7	4/7; 29/7	15-18/6-7	CO-029: A	AA
A1.B16	BGA	2	16,65	15,00	11,40	11,40	36; 49; 64	10	26	260	9 × 9	3/5; 24/6	12-15/4-7	CO-029: A	AB
A1.B17	BGA	2	17,20	16,80	13,40	14,50	49; 64; 100	8	22	176	11 × 11	3/4; 20/5	11-12/4-5	CO-029: A	AC
A1.B18	BGA	2	15,45	15,00	15,00	15,00	64; 100; 144	8	20	160	13 × 13	3/4; 18/5	10-11/4-5	CO-029: A	AD
A1.B19	BGA	2	16,35	11,30	17,20	17,20	100; 121; 196	7	18	126	15 × 15	2/4; 17/4	9-10/3-5	CO-029: A	AE
A1.B20	BGA	2	19,20	21,00	19,50	19,50	121; 169; 256	6	15	90	17 × 17	2/3; 14/4	7-9/3-4	CO-029: A	AF
A1.B21	BGA	2	14,60	18,79	21,34	21,34	144; 196; 225; 289; 324	6	14	84	19 × 19; 18,5 × 18,5	2/3;13/4	7-8/3-4	CO-029: A	AG
A1.B22	BGA	2	20,15	26,05	23,90	23,90	196; 256; 400	5	12	60	21 × 21	2/2; 11/4	6-7/2-4	CO-029: A	AH
A1.B23	BGA	2	16,95	17,25	25,50	25,50	225; 324; 484	5	12	60	23 × 23	2/2; 11/4	6-7/3	CO-029: A	AJ
A1.B24	BGA	2	26,70	20,00	27,50	27,50	256; 361; 576	4	11	44	25 × 25	2/2; 10/3	6/2-3	CO-029: A	AK
A1.B25	BGA	2	25,40	29,70	28,40	28,40	—	4	10	40	26 × 26	2/2; 9/3	5-6/2-3	ED-7613	—
A1.B26	BGA	2	24,15	26,10	29,20	29,20	324; 441; 676	4	10	40	27 × 27	2/2; 9/3	5/3; 6/2	CO-029: A	AL

Tray			*M*	*M*1	*M*2	*M*3	*N*	*N*1	*N*2	*N*3	*N*4	*N*5	*N*6	Origin	
Type	Component Type	Fig	Basic Dim.	Basic Dim.	Basic Dim.	Basic Dim.	Pin count	Columns	Rows	Pockets	Form	Row/Column	Row/Column	Standard	Var
A1.B27	BGA	2	20,85	31,10	31,60	31,40	361; 484; 784	4	9	36	29 × 29	2/2; 8/3	5/2-3	CO-029: A	AM
A1.B28	BGA	2	25,05	21,90	33,90	42,90	400; 576; 900	3	9	27	31 × 31	2/2; 8/3	5/2	CO-029: A	AN
A1.B29	BGA	2	32,45	33,25	35,50	35,50	441; 484; 625; 676; 1024	3	8	24	33 × 33; 32,5 × 32,5	2/2; 7/2	4-5/2	CO-029: A	AP
A1.B30	BGA	2	29,95	24,50	38,00	38,00	529; 729; 1156	3	8	24	35 × 35	2/2; 7/2	4-5/2	CO-029: A	AR
A1.B31	BGA	2	27,95	37,50	40,00	40,00	625; 841; 1369	3	7	21	37,5 × 37,5	2/2; 6/2	4/2	CO-029: A	AS
A1.B32	BGA	2	26,65	30,60	42,30	42,30	676; 961; 1521	3	7	21	40 × 40	2/2; 6/2	4/2	CO-029: A	AT
A1.B33	BGA	2	26,70	43,75	45,50	82,50	784; 1089; 1764	2	6	12	42,5 × 42,5	not applicable	not applicable	CO-029: A	AU
A1.B34	BGA	2	30,00	30,00	51,00	75,90	900; 1225; 1936	2	6	12	45 × 45	1/1; 6/2	3/2; 4/1	CO-029: A	AV
A1.B35	BGA	2	30,00	31,25	50,50	75,90	961; 1369; 2209	2	6	12	47,5 × 47,5	1/1; 6/2	3/2; 4/1	CO-029: A	AW
A1.B36	BGA	2	41,45	51,50	53,00	53,00	1089; 1521; 2401	2	5	10	50 × 50	1/1; 5/2	3/1-2	CO-029: A	AX
