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

This edition includes the following significant technical changes from the previous edition.

a) The generic rules for the design of matrix trays are given in this standard. 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.

This consolidated version of IEC 60286-5 consists of the second edition (2003) [documents 40/1341/FDIS and 40/1364/RVD] and its amendment 1 (2009) [documents 40/1942/FDIS and 40/1971/RVD].

The technical content is therefore identical to the base edition and its amendment and has been prepared for user convenience.

It bears the edition number 2.1.

A vertical line in the margin shows where the base publication has been modified by amendment 1.

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

The committee has decided that the contents of the base publication and its amendments will remain unchanged until the maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication 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- withdrawn,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 which 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 standard.. 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.

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

2 Material

2.1 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.

2.2 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.

2.3 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’.

3 Mechanical stability

3.1 Loaded tray

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

3.2 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.

3.3 Outer edges

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

4 Tray design, dimensions and other physical properties

4.1 Tray design

4.1.1 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 4.1.3.

4.1.2 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.

4.1.3 Design rules for pocket density

4.1.3.1 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 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 $M1$.

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

4.1.3.2 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 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 ($N1 \times N2 = N3$)

$N4$ 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 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.

4.2 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 are described in Annex B.

4.3 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 which may require matrix trays.

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

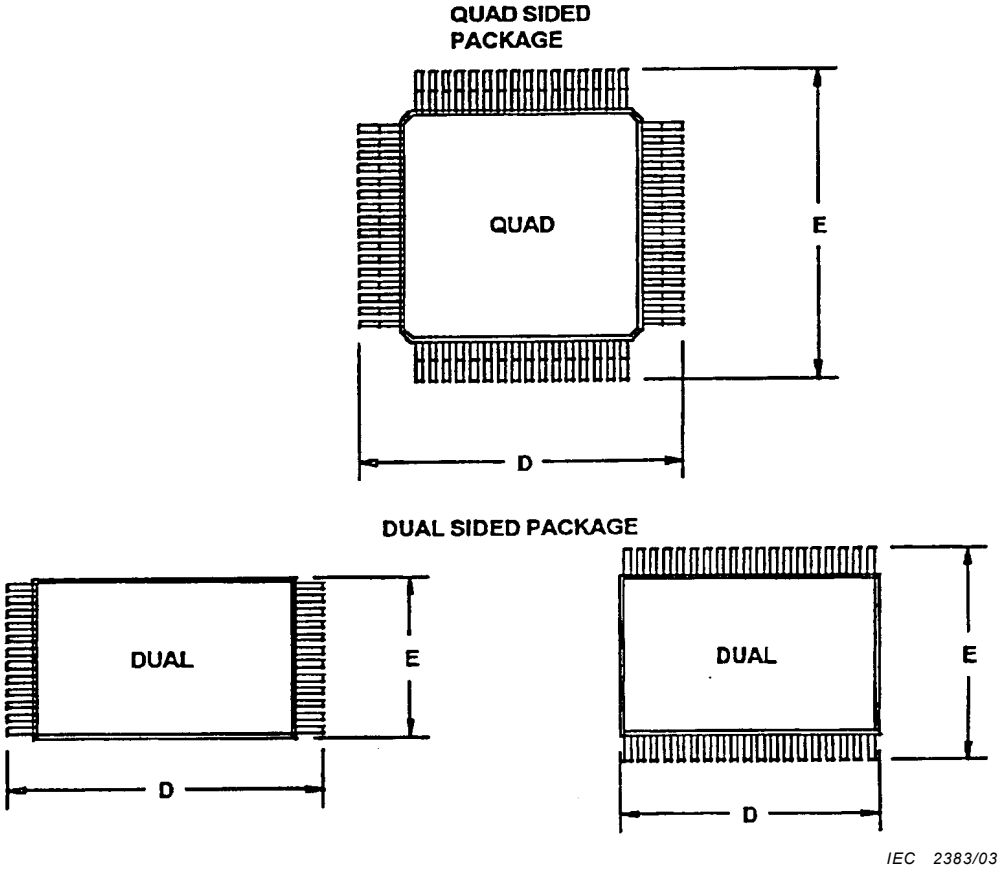


Figure 1 – Sample of leaded packages

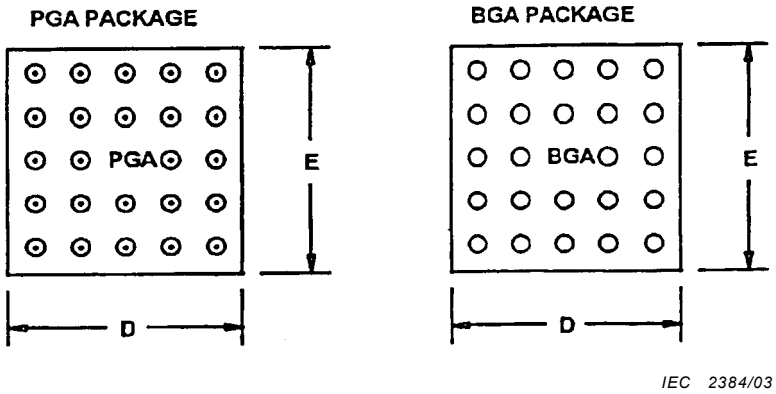


Figure 2 – Sample of grid array packages

4.4 Tray vacuum pick-up sites

4.4.1 Size

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

4.4.2 Centre

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

4.4.3 Perimeter

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

4.5 Detail features

All cavity detail features must begin at a minimum distance of P = 3,2 mm [Thin tray(normal tray)] or P = 5,0 mm [Thin tray(Low stack tray) and Thick tray)].

