Standard of Electronic Industries Association of Japan

EIAJ ED-7304-1

Measuring Method for Package Dimensions of Small Outline Package (SOP)

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Prepared by
Technical Standardization Committee on Semiconductor Device Package

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Method of Measuring Specified Dimension for Semiconductor Device Packages for Shrink Small Outline Pachage, Thin Small Outline Pachage (type I) and Thin Small Outline Pachage (type II) (SSOP, TSOP (I), TSOP (II))

1. Scope

This standard stipulates a method for measuring dimensions specified in the general dimensions rules of the SSOP TSOP (I), TSOP (II) (ref. **EIAJ ED-7300**).

2. Definition of terms

The main terms used in this standard are as defined below and new terms are defined in the text.

(1) **EIAJ ED-7300** Basic standard for preparation of general dimensions rules of semiconductor device packages
(2) **EIAJ ED-7314** Design guideline of integrated circuits for Shrink Small Outline Package(SSOP)
(3) **EIAJ ED-7312** Design guideline of integrated circuits for Thin Small Outline Package(type I)
(4) **EIAJ ED-7313** Design guideline of integrated circuits for Thin Small Outline Package(type II)
(5) **JIS Z 8310** General rules of drawing
(6) **JIS B 0021** Illustrating method of geometrical tolerance
(7) **JIS B 0061** Definition and display of geometrical deviations
(8) **ANSI Y 14.5M** Dimensions and tolerating

3. History

External dimensions of packages for semiconductor devices are specified in the general dimensions rules. However, the specified external dimensions have been measured in a variety of methods by companies. As a result, measured results are so different that some trouble has occurred between semiconductor manufacturers and users. Further more, there are some dimensions specified in the general dimensions rules that are very difficult to measure. This is set up to make the definitions of the specified dimensions clear and to standardize the measuring method of them.

4. Definition of measuring method

The measuring method in this standard is defined for dimension values guaranteed to users on the basis of the following items.

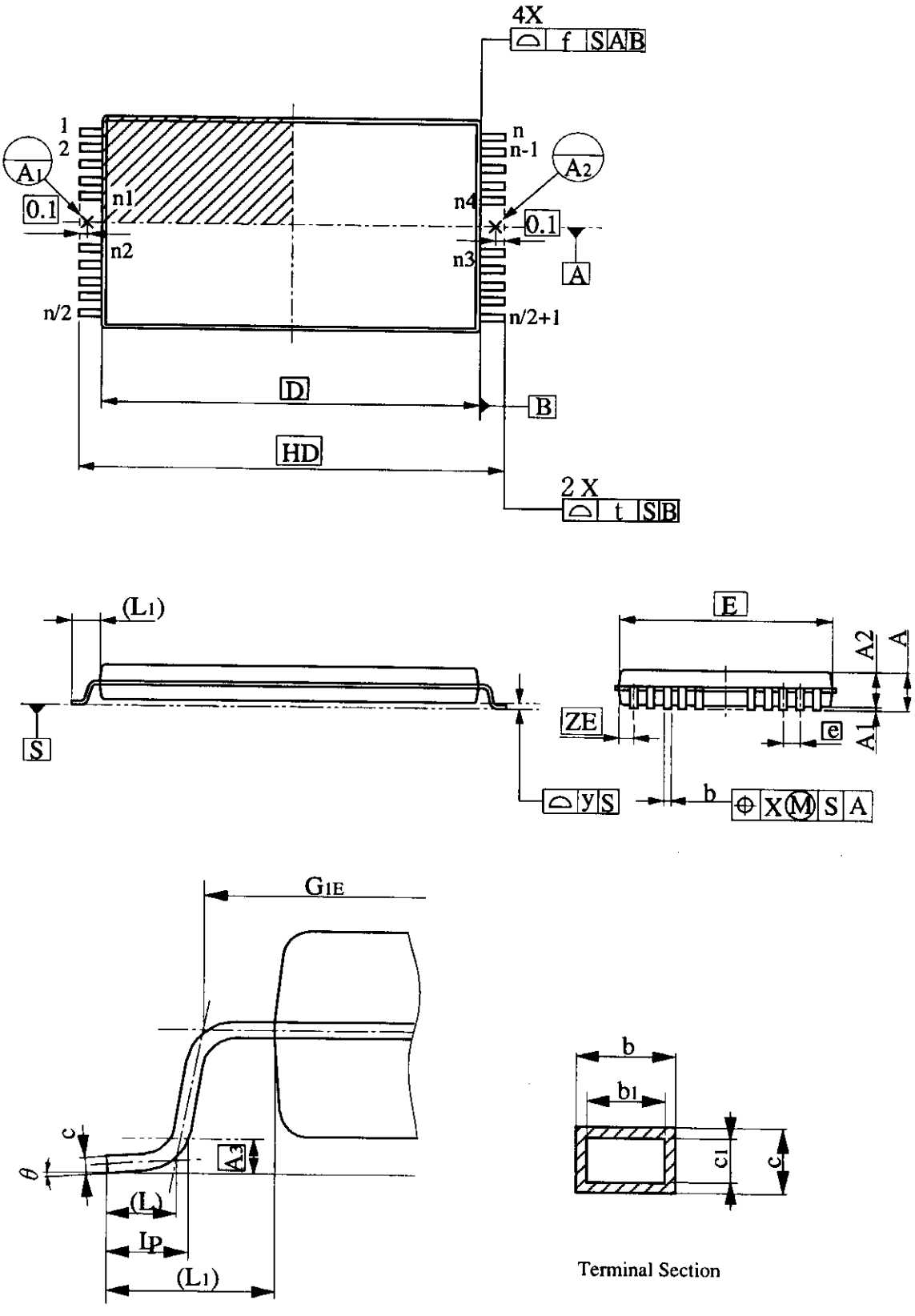
(1) In general, measuring the dimensions shall be made with the semiconductor packages mounted on printed circuit board as the guarantee is made to user.
(2) In general, measurement may be made either by hand or automatically.
(3) Even if a measuring method deviates out of the original definition of dimensions, it is defined as an alternative measuring method as long as it is equivalent in view of accuracy and can be used easily.
(4) The dimensions that cannot be measured unless the packages is destroyed, may be calculated from other dimensions or alternated by representative values.

