

Mechanical standardization of semiconductor devices —

Part 3. General rules for the preparation of outline drawings of integrated circuits

The European Standard EN 60191-3:1999 has the status of a
British Standard

ICS 01.100.25; 31.080.01

National foreword

This British Standard is the official English language version of EN 60191-3:1999. It is identical with IEC 60191-3:1999. It supersedes BS 3934-3:1992 which is withdrawn.

The UK participation in its preparation was entrusted by Technical Committee EPL/47, Semiconductors, to Subcommittee EPL/47/4, Mechanical standardization, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

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Cross-references

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Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 57 and a back cover.

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Normalisation mécanique des
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Partie 3: Règles générales pour
la préparation des dessins
d'encombrement des circuits intégrés
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Mechanische Normung von
Halbleiterbauelementen
Teil 3: Allgemeine Regeln für die
Erstellung von Gehäusezeichnungen
für integrierte Schaltungen
(IEC 60191-3:1999)

This European Standard was approved by CENELEC on 1999-10-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Foreword

The text of document 47D/299/FDIS, future edition 2 of IEC 60191-3, prepared by SC 47D, Mechanical standardization of semiconductor devices, of IEC TC 47, Semiconductor devices, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60191-3 on 1999-10-01.

The following dates were fixed:

- latest date by which the EN has to be implemented
at national level by publication of an identical
national standard or by endorsement (dop) 2000-07-01
- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 2002-10-01

Annexes designated "normative" are part of the body of the standard.

Annexes designated "informative" are given for information only.

In this standard, annexes A, C, D, E, F, G, H, K and ZA are normative and annex B is informative.

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 60191-3:1999 was approved by CENELEC as a European Standard without any modification.

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MECHANICAL STANDARDIZATION OF SEMICONDUCTOR DEVICES –

Part 3: General rules for the preparation of outline drawings of integrated circuits

1 General

1.1 Scope

This part of IEC 60191 gives guidance on the preparation of drawings of integrated circuit outlines.

1.2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 60191. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of IEC 60191 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60191-1:1966, *Mechanical standardization of semiconductor devices – Part 1: Preparation of drawings of semiconductor devices*

IEC 60191-2:1995, *Mechanical standardization of semiconductor devices – Part 2: Dimensions*

IEC 60191-4:1999, *Mechanical standardization of semiconductor devices – Part 4: Coding system and classification into forms of package outlines for semiconductor devices*

ISO 1101-1, — *Geometrical Product Specification (GPS) – Geometrical tolerancing – Generalities, definitions, symbols, indications on drawings* ¹⁾

ISO 2692:1988, *Technical drawings – Geometrical tolerancing – Maximum material principle*

2 Terminology and definitions

For the purpose of this part of IEC 60191, the following definitions apply.

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.

¹⁾ To be published.

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 plane 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 or 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 should 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.

2.14

dambar

metal barrier extending between adjacent leads to restrict the flow of mold compound material between and along leads.

2.15

dambar protrusion

the presence of excess metal extending outward from the edge of a lead shoulder.

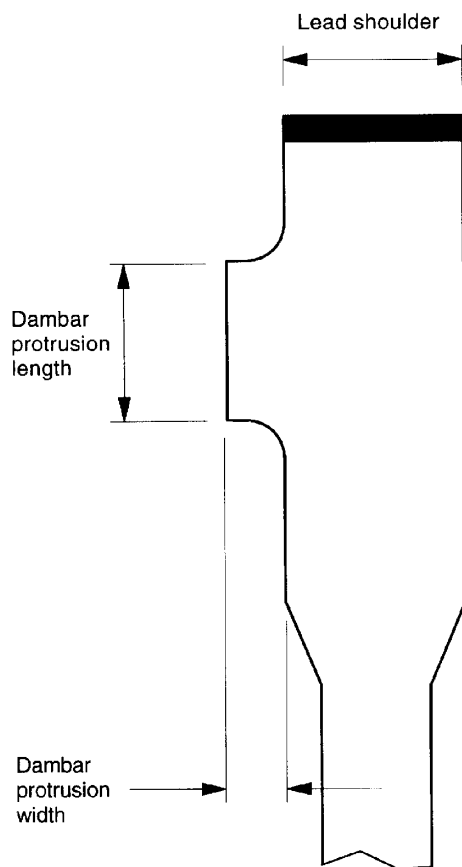
The width of the protrusion is the perpendicular distance from the defined lead edge to the outermost portion of the excess metal. The length of the protrusion is the largest dimension of the excess metal parallel to the defined lead edge (see figure 1a).

