

# Mechanical standardization of semiconductor devices —

## Part 3: Recommendations for the preparation of outline drawings of integrated circuits

# Committees responsible for this British Standard

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- EEA (the Association of Electronics, Telecommunications and Business Equipment Industries)
- Electronic Components Industry Federation
- GAMBICA (BEAMA Ltd.)
- Ministry of Defence
- National Supervising Inspectorate
- Society of British Aerospace Companies Ltd.

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# Foreword

This British Standard has been prepared under the direction of the Electronic Components Standards Policy Committee. It is technically equivalent to IEC 191-3:1974 *“Mechanical standardization of semiconductor devices, Part 3: General rules for the preparation of outline drawings of integrated circuits”*, published by the International Electrotechnical Commission (IEC). It incorporates amendment No. 1 (1983) and supplements A to F to IEC 191-3 (1974).

The differences between BS 3934-3 and IEC 191-3 are purely editorial in nature. For ease of reproduction, use has been made of the IEC text where appropriate; consequently some terminology and certain conventions are not identical with those used in British Standards.

This British Standard is Part of a series of standards corresponding to the Parts of the IEC publication on *“Mechanical standardization of semiconductor devices”*. The other Parts of BS 3934 are as follows.

- *Part 1: Recommendations for the preparation of drawings of semiconductor devices;*  
(Technically equivalent to IEC 191-1)
- *Part 2: Schedule of international drawings giving dimensions;*  
(Identical with IEC 191-2)
- *Part 4: Recommendations for a coding system and classification into forms of package outlines for semiconductor devices;*  
(Identical with IEC 191-4)
- *Part 5: Recommendations for tape automated bonding (TAB) of integrated circuits;*  
(Identical with IEC 191-5)
- *Part 6: Specification for the preparation of outline drawings of surface mounted semiconductor device packages;*  
(Identical with IEC 191-6)
- *Part 10: Schedule of UK national drawings giving dimensions.*

All purely national work in this area is issued in BS 3934-10.  
BS 3934-1 to BS 3934-6 and BS 3934-10 supersede BS 3934:1965, which is withdrawn.

## Cross-references

Details of International Standards quoted in this British Standard for which there is an identical or technically equivalent British Standard are given below.

| International Standard <sup>a</sup> | Corresponding British Standard                                                                                          |
|-------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
|                                     | BS 3934: <i>Mechanical standardization of semiconductor devices</i>                                                     |
| IEC 191-1:1966                      | Part 1:1992 <i>Recommendations for the preparation of drawings of semiconductor devices</i><br>(Technically equivalent) |
| IEC 191-2:1966                      | Part 2:1992 <i>Schedule of international drawings giving dimensions</i><br>(Identical)                                  |

<sup>a</sup> Undated in the text.

A related British Standard to ISO 1101 and ISO 2692 is BS 308 *“Engineering drawing practice”* Part 3:1990 *“Recommendations for geometrical tolerancing”*.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

**Compliance with a British Standard does not of itself confer immunity from legal obligations.**

#### **Summary of pages**

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 40, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

## 1 Scope

This recommendation on mechanical standardization gives recommended practice for the preparation of drawings of integrated circuit outlines.

## 2 Terminology and definitions

### 2.1

#### **package outline drawing**

the drawing of a package which specifies the dimensional characteristics and other closely associated features which are required for mechanical interchangeability

### 2.2

#### **seating plane**

a plane which designates the plane of contact of the package, including any stand-off, with the surface on which it will be mounted

NOTE This is often used as the reference plane.

### 2.3

#### **base plane**

a plane drawn parallel to the seating plane through the lowest point of the package, excluding any stand-off

### 2.4

#### **gauging plane**

a plane perpendicular to the terminals, at which the position of the terminals is controlled

NOTE In some packages, two or more of the above-mentioned planes may coincide.

### 2.5

#### **terminal position**

one of a series of equally spaced locations on a circle or on a row which may or may not be occupied by a terminal

### 2.6

#### **visual index**

a reference feature (e.g. mark, chamfer, notch, tab, depression, etc.) which identifies the first terminal position

### 2.7

#### **index area**

the area in which a portion or all of the visual index must lie

### 2.8

#### **mechanical index**

a feature (e.g. tab, notch, flat, groove, etc.) which provides orientation during automatic handling where possible, the mechanical index should coincide with the visual index

### 2.9

#### **index centre line or datum line**

a centre line through a visual index feature (e.g. tab) which is used to orientate the index with the first terminal position