5. Reference characters and drawings

5.1 Outline Drawings

(1) TSOP (I)

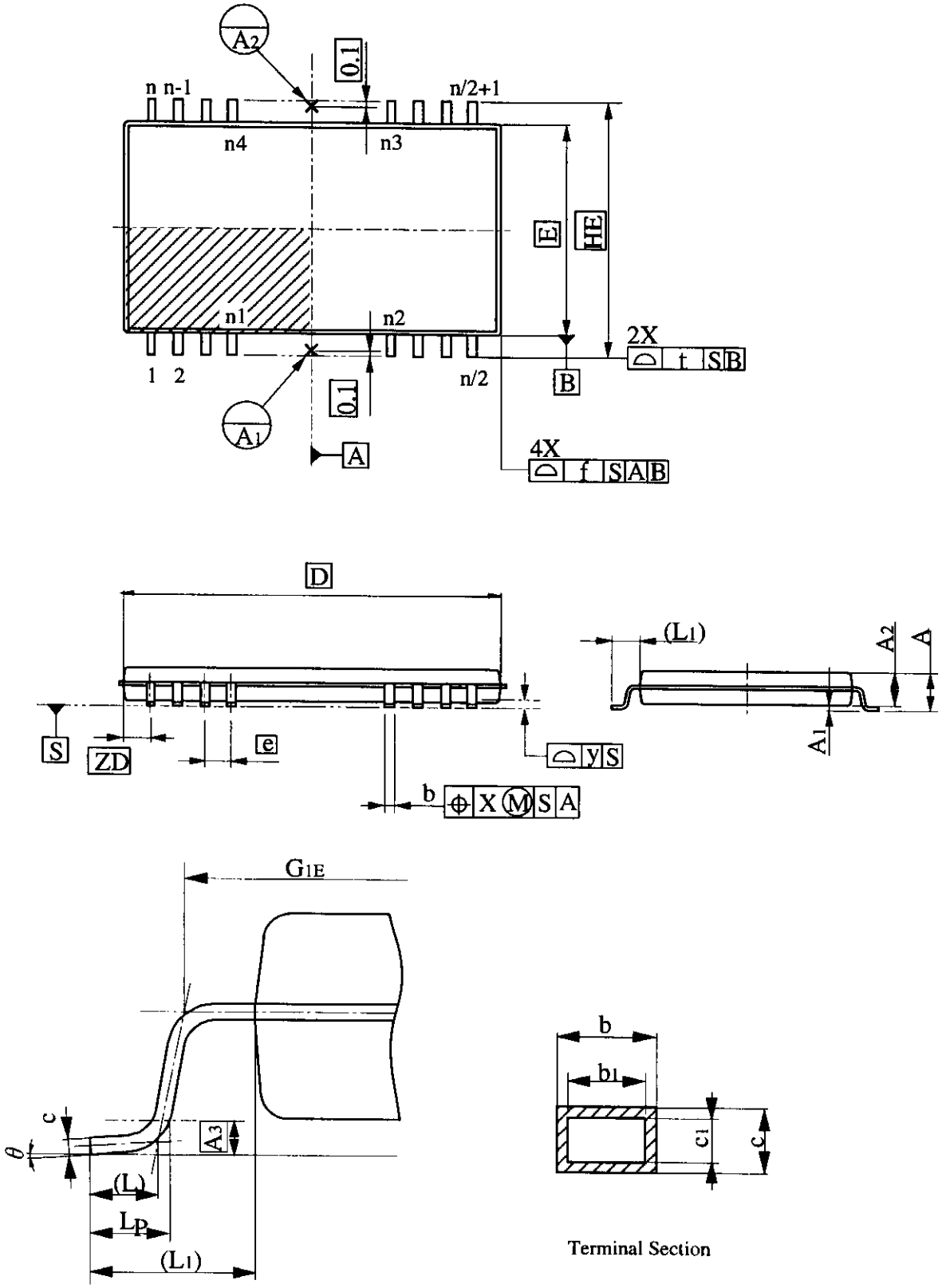
Figure 1



Terminal Section

(2) SSOP, TSOP (II)

Figure 2



5.2 Datum

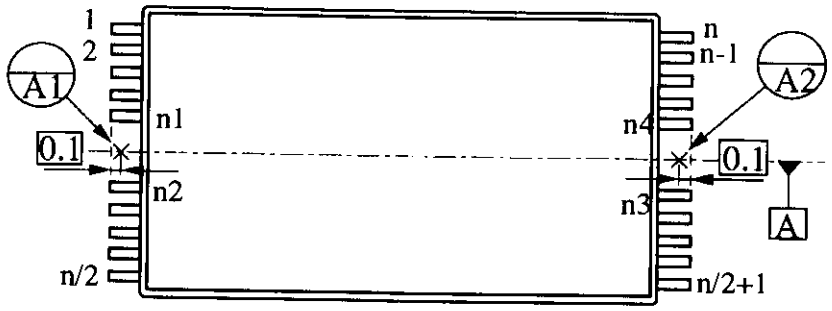
The datum shall be defined as follows.

(1) **datum A**

The centers of the both sides of the package shall be connected togather.

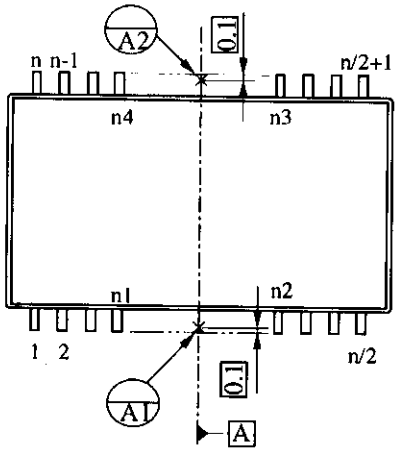
(a) **TSOP (I)**

Figure 3



(b) **SSOP, TSOP (II)**

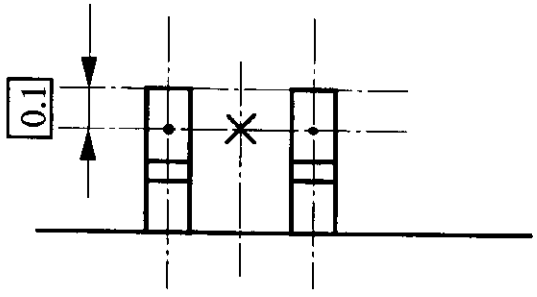
Figure 4



The definition of the Center of a package side

(1) For even number of terminals on a package side

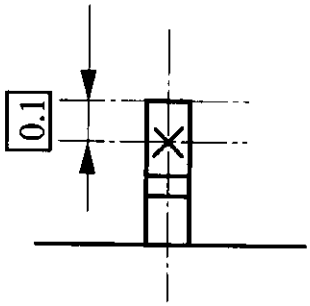
Figure 5



The center point of the centers of the adjacent two terminals in the center at the position 0.1mm inside from the tip of the terminals.