2.16

dambar intrusion

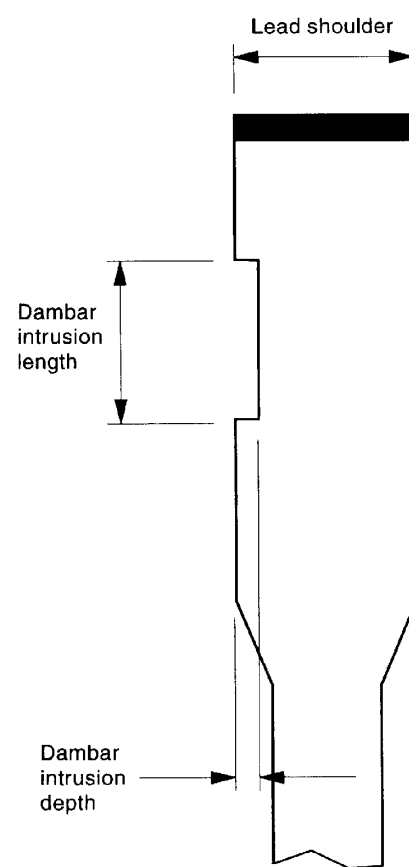
the absence of metal causing a discontinuity along the intended profile of a lead shoulder.

The depth of the intrusion is the perpendicular distance from the defined lead shoulder edge to the innermost edge of the region of absent metal. The length of the intrusion is the largest dimension of the region of absent metal parallel to the defined lead edge (see figure 1b).



IEC 739/98

Figure 1a – Protrusion



IEC 740/98

Figure 1b – Intrusion

Figure 1 – Dambar protrusion and intrusion

2.17

mold flash

opaque mold compound material attached to the finished part and extending onto, between, and/or around adjacent leads and package edges.

2.18

interlead (window) flash

opaque mold compound material attached to an area between adjacent leads remaining after dambar trim operations.

2.19

protrusion

plastic or metal excess material remaining from the molding and trim/form/singulation operations.

2.20

gate burrs

excess metal material remaining after singulating the package from its leadframe at the mold gate area.

3 Cross-referencing of packages

The classification into forms of package outlines for semiconductor devices in IEC 60191-4 has superseded the form descriptions of forms 1 - 5 below. The cross-referencing to forms 1 - 5 is given for information purposes only.

Cross-referencing is achieved by using the drawings in annex B as follows.

3.1 Form 1 (axial) – figures B.1, B.2, B.3, B.4, B.5 and B.6

3.2 Form 2 (axial) – figures B.7, B.7a, B.8 and B.9

3.3 Form 3 (axial) – figures B.10, B.11 and B.12

3.4 Form 4 (peripheral) – figures B.13, B.14, B.15, B.16, B.16a, B.17 and B.18

3.5 Form 5 (special)

This form, for which there are no examples given in annex 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 B.2)

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 figures B.10 and B.11)

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 in a 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 B.12)

The rules given in 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 figures B.1, B.3, B.4, B.6, B.7, B.7a, B.8, B.9, B.13, B.14, B.25, B.16, B.16a, B.17 and B.18)

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.

When terminal No. 1 marking is required on the bottom side of the package, the following convention is used (see figures H.1 and H.2).

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 last occupied terminal positions, these two numbers being separated by a dash.

(For a theoretical example, see figure 2.)

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 a theoretical example, see figure 3.)