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

4.6 Weight

The empty tray weight shall not exceed 300 g.

4.7 Movement of components

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

4.8 Dimensional information

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

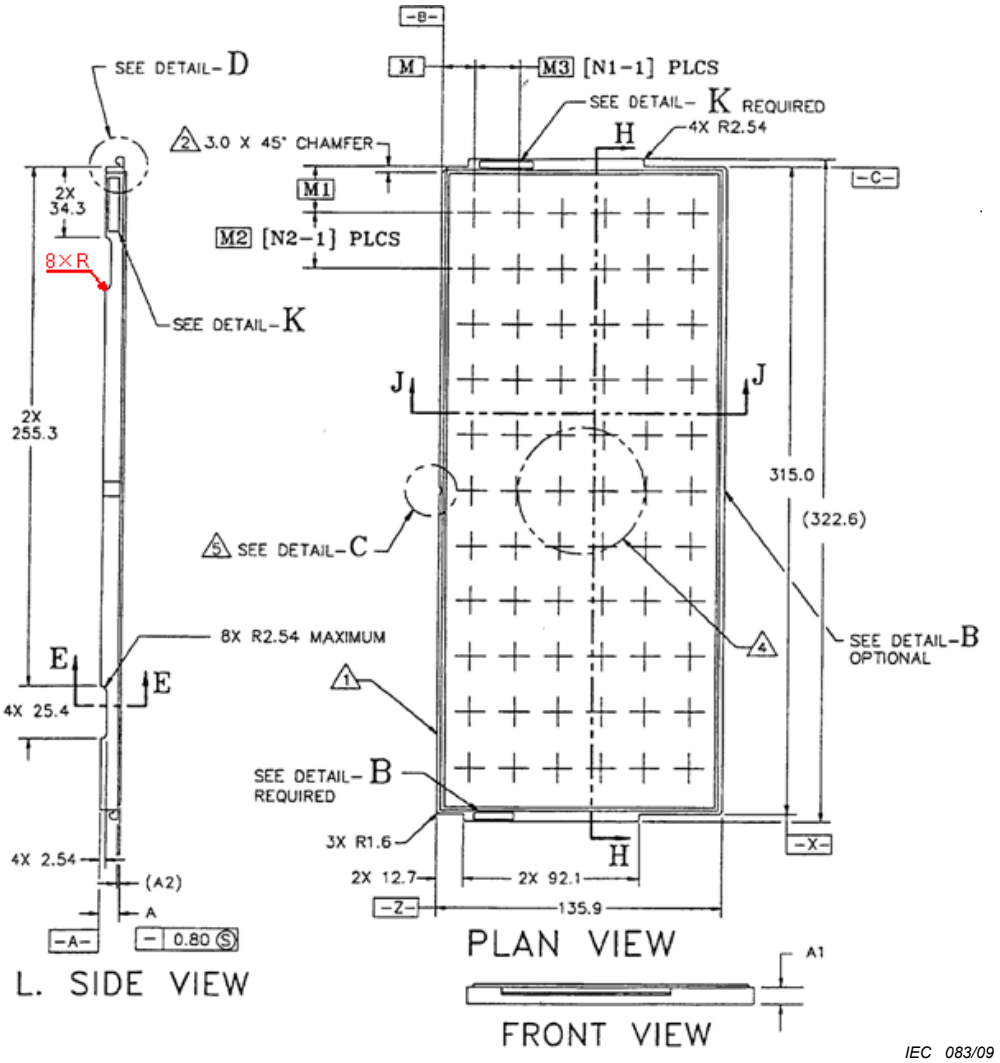


Figure 3 – Tray main view

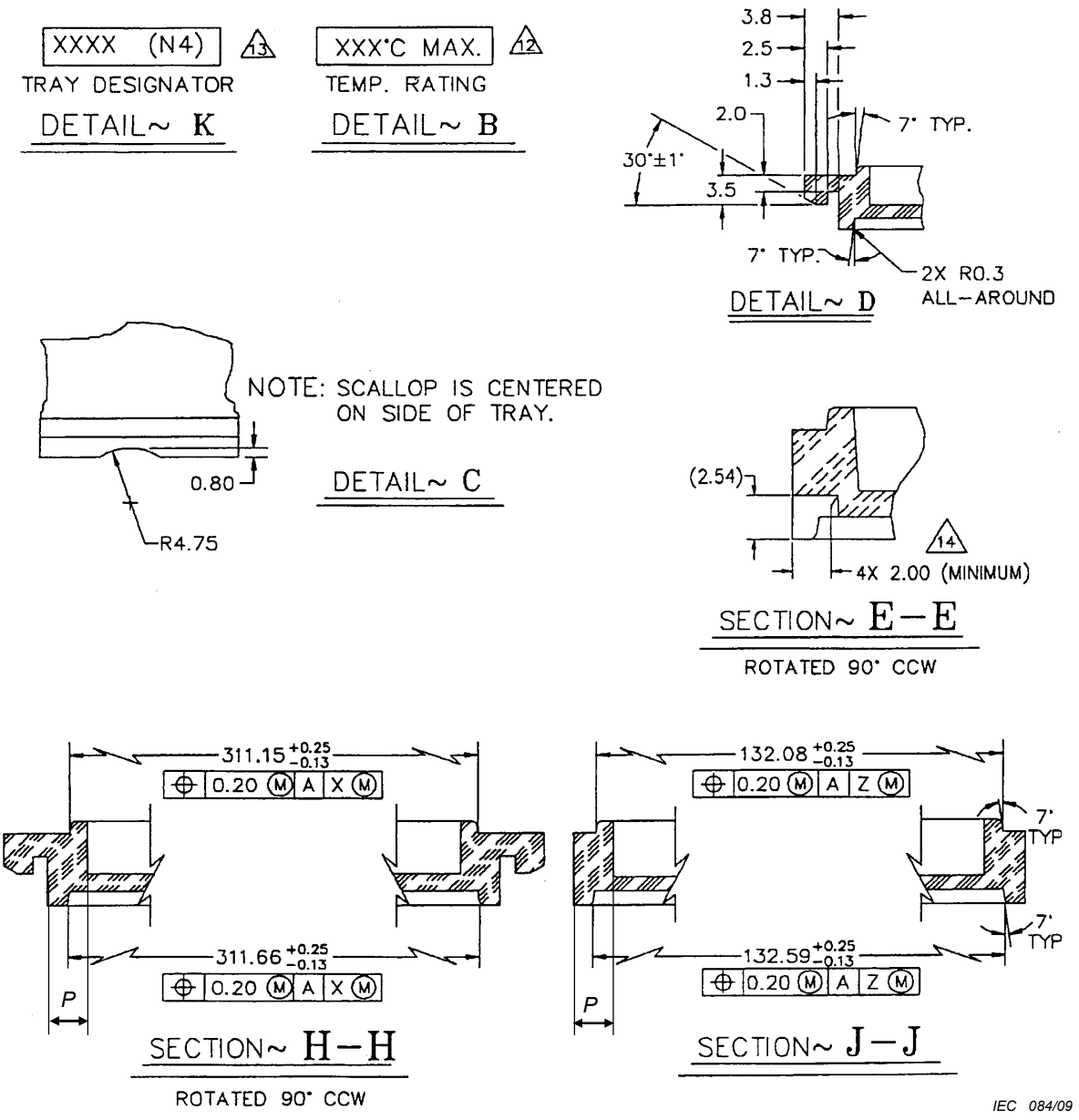


Figure 4 – Tray stacking details

Notes related to Figures 3 and 4

1	These surfaces should be free of seams.
2	Chamfer denotes 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.

5 Polarity and orientation of components in the tray

5.1 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.

5.2 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.

6 Tray stacking

6.1 Bundling

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

6.2 Top protection

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

6.3 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.

6.4 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.

6.5 Stack-up

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

6.6 Damaging of components

Trays shall be stackable without damaging contained components.

7 Missing components

Missing components are not allowed, except for an intentionally partially filled tray as described in 6.3.

8 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 scallop).

