

INTERNATIONAL STANDARD

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

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IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

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INTERNATIONAL STANDARD

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

INTERNATIONAL
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CONTENTS

FOREWORD	5
1 Scope	7
2 Normative references	7
3 Terms, definitions and abbreviated terms	7
3.1 Terms and definitions	7
3.2 Abbreviated terms	7
4 Material	8
4.1 Electrostatic dissipative requirements	8
4.2 Effect of properties	8
4.3 Recycling and rigidity	8
5 Mechanical stability	8
5.1 Loaded tray	8
5.2 Empty tray	8
5.3 Outer edges	8
6 Tray design, dimensions and other physical properties	8
6.1 Tray design	8
6.1.1 Number of pockets	8
6.1.2 Orientation of pockets	8
6.1.3 Design rules for pocket density	9
6.2 Overall tray dimensions	10
6.3 Cell dimensions	10
6.4 Tray vacuum pick-up sites	11
6.4.1 Size	11
6.4.2 Centre	11
6.4.3 Perimeter	11
6.5 Detail features	11
6.6 Weight	12
6.7 Movement of components	12
6.8 Dimensional information	12
7 Polarity and orientation of components in the tray	15
7.1 Pin one	15
7.2 Loading	15
8 Tray stacking	15
8.1 Bundling	15
8.2 Top protection	16
8.3 Partial filling	16
8.4 Protrusion of components	16
8.5 Stack-up	16
8.6 Damaging of components	16
8.7 Warpage	16
9 Missing components	16
10 Marking	16
Annex A (informative) List of existing matrix trays with wide anticipated use in the electronic industries	17
A.1 Matrix trays (for different packages)	17

A.2	Matrix trays for PGA packages	25
A.2.1	Dimensional information	25
A.2.2	Variation sheet PGA (pin grid array package)	28
Annex B	(normative) Measurement methodology of the tray dimensions	29
B.1	General	29
B.2	Definition of the dimensions	29
B.2.1	Outline dimensions	29
B.2.2	Tray thickness (<i>A</i>)	30
B.2.3	Dimensions of the stacking feature	31
B.2.4	Warpage	31
B.3	Measuring instrument	31
B.4	Measurement conditions	31
B.5	Measurement methodology	31
B.5.1	Outline dimensions	31
B.5.2	Tray thickness (<i>A</i>)	32
B.5.3	Dimensions of the stacking feature	33
B.5.4	Warpage	33
Annex C	(normative) Matrix trays – General considerations for design (design value)	34
C.1	Lateral movement of leaded devices	34
C.2	Lateral movement of un-leaded devices	34
C.3	Lead protection	35
Figure 1	– Sample of leaded packages	11
Figure 2	– Sample of grid array packages	11
Figure 3	– Tray main view	13
Figure 4	– Tray stacking details	14
Figure 5	– Tray tolerances	14
Figure A.1	– Thin tray	18
Figure A.2	– Thick matrix	26
Figure B.1	– Cross-sections of the outline dimensions	30
Figure B.2	– Tray thickness	30
Figure B.3	– Examples of tray warpage	31
Figure B.4	– Top view of a tray showing the measurement locations for the outline dimensions	32
Figure B.5	– Measurement locations for tray thickness	32
Figure B.6	– Holding position in calliper jaws for measurement	32
Figure B.7	– Correction of a lift of the tray at the measurement point	32
Figure B.8	– Measurement locations for the stackable design	33
Figure B.9	– Measurement points for warpage	33
Figure C.1	– Lateral movement of leaded devices A to I	34
Figure C.2	– Lateral movement of un-leaded devices check points A to C	34
Figure C.3	– Lateral movement of un-leaded devices check points D to F	35
Figure C.4	– Lead protection gap	35
Table 1	– <i>P</i> and <i>W</i> dimension	9
Table 2	– Height dimensions	10

Table 3 – Notes related to Figures 3 and 4	15
Table A.1 – Variations	19
Table A.2 – Notes related to Figures A.1 and A.2.....	27
Table A.3 – PGA variations	28

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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

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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.

