

Mechanical standardization of semiconductor devices —

Part 5: Recommendations applying to tape automated bonding (TAB) of integrated circuits

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the CEI IEC title page, page ii, pages 1 to 30 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.

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des dispositifs à semiconducteurs –**

**Partie 5:
Recommandations applicables aux boîtiers
à transfert automatisé sur bande (TAB)
des circuits intégrés**

**Mechanical standardization
of semiconductor devices –**

**Part 5:
Recommendations applying to integrated
circuit packages using tape automated
bonding (TAB)**



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Introduction

The recommendations contained in this standard cover the requirements for tape with bonded integrated circuits (IC) as supplied by a manufacturer to a user. They are not intended to govern strictly internal usage by a company such as the use of TAB as one step in the manufacture of QFP or other packages.

Dimensional values or requirements given in this standard for tape width, sprocket holes, test pad patterns, or outer leads, etc. correspond to the state of the technology at the date of publication of this standard. Tape width and sprocket hole dimensions have been derived from motion picture film standards. This standard does not attempt to define the ultimate possibilities of the technology. Progress in integrated circuit assembly technology may lead to inclusion of new or additional recommended dimensions in the future.

1 Scope

This part of IEC 60191 on mechanical standardization gives recommendations applying to integrated circuits supplied in packages using tape automated bonding (TAB) as the principal component for structural and interconnection functions. This standard is applicable to the finished component supplied by a manufacturer to a user and does not define requirements relating to the IC to tape interface (the inner lead bond or ILB).

2 Terms and definitions

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

2.1

chip (or die)

a portion of a silicon wafer which contains at least one integrated circuit which has been separated from the wafer containing an array of such devices

2.2

tape carrier¹⁾

a linear strip of a laminate of an insulating material and a conducting material patterned so as to mechanically support and electrically contact a chip. The strip may contain a series of such patterns and each such pattern is a tape site

2.3

sprocket hole

a row of holes on each side of the tape carrier used for driving the tape through equipment or for coarse alignment

2.4

lead pattern

the pattern of etched conductive material on a tape carrier including the inner and outer leads and the test pads

2.5

inner lead

the extreme interior end of the lead pattern conductor which is used for connection to a chip

2.6

device window

a perforation at the centre of a tape site within which the chip and the inner leads are located

2.7

outer lead or excise window

a rectangular perforation on each side of the tape site over which the conductor pattern is suspended. These perforations may form a continuous opening around the tape site. The bonded circuit is normally excised from the tape by cutting in this opening

¹⁾ "Tape carrier" may be abbreviated to "tape" when no confusion can arise.

2.8**support ring**

the portion of the insulating film which supports the conductor pattern between the device window and the outer lead window

2.9**body size**

the outside dimension of the support ring

2.10**outer lead**

the extreme exterior end of the lead pattern conductor which is used for connection at the next level of assembly after the bonded IC is excised from the tape carrier

2.11**alignment holes**

auxiliary holes in the polymer film used for fine alignment of the tape carrier during inner lead bonding, electrical test and burn-in, excise and outer lead bonding

2.12**test pads**

portions of the conductor pattern which are used to make electrical contact to the tape carrier during electrical test and burn-in operations

3 Description of tape automated bonding (TAB)

Tape automated bonding (TAB) is an assembly process applicable to integrated circuits (IC) which are used without conventional packages, that is with the silicon chip exposed. The basic principle is the attachment of each silicon chip to a special flexible tape. Like a flexible printed circuit, the tape consists of a thin plastic base on which metal conductors have been formed. At the inner end of the conductors the pattern matches the pattern of connecting pads on the chip. At the extreme outer end of the conductors, each conductor is attached to a pad for temporary contact for electrical test. Between the test pad locations and the chip connection points, there is a length of conductor unsupported by the insulating film which will ultimately form the outer lead of the TAB package. Like a movie film, the tape has a row of sprocket holes on each side of the tape width which are used to move the tape easily during processing.