(2) For odd number of terminals on a package side

Figure 6



The center of the terminal in the center at the position 0.1mm inside from the tip of the terminal.

(2) datum B

The datum line is the center line of the package body , which have terminal leads .
The center line of the mold package is the center line of the pair of lines whose distance is the minimum among pairs of pararell lines crossing outmost package body.

Figure 7

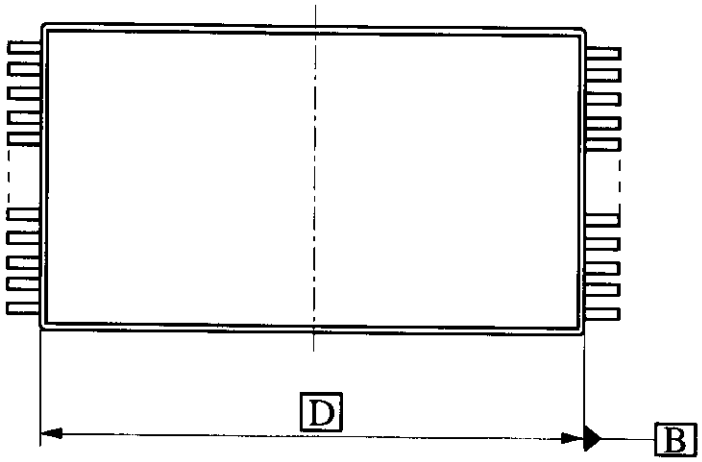
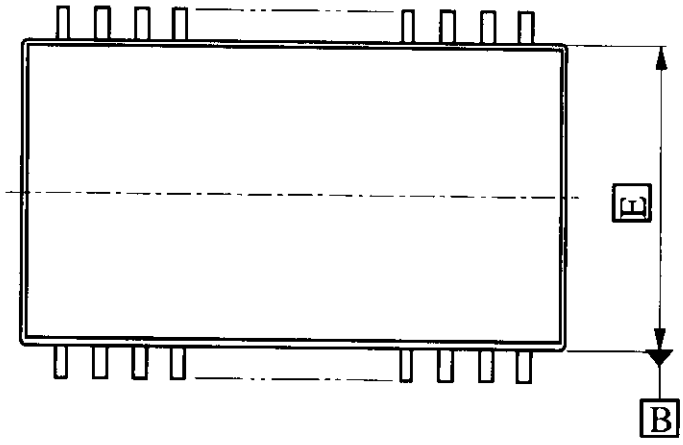


Figure 8



6. Measuring method

6.1 Profile of lead tips

(1) Definition

The position of the lead tips should be located within the range t centering on the position which is at a theoretically correct distance of HD/2 or HE/2 from the datum line B.

Figure 9

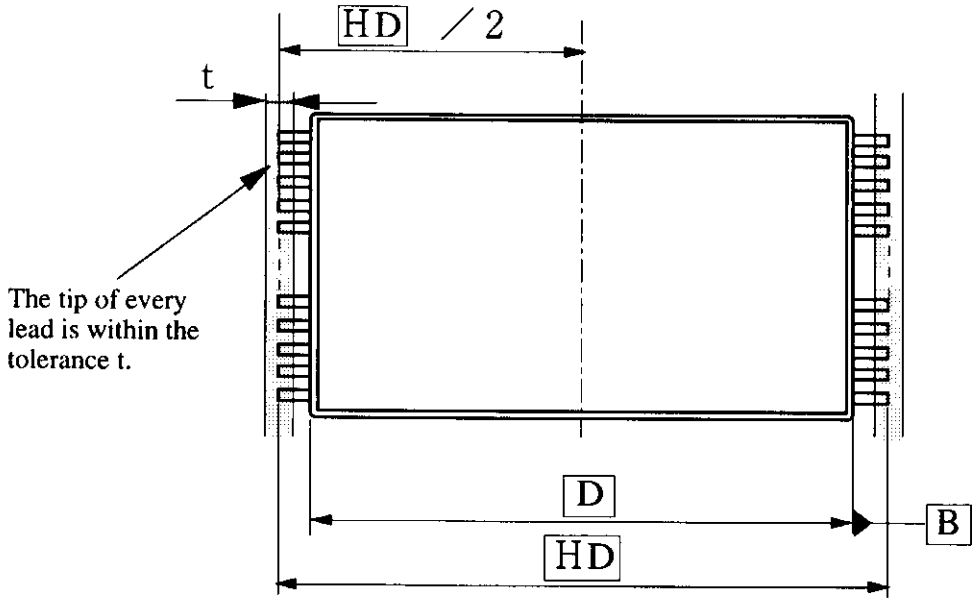
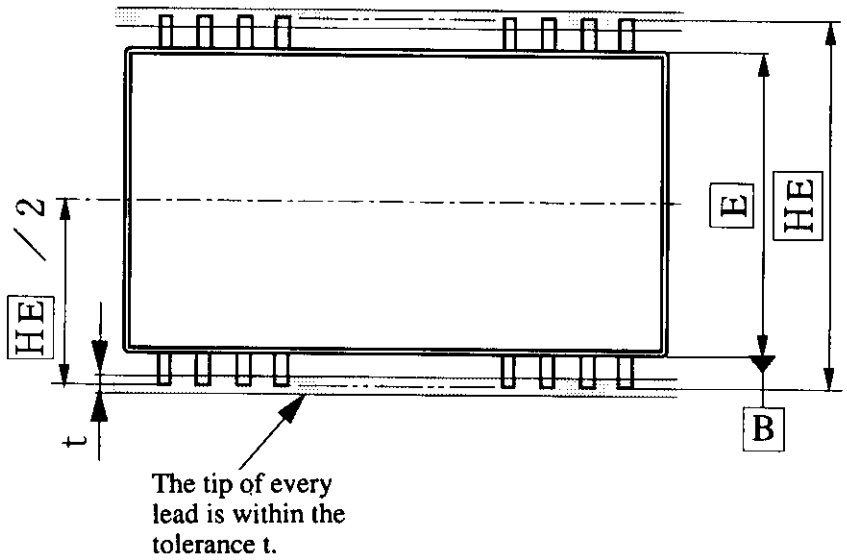


Figure 10



(2) Measuring method

(a) Put the package on the surface plate.

(b) Make the datum B coincide with the measuring reference.

(c) Find the logically precise distances HD/2 and HE/2 from the datum B. Then, check if the tip of every lead on each package side is within the tolerance t (range) specified as the center.