<u>b</u> all <u>g</u> rid <u>a</u> rray (<u>b</u> all <u>g</u> rid <u>a</u> rray type <u>p</u> ackage)	BGA
<u>c</u> eramic <u>q</u> uad <u>f</u> lat <u>p</u> ackage (<u>c</u> eramic <u>q</u> uad <u>f</u> lat type <u>p</u> ackage)	CQFP
<u>m</u> etric <u>q</u> uad <u>f</u> lat <u>p</u> ackage (<u>m</u> etric <u>q</u> uad <u>f</u> lat type <u>p</u> ackage)	MQFP
<u>p</u> lastic <u>l</u> eaded <u>c</u> hip <u>c</u> arrier (<u>p</u> lastic <u>l</u> eaded type <u>c</u> hip <u>c</u> arrier)	PLCC
<u>p</u> lastic <u>q</u> uad <u>f</u> lat <u>p</u> ackage (<u>p</u> lastic <u>q</u> uad <u>f</u> lat type <u>p</u> ackage)	PQFP
<u>t</u> hin <u>q</u> uad <u>f</u> lat <u>p</u> ackage (<u>t</u> hin <u>q</u> uad <u>f</u> lat type <u>p</u> ackage)	TQFP
<u>s</u> mall <u>o</u> utline <u>j</u> -leaded package (<u>s</u> mall <u>o</u> utline <u>j</u> -leaded type package)	SOJ
type 1 <u>t</u> hin <u>s</u> mall <u>o</u> utline <u>p</u> ackage (<u>t</u> hin <u>s</u> mall <u>o</u> utline type package1)	TSOP (I)
type 2 <u>t</u> hin <u>s</u> mall <u>o</u> utline <u>p</u> ackage (<u>t</u> hin <u>s</u> mall <u>o</u> utline 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 $(135,9 \text{ mm} - M3(N1 - 1))/2$

$M1$ is $(315,0 \text{ mm} - M2(N2 - 1))/2$

$M2$ is $[(315,0 \text{ mm} - 2P \text{ mm}) - W(N2 - 1)]/N2 + W$

$M3$ is $[(135,9 \text{ mm} - 2P \text{ mm}) - W(N1 - 1)]/N1 + W$

$N1$ is $(135,9 \text{ mm} - 2P \text{ mm})/ET$ (rounded down to a whole number)

$N2$ is $(315,0 \text{ mm} - 2P \text{ mm})/DT$ (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 $< (7 \times 7)$ 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 mm
	Normal stacking tray mm	Low stacking tray 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 ($N1 \times N2 = N3$)

$N4$ 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 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 mm
	Normal stacking tray mm	Low stacking tray 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).

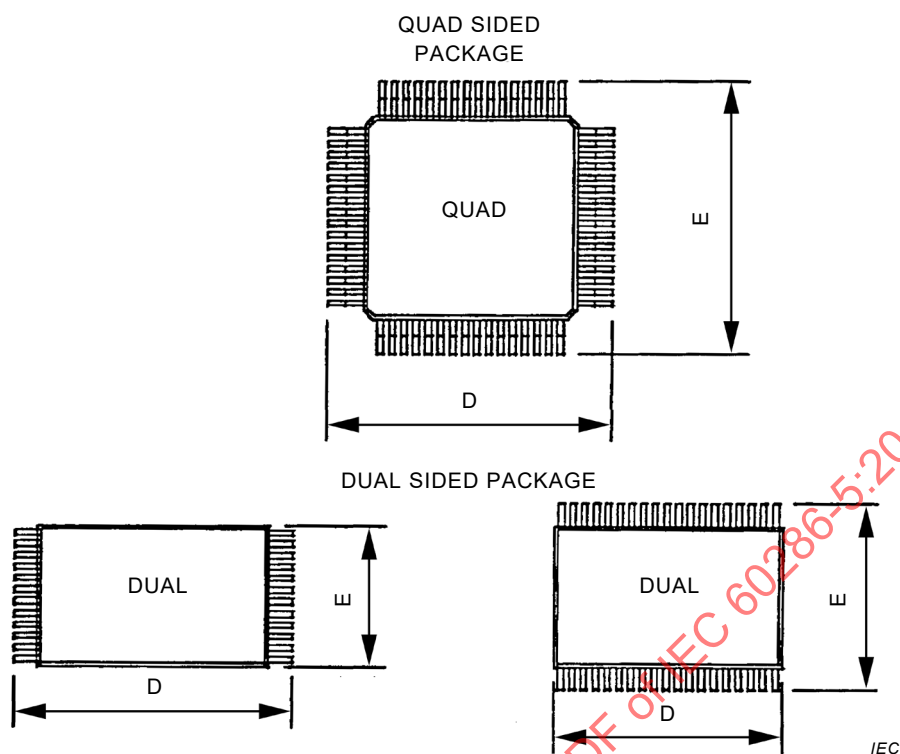


Figure 1 – Sample of leaded packages

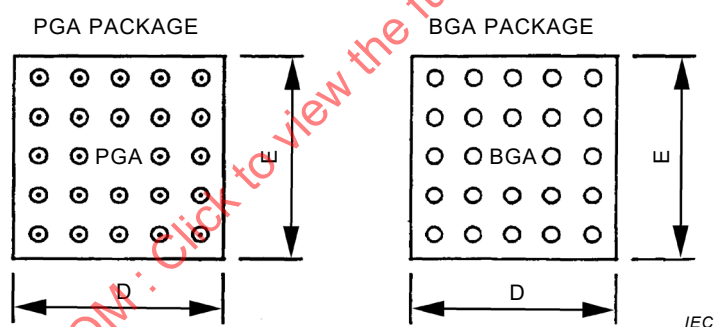


Figure 2 – Sample of grid array packages

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 $\geq 7\text{ mm} \times 7\text{ mm}$: rotation $< 5^\circ$