The TAB tape is normally used in three main steps:

- a) inner lead bonding — IC chip pads are bonded to the inner ends of the conductors (the inner leads) on the tape. The surface of the bonded IC may then be coated with an organic protective layer, or the entire IC may be encapsulated.
- b) electrical test — Inner lead bonded chips can be electrically tested using the test pads provided on the tape. Similarly, the IC may be subjected to high temperature preconditioning or “burn-in”.
- c) outer lead bonding — The ICs are transferred to their final interconnection location (PC board or other substrate) after being excised from the tape. The unsupported lengths of conductor are retained after excising and form the outer leads of the TAB package. The outer leads are bonded to the final substrate.

The manufacturer of the TAB package normally performs all functions required by steps a) and b). The user will normally perform all functions required by step c). This standard defines the format of the product resulting from steps a) and b).

4 Dimensional requirements

The parameters that define a specific TAB variation are film format, body size, test pad pitch and outer lead pitch. Because the dimensions based on these four parameters can be organized into four groups with a high degree of commonality within each group, the complete dimensional requirements in this standard are presented in four tables of common dimensions (see Table 1 to Table 4). In addition, a table which shows the maximum lead count for each of the permutations of these four parameters is included (see Table 5).

4.1 Film format

The film format is defined by the tape width and the sprocket hole size.

Dimension D6 defines the tape width. The tape widths included in this standard are 35 mm, 48 mm and 70 mm. The outside edges of the tape should not be used as a mechanical reference except in the least sensitive operations. The length of an individual tape site when excised from a tape carrier strip is given by dimension E6.

Sprocket hole size is defined by dimension G. Only the sizes referred to as “super” and “wide” are included herein. Either super or wide sprocket holes are allowed with 48 mm and 70 mm tape formats, but only super sprocket holes are allowed with the 35 mm format.

Dimensions associated primarily with the film format are included in Table 1.

4.2 Alignment holes

Two options for the alignment holes are allowed. These features may be etched or punched holes in the support film, or etched metal features. Use of the film alignment hole option will require very precise alignment of the metallization artwork during tape manufacture in order for the finished tape to meet the positional tolerance requirements. Use of the metal alignment hole option decreases the need for such precise artwork alignment because the relationship between the alignment holes and the metallization in that case is the precision of the artwork itself. For these reasons the metal option is highly recommended for TAB packages with the finer outer lead or test pad pitches. The metal alignment feature is, however, more easily damaged and, when it is present on a package, should be used only for operations such as electrical test and burn-in that require the most precise alignment. Because of the area required for the metal ring, when the metal alignment hole is used, a reduction in the maximum number of test pads may be necessary.

The alignment holes are also used as features for defining datums X, Y and Z. All positional tolerances reference these datums.

The alignment hole size is defined by dimension F and their locations are defined by dimensions D5 and E5. The values of dimensions associated with the alignment holes are shown in Table 1.

4.3 Body size

The body size for the tape carrier package is given by dimensions D1 and E1. Only specific body sizes are possible or allowed for each tape width as follows:

Film format: body sizes

35 mm: 14 mm, 16 mm, 18 mm and 20 mm;

48 mm: 16 mm, 20 mm, 24 mm, 26 mm and 28 mm;

70 mm: 24 mm, 28 mm, 32 mm, 36 mm and 40 mm.

Dimensions associated primarily with the body size of a tape carrier package are included in Table 2.

4.4 Test pad patterns

All test pads are arranged in two nested rows on all four sides of the tape site. The length and width of the test pads are defined by dimensions B1 and B2. The overall pitch of the test pad array is defined by dimension e1, but the two rows on each side are staggered so that the pitch within each row is two times e1. The location of the test pad arrays on the tape site are defined by dimensions D3, D4, E3 and E4; the pitch between the two rows is a constant value for tape widths.