A1.B37	BGA	2	9,00	9,15	12,90	13,10	25; 36; 49; 64; 81	10	24	240	10 × 10	2/5; 23/6	11-14/4-6	CO-029: D	AY
A1.B38	BGA	2	9,55	10,00	14,75	14,60	49; 64; 81; 100; 121	9	21	189	12 × 12	2/5; 20/5	10-12/4-6	CO-029: D	AZ
A1.B39	BGA	2	12,75	23,30	24,40	18,40	119; 153	7	12	84	22 × 14	2/4; 11/4	6-7/3-5	CO-029: A	BA
A1.B40	BGA	2	14,60	16,50	23,50	21,34	168; 224; 340	6	13	78	21 × 18,5	2/3; 12/4	7/3-4	CO-029: A	BB
A1.B41	BGA	2	20,95	20,00	27,50	23,50	224; 304; 480	5	11	55	25 × 21	2/2; 10/4	6/2-4	CO-029: A	BC
A1.B42	BGA	2	26,70	33,25	35,50	27,50	336; 475; 744	4	8	32	32,5 × 25	2/2; 7/3	4-5/2-3	CO-029: A	BD
A1.B43	BGA	2	11,60	24,95	24,10	16,10	119; 153	8	12	96	22 × 14	2/4; 11/5	6-7/4-5	CO-029: B	BE
A1.B44	BGA	2	8,20	12,60	20,70	11,95	60	11	15	165	16 × 8	6/2; 6/14	5-7/7-9	CO-029: D	BF
A1.C1	CQFP	1	17,81	17,93	25,37	25,07	28; 52	5	12	60	-	3/3; 10/3	6-7/3	CO-011: B	AA
A1.C2	CQFP	1	20,93	23,98	33,38	31,34	68	4	9	36	-	2/2; 8/3	5/2	CO-011: B	AB
A1.C3	CQFP	1	29,49	29,49	38,05	38,46	44; 84	3	8	24	-	2/2; 7/2	5/2	CO-011: B	AC
A1.C4	CQFP	1	20,93	23,98	33,38	31,34	52; 100	4	9	36	-	2/2; 8/3	5/2	CO-011: B	AD
A1.C5	CQFP	1	20,93	23,98	33,38	31,34	68; 132	4	9	36	-	2/2; 8/3	5/2	CO-011: B	AE
A1.C6	CQFP	1	29,49	29,49	38,05	38,46	84; 164	3	8	24	-	2/2; 7/2	5/2	CO-011: B	AF
A1.D1	MQFP	1	18,30	17,25	18,70	19,86	36; 44; 52;64; 80	6	16	96	10 × 10	3/3; 14/4	8-9/3-4	CS-004: A	AA
A1.D2	MQFP	1	15,45	17,75	21,50	21,00	52; 64; 80; 100; 120	6	14	84	14 × 14	3/3; 12/4	7-8/3-4	CS-004: A	AB
A1.D3	MQFP	1	15,45	22,50	27,00	21,00	64; 80; 100; 128	6	11	66	14 × 20	2/3; 10/4	6/3-4	CS-004: A	AC

Tray			*M*	*M*1	*M*2	*M*3	*N*	*N*1	*N*2	*N*3	*N*4	*N*5	*N*6	Origin	
Type	Component Type	Fig	Basic Dim.	Basic Dim.	Basic Dim.	Basic Dim.	Pin count	Columns	Rows	Pockets	Form	Row/Column	Row/Column	Standard	Var
A1.D4	MQFP	1	30,93	27,93	37,02	37,02	120; 128; 144; 160; 208; 256	3	8	24	28 × 28	2/2; 7/2	4-5/2	CS-004: A	AD
A1.D5	MQFP	1	26,57	25,13	37,82	41,38	184; 240; 296	3	8	24	32 × 32	2/2; 7/2	4-5/2	CS-004: A	AE
A1.D6	MQFP	1	29,22	31,10	50,56	77,46	232; 304; 376	2	6	12	40 × 40	not applicable	not applicable	CS-004: A	AF
A1.D7	MQFP	1	10,20	11,05	10,10	10,50	32; 40	12	30	360	5 × 5	2/6; 29/7	14-17/5-8	CS-004: B	AG
A1.D8	MQFP	1	11,25	11,10	12,20	12,60	32; 40; 48; 64	10	25	250	7 × 7	2/5; 24/6	12-14/4-7	CS-004: B	AH
A1.D9	MQFP	1	13,95	14,30	17,90	18,00	48; 64; 80; 100	7	17	119	12 × 12	2/4; 16/4	8-10/3-5	CS-004: B	AJ