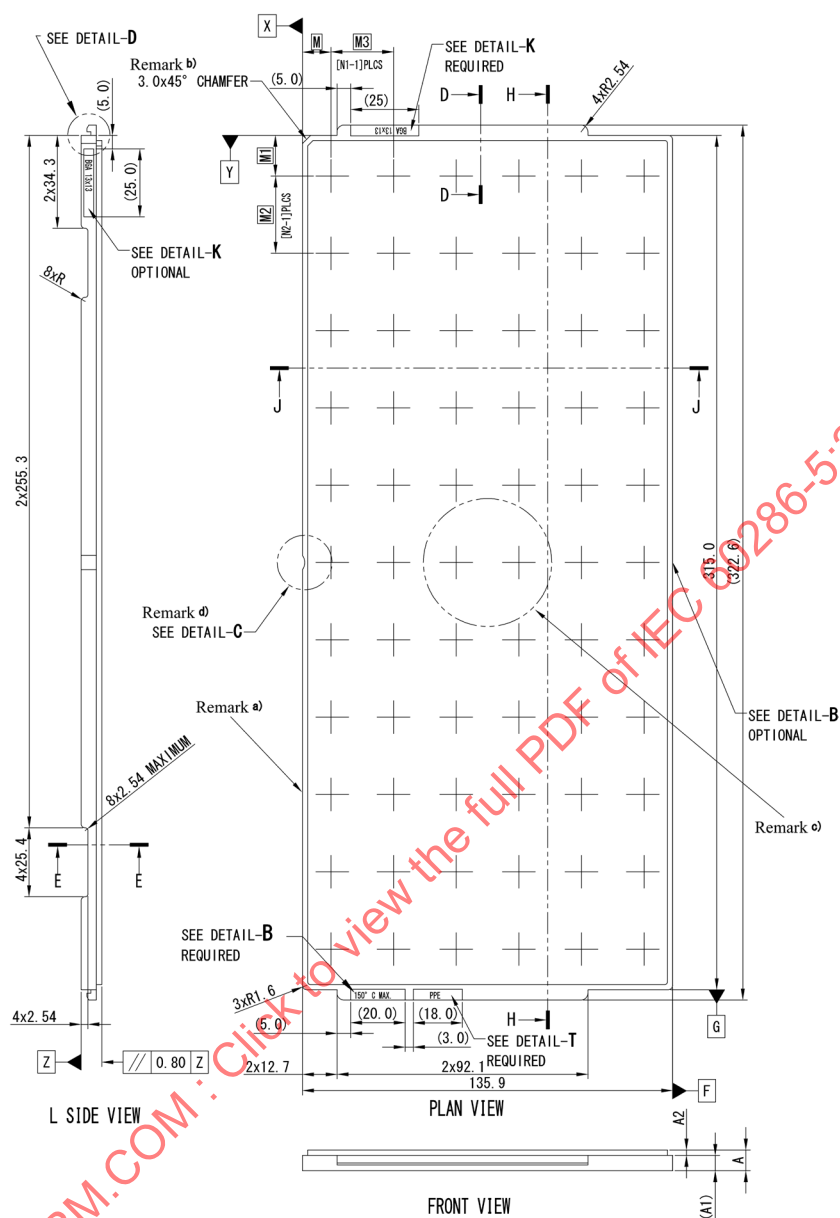
For packages $< 7\text{ mm} \times 7\text{ mm}$: rotation $< 10^\circ$ (design value)