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

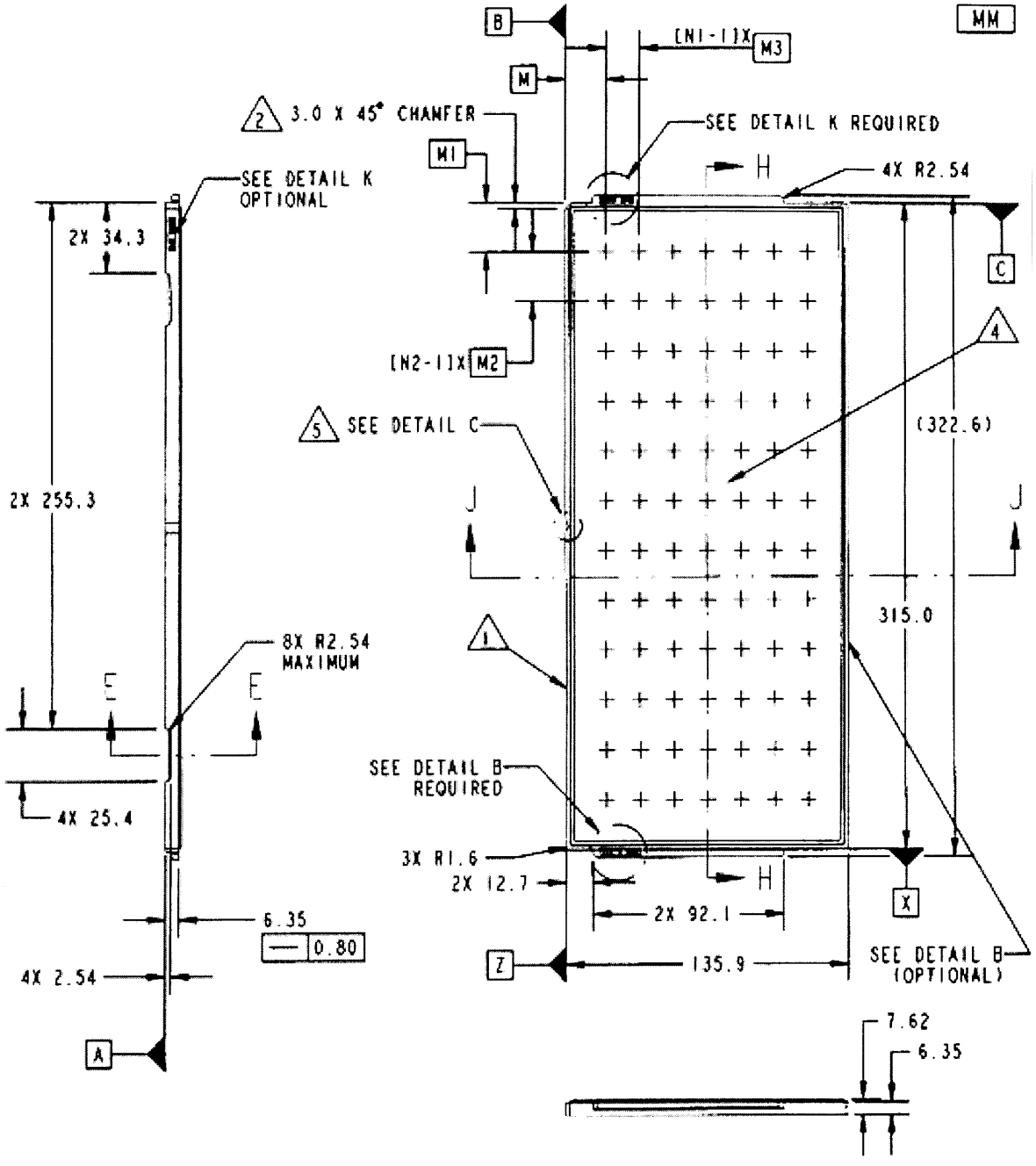
Annex A
(informative)