A1.D10	MQFP	1	17,55	17,80	25,40	25,20	128; 144; 176	5	12	60	20 × 20	2/3; 11/3	6-7/2-4	CS-004: B	AK
A1.D11	MQFP	1	20,70	20,70	30,40	31,50	160; 176; 216	4	10	40	24 × 24	2/2; 9/3	5-6/2-3	CS-004: B	AL
A1.D12	MQFP	1	26,40	32,70	41,60	41,60	—	3	7	21	36 × 36	2/2; 6/2	4/2	ED-7614	—
A1.E1	MQFP-HD	1	13,00	13,10	15,20	15,70	44; 52; 64; 80	8	20	160	10 × 10	2/4; 19/5	10-11/4-5	CO-027: B	AC
A1.E2	MQFP-HD	1	15,45	15,40	20,30	21,00	52; 64; 80; 100; 120	6	15	90	14 × 14	2/3; 14/4	7-9/3-4	CO-027: B	AE
A1.E3	MQFP-HD	1	15,45	17,80	25,40	21,00	80; 100; 128	6	12	72	14 × 20	2/3; 11/4	6-7/3-4	CO-027: B	AF
A1.F1	PLCC	1	11,80	17,09	14,78	11,23	18	11	20	220	rectangular	3/6; 18/6	10-11/5-7	CS-003: A	AA
A1.F2	PLCC	1	10,80	17,25	16,50	11,43	22	11	18	198	rectangular	3/6; 16/6	9-10/5-7	CS-003: A	AB
A1.F3	PLCC	1	16,11	22,20	18,04	12,96	28	9	16	144	rectangular	2/5; 15/5	8-9/4-6	CS-003: A	AC
A1.F4	PLCC	1	13,70	22,20	18,04	15,50	32	8	16	128	rectangular	2/4; 15/5	8-9/4-5	CS-003: A	AD
A1.F5	PLCC	1	16,11	14,94	12,96	12,96	20	9	23	207	square	4/5; 20/5	11-13/4-6	CS-003: A	AE
A1.F6	PLCC	1	13,70	18,00	15,50	15,50	28	8	19	152	square	3/4; 17/5	9-11/4-5	CS-003: A	AF
A1.F7	PLCC	1	16,50	23,73	20,58	20,58	44	6	14	84	square	2/3; 13/4	7-8/3-4	CS-003: A	AG
A1.F8	PLCC	1	21,71	18,78	23,12	23,12	52	5	13	65	square	2/3; 12/3	6-8/2-4	CS-003: A	AH
A1.F9	PLCC	1	25,65	30,60	28,20	28,20	68	4	10	40	square	2/2; 9/3	5-6/2-3	CS-003: A	AJ
A1.F10	PLCC	1	34,67	24,38	33,28	33,28	84	3	9	27	square	2/2; 8/2	5/2	CS-003: A	AK
A1.F11	PLCC	1	29,59	23,24	38,36	38,36	100	3	8	24	square	2/2; 7/2	4-5/2	CS-003: A	AL
A1.G1	PQFP	1	15,70	18,24	23,21	20,90	68	6	13	78	-	3/3; 11/4	6-8/3-4	CS-002: A	AA
A1.G2	PQFP	1	17,81	17,91	25,38	25,07	84	5	12	60	-	3/3; 10/3	6-7/2-4	CS-002: A	AB
A1.G3	PQFP	1	17,81	19,05	27,69	25,07	100	5	11	55	-	3/3; 9/3	6/2-4	CS-002: A	AC
A1.G4	PQFP	1	20,94	23,98	33,38	31,34	132	4	9	36	-	2/2; 8/3	5/2-3	CS-002: A	AD

Tray			*M*	*M*1	*M*2	*M*3	*N*	*N*1	*N*2	*N*3	*N*4	*N*5	*N*6	Origin	
Type	Component Type	Fig	Basic Dim.	Basic Dim.	Basic Dim.	Basic Dim.	Pin count	Columns	Rows	Pockets	Form	Row/Column	Row/Column	Standard	Var
A1.G5	PQFP	1	29,49	24,29	38,06	38,46	164	3	8	24	-	2/2; 7/2	4-5/2	CS-002: A	AE
A1.G6	PQFP	1	26,17	27,03	43,49	41,78	196	3	7	21	-	2/2; 6/2	4/2	CS-002: A	AF