6.8 Dimensional information

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

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Dimensions in millimetres

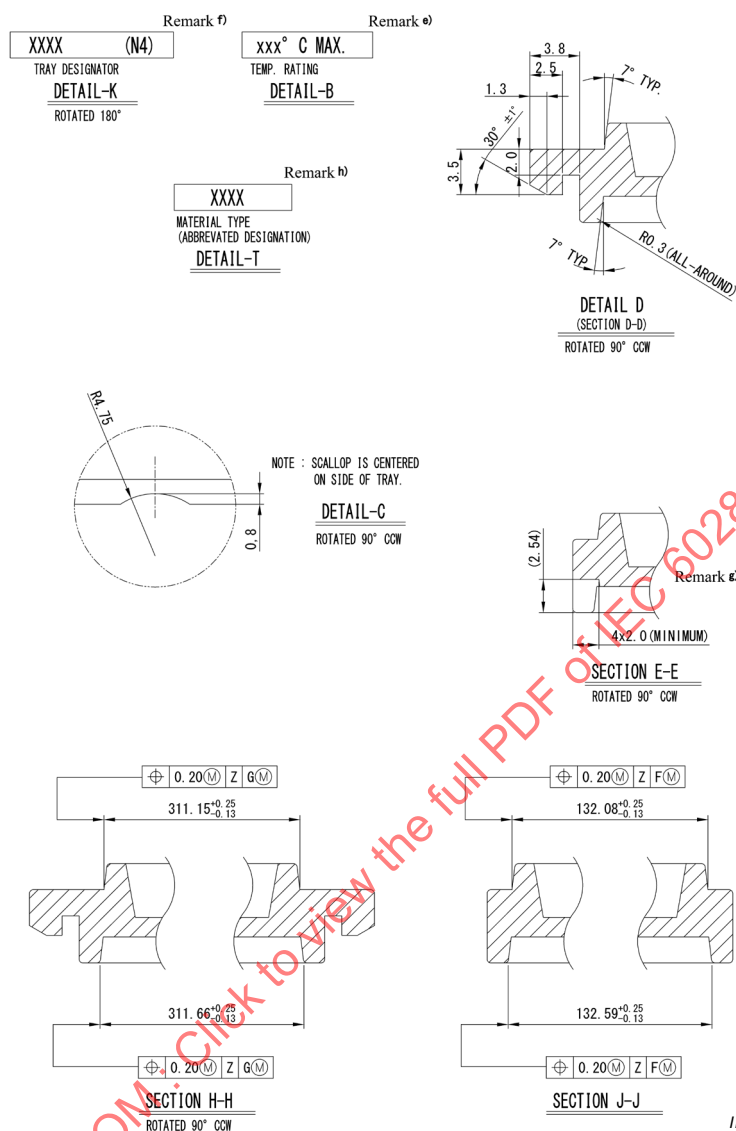


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NOTE For notes, see Table 3.

Figure 3 – Tray main view

Dimensions in millimetres



NOTE For notes, see Table 3.

Figure 4 – Tray stacking details

Dimensions in millimetres

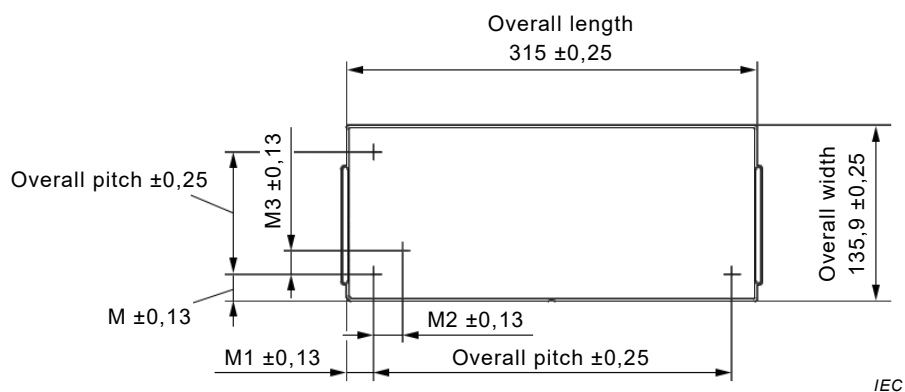


Figure 5 – Tray tolerances

Table 3 – Notes related to Figures 3 and 4

	These surfaces should be free of seams.
	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 <i>N</i> 5.
	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 <i>N</i> 6.
	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 <i>N</i> 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 <i>M</i> , <i>M</i> 1, <i>M</i> 2 and <i>M</i> 3 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.
	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.
	<i>N</i> 4 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. 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.

