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D E C I S I O N
of 29 May 2002

Case Number: T 0833/97 - 3.4.3

Application Number: 91106510.0

Publication Number: 0454053

IPC: H01L 21/48

Language of the proceedings: EN

Title of invention:
Method of bending outer leads of a semiconductor device

Applicant:
KABUSHIKI KAISHA TOSHIBA

Opponent:
-

Headword:
-

Relevant legal provisions:
EPC Art. 56, 123(2)

Keyword:
"Inventive step (no)"
"Amendments - added subject-matter (yes)"
"A particular direction is not disclosed by a general direction"

Decisions cited:
-

Catchword:
-

Case Number: T 0833/97 - 3.4.3

D E C I S I O N
of the Technical Board of Appeal 3.4.3
of 29 May 2002

Appellant: KABUSHIKI KAISHA TOSHIBA
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Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 25 March 1997 refusing European patent application No. 91 106 510.0 pursuant to Article 97(1) EPC.**

Composition of the Board:

Chairman: R. K. Shukla
Members: V. L. P. Frank
J. H. Van Moer

Summary of Facts and Submissions

I. The appeal lies against the decision of the examining division dated 25 March 1997 refusing the European patent application No. 91 106 510.0. The ground for the refusal was that the claims did not involve an inventive step (Article 56 EPC) having regard to the prior art document:

D2: Patent Abstracts of Japan, vol. 10, No. 158 (E-409) [2214] 6 June 1986 & JP-A-61 12052

II. The appellant (applicant) lodged an appeal on 26 May 1997, paying the appeal fee the same day. The statement setting out the grounds of appeal was filed on 21 July 1997 together with new claims according to a first auxiliary request, the main request being the grant of a patent on the basis of claims filed on 24 April 1996.

III. At the oral proceedings held on 29 May 2002, the appellant submitted a further auxiliary request. The appellant thus requested that the decision under appeal be set aside and a patent be granted on the basis of one of the following requests:

Main request: claims 1 to 5 filed with the letter of 24 April 1996;

1st auxiliary request: claims 1 to 5 filed with the statement of grounds of appeal; and

2nd auxiliary request: claims 1 to 4 filed during the oral proceedings.

IV. The independent claims 1 according to these requests read as follows:

Main request:

"1. A method of bending outer leads of a semiconductor device, comprising the steps of:

preparatorily bending all the outer leads (2A, 2B) having a variation in the vertical direction relative to their roots, upward and downward from their roots where the outer leads (2A, 2B) are rooted in a resin (1); and

bending the outer leads (2A, 2B) at points away from the roots to obtain final outer leads (2A', 2B')."

1st auxiliary request:

"1. A method of bending outer leads (2A, 2B) of a semiconductor device, said method being applied before bending the outer leads at points on each of the leads away from respective roots (3) of the leads to obtain a final configuration (2A', 2B') of the outer leads,

characterized by comprising the steps of:

bending the outer leads at the respective roots (3) of the leads in a first direction perpendicular to a plane defined by the leads; and

bending the outer leads at the respective roots of the leads in a second direction opposite to the

first direction."

2nd auxiliary request:

Claim 1 according to this request comprises in addition to the subject-matter of claim 1 of the main request the following subject-matter which is inserted before the last step of bending the outer leads of claim 1 according to the main request:

"placing the outer leads (2A, 2B) back into horizontal positions; and"

V. The arguments of the appellant in favour of inventive step can be summarized as follows:

(a) The English abstract of document D2 does not disclose if the bending of the leads is a preparatory bending step or if the leads are already bent into their final form. It is therefore doubtful if this document suggests the use of a preparatory bending step as disclosed in the application in suit.

(b) The preparatory bending step according to the application in suit requires that the leads are bent at their roots. This cannot be accomplished by the method disclosed in document D2 in which a die with a cavity is used, since, due to fabrication tolerance of the device package which has to be accommodated in the cavity of the die, the lead's bending point is inevitably away from the lead's roots.