### 2.10

#### **grid reference corner**

the first terminal position (viewed from the free end of the terminals) in an alphanumeric grid system

### 2.11

#### **terminal row**

a series of equally spaced terminal positions which are located on a straight line

### 2.12

#### **terminal circle**

a series of equally spaced terminal positions which are located on a circle

### 2.13

#### **gauging zone**

a control zone within which positional tolerances for the terminal axes or the planes of terminal symmetry are specified

## 3 Cross-referencing of packages

Cross-referencing is achieved by using the drawings in Appendix B as follows:

**3.1** Form 1 (axial) — Figure 9, Figure 10, Figure 11, Figure 12, Figure 13 and Figure 14.

**3.2** Form 2 (axial) — Figure 15, Figure 15a, Figure 16 and Figure 17.

**3.3** Form 3 (axial) — Figure 18, Figure 19 and Figure 20.

**3.4** Form 4 (peripheral) — Figure 21, Figure 22, Figure 23, Figure 24 and Figure 24a.

**3.5** Form 5 (special).

This form, for which there are no examples given in Appendix B, refers to figures which are combinations of axial and peripheral or which, for other reasons, e.g. leadless packages, do not fit in the axial or peripheral categories.

## 4 Terminal identification — Numbering of terminals

Where possible, device terminals should be identified according to the following rules.

### 4.1 Devices with terminals disposed in linear array

(See Figure 10 in Appendix B.)

The terminals are considered as being viewed from their free ends. The terminal nearest the visual index should be numbered as No. 1, the other terminals should be numbered progressively from terminal No. 1.

#### **4.2 Devices with terminals disposed on a single circular array**

(See Figure 18 and Figure 19 in Appendix B.)

The terminals are considered as being viewed from their free ends. The terminal, the centre of which is past the datum line of the visual index, should be numbered as No. 1, the other terminals should be numbered progressively and in clockwise sequence from terminal No. 1.

Where omission of one terminal in an otherwise equally spaced array identifies the datum line, the position of the omitted terminal should not be numbered; but in a fixed modular circuit array, any location of omitted terminal which does not define a datum line shall be numbered.

#### **4.3 Devices with terminals disposed on multiple circular arrays**

(See Figure 20 in Appendix B.)

The rules given in Sub-clause 4.2 will be applied as follows: the terminals located on the pitch circle of the largest diameter should be numbered A1, A2, A3, etc., the terminals located on the other pitch circles of decreasing diameter should be numbered progressively B1, B2, B3, etc., C1, C2, C3, etc.

#### **4.4 Devices with terminals disposed on a square or rectangular periphery**

(See Figure 9, Figure 11, Figure 12, Figure 14, Figure 15, Figure 15a, Figure 16, Figure 17, Figure 21, Figure 22, Figure 23, Figure 24 and Figure 24a in Appendix B.)

Visual identification of the top of the device should be provided. The means of identification of terminal position No. 1 should also be provided. These identifications may be combined.

The terminal positions should be numbered progressively in an anti-clockwise direction around the periphery of the device as viewed from the top. The terminal position No. 1 shall be the first position anti-clockwise from the means of identification.

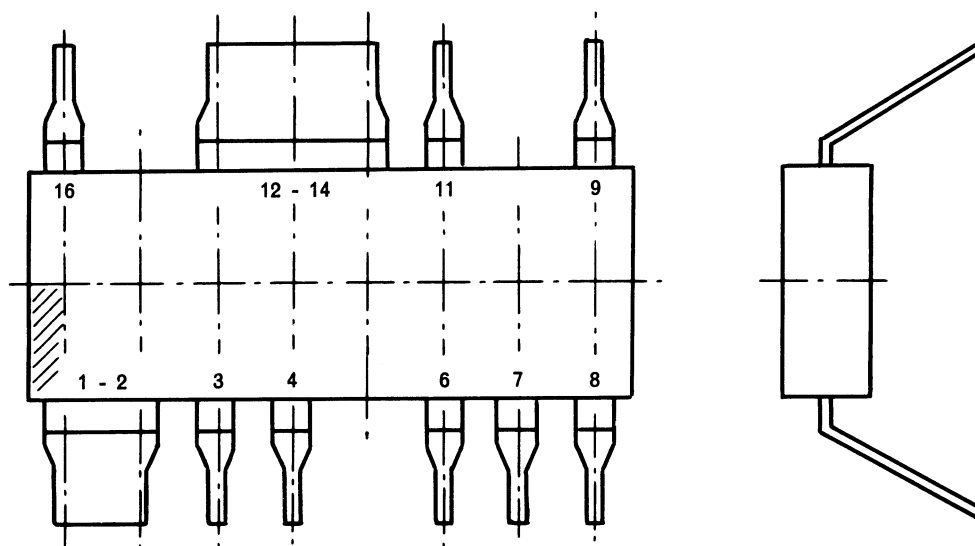
Each terminal shall be identified by the number of its position. Terminals may not necessarily be present in all the numbered positions, but those present shall have the number of the position.