The number of test pads on the tape carrier package is given by the values for the symbols M1, M2, M3 and M4 for the four allowed test pad pitches. These values are dependent on the test pad pitch and the available space between the alignment holes on each side of the tape site. The minimum spacing between the edge of the outermost test pad and the alignment hole centre is 1,20 mm for the film hole option and 1,40 mm for the metal hole option. The centre pad in the outer row of test pads on each side of the tape site is electrically connected only when an odd number of outer leads per side is used and is identified with a special shape.

Dimensions primarily associated with the test pad patterns are included in Table 1 and Table 3.

4.5 Outer lead patterns

The pitch and width of the outer lead conductors is defined by dimensions e and b. Prior to excise and outer lead bonding, the outer lead conductors span the outer lead window defined by dimensions D and D1. An even number of leads per side of the tape carrier package is required for all combinations of tape format and body size with the exception of 35 mm tape with 20 mm body and 48 mm tape with 28 mm body. For these two combinations only, an odd number of leads per side is defined. The maximum number of leads for each tape carrier package is determined on the basis of lead pitch, body size, number of test pads and conductor routing between outer leads and test pads. All outer leads shall be connected to a test pad.

Dimensions associated primarily with the outer lead pattern are included in Table 4.

4.6 Maximum lead count

The specified lead counts in Table 5 have been determined by studies of the routing between the outer leads and the test pads. These studies followed a design rule requiring that the minimum width of conductors and the spaces between them be 60 μm . This rule represents the manufacturing state of the art for TAB tape. The difficulty of routing outer leads to test pads proved to be the primary limiting factor for maximum lead count and not the number of test pads or the outer lead pitch. These routing studies also demonstrated the occurrence of unroutable variations and of duplication of the same lead count for different combinations. So, only a subset of the possible variations has been explicitly assigned variation codes in the table. The four criteria that were used to select the coded variations were the following:

- code variations only which can be routed following the 60 μm design rule;
- code variations only where an increase in body size results in an increase in lead count;
- code variations only where a decrease in test pad pitch results in an increase in lead count;
- code variations only where a decrease in outer lead pitch results in an increase in lead count.

Some duplicate lead count variations have been assigned codes where choices among film format, outer lead pitch and test pad pitch options could not be easily made. The configurations which have been assigned variation codes are those that are recommended for general use. (See Annex A and Annex B for super and wide variations respectively.)

5 Variation codes

Variations have been coded using the form UY-ZW where U represents the film format, Y represents the body size, Z represents the test pad pitch, and W represents the outer lead pitch. The allowed values for each of these variables are as follows:

U = A, B or C for 35 mm, 48 mm or 70 mm super format and D or E for 48 mm and 70 mm wide format respectively;

Y = A, B, C, D, E, F, G, H, J or K for 14 mm $\times$ 14 mm to 40 mm $\times$ 40 mm square body sizes respectively (note that the letter l is not used);

Z = 1, 2, 3 or 4 for 0,50 mm, 0,40 mm, 0,30 mm or 0,25 mm test pad pitch respectively;