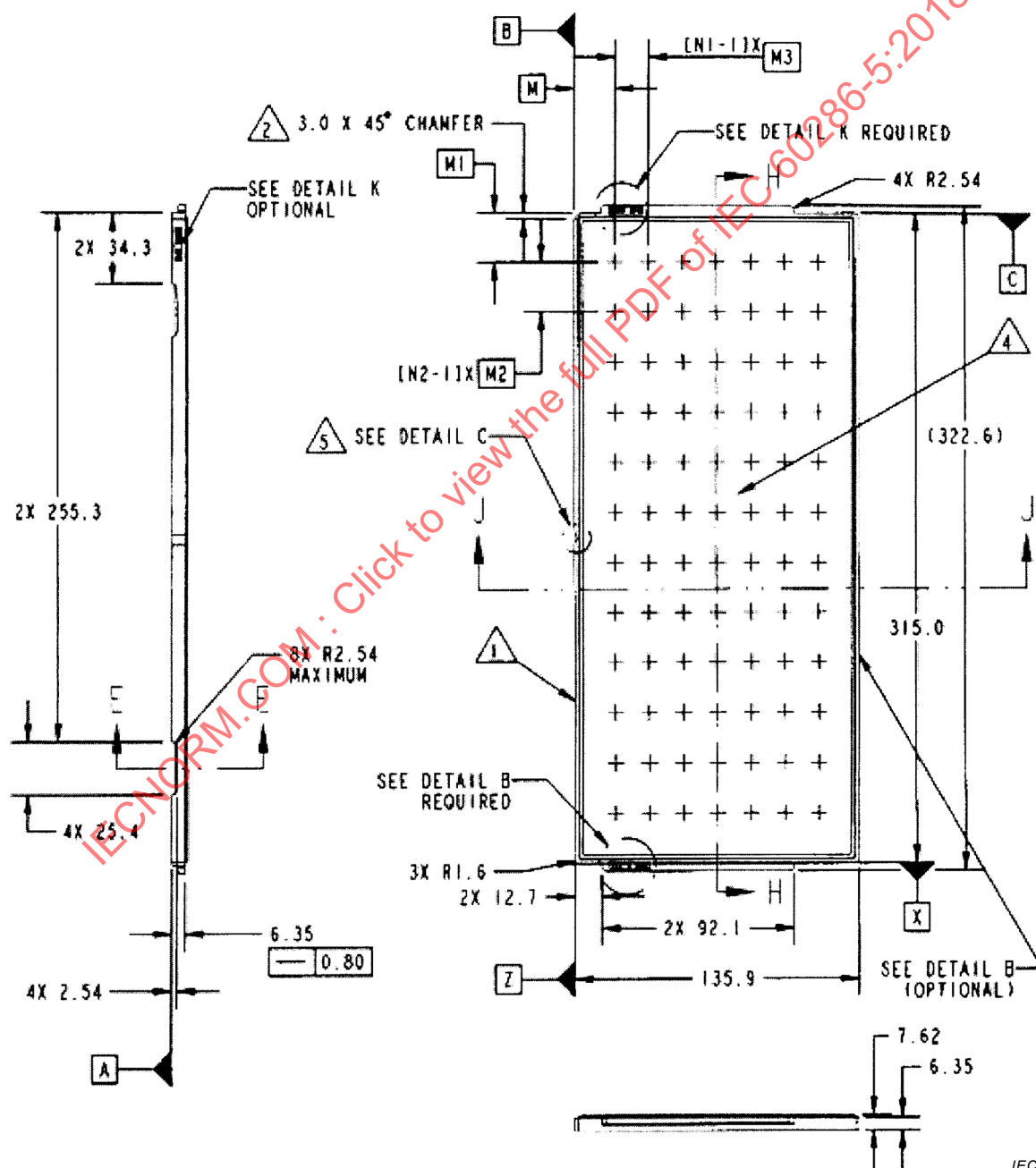
Annex A (informative)

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

A.1 Matrix trays (for different packages)