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 tray”, and Figure A.1



IEC 2387/03

Figure A.1a – Main view

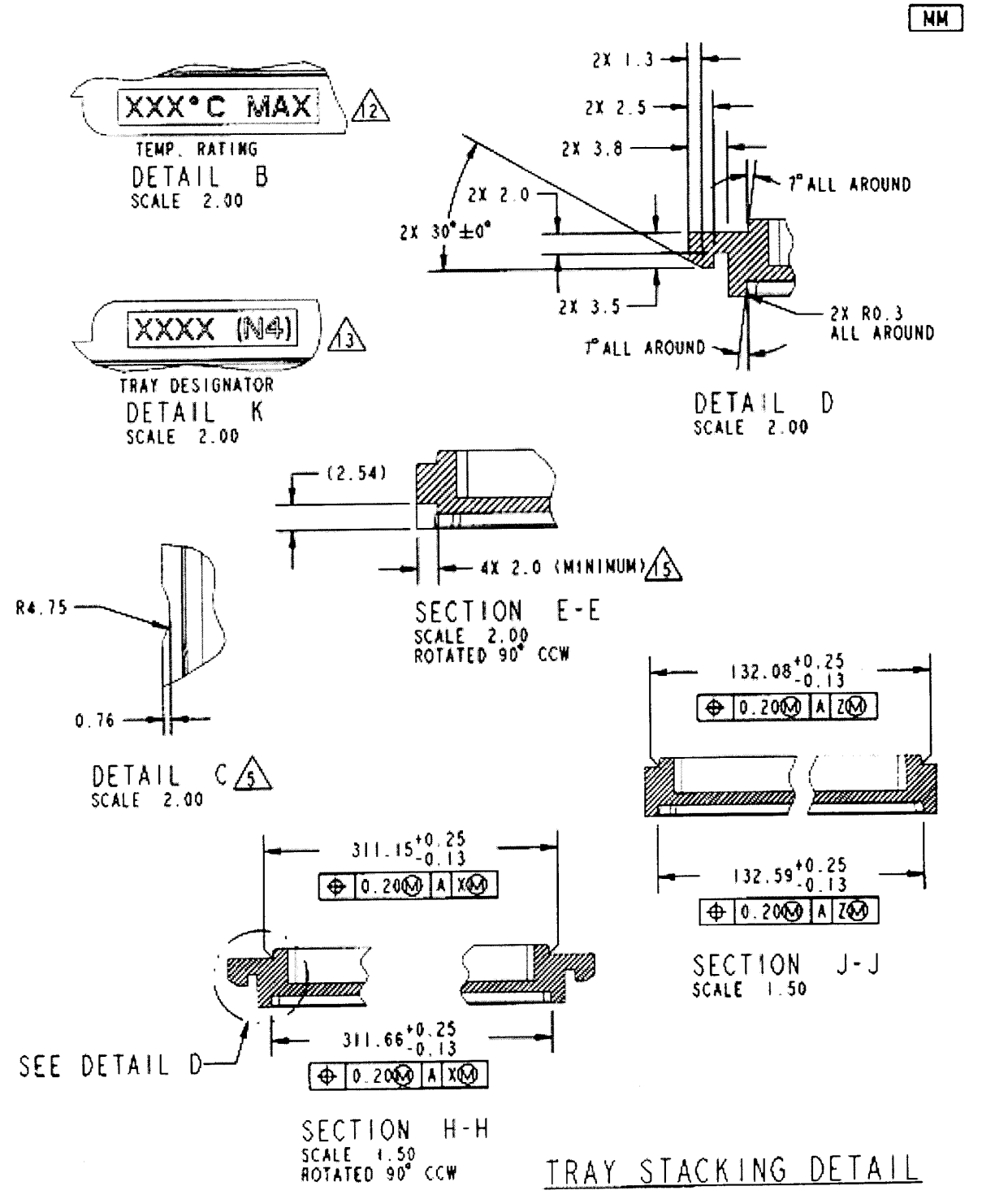


Figure A.1b – Stacking details

NOTE For notes, see page 26.

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	M1	M2	M3	N	N1	N2	N3	N4	N5	N6	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 x 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 x 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 x 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 x 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 x 32,5; 33 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 19; 18,5 x 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 x 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 x 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 x 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 x 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 x 27	2/2; 9/3	5/3; 6/2	CO-029: A	AL
A1.B27	BGA	2	20,85	31,10	31,60	31,40	361; 484; 784	4	9	36	29 x 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 x 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 x 33; 32,5 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 20	2/3; 10/4	6/3-4	CS-004: A	AC
A1.D4	MQFP	1	30,93	27,93	37,02	37,02	120; 128; 144; 160; 208; 256	3	8	24	28 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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
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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 18	2/3-4; 12/3-4	6-8/7-10	CS-008: A	AC
A1.L4	TSOP(I)	1	8,70	17,25	25,50	7,90	24	16	12	192	6 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 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 x 22,22 10,16 x 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 x 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 x 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 x 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 x 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 x 26,03	2/2-3; 10/5-6	6/3-5	CS-005: B	AL
A1.M12	TSOP(II)	1	19,32	18,00	31,00	16,21	70	7	10	70	12,70 x 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 x 22,22	2/3-4,11/6-7	6-7/4-6	ED-7611	—

NOTE 1 Dimension 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 $N3 = N1 \times N2$ (columns x 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 $N5$.

NOTE 6 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 $N6$.