6.2 Profile of Package end face

(1) Definition

As to the package width and package length, the package end face should be located within the range f centering on the position which is at a theoretically correct distance of E/2 or D/2 from the datum A and B.

Figure 11

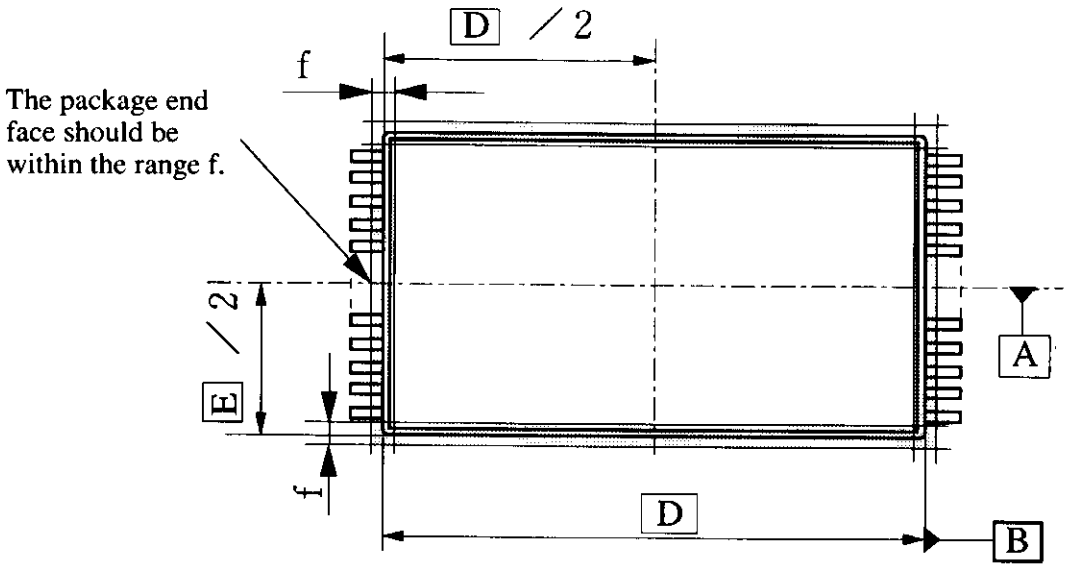
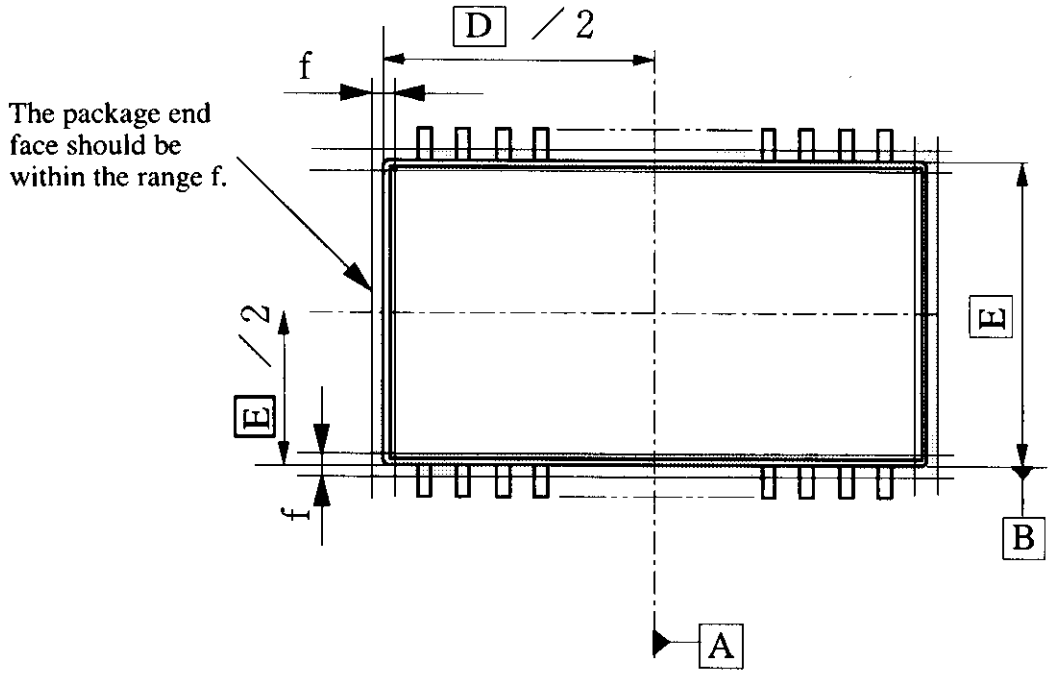


Figure 12



(2) Measuring method

(a) Put the package on the surface plate.

(b) Make the datum A and B coincide with the measuring reference.

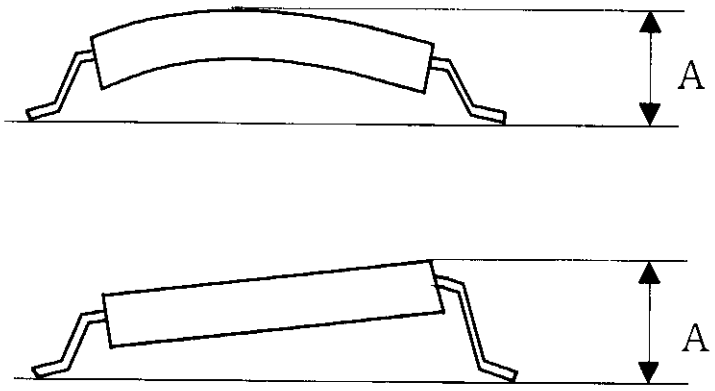
(c) Find the logically precise distances D/2 and E/2 from the datum A and B. Then, check if the package end faces are within the tolerance t (range) specified as the center.

6.3 Mounting height A

(1) Definition

Let the height of a package from the seating plane to the top of the package be denoted as the mounting height A. The mounting height therefore includes inclination and warping of the package.

Figure 13



(2) Measuring method

(a) Put the package on the surface plate.