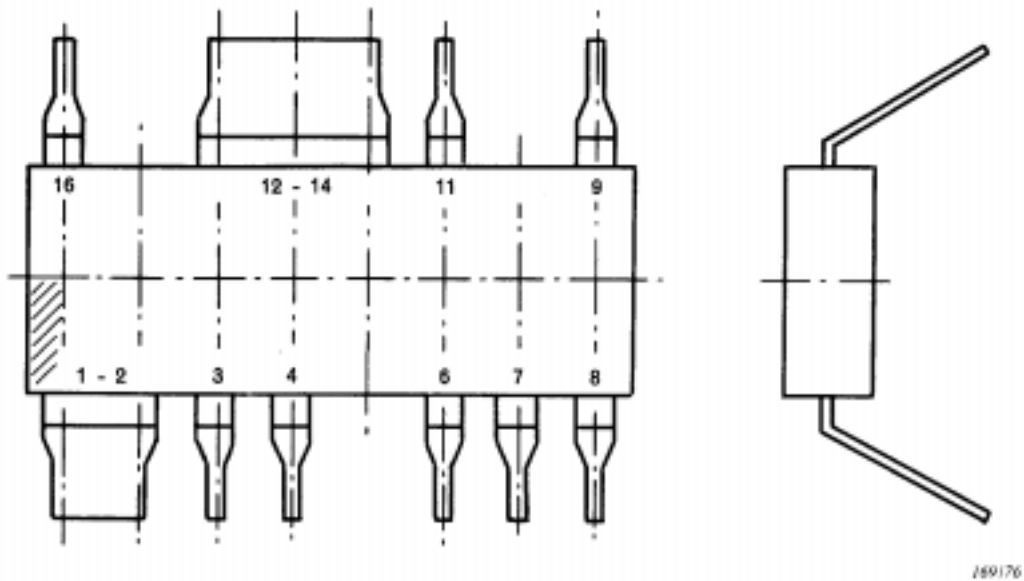


Figure 2 – Theoretical example showing how to number the terminals of a device with terminals disposed on a rectangular periphery and with some of them occupying more than one terminal position

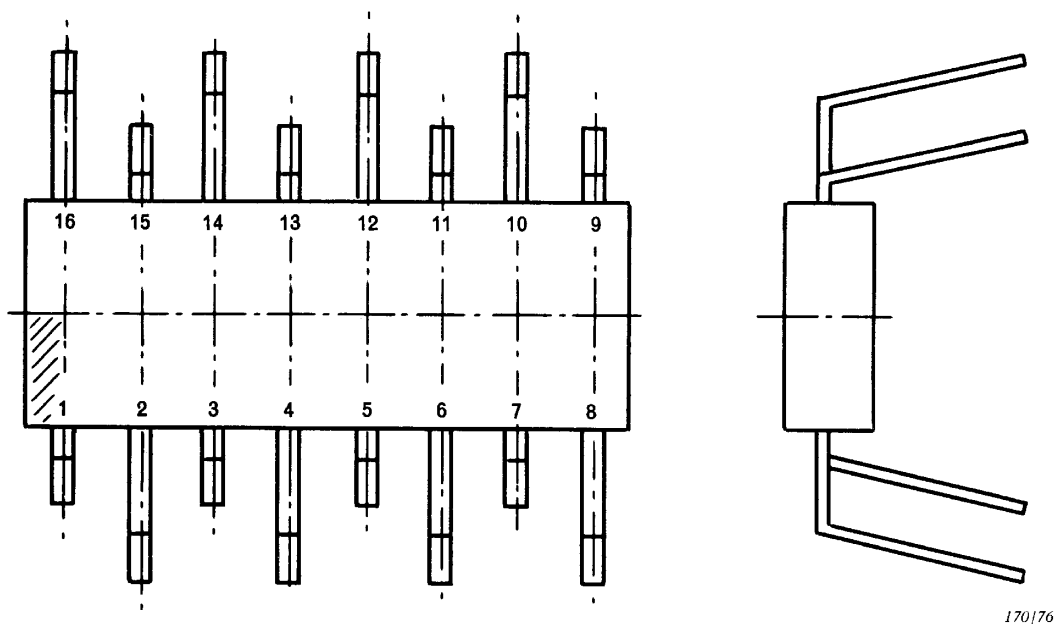


Figure 3 – Example showing how to number the terminals of a "QUIL" package

4.5 Devices with terminals disposed in three or more rows in each orthogonal direction (see figure B.5)

- 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 1;
 - b) the first horizontal row is lettered A, the other horizontal rows are lettered in alphabetical order from A (without using I, O, Q, S, X and Z).(Figure C.1 shows an example of this designation system.)
- 4) When more than 20 rows are possible, the rows after row Y (the 21st) shall be given an alphabetical prefix, AA, the 22nd AB, etc.
(Figure C.2 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 "20e" 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_1)

distance between the seating plane and the base plane.

5.3

package height (A_2)

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

5.4

terminal circle diameter ($\varnothing a$, $\varnothing a_A$, $\varnothing a_B$, etc.)

diameter of the circle upon which the terminal positions are located. $\varnothing a$ 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_1)

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_1, b_2, b_3 , 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 figures B.10 and B.11).

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 B.16a).

5.13

other package length(s) (D_1, D_2 , 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_1, d_2, d_A, d_B , 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_1, E_2 , etc.)

other package width(s), usually smaller than E .

5.19

terminal spacing, linear (e, e_1, e_2, e_A, e_B , 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_1)

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 of 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 in the length direction.