(c) Furthermore, document D2 discloses a single

bending step. There is no suggestion in this document that the alignment of the leads could be improved by performing a second bending step in a direction opposite to the first direction.

(d) Moreover, document D2 does not disclose that the bending is performed in a direction perpendicular to a plane defined by the leads as required in the first auxiliary request. A bending step as in document D2 in which a die is used does not fulfill this requirement.

(e) According to the second auxiliary request, the leads are placed back into a horizontal position before being bent into their final shape. This further step is neither disclosed nor suggested by document D2.

Reasons for the Decision

1. The appeal is admissible.

2. The application concerns the bending of the outer leads of a packaged semiconductor device into their final shape. In the art of packaging semiconductor devices, integrated circuit chips are mounted on lead frames and encapsulated by a resin. After encapsulation, the outer leads of the lead frame protrude from the sides of the resin package and have to be bent into their final shape. However, due to contraction of the resin some leads do not lie in the same plane and are thereby misaligned in the vertical direction and this misalignment may remain even after the final bending step, making the automatic mounting of the devices

unreliable. It is the aim of the application in suit to reduce the degree of misalignment of the outer leads, after the final bending.

3. *Disclosure of Document D2*

3.1 Document D2 represents the closest state of the art and this has not been disputed by the appellant. This document discloses a method for reducing the angular dispersion of the outer leads of a semiconductor package. The outer leads are bent in one direction beyond their plastic deformation limit with the aid of a die having a tetrahedral conic shape (cf. English abstract). This preparatory bending step reduces the angular dispersion of the outer leads from a range of 10°-20° down to 0°-3° (cf. Figures 3A and 3B of the Japanese patent application). In a further bending step the leads are bent into their final shape (cf. ibid Figure 3C).

3.2 During the oral proceedings the appellant contested the above interpretation of the disclosure of document D2 which is based on the English abstract and the figures of the Japanese application. According to the appellant the bending of the outer leads described in the abstract of this document corresponds to the final bending step described in the application in suit, and, therefore, no preparatory bending step is disclosed in this prior art document.

The Board, however, does not consider this argument well founded, since, as can be seen from Figures 3C and 8C of the Japanese patent application (D2), there is a bent shape of the outer leads, conforming to the final shape of the outer leads of the packaged device shown

in Figure 6 of this document. Also, a skilled reader would clearly derive form Figures 3A, B, C and 8A, B, C that the shapes in Figures 3C and 8C follow the bending operations in Figures 3B and 8B, respectively.

Besides, the abstract of document D2 states that the lead correcting process is done "to reduce the angle dispersion of lead by a method wherein a lead of flat pack is forcibly plastic-deformed". It is therefore specified that the described process reduces the misalignment of the leads, and does not bend the leads into their final shape.

3.3 For these reasons, it is the Board's view that the person skilled in the art would have interpreted the disclosure of document D2 as described above under point 3.1.

4. *Main request*

4.1 Since the subject-matters of claims 1 of the main and second auxiliary requests are not patentable for lack of an inventive step for the reasons which follow, the Board does not consider it necessary to consider the other requirements of the Convention such as the requirements of Articles 84 and 123(2) EPC in respect of these requests.

4.2 The method of claim 1 according to the main request differs from the prior art method described in document D2 in that (i) the preparatory bending of the outer leads is done at their roots, ie. at the point where the outer leads emerge from the resin, and (ii) the preparatory bending step is repeated in a second direction opposite to the first direction.

4.3 According to the application in suit both measures improve the coplanarity of the outer leads which results in a stable final product (cf. column 1, lines 27 to 33 of the published application).

Consequently, the technical problem addressed by the application is to further improve the coplanarity of the outer leads with respect to the method disclosed in document D2.