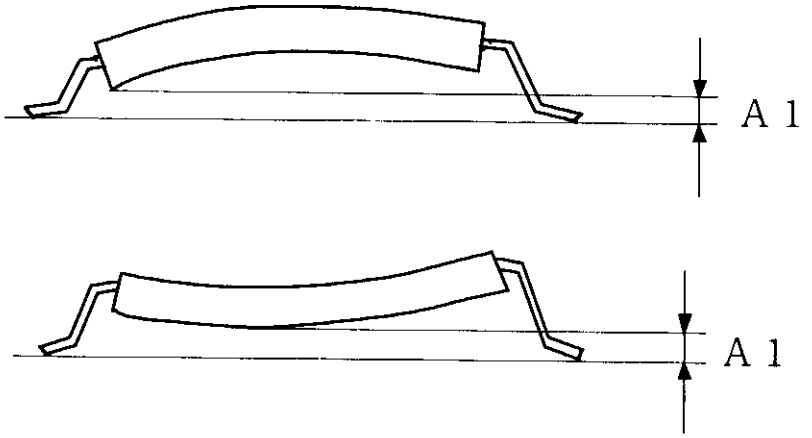
(b) From the side or top, measure the distance from the reference surface (surface plate) to the highest point. Let the distance be denoted as the mounting height A.

6.4 Stand-off A_1

(1) Definition

Let the height of a package from the seating plane to the lowest point of the package be denoted as the stand-off A_1.

Figure 14



(2) Measuring method

(a) Put the package on the surface plate.

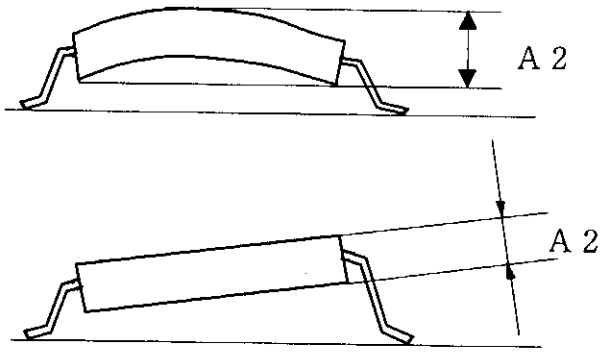
(b) Measure the distance from the reference surface (surface plate) to the lowest point. Let the distance be denoted as the mounting height A_1.

6.5 Body thickness A_2

(1) Definition

The body thickness is defined as a distance between parallel planes, tangent to the highest point and the lowest point of the body. Let the distance be denoted as the body thickness A_2.

Figure 15



(2) Measuring method

(a) Put the package between surface plates which are larger than the package vertically parallel. Never touch the leads.

(b) Measure the total thickness including the surface plates and subtract the thickness of surface plates from the total thickness so as to obtain the body thickness A_2 of the package.

(3) Quick measuring method

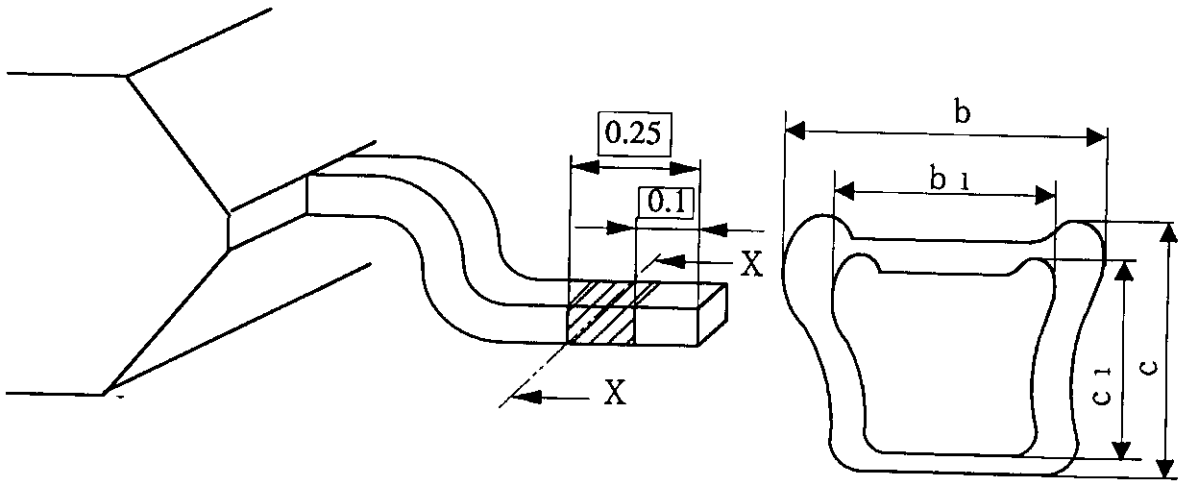
Put the vernier caliper on each of the diagonal lines (two directions) of the package. Let the maximum value be denoted as the body thickness A_2.

6.6 Lead width b and b1, lead thickness c and c1

(1) Definition

The outmost width and outmost thickness in the range of 0.1 to 0.25mm from the tip of the stable shape of the lead having little burrs and crushing shall be defined as the lead width b, b1 and lead thickness c, c1 on the seating plane. The lead width and lead thickness, as shown in the right figure, include burrs, crushing, and sagging. In this case, the outmost width and the outmost thickness after surface plating shall be defined as b and c, and the outmost width and the outmost thickness before surface plating shall be defined as b1 and c1 respectively.

Figure 16



Section X-X

(2) **Measuring method**

Lead widths b and b1

(a) Put the package on the surface plate.

(b) Make the datum parallel with the measuring reference.

(c) Measure the lead width (shown above) from the top.

Lead thickness c and c1

(a) Put the package on the surface plate.

(b) Measure the lead thickness (shown above) from the side b1 and c1 may be measured before plating..

(3) **Remarks**

(a) b1 and c1 may be measured before the lead is processed. If this is the case, measure b1 and c1 at the position within the above specified range after processing.

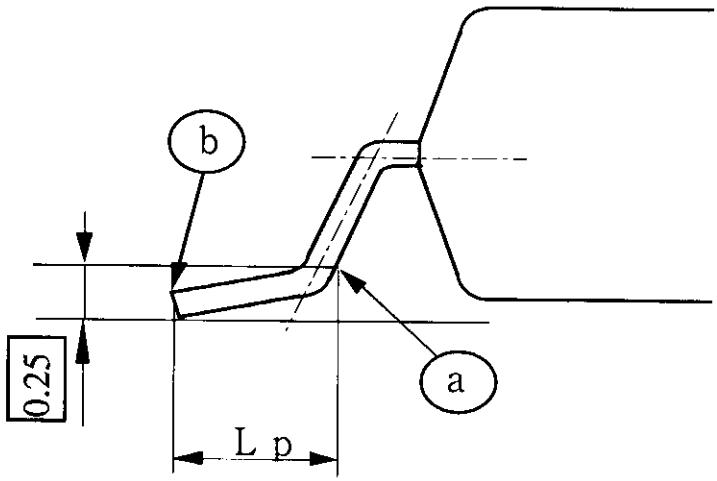
(b) The lead thickness may be measured at 4 points on the 4 corners of the package as representative values.