A1.G7	PQFP	1	42,37	30,60	50,76	51,16	244	2	6	12	-	2/1; 5/2	3-4/1-2	CS-002: A	AG
A1.H1	SOJ	1	10,20	14,30	17,90	10,50	24	12	17	204	7,62 × 15,87	2/6; 16/7	8-10/5-8	CO-032: A	AA
A1.H2	SOJ	1	10,20	13,50	19,20	10,50	20; 24	12	16	192	7,62 × 17,14	2/6; 15/7	8-9/5-8	CO-032: A	AB
A1.H3	SOJ	1	10,20	14,70	20,40	10,50	28	12	15	180	7,62 × 18,14	2/6; 14/7	7-9/5-8	CO-032: A	AC
A1.H4	SOJ	1	10,20	19,80	22,95	10,50	32	12	13	156	7,62 × 20,95	2/6; 12/7	6-8/5-8	CO-032: A	AD
A1.H5	SOJ	1	10,20	25,65	29,30	10,50	42	12	10	120	7,62 × 27,30	2/6; 9/7	5-6/5-8	CO-032: A	AE
A1.H6	SOJ	1	15,15	14,70	20,40	13,20	24; 24	9	15	135	10,16 × 18,14	2/5; 14/5	7-9/4-5	CO-032: A	BA
A1.H7	SOJ	1	15,15	19,80	22,95	13,20	32	9	13	117	10,16 × 20,95	2/5; 12/5	6-8/4-6	CO-032: A	BB
A1.H8	SOJ	1	15,15	23,85	24,30	13,20	34	9	12	108	10,16 × 22,22	2/5; 11/5	6-7/4-5	CO-032: A	BC
A1.H9	SOJ	1	15,15	17,25	25,50	13,20	36	9	12	108	10,16 × 23,49	2/5; 11/5	6-7/4-6	CO-032: A	BD
A1.H10	SOJ	1	15,15	17,50	28,00	13,20	40	9	11	99	10,16 × 26,03	2/5; 10/5	6/4-6	CO-032: A	BE
A1.H11	SOJ	1	14,75	24,75	29,50	13,30	42	9	10	90	10,16 × 27,30	2/5; 9/5	5-6/4-6	CO-032: A	BF
A1.H12	SOJ	1	15,15	19,80	30,60	13,20	44	9	10	90	10,16 × 28,57	2/5; 9/5	5-6/4-6	CO-032: A	BG
A1.K1	TQFP	1	10,20	11,05	10,10	10,50	32; 40	12	30	360	5 × 5	2/6;27/7	14-17/5-8	CS-007: A	AA
A1.K2	TQFP	1	11,25	11,10	12,20	12,60	32; 40; 48; 64	10	25	250	7 × 7	2/5;24/6	12-14/4-7	CS-007: A	AB
A1.K3	TQFP	1	13,00	13,10	15,20	15,70	36; 44; 52; 64; 80	8	20	160	10 × 10	2/4;19/5	10-11/4-5	CS-007: A	AC
A1.K4	TQFP	1	13,95	14,30	17,90	18,00	44; 52; 64; 80; 100	7	17	119	12 × 12	2/4;16/4	8-10/3-5	CS-007: A	AD
A1.K5	TQFP	1	15,45	15,40	20,30	21,00	52; 64; 80; 100; 120	6	15	90	14 × 14	2/3;14/4	7-9/3-4	CS-007: A	AE
A1.K6	TQFP	1	15,45	17,80	25,40	21,00	100; 128	6	12	72	14 × 20	2/3;11/4	6-7/3-4	CS-007: A	AF
A1.K7	TQFP	1	17,55	17,80	25,40	25,20	144; 176	5	12	60	20 × 20	2/3;11/3	6-7/2-4	CS-007: A	AG
A1.K8	TQFP	1	20,70	20,70	30,40	31,50	176; 216	4	10	40	24 × 24	2/2;9/3	5-6/2-3	CS-007: A	AH
A1.K9	TQFP	1	19,65	28,70	32,20	32,20	160; 208; 256	4	9	36	28 × 28	2/2-3;8/2-3	5/2-3	CS-007: A	AJ
A1.L1	TSOP(I)	1	8,70	15,00	19,00	7,90	24	16	16	256	6 × 14	3/3-4;14/13-14	8-9/7-10	CS-008: A	AA
A1.L2	TSOP(I)	1	8,70	14,00	20,50	7,90	24	16	15	240	6 × 16	3/3-4; 13/3-4	7/7-10; 9/7-10	CS-008: A	AB
A1.L3	TSOP(I)	1	8,70	16,50	23,50	7,90	24	16	13	208	6 × 18	2/3-4; 12/3-4	6-8/7-10	CS-008: A	AC