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**Datasheet for the decision
of 11 March 2014**

Case Number: T 0826/10 - 3.4.03

Application Number: 98201848.3

Publication Number: 889512

IPC: H01L21/48, H01L21/60,
H01L23/485, H01L23/498

Language of the proceedings: EN

Title of invention:

Method for controlling solder bump shape and stand-off height

Applicant:

Casantra Acquisition III LLC

Headword:

Relevant legal provisions:

EPC 1973 Art. 56, 84
EPC 1973 R. 42(1)
EPC Art. 123(2)
EPC R. 100(2)

Keyword:

Inventive step - (yes)

Decisions cited:

T 1019/99

Catchword:



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Chambres de recours**

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Case Number: T 0826/10 - 3.4.03

D E C I S I O N
of Technical Board of Appeal 3.4.03
of 11 March 2014

Appellant: Casantra Acquisition III LLC
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Decision under appeal: **Decision of the Examining Division of the
European Patent Office posted on 20 November
2009 refusing European patent application No.
98201848.3 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman: G. Eliasson
Members: S. Ward
T. Karamanli

Summary of Facts and Submissions

- I. The appeal is against the decision of the Examining Division refusing European patent application No. 98 201 848 on the ground that the claimed subject-matter did not involve an inventive step within the meaning of Article 56 EPC 1973 having regard to the following prior art:
- D2: US 5 480 835 A.
- II. With the statement of grounds of appeal dated 23 March 2010 the appellant filed a main request comprising claims 1-6 and first to seventh auxiliary requests.
- III. The Board sent the appellant a communication pursuant to Rule 100(2) EPC setting out its provisional view that the claims of the main request met the requirements of the EPC. Amendment of the description, however, to acknowledge the document D2 (Rule 27(1)(b) EPC 1973) appeared to be appropriate.
- IV. With a letter dated 4 February 2014 the appellant filed a new complete description comprising pages 1, 2, 2a and 3-11.
- V. The appellant requests that the decision under appeal be set aside and that, as a main request, a patent be granted on the basis of the following documents:
- claims 1 to 6 of the main request filed with the letter dated 23 March 2010 stating the grounds of appeal;
 - description pages 1, 2, 2a and 3-11 filed with the letter dated 4 February 2014; and

- drawing sheets 1/2 to 2/2, as originally filed.

Alternatively, the appellant requests the grant of a patent on the basis of one of the first to seventh auxiliary requests filed with the letter stating the grounds of appeal.

VI. Claims 1 to 6 according to the main request are identical to claims 1 to 6 upon which the contested decision was based. Claim 1 (the sole independent claim) reads:

"A method comprising the sequential steps of

forming a nonsolderable conductor (112) formed of a nonsolderable material on a substrate (10) so as to define a conductor pattern;

forming a solderable conductor pillar (114) formed of a solderable material on the nonsolderable conductor (112), the solderable conductor pillar (114) constituting a limited portion of the nonsolderable conductor (112), the solderable conductor pillar (114) having a shape chosen from the group consisting of square, circular and shapes that are elongate in a longitudinal direction of the conductor (112);

registering a surface mount device with the conductor pattern, wherein a solder bump (16) on the surface mount device contacts the solderable conductor pillar;
and

heating the solder bump (16) so as to reflow the solder bump (16) and form a solder bump connection that bonds the surface mount component to the solderable conductor pillar."

VII. In the contested decision, the Examining Division argued essentially as follows:

"Document D2 discloses (see column 2, line 57 to column 3, line 18) to form solder balls on the pads of an integrated circuit or of a substrate." For the purpose of the "discussion of the disclosure of document D2 the latter solution with solder balls on the pads of a substrate has been selected."

"Furthermore, in the discussion of the prior art in column 1, lines 14 to 19 it is disclosed by document D2 to form solder balls both on the integrated circuit and on the substrate. In such a case it would be immediately obvious to the person skilled in the art to form the solder balls on the pads of the integrated circuit according to the method disclosed in document D2. Such an integrated circuit with solder balls is a 'surface mount device' or 'surface mount component' in the meaning of claim 1 of the present application."

"A solder bump is a conductor and it is clearly solderable. Therefore in the examining division's view a solder bump has to be considered as an example of a solderable conductor." Hence, the applicant's argument that the solder bump on the surface did not correspond to a solderable contact pillar could not be accepted.

No surprising technical effects would be achieved by the claimed pillar shapes, which would be "chosen by the person skilled in the art according to circumstances."

VIII. The appellant argued essentially as follows:

The refusal was based on the ground of lack of inventive step in view of document D2, a document which "only teaches the use of a structure having solderable and non-solderable conductors as a means to manufacture a solder ball". The present invention, however, "teaches to provide a structure which is not used in a process for manufacturing a solder ball but to provide a contact pad to which a previously-manufactured solder ball can be made to adhere by a reflow operation with reduced risk of short circuiting between adjacent electrodes".