6.7 Soldered portion length Lp

(1) **Definition**

Soldered portion length Lp: The distance from the cross point (a) to the tip (b) of the lead in the direction of the seating plane. The cross point (a) is the point where the plane 0.25mm far from and in parallel with the seating plane cross the inside surface of a descending portion of the lead.

Figure 17



(2) **Measuring method**

(a) Put the package on the surface plate.

(b) Make the datum parallel with the measuring reference.

(c) Observe the lead toward the package side(in the seating plane direction) . Measure the positions of points (a) and (b) in the seating plane direction.

(3) **Remarks**

This measuring method can be done only from the side. Therefore, the values of the leads observable from the side are allowed as representative values.

6.8 Positional Tolerance of terminal tips

(1) Definition

Let S, A, and B denote datum as shown in the above figures. Obtain positions of tips of leads at the points of 0.1mm inside from the tips. Obtain differences from the theoretical positions. Acceptable differences are defined as the tolerance at center positions of terminal tips.

Figure 18

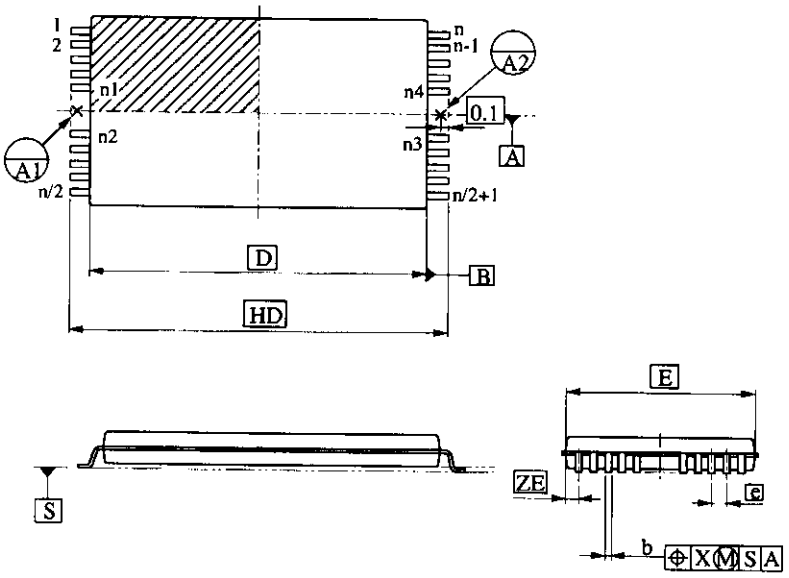
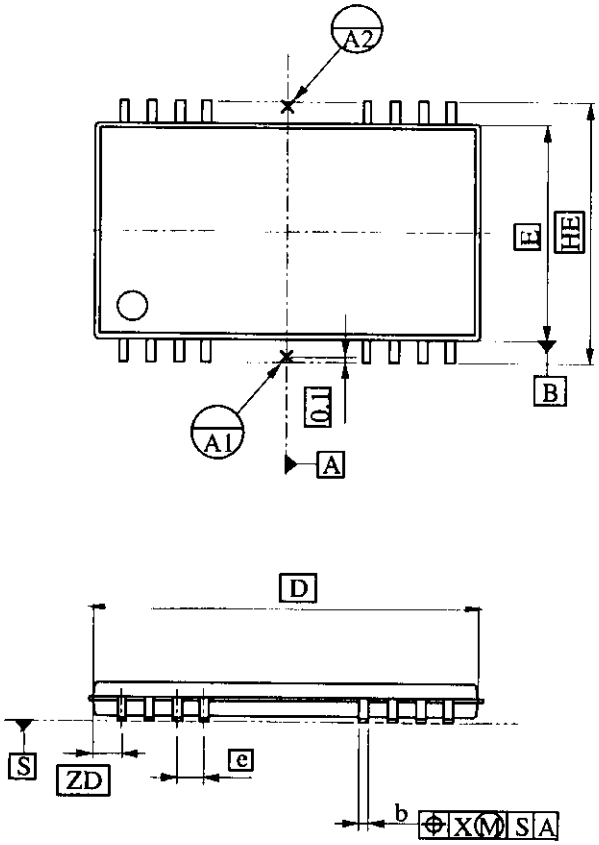


Figure 19



(2) **Measuring method**

(a) Put the package on the surface plate.

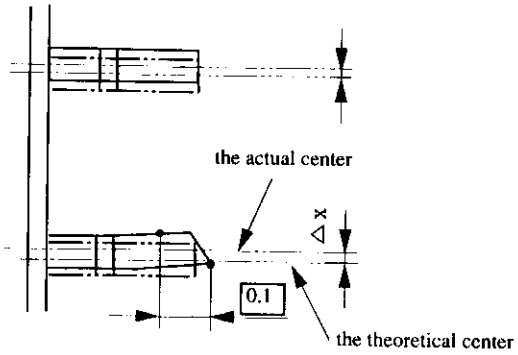
(b) Make the datum parallel with the measuring reference.

(c) Obtain positions of the centers of leads at the points of 0.1mm inside from the the tips.

(d) Obtain the differences from the theoretical centers of the leads.

(e) Check the differences within the tolerance of lead center position.

Figure 20



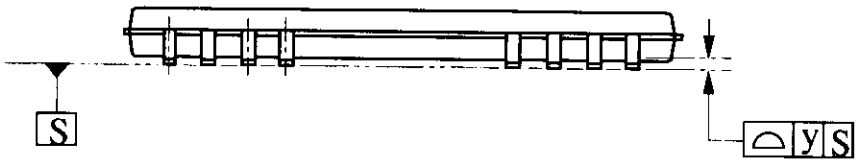
note:the tolerance depends on the terminal width;
$\Delta x < (b\,max - b + x) / 2$

6.9 Coplanarity y of lowest surfaces of leads

(1) **Definition**

The vertical distance from the seating plane to the lowest point of each lead shall be referred to as coplanarity of the lowest surfaces of the leads. The distance up to the lowest point of the lead furthest from the seating plane shall be defined as y.

Figure 21



(2) Measuring method

(a) Put the package on the surface plate.

(b) Observe the lowest surfaces of all the leads from the front side of the leads to measure the vertical distances from the surface plate to the lowest surfaces.

(c) The maximum value of the distances shall be defined as the coplanarity y .

note: Coplanarity may change because of the seesaw phenomenon. In the case of the seesaw, the larger y data should be adopted.

To avoid the seesaw's case, the virtual plane method can be the measuring method.