A.2 Matrix trays for PGA packages

A.2.1 Dimensional information

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

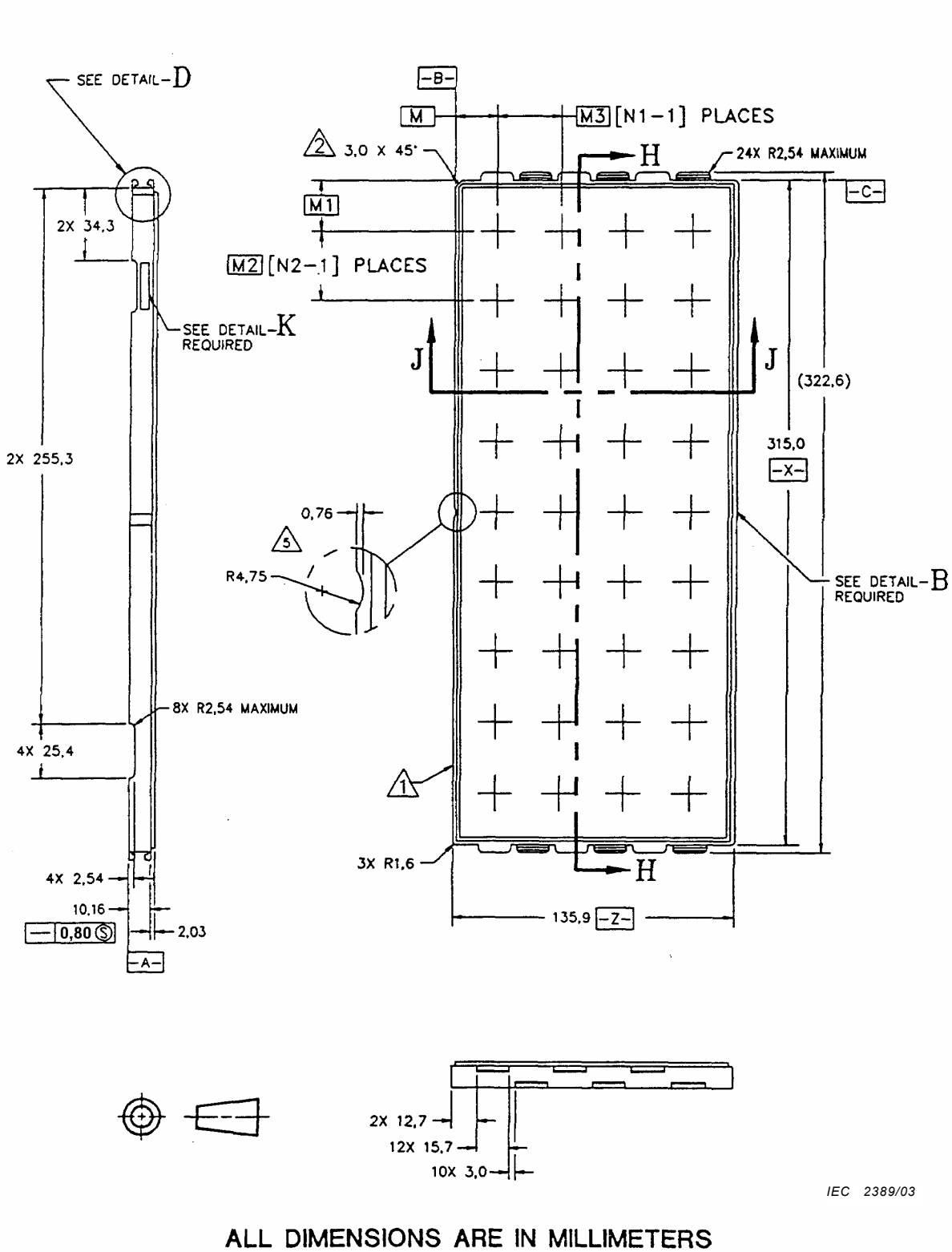


Figure A.2a – Tray outline for PGA packages

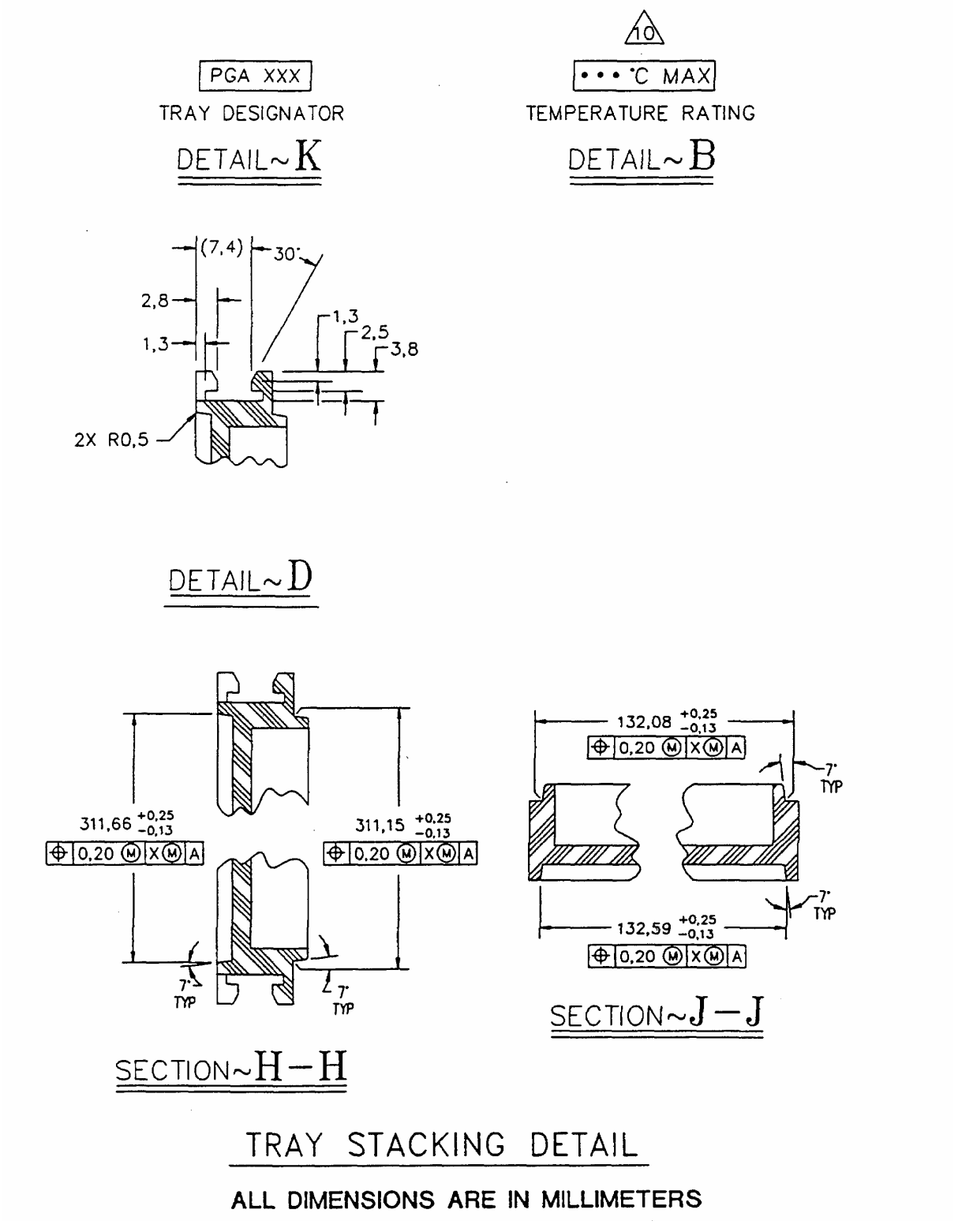


Figure A.2b – Outline for PGA packages (details)

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NOTE For notes, see page 26.

Figure A.2 – Thick matrix

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 $\times$ 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.2 – PGA variations

Tray			M	M1	M2	M3	N	N1	N2	N3	N4	N5	N6	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 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 x 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.