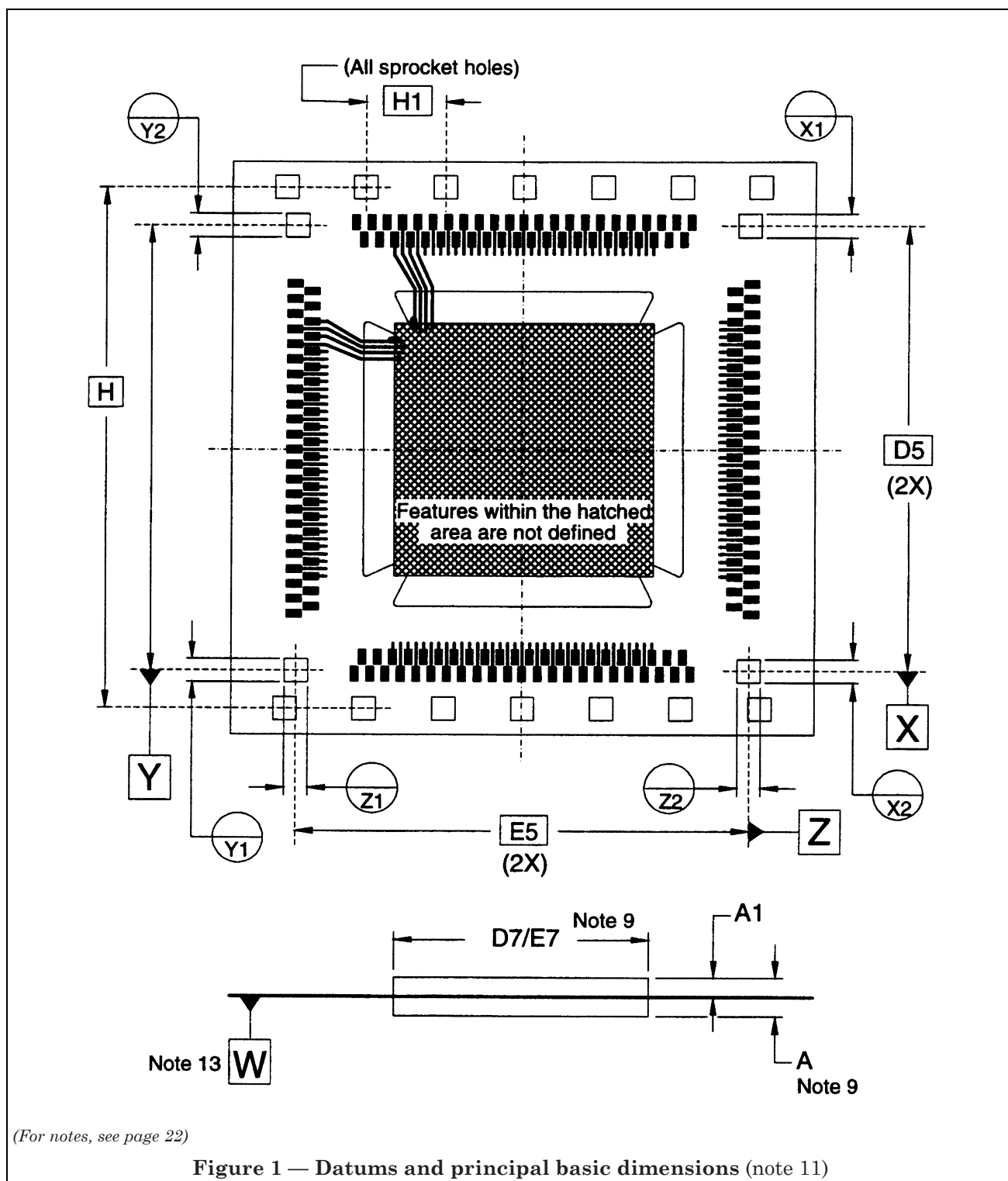
W = 1, 2, 3, 4, 5 or 6 for 0,50 mm, 0,40 mm, 0,30 mm, 0,25 mm, 0,20 mm or 0,15 mm outer lead pitch respectively.