4.4 The appellant has argued that a method in which a die is used for bending the outer leads, as it is the case with the method disclosed in document D2, does not permit that the outer leads be bent at their roots. The width of the cavity in the die where a chip package is mounted has to be wider than the width of the package, so as not to damage the package itself having regard to fabrication tolerances of the resin mould.

Moreover, there is no suggestion in document D2 that a second preparatory bending step is required or even that it would be useful in improving the coplanarity of the leads. The evidence submitted by the applicant with the letter dated 17 January 1997, ie. during the examination procedure, show that the misalignment of the leads is reduced from the original value of 60 µm to 30 µm, 23 µm and 24 µm by a first, second and third preparatory bending step, respectively.

4.5 The Board concurs with the appellant in that it would have been difficult or even impossible to bend the leads at their roots by using a die. However, it would be obvious to the person skilled in the art to employ other ways of bending the leads which allow that the bending point is at the roots of the leads, if the

necessity to do so arises. It is also obvious to the person skilled in the art that the bending point should be as close as possible to the resin package, a fact recognizable in the die used in document D2 in which the bending point is as close as possible to the resin package, since otherwise the lead's portion located between the resin package and the bending point would not be plastically deformed and would retain its original misalignment.

The fact that a second preparatory bending of the leads improves their coplanarity is also obvious to the person skilled in the art, since it allows that leads which initially were pointing in the direction of the first bending step, and which, therefore, would only be bent within their elastic limit, be also plastically deformed by bending them into a direction opposite to the first.

4.6 In consequence, in the Board's judgement the method according to claim 1 of the main request does not involve an inventive step in the sense of Article 56 EPC.

5. *First auxiliary request*

5.1 According to the first auxiliary request the preliminary bending step is done in "a first direction perpendicular to a plane defined by the leads" and in "a second direction opposite to the first direction". These expressions restrict the possible directions into which the leads may be bent to a unique direction. In contrast thereto, the expressions "upwards" and "downwards" used in the main and second auxiliary requests comprise a spread of directions around the

"vertical" direction.

5.2 There is, however, no basis in the application as originally filed for bending of the leads in a first direction which is **perpendicular** to a plane defined by the leads. The bending of the leads is disclosed in the application in suit as "upwards" or "downwards" apparently with respect to the packaged semiconductor device, and not with respect to a plane defined by the leads. Moreover, the terms "upwards" and "downwards" define in general the direction of bending, which although include the specific perpendicular direction, does not **disclose** the specific direction (cf. column 1, lines 37 to 38; column 2, lines 18, 24, 30 and 56; column 3, lines 1 and 9 to 14 of the published application).

5.3 For these reasons, in the Board's judgement, claim 1 according to the first auxiliary request does not fulfill the requirements of Article 123(2) EPC.

6. *Second auxiliary request*

6.1 The method according to claim 1 of this request further differs from the method disclosed in document D2 in that (iii) the outer leads are placed back into the horizontal position before being bent into their final shape. Although in document D2 (cf Figures 3C, 6 and 8C) the leads in their final shape have a horizontal portion emerging from the resin, it is not clear that the leads were put in the horizontal position prior to the final bending step.

6.2 The application in suit does not disclose any technical effect achieved by this further bending step. In fact,

a third bending step according to the applicant's letter of 17 January 1997 does not have any noticeable effect on the coplanarity of the leads.

Moreover, as stated above, document D2 discloses (cf. Figure 3C) that the final shape of the leads comprises an approximately horizontal portion. This portion is located between the lead's root and a first bending point at which the leads are bent into a vertical direction.

To introduce a step in which the leads are placed back into a horizontal position or to directly bend them into their final shape is, however, an option that the person skilled in the art would apply according to the circumstances without exercising an inventive step.

6.3 For these reasons and the reasons mentioned with respect to the main request, it is the judgement of the Board that the method according to claim 1 of the second auxiliary request does not involve an inventive step.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

D. Spigarelli R. K. Shukla