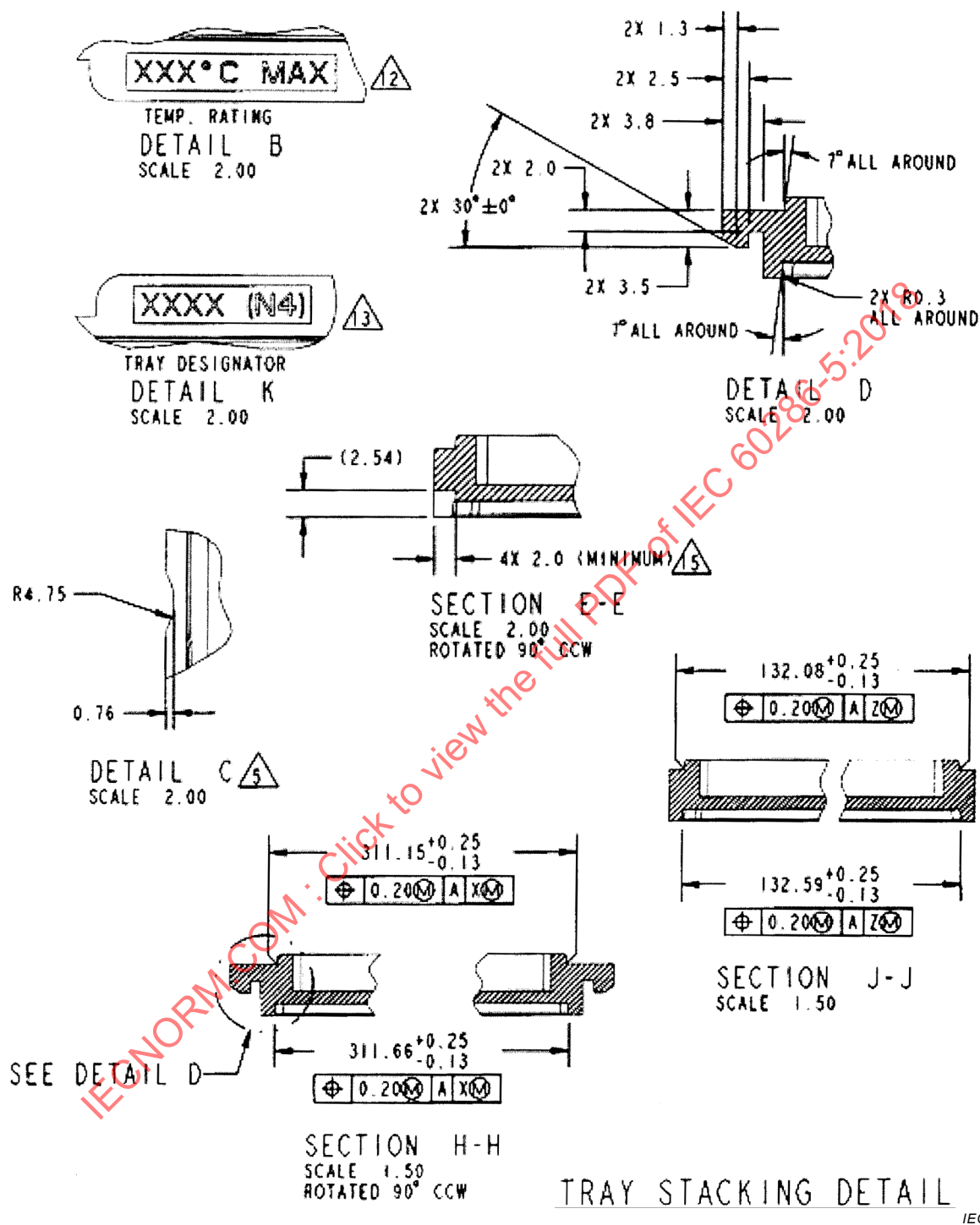
See Table 1, column "Thin tray", and Figure A.1.

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

Type	Tray		M	M1	M2	M3	N	Pin count	N1	N2	N3	N4	N5	N6	Origin	
	Component Type	Fig	Basic Dim.	Basic Dim.	Basic Dim.	Basic Dim.			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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	4	10	40	27 × 27	2/2; 9/3	5/3; 6/2	CO-029: A	AL

Tray		M	M1	M2	M3	N	N1	N2	N3	N4	N5	N6	Origin	
Type	Component Type	Fig	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	11	66	14 × 20	2/3; 10/4	6/3-4	CS-004: A	AC

Tray			M	M1	M2	M3	N	N1	N2	N3	N4	N5	N6	Origin	
Type	Component Type	Fig												Standard	Var
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

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.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	14	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

Tray			M	M1	M2	M3	N	N1	N2	N3	N4	N5	N6	Origin	
Type	Component Type	Fig												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	189	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	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	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.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	—

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.