NOTE 6 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 N6.

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.

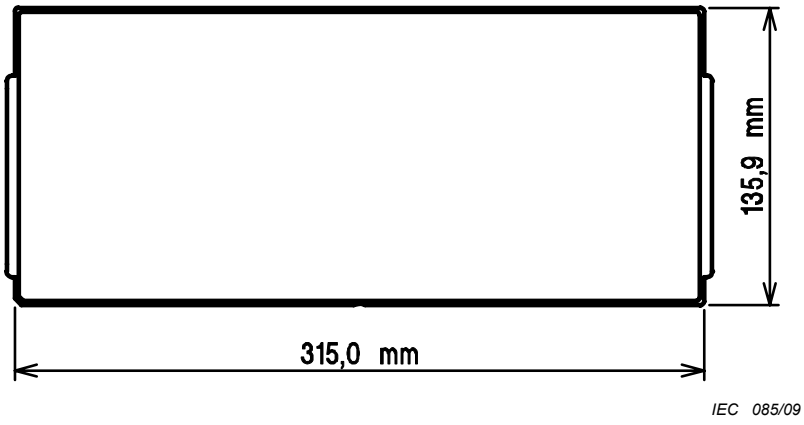


Figure B.1a – Dimensions 315,0 mm and 135,9 mm

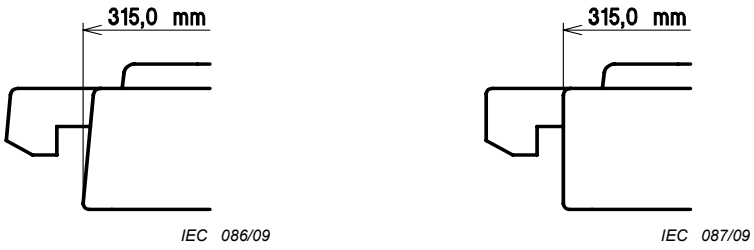


Figure B.1b – Dimension 315,0 mm

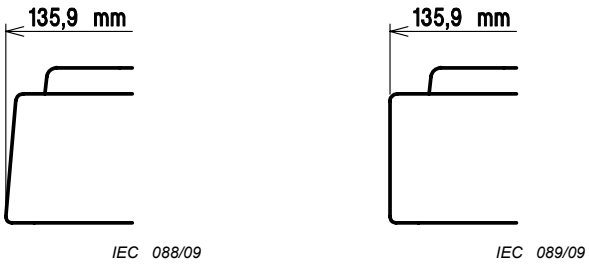


Figure B.1c – Dimension 135,9 mm

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

B.2.2 Tray thickness (*A*)

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

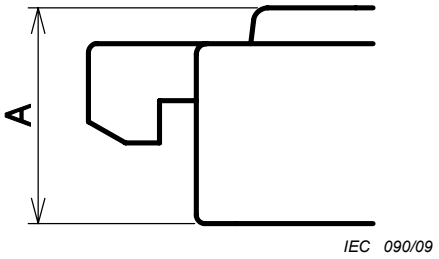


Figure B.2 – Tray thickness

B.2.3 Dimensions of the stacking feature

Dimensions of the stacking feature are length (311,15 mm. 311,66 mm) and width (132,08 mm. 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.4.)

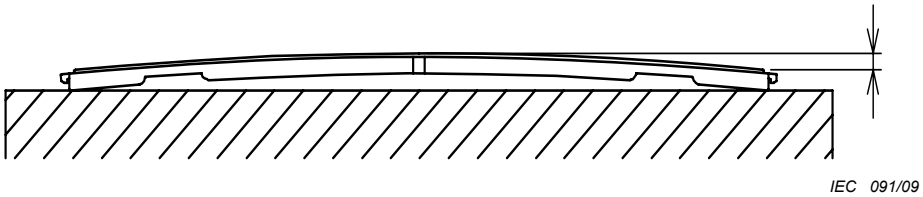


Figure B.4a – Convex warpage

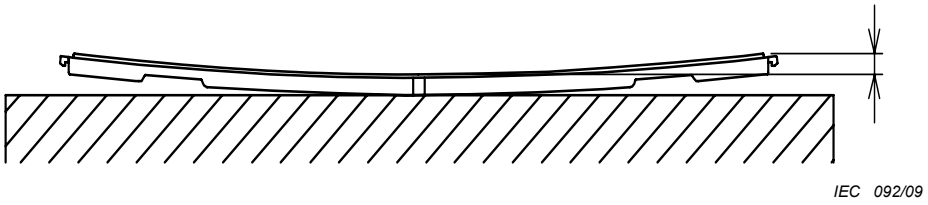


Figure B.4b – Concave warpage

Figure B.4 – 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 % – 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 measurement taken in the vicinity of section a-a or b-b in Figure B.5. 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.5.