When a terminal occupies more than one terminal position, this terminal should be identified by the number of the first and the last occupied terminal positions, these two numbers being separated by a dash.

For a theoretical example, see Figure 1, page 3.)

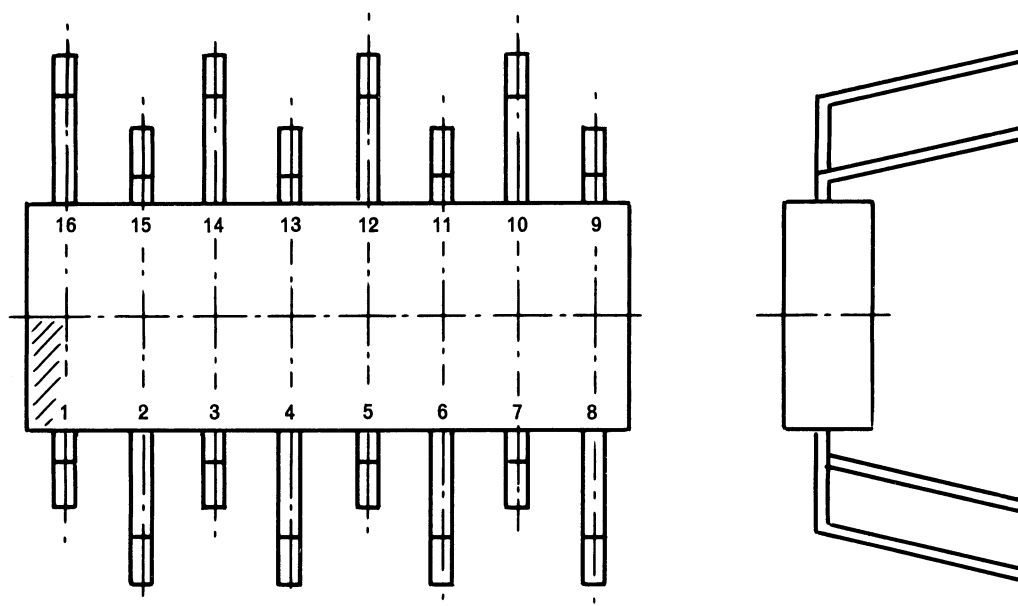
When the device presents more than two rows of terminals in one direction, because the folding of the terminals emerging in one plane has been made in more than two planes, the terminals should be numbered progressively in correspondence with the position of their point of emergence from the body of the device.

(For an example, see Figure 2, page 3.)



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Figure 1 — Theoretical example showing how to number the terminals of a device with terminals disposed on a rectangular periphery and with some of them occupying more than one terminal position



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Figure 2 — Example showing how to number the terminals of a "QUIL" package

#### 4.5 Devices with terminals disposed in three or more rows in each orthogonal direction

(See Figure 13 in Appendix B.)

1. The terminal position should be on an orthogonal network of equal pitch respectively in both directions.
2. Terminal positions shall be numbered whether or not a terminal is present.
3. With the device viewed from the free end of the terminals and from the index area in the lower left:
  - a) the first vertical row is numbered 1, the other vertical rows are numbered progressively from No. 1;
  - b) the first horizontal row is lettered A, the other horizontal rows are lettered in alphabetical order from A (without using I and O).

(Figure 25 in Appendix C shows an example of this designation system.)

#### 4.6 When more than 24 rows are possible, the rows after row Z shall be given an alphabetical prefix, e.g. AA, AB, etc.

(Figure 26 in Appendix C shows an example of a device having two rows near to the edges of the long side of the package and with a pitch equal to “e” in one direction and “2e” in the other and with a distance equal to “24e” between the inner two rows.)

### 5 Dimensions and reference letter symbols

#### 5.1 Seated height (*A*)

Distance from the seating plane to the highest point of the package.

#### 5.2 Stand-off height (*A*<sub>1</sub>)

Distance between the seating plane and the base plane.

#### 5.3 Package height (*A*<sub>2</sub>)

Distance from the base plane to the highest point of the package.