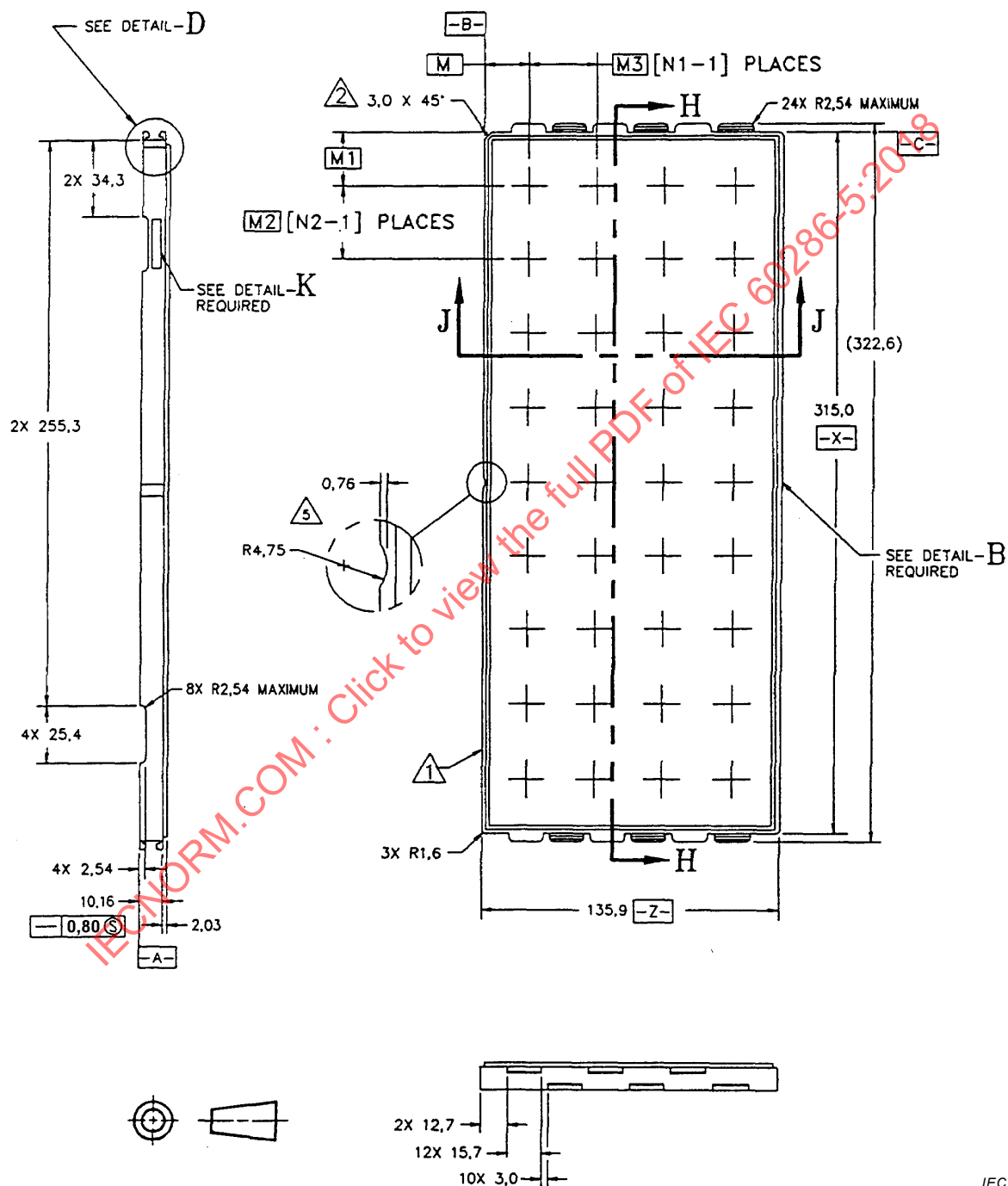
NOTE 5 The tray vacuum pick-up method allows two separate pick-up areas resulting in four closed cells per tray. Optical vacuum pick-up cell locations are N5.