Definition of Virtual Plane

Of the geometrical planes that pass the lowest points of given 3 leads, the plane on which the lowest points of all the leads exist on the package body side shall be referred to as the virtual plane. In this case, however, the center of the package gravity must exist inside of the triangle formed with the 3 points or on one side of the triangle.

If there are plural combinations that satisfy the above conditions, the combination shall be adopted so that a larger y value may be obtained.

(3) Measuring method 2 (Virtual palne method)

(a) Obtain the virtual plane.

(b) Measure the vertical distances from the virtual plane to the lowest surfaces of the terminal tips.

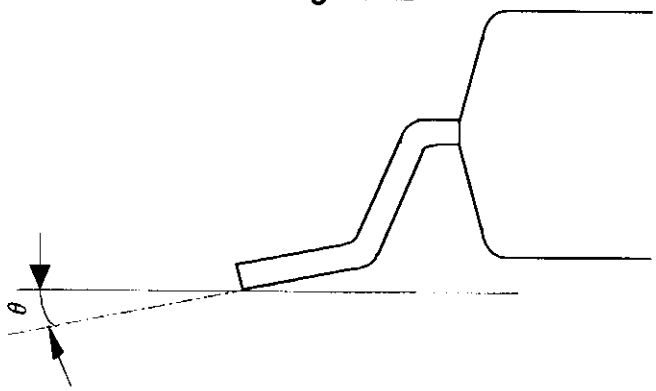
(c) The maximum value of the distances shall be defined as the coplanarity y .

6.10 Angle θ of flat portion of lead

(1) Definition

The angle of the flat portion of the lead of gull wing type to the seating plane is defined as the angle θ of the flat portion of the lead.

Figure 22



(2) Measuring method

(a) Put the package on the surface plate.

(b) Make the datum parallel with the measuring reference.

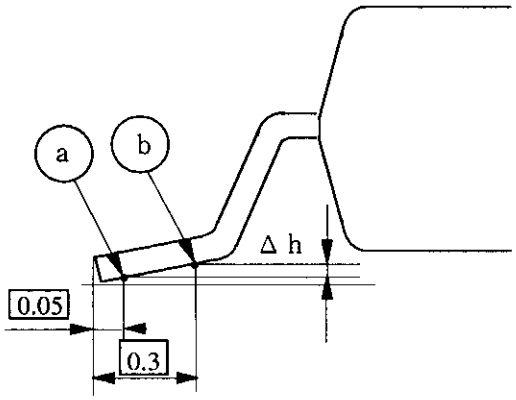
(c) Measure the height at the lowest point (a) of 0.05mm inside from the tip of the lead.

(d) Measure the height at the lowest point (b) of 0.30mm inside from the tip of the lead.Calculate the ifference Δ h.

(e) Substitute the value for the following equation. Let the obtained value be denoted as the angle θ of flat portion of lead.

$$\theta = \tan^{-1} \quad \Delta h/0.25$$

Figure 23



(3) Measuring method 2 (Virtual plane method)

Execute the above measuring method on the virtual plane in stead of the surface plane.

(4) Remarks

This measuring method can be done only from the side. Therefore, the values of the leads observable from the side are allowed as representative values.

Explanation

1. Purpose

This standard is aimed to provide the common measuring method of dimensions that have been defined in the design guideline of semiconductor device.

2. Background

This measuring method has been established only for QFP package in May, 1995, in order to prevent the difference of the measured dimensions between user and supplier. For SSOP, TSOP (I) and TSOP (II), the measuring method was discussed by the Outer Dimension Measuring Method Project Group, finally determined by the Plastic Sub-Committee, and officially approved and determined to establish and issue the document by Semiconductor Package Standardization Committee in March, 1997.

3. Major Contents

3.1 Allowable Value of Terminal Center Position

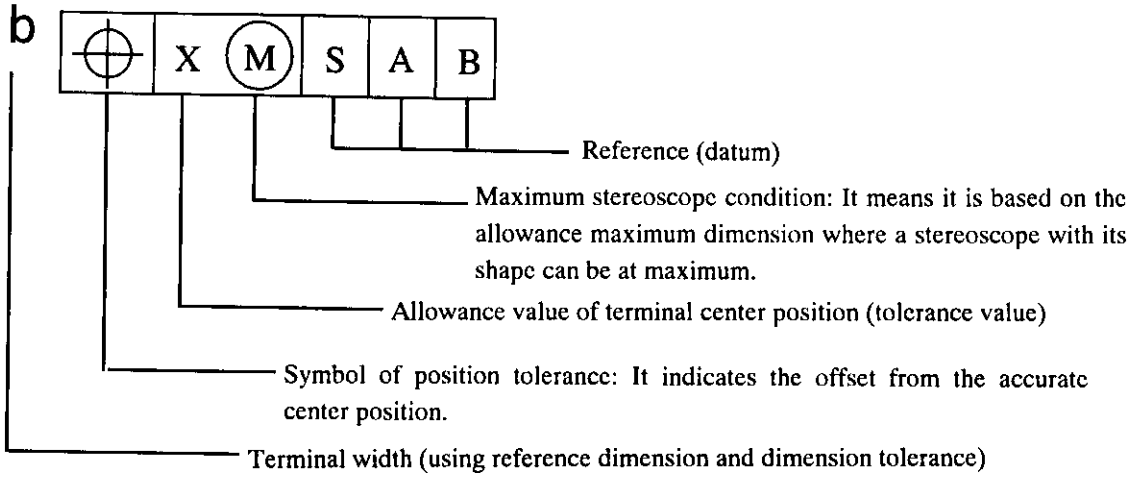
The allowable value of terminal center position (reference character: x) is indicated with the geometrical tolerance and additional symbol in the integrated circuit package design guide. This value is provided as the allowable range of terminal center position in relative to terminal straight line interval and terminal width.

It includes terminal width, symbol of position tolerance, allowable value (tolerance value) of terminal center, maximum stereoscope condition, and reference (datum).