#### 5.4 Terminal circle diameter ( $\varnothing\alpha$ , $\varnothing\alpha_A$ , $\varnothing\alpha_B$ , etc.)

Diameter of the circle upon which the terminal positions are located.

$\varnothing\alpha$  should be used for the largest pitch circle diameter when there is more than one pitch circle present.

#### 5.5 Stand-off major dimension (*B*)

Major dimension of the stand-off cross-section.

#### 5.6 Stand-off minor dimension (*B*<sub>1</sub>)

Minor dimension of the stand-off cross-section.

#### 5.7 Stand-off diameter ( $\varnothing B$ )

Diameter of the stand-off cross-section.

#### 5.8 Terminal width (*b*)

Major dimension of the cross-section of a terminal.

#### 5.9 Other terminal width(s) (*b*<sub>1</sub>, *b*<sub>2</sub>, *b*<sub>3</sub>, etc.)

#### 5.10 Terminal diameter(s) ( $\varnothing b$ , $\varnothing b_0$ , $\varnothing b_1$ , $\varnothing b_2$ , $\varnothing b_3$ , etc.)

Diameter of the circumscribed circle containing the terminal.

NOTE  $\varnothing b_0$  and  $\varnothing b_2$  usually refer to diameters which are closely controlled over a specified terminal length (see Figure 18 and Figure 19).

#### 5.11 Terminal thickness (*c*)

Minor dimension of the cross-section of a terminal.

#### 5.12 Package length (*D*)

Major dimension of the package, excluding terminals, measured in a plane parallel to the seating plane.

NOTE If terminals are presented for mounting in two opposite directions only, they are deemed to extend in the width direction (*E*) (see Figure 24a).

#### 5.13 Other package length(s) (*D*<sub>1</sub>, *D*<sub>2</sub>, etc.)

Other package length(s), usually smaller than *D*.

#### 5.14 Package diameter ( $\varnothing D$ )

Major diameter of the package, excluding terminals, measured in a plane parallel to the seating plane.

#### 5.15 Other package diameter(s) ( $\varnothing D_1$ , $\varnothing D_2$ , etc.)

Other package diameter(s), usually smaller than  $\varnothing D$ .

#### 5.16 Stand-off spacing(s), linear (*d*, *d*<sub>1</sub>, *d*<sub>2</sub>, *d*<sub>A</sub>, *d*<sub>B</sub>, etc.)

Linear spacing(s) between true positions of stand-off centres.

#### 5.17 Package width (*E*)

Minor dimension of the package, excluding terminals, measured in a plane parallel to the seating plane.

#### 5.18 Other package width(s) (*E*<sub>1</sub>, *E*<sub>2</sub>, etc.)

Other package width(s), usually smaller than *E*.

#### 5.19 Terminal spacing, linear (*e*, *e*<sub>1</sub>, *e*<sub>2</sub>, *e*<sub>A</sub>, *e*<sub>B</sub>, etc.)

Linear spacing between true positions of terminal centres.

#### 5.20 Flange zone height (*F*)

Overall dimension of the flange zone including any fillet, measured from the base plane.

#### 5.21 Flange height (*F*<sub>1</sub>)

Flange dimension excluding any fillet.

**5.22 Package length zone ( $G_D$ )**

Length of a zone which includes the actual package length, package irregularities and the uncontrolled part of any peripheral terminals which are presented for mounting in the length direction.

**5.23 Package width zone ( $G_E$ )**

Length of a zone which includes the actual package width, package irregularities and the uncontrolled part of any peripheral terminals which are presented for mounting in the width direction.

**5.24 Package diameter zone ( $\varnothing G$ )**

Diameter of a zone which includes the actual package diameter, package irregularities and the uncontrolled part any peripheral terminals which are presented for mounting radially.

**5.25 Overall length ( $H_D$ )**

Largest overall dimension, including package length, of peripheral terminals which are presented for mounting the length direction.

**5.26 Overall width ( $H_E$ )**

Largest overall dimension, including package width, of peripheral terminals which are presented for mounting the width direction.

**5.27 Overall diameter ( $\varnothing H$ )**

Largest overall diameter of peripheral terminals which are presented for mounting radially.

**5.28 Index height or depth ( $h$ )**

Height or depth of index feature.

**5.29 Index width ( $j$ )**

Width of index feature.

**5.30 Index length ( $k$ )**

Length of index feature.

On cylindrical packages, the index length (e.g. tab) is measured from the actual overall diameter  $\varnothing D$  of the device.

**5.31 Terminal length(s) ( $L, L_0$ )**

Length(s) of terminal available for mounting, measured from the seating plane.