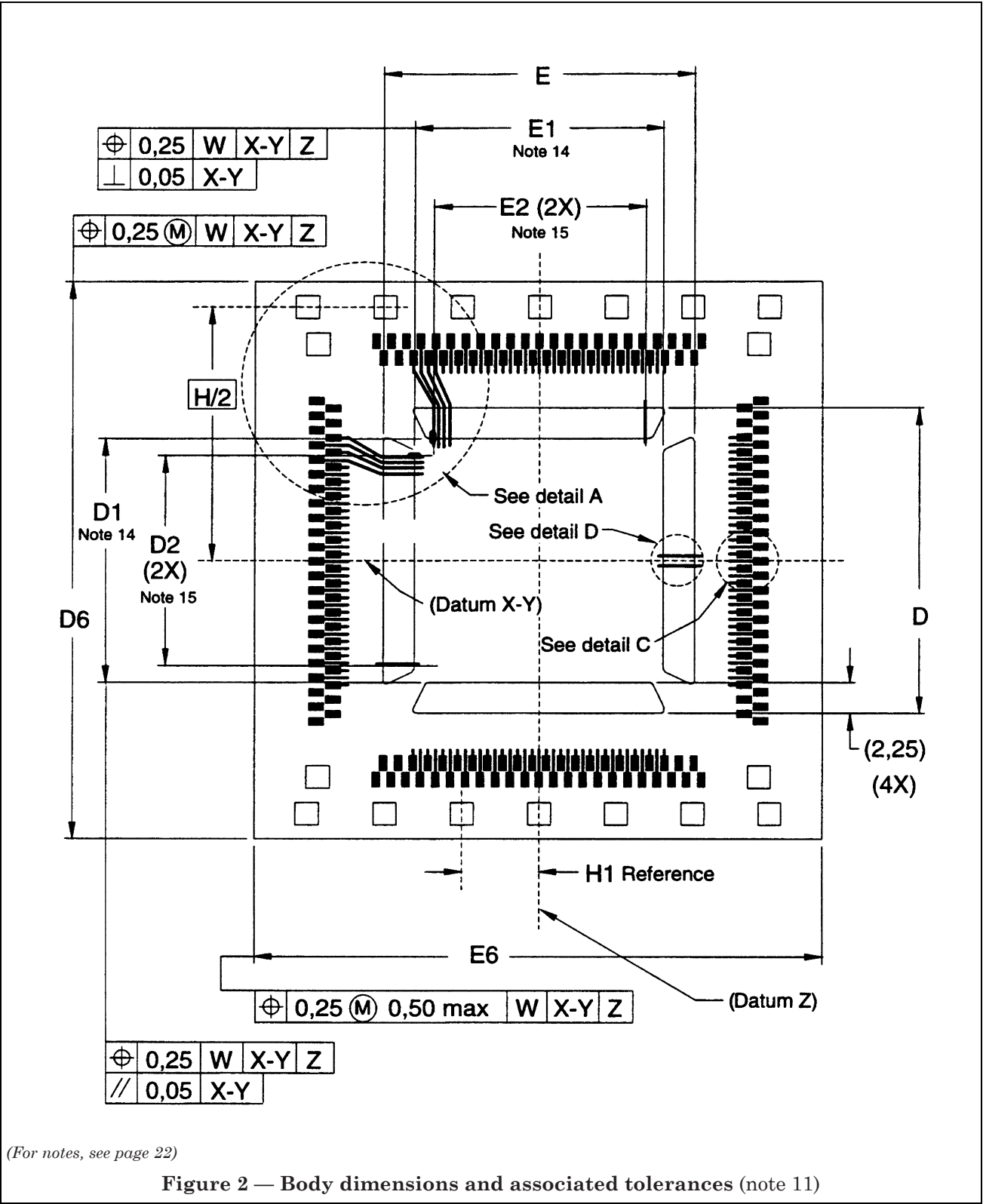
The table of lead count variations (see Table 5) shows all of the 576 possible combinations of these four principal design parameters. The designation for each variation has been coded as above to clearly identify the values of the four parameters that result in that specific variation. Thus, variation AA-22 is in 35 mm super film format with a 14 mm $\times$ 14 mm body size (see note 14 to the figures), 0,40 mm test pad pitch and 0,40 mm outer lead pitch. Likewise, variation CE-25 is in 70 mm super film format with a 24 mm $\times$ 24 mm body size, 0,40 mm test pad pitch and 0,20 mm outer lead pitch. The table of lead counts shows all of the allowed combinations of film format and body size (see 4.3).

6 Requirements for inner and outer lead bonding (ILB and OLB)

The configuration and dimensions of the pattern of inner leads cannot be specified in a detailed manner because the size of integrated circuits and the pad patterns on the die are not standardized.

Similarly, the form and dimensions of the outer leads after excise and lead forming cannot be standardized because the OLB processes and lead forming processes vary according to applications.





(For notes, see page 22)

Figure 2 — Body dimensions and associated tolerances (note 11)