5.26

overall width (H_E)

largest overall dimension, including package width, of peripheral terminals which are presented for mounting in 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 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 B.11).

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 the 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 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) is 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 4 shows an example of holes in a gauge for QUIL packages, in which the device will be seated.

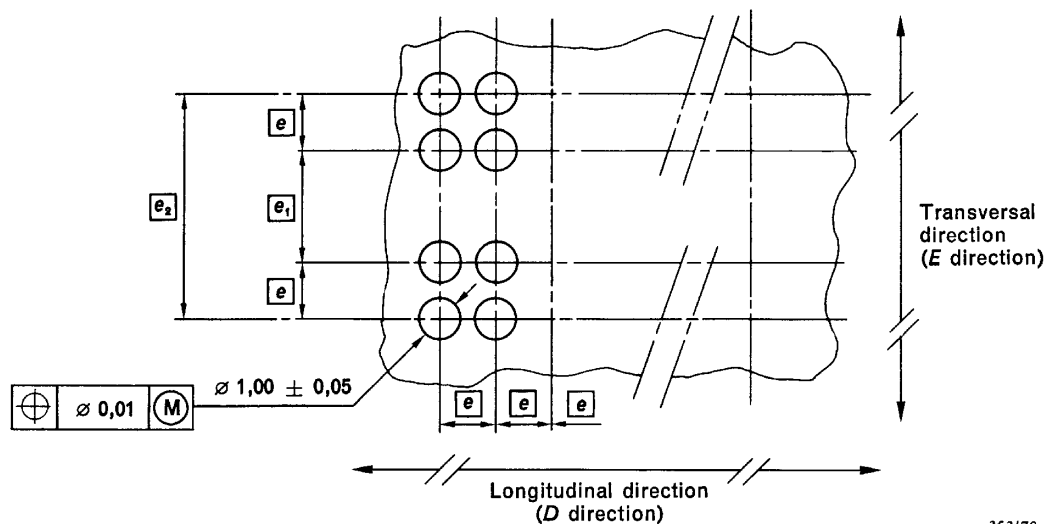


Figure 4 – Example of holes in a gauge for QUIL packages

NOTE 2 – M_D (M_E) max. is 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 B.1).

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

$$\begin{aligned} Z &\leq \frac{e}{2} \\ \frac{e}{2} &< Z \leq e \\ e &< Z \leq \frac{3e}{2} \text{ etc.} \end{aligned}$$

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.

α_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 (β , β_A , β_B , etc.)

angular spacing between true positions of terminal centres.

β_A refers to the largest diameter circle

5.45

angle(s) base (γ , γ_1 , γ_2 , etc.)

other angular features associated with the base.

5.46

Terminal spread, angular (θ)

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

5.47

angle(s), package (θ_1 , θ_2 , etc.)

other angular features associated with the package.

6 Drawing layout

The requirements of 1.1 of IEC 60191-1 are applicable.

7 Dimensioning and tolerances

The requirements of 1.2 of IEC 60191-1 are applicable, except for 1.2.9.

The principles given in ISO 1101, are also applicable. The limits which should normally be given for the dimensions listed in clause 5 above are contained in the table of annex A.

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

The requirements of 1.3 of IEC 60191-1 are applicable.

9 Definition of families

(For information only; see also clause 3.)

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 figures B.10 to B.12).

Terminal pitch circle diameter	$\varnothing a \text{ nom.}^*$
Terminal diameter	$\left\{ \begin{array}{l} \varnothing b_2 \text{ min.} \\ \varnothing b_2 \text{ max.} \end{array} \right.$
Package diameter	$\varnothing D \text{ max.}$

9.4 Family of form 4

The family of form 4 is defined by the following list of fixed dimensions (examples are shown in figures B.13 to B.18):

Seated height	$A \text{ max.}$
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	$e \text{ nom.}^*$
Package width zone	$G_E \text{ max.}$
and/or	
Package length zone	$G_D \text{ max.}$
Terminal length	$L_D \text{ min.}, L_E \text{ min.}$
Overall width	$\left\{ \begin{array}{l} H_E \text{ min.} \\ H_E \text{ max.} \end{array} \right.$
and/or	
Overall length	$\left\{ \begin{array}{l} H_D \text{ min.} \\ H_D \text{ max.} \end{array} \right.$

10 Examples of drawings

See annex B.

11 Design procedure for dimensions of integrated circuit packages

11.1 Integrated circuit packages of form G family

See annex D.

11.2 Packages of form G intended for automated handling

See annex 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:

* Means true geometrical position.