NOTE  $L_0$  usually refers to that part of the terminal over which the diameter ( $\varnothing b_0$ ) is closely controlled (see Figure 19, Appendix B).

**5.32 Terminal length(s) ( $L_D, L_E$ )**

Controlled terminal zone(s) for mounting, measured from ends of peripheral terminals.

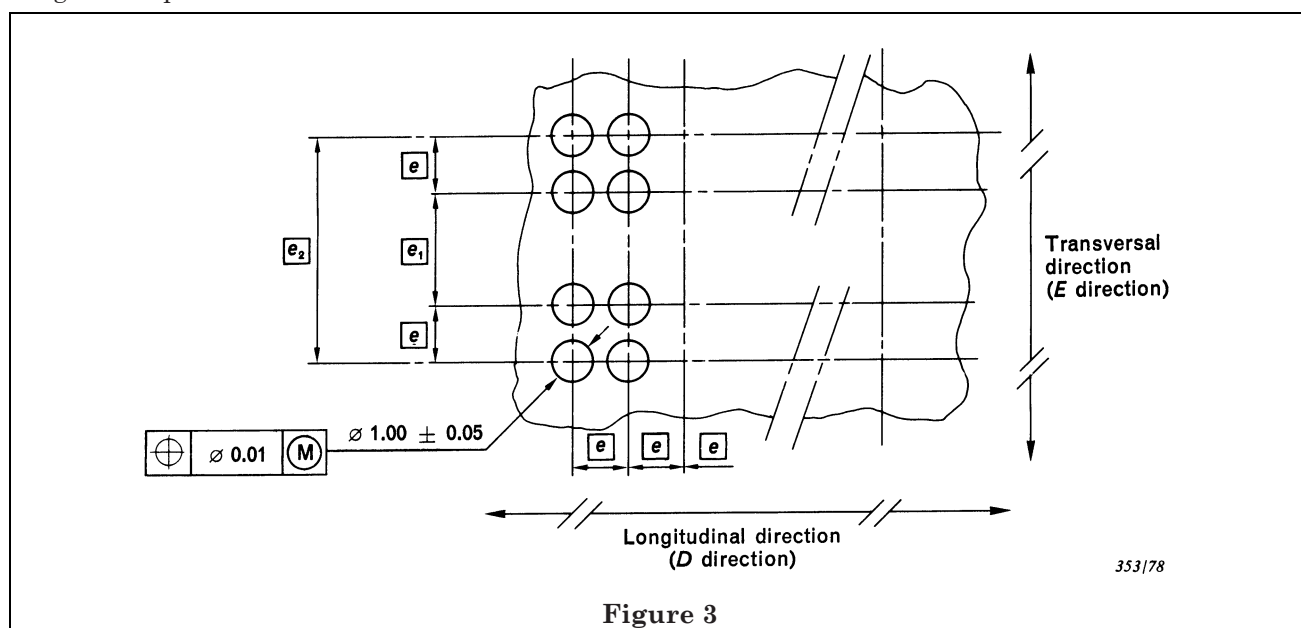
**5.33 Terminal length(s) ( $L_1, L_2, L_3$ , etc.)**

Terminal length(s) measured from the base plane.

NOTE  $L_2 - L_1$  usually refers to that part of the terminal over which terminal diameter ( $\varnothing b_2$ ) is closely controlled.

**5.34 Mounted length ( $M_D$ )**

Distance measured parallel to the seating plane, in the  $D$  direction, between the outer faces of the outer rows of terminals, when the device is fully seated in the holes of a given gauge (see notes 1 and 2 of Sub-clause 5.35).



### 5.35 Mounted width ( $M_E$ )

Distance measured parallel to the seating plane, in the  $E$  direction, between the outer faces of the outer rows of terminals, when the device is fully seated in the holes of a given gauge.

NOTE 1  $M_D$  ( $M_E$ ) shall be measured between two planes, perpendicular to the seating plane, which are in contact with the outer faces of the terminals in the outer rows at their widest point above the seating plane, when viewed parallel to the transversal (longitudinal) centre line [centre line in the  $E$  ( $D$ ) direction] of the device.

Figure 3, shows an example of holes in a gauge for QUIL packages, in which the device will be seated.

NOTE 2  $M_D$  ( $M_E$ ) *max.* shall be chosen to be equal to the sum of the terminal rows spacing and the mounting hole diameter, rounded up to the first decimal value.

### 5.36 Quantity of terminal positions ( $n$ )

Total quantity of potential terminal positions in accordance with the specified terminal position designation system. The actual quantity of terminals present may be less than ( $n$ ).