A.2 Matrix trays for PGA packages

A.2.1 Dimensional information

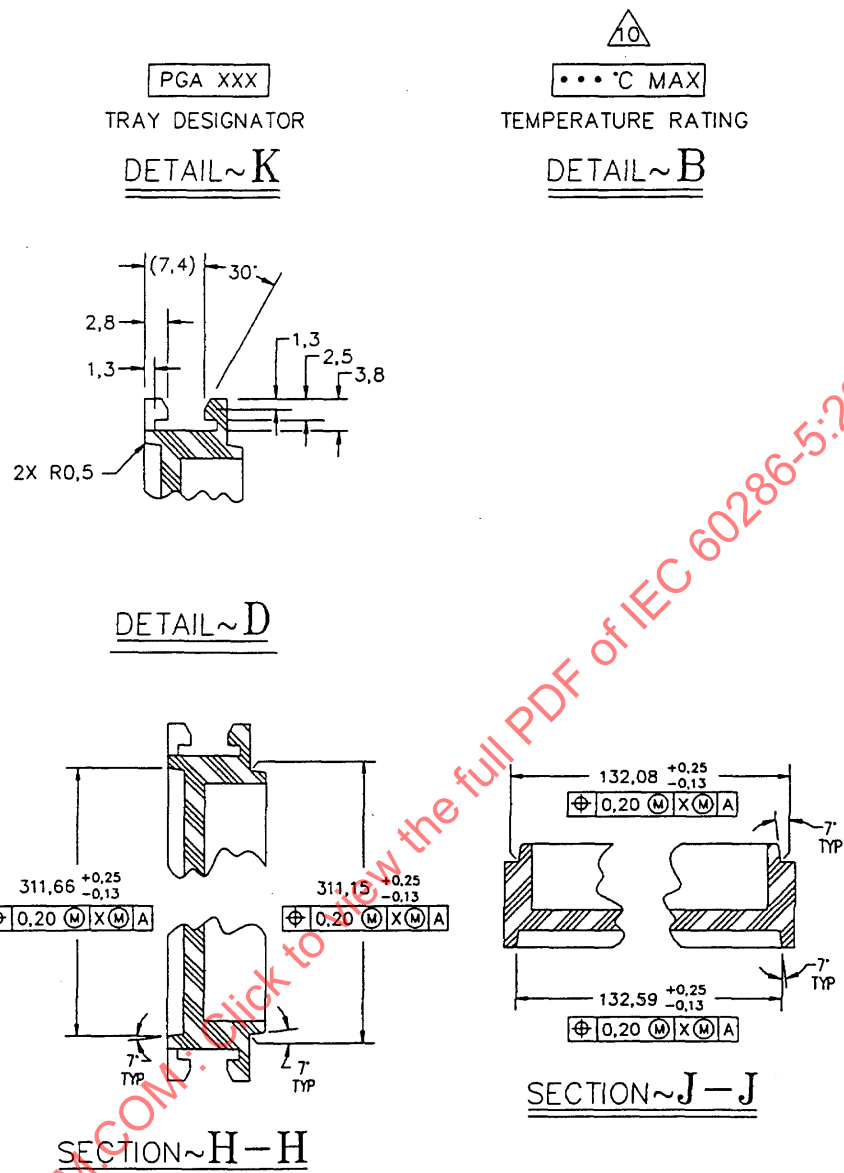
See Table 1, column "Thick tray", and Figure A.2.

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 <i>N5</i> .
	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 <i>N6</i> .
	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 <i>N</i> 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 <i>M</i> , <i>M1</i> , <i>M2</i> and <i>M3</i> 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 $.X = \pm 0,25$; $.XX = \pm 0,13$; angles = $\pm 0,5^\circ$.
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.
	<i>N4</i> 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	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

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.

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.

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.

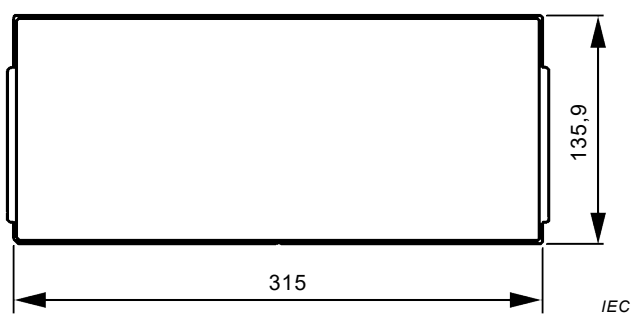
B.2 Definition of the dimensions

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.

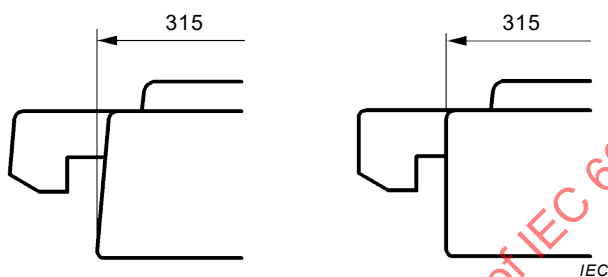
NOTE See Figure 3.

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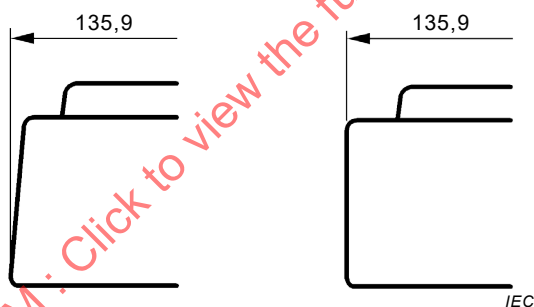
a) Dimensions 315,0 mm and 135,9 mm

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).

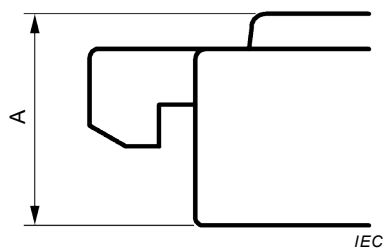


Figure B.2 – Tray thickness