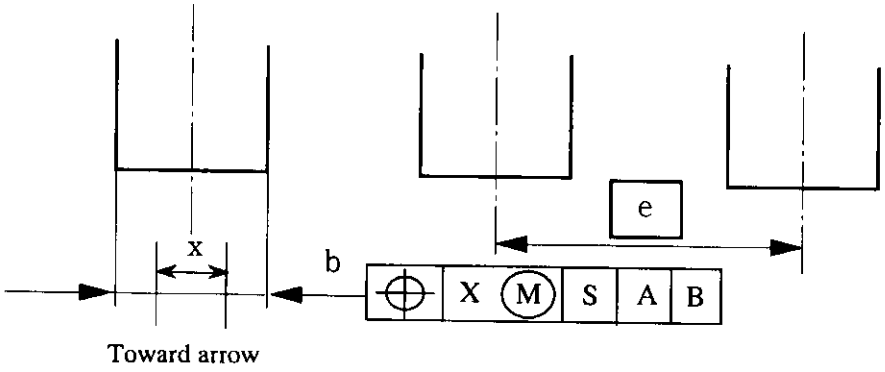
"Allowable range of terminal center position" refers to the limit of x width that is measured toward the arrow, considering the specified line as center when the terminal width is maximum.

The offset amount from the terminal center position ($\triangle x$) shall be below x / 2 if the terminal width is maximum. If not, it will slightly change accordingly. ($\triangle x < (b\ max - b + x) / 2$)

(1) Indicating Method



(2) Definitions

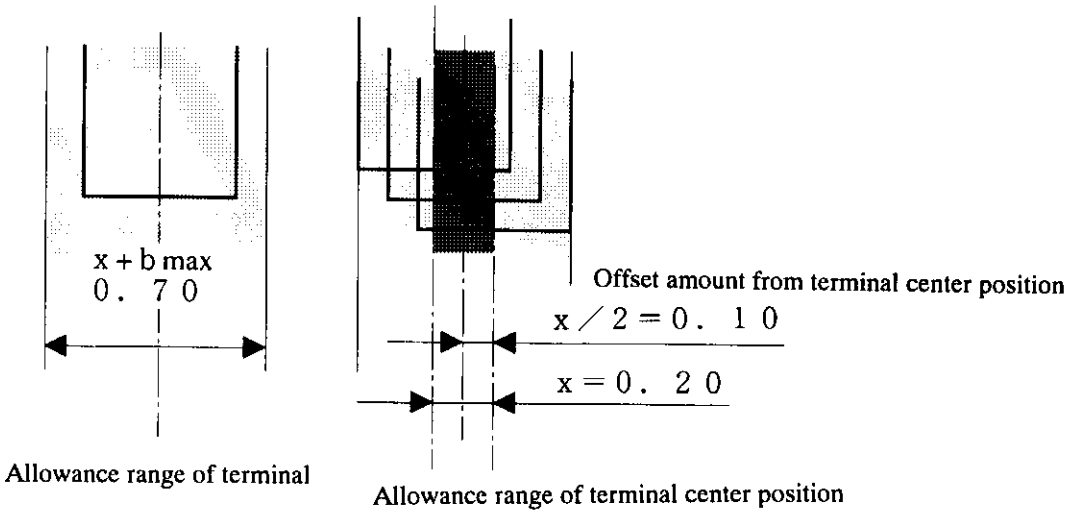


(3) Offset Amount from Terminal Center Position

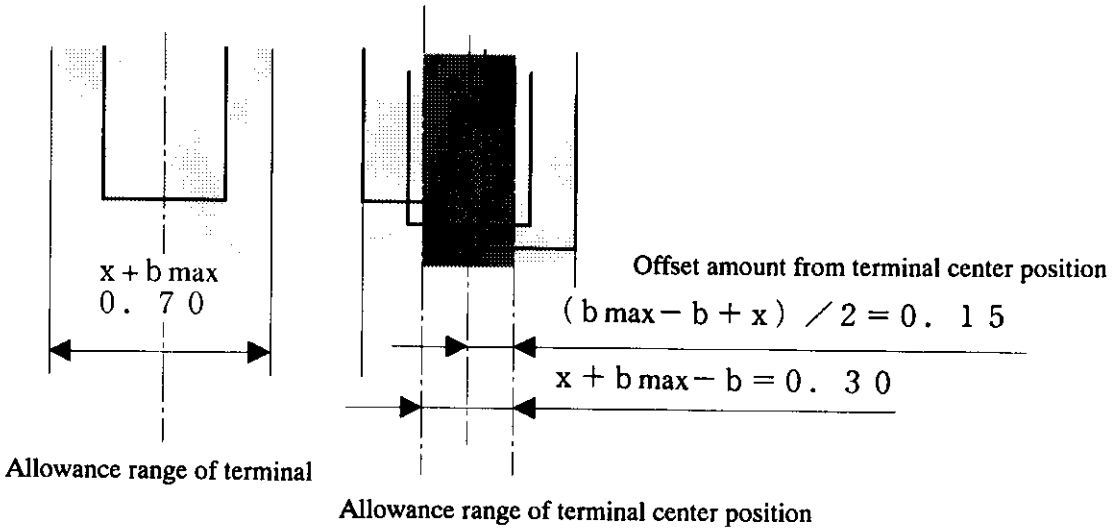
The allowance rang of terminal is fixed to the sum of the terminal width (b max) and the allowance value of terminal center position (x). Therefore, the offset from the terminal center position shall be x / 2 when the terminal width is maximum and (b max - b + x) / 2 or below when it is b.

Example: Terminal straight line interval : e = 1.00
Terminal width : b max = 0.50
: b min = 0.35
Allowance value of terminal center position : x = 0.20

(a) When Terminal Width is Maximum (0.50):



(b) When Terminal Width is 0.4 (b = 0.40):



3.2 Package Height

In EIAJ ED-7300 series, package height refers to the distance from the base surface to the top end of the package. The base surface refers to that, parallel to the mounting surface, where the bottom point of the package passes through. However, the package height A2 is defined as the thickness of package. In this standard, the method to measure the thickness is provided.

4. Committee Members

This measuring method was discussed mainly by Semiconductor Common Standard Sub-Committee of Semiconductor Package Standardization Committee and Package Dimension Measuring Method Project Group. The members are as shown below.

<Semiconductor Package Standardization Committee>

Chairman	Toshiaki Shinohara	MITSUBISHI ELECTRIC CORPORATION

<Semiconductor Common Standard Sub-Committee>

Chief	Michio Sono	FUJITSU LIMITED

<Package Dimension Measuring Method Project Group>

Leader	Yasushi Otsuka	Sony Corporation
Sub-Leader	Tsuneo Kobayashi	IBM JAPAN, LTD.
	Eiji Mizutani	KOMATSU Ltd.
	Hideya Harukuchi	SHARP CORPORATION
	Hideo Taguchi	TOSHIBA CORPORATION
	Gohei Nanjoh	Nagase & Company, Ltd.
	Takahiro Naitoh	Hitachi, Ltd.
	Kenji Imamura	MITSUBISHI ELECTRIC CORPORATION
	Masahiko Fukuoka	YASUNAGA CORPORATION