### 5.37 Allowable quantity of missing terminals ( $n_1$ )

Maximum quantity of terminal positions which can be unoccupied.

### 5.38 Package mounting hole diameter ( $\varnothing p$ )

Diameter of the hole in the package for mounting.

### 5.39 Terminal emergence height ( $Q$ )

Distance from the seating plane to the underside of the terminals where they emerge from the package.

### 5.40 Terminal emergence dimension ( $Q_1$ )

Distance from the top surface of the package to the top surface of terminals where they emerge from the package.

### 5.41 Other terminal emergence dimensions ( $Q_2$ , $Q_3$ , etc.)

Dimensions of other terminal features.

### 5.42 Package overhang(s) ( $Z$ , $Z_1$ , $Z_2$ , etc.)

Distance from the end terminal true position to the extremity of the package.

In the case where the terminals extend beyond the package,  $Z$ ,  $Z_1$  shall be specified as zero. Negative dimensions shall not be used.

The overhang at the opposite end of the package, if different from  $Z$ , shall be designated as  $Z_1$  (see Figure 9, Appendix B).

NOTE It is recommended that the minimum and maximum values of  $Z$  ( $Z_1$ ) fulfil one of the following relations:

$$Z \leq \frac{e}{2}$$

$$\frac{e}{2} < Z \leq e$$

$$e < Z \leq \frac{3e}{2} \text{ etc.}$$

### 5.43 Index datum angle(s) ( $\alpha$ , $\alpha_A$ , $\alpha_B$ , etc.)

Angular spacing between the index feature (datum) and the first terminal true position on a terminal circle.

$\alpha_A$  should be used for the angular spacing between the index feature and the first terminal located on the largest diameter circle.

### 5.44 Terminal spacing, angular ( $\beta$ , $\beta_A$ , $\beta_B$ , etc.)

Angular spacing between true positions of terminal centres.

$\beta_A$  refers to the largest diameter circle.

### 5.45 Angle(s), base ( $\gamma$ , $\gamma_1$ , $\gamma_2$ , etc.)

Other angular features associated with the base.

### 5.46 Terminal spread, angular ( $\theta$ )

Angle between the terminal and a line perpendicular to the seating plane.

### 5.47 Angle(s), package ( $\theta_1$ , $\theta_2$ , etc.)

Other angular features associated with the package.

## 6 Drawing layout

The requirements of Sub-clause 1.1 of IEC Publication 191-1 are applicable.

## 7 Dimensioning and tolerances

The requirements of Sub-clause 1.2 of IEC Publication 191-1 are applicable, except for Sub-clause 1.2.9.

The principles given in ISO Recommendation ISO No. 1101, formerly ISO No. 1016, are also applicable. The limits which should normally be given for the dimensions listed in Section 5 above are contained in the table of Appendix A.

## 8 Inter-conversion of inch and millimetre dimensions and rules for rounding-off

The requirements of Sub-clause 1.3 of IEC Publication 191-1 are applicable.

## 9 Definition of families

### 9.1 Family of Form 1

Under consideration.

### 9.2 Family of Form 2

Under consideration.

### 9.3 Family of Form 3

The family of Form 3 is defined by the following list of fixed dimensions (examples are shown in Figure 18 to Figure 20, pages 21 and 22):

|                                |                                                                                                             |
|--------------------------------|-------------------------------------------------------------------------------------------------------------|
| Terminal pitch circle diameter | $\varnothing a$ nom. <sup>a</sup>                                                                           |
| Terminal diameter              | $\left\{ \begin{array}{l} \varnothing b_2 \text{ min.} \\ \varnothing b_2 \text{ max.} \end{array} \right.$ |
| Package diameter               | $\varnothing D$ max.                                                                                        |

<sup>a</sup> Means true geometrical position.

### 9.4 Family of Form 4

The family of Form 4 is defined by the following list of fixed dimensions (examples are shown in Figure 21 to Figure 24, pages 23 and 24):

|                              |                                                                                     |
|------------------------------|-------------------------------------------------------------------------------------|
| Seated height                | $A$ max.                                                                            |
| Terminal width               | $\left\{ \begin{array}{l} b \text{ min.} \\ b \text{ max.} \end{array} \right.$     |
| Terminal thickness           | $\left\{ \begin{array}{l} c \text{ min.} \\ c \text{ max.} \end{array} \right.$     |
| Terminal spacing linear      | $e$ nom. <sup>a</sup>                                                               |
| Package width zone<br>and/or | $G_E$ max.                                                                          |
| Package length zone          | $G_D$ max.                                                                          |
| Terminal length              | $L_D$ min., $L_E$ min.                                                              |
| Overall width<br>and/or      | $\left\{ \begin{array}{l} H_E \text{ min.} \\ H_E \text{ max.} \end{array} \right.$ |
| Overall length               | $\left\{ \begin{array}{l} H_D \text{ min.} \\ H_D \text{ max.} \end{array} \right.$ |

<sup>a</sup> Means true geometrical position.