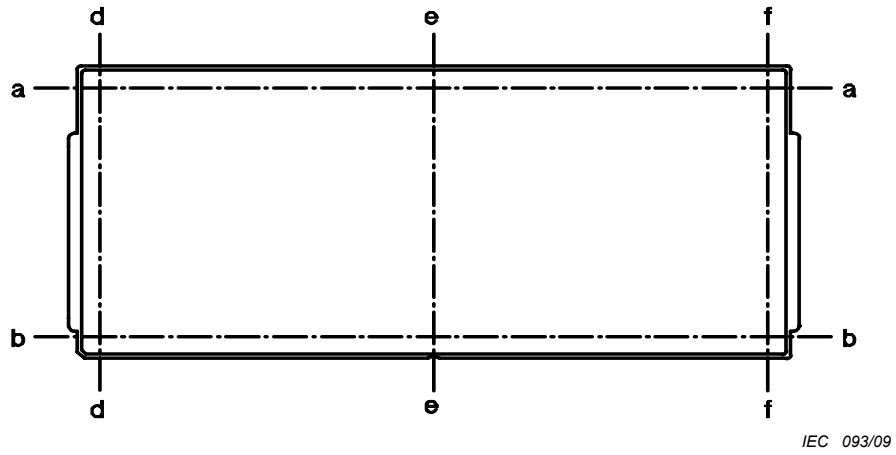


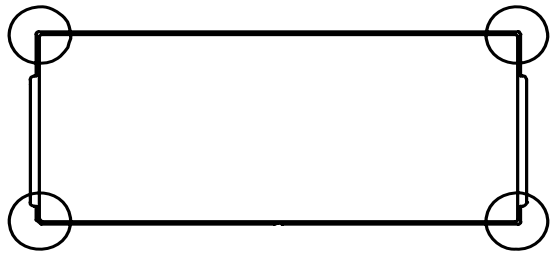
Figure B.5 – Top view of a tray showing the measurement locations for the outline dimensions

B.5.2 Tray thickness (*A*)

There are two measurement methods as given below.

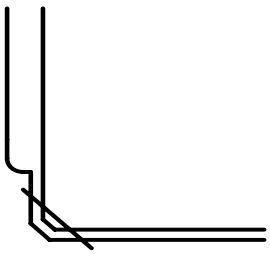
a) Measurement method using a vernier calliper

Tray thickness shall be measured for all four corners of the tray by placing tray corner between the two jaws of calliper. (Refer to Figure B.6 and Figure B.7).



IEC 094/09

Figure B.6 – Measurement locations for tray thickness



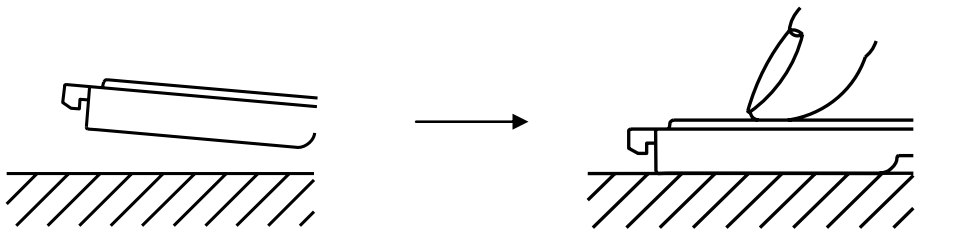
IEC 095/09

Figure B.7 – 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 use for measurement.

Any lift of the tray from the reference plane shall be corrected for measurement. Example of correction is shown in Figure B.8.



IEC 096/09

Figure B.8 – 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 measurement 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 maximum dimension among the measurement 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 center-lines of the tray. (Refer to Figure B.9.)

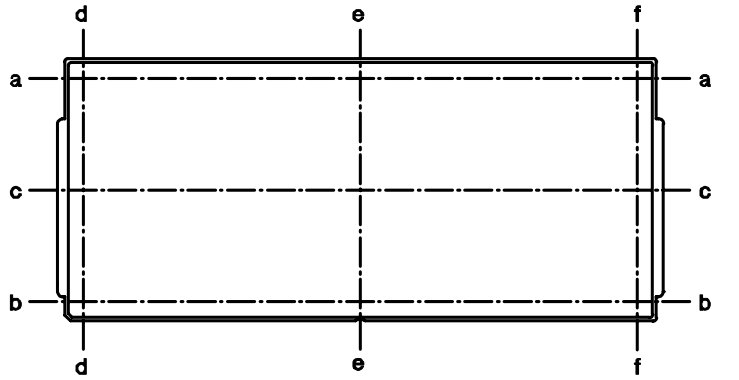


Figure B.9 – Measurement locations for the stackable design

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.10

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

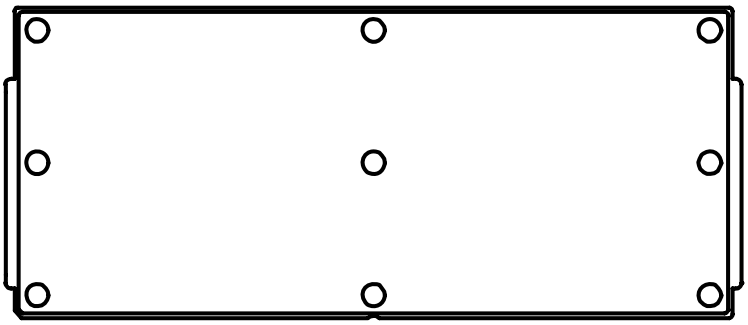


Figure B.10 – Measurement points for warpage

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