## 10 Examples of drawings

See Appendix B.

## 11 Design procedure for dimensions of integrated circuit packages

### 11.1 Integrated circuit packages of Form 2 family

See Appendix D.

### 11.2 Packages of form G intended for automated handling

See Appendix E.

## 12 Rules for mounting integrated circuit packages into carriers

Devices, when supplied in carriers, will be mounted with terminal No. 1 position at the side with the polarizing slot:

— For dual-in-line packages, terminal No. 1 will be at the end of the carrier which has two polarizing cut-outs (see Figure 4, page 8).

— For flat packages, terminal No. 1 will be at the end of the carrier which has one polarizing cut-out (see Figure 5, page 8).

## 13 Bending of terminals of QUIL packages (packages of a sub-family of Form 2)

1) As specified in Sub-clause 4.4, the position of terminal No. 1 shall be the first position anti-clockwise from the means of identification, the device being viewed from the top.

2) Bending of terminal No. 1 shall be made so that the free end of this terminal will be on the row of terminal ends, the axial spacing of which is  $e_1$ , in other words the row nearest to the package side from which terminals exit.

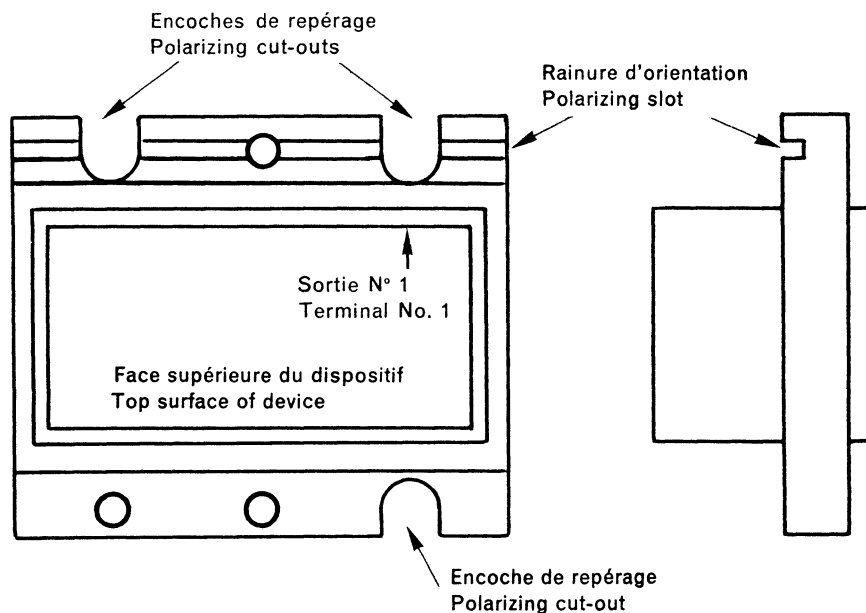
NOTE Rule 2 should apply without restriction to asymmetrically staggered QUIL packages (see Figure 6, page 9). For symmetrically staggered QUIL packages, it is a preferential recommendation to be followed when a new package is designed (see Figure 7 and Figure 8, page 9).

## 14 Pin grid arrays

See Appendix F.

## 15 Rule for orientation of integrated circuit packages in handling and shipping carriers such as stick magazines and rails

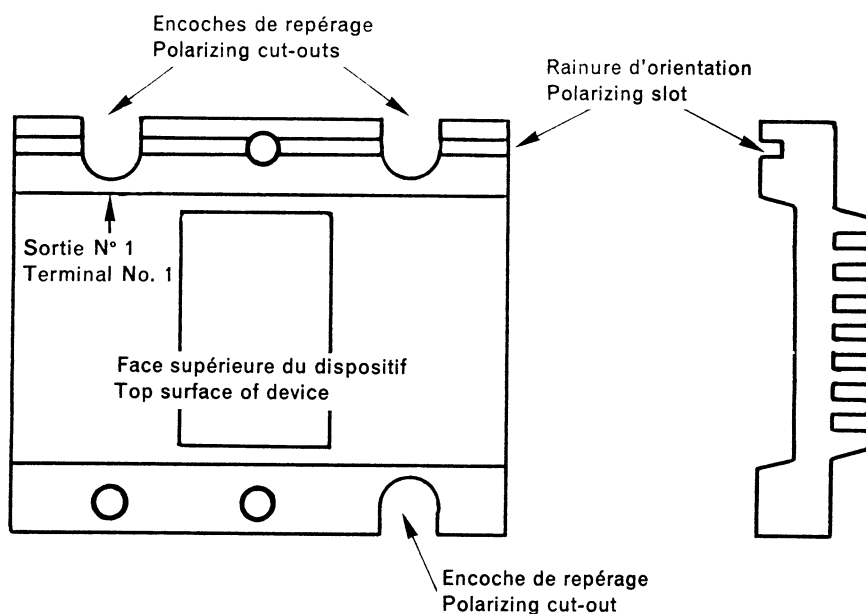
See Appendix G.



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NOTE Dimensions of this carrier are dependent on the corresponding dual-in-line packages, but its precise shape is not mandatory.

**Figure 4 — Example of carrier for dual-in-line packages showing the recommended method for locating terminal No. 1 by means of polarizing slot and cut-outs**



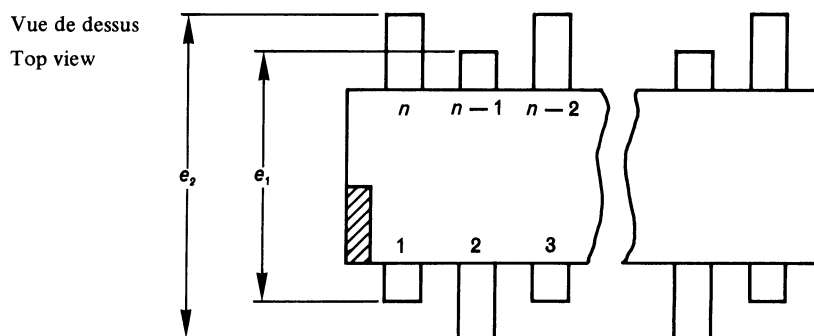
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NOTE Dimensions of this carrier are dependent on the corresponding flat packages, but its precise shape is not mandatory.

**Figure 5 — Example of carrier for flat packages showing the recommended method for locating terminal No. 1 by means of polarizing slot and cut-outs**

## Asymmetrically staggered QUIL package

(Exemple de dessin – Drawing example)

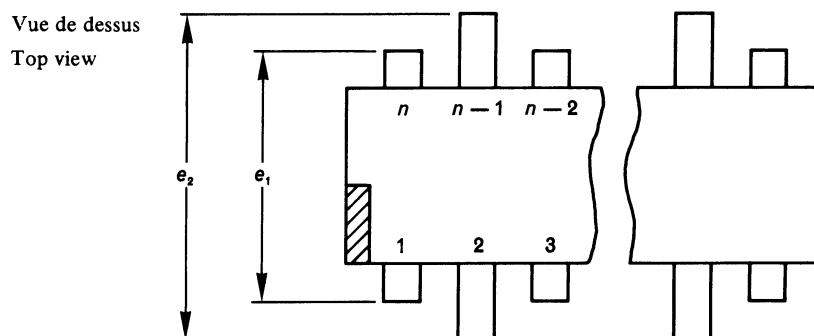


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Figure 6 — Standardized version

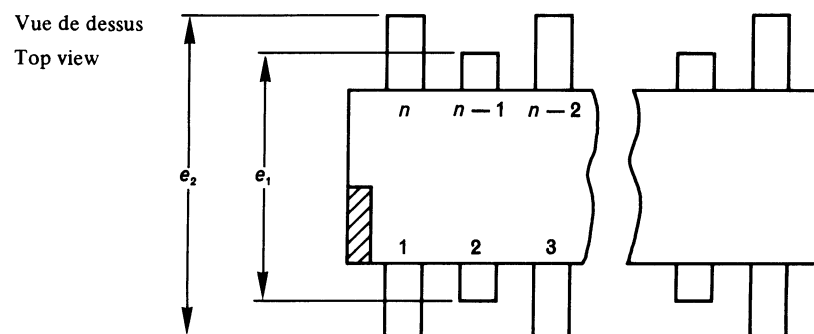
## Symmetrically staggered QUIL packages

(Exemples de dessin – Drawing examples)



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Figure 7 — Preferred version



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Figure 8 — Permitted version