"The problem addressed by D2 is the production of solder balls of increased height with simplified manufacture."

Document D2 was not concerned with the problem underlying the present invention, as "[t]he way in which the solder ball is subsequently reflowed, or the electrode to which the solder ball is to be attached by reflowing, is not addressed by D2."

Furthermore, the "skilled person is taught by D2 a technique of making solder balls on only one substrate which are aligned with a pad on the other substrate", and this is "the only technique disclosed by the embodiments of D2". Document D2 provides no incentive to manufacture balls on both sets of electrodes.

Reasons for the Decision

1. The appeal is admissible.

2. *Article 123(2) EPC: Main Request*

- 2.1 The subject-matter of claim 1 of the main request is a combination of the subject-matter of claims 1 and 10 as originally filed, plus features disclosed in the passage of the description from page 6, line 30 to page 7, line 1 (see also original claim 4 in this regard). Dependent claims 2 to 6 are based on claims 2, 3, 5, 7 and 8 as originally filed.

The Board is therefore satisfied that the main request fulfils the requirements of Article 123(2) EPC.

3. *Clarity of the term "pillar"*

- 3.1 Under the title, "Additional Remarks", the Examining Division expressed reservations about the use of the term "pillar" in claim 1, and provided an explanation of the manner in which this term had been interpreted for the purposes of assessing novelty and inventive step.

Although the appellant referred, in the statement of grounds of appeal, to "the objection of lack of clarity", the Examining Division did not in fact raise any specific objection under Article 84 EPC 1973 or any other provision of the EPC in this regard. The Board also sees no reason to raise any such objection.

4. *Inventive Step: Main Request*

- 4.1 In the contested decision document D2 was cited as the closest prior art; the Board also considers it to be a suitable starting point for evaluating inventive step.

In determining which of the features of claim 1 of the main request may be identified in document D2, it should be noted that the terms "nonsolderable" and "solderable" used in the present application have essentially the same meaning as the terms "non-wetting" and "wetttable" used in document D2 (compare the definitions of "nonsolderable" and "solderable" in the description of the present application, page 7, lines 2 to 6 with the definitions of "non-wetting" and "wetttable" in document D2, column 3, lines 32-41 and 50-53).

Furthermore, document D2 discloses that the solder balls are sited on pads which may be on the substrate or on the integrated circuit. For the purpose of comparison with claim 1, the embodiment of D2 in which the solder balls are on the pads of the substrate will be considered.

4.2 Document D2 discloses (in figures 2 and 5-7, and the associated text) a method comprising the sequential steps of:

- forming a nonsolderable conductor (26 or the element having surface 72) formed of a nonsolderable material on a substrate (21,71) so as to define a conductor pattern;
- forming a solderable conductor pillar (27 or the element having surface 73, there being no reason why this element may not be referred to as a "pillar") formed of a solderable material on the nonsolderable conductor, the solderable conductor pillar constituting a limited portion of the nonsolderable conductor (see figure 1 etc.);

- registering a surface mount device with the conductor pattern (see column 1, lines 11-19 and column 2, line 60 to column 3, line 19); and
- heating the solder bump so as to reflow the solder bump and form a solder bump connection that bonds the surface mount component to the solderable conductor pillar.

4.3 The principal feature distinguishing the subject-matter of claim 1 from that of document D2 is therefore as follows:

- "registering a surface mount device with the conductor pattern, *wherein a solder bump (16) on the surface mount device contacts the solderable conductor pillar*" (emphasis added by the Board).

By contrast, in document D2 the interconnect ball 74 (i.e. the "solder bump") is already mounted on the surface 73 (i.e. the "solderable conductor pillar") prior to registration. At the registration stage the interconnect ball contacts a pad on the surface mount device (integrated circuit) and reflow takes place.

4.4 A further difference between the subject-matter of claim 1 and that of document D2 is the following:

- "the solderable conductor pillar (114) having a shape chosen from the group consisting of square, circular and shapes that are elongate in a longitudinal direction of the conductor (112)".

4.5 In the description of the present application (for example, page 4, lines 8-15 and page 7, line 27 to page 8, line 24), the problem solved by the claimed method

is said to be to provide accurate control of the height, shape and distribution of the solder connection between a surface mount device and a substrate following the reflow step by which the surface mount device and the substrate are mechanically and electrically connected. The Board is satisfied that this represents a technical problem which is plausibly solved by the principal distinguishing feature of claim 1 of the main request.

This being the case, no justification can be seen for reformulating this problem to the more general one of "mounting a surface mount device to the substrate", as stated in the contested decision. It is established case law that "the correct procedure for formulating the problem is to choose a problem based on the technical effect of exactly those features distinguishing the claim from the prior art that is as specific as possible without containing elements or pointers to the solution" (T 1019/99, point 3.3 of the Reasons). The general formulation "mounting a surface mount device to the substrate" is therefore inappropriate as it does not take into account the specific technical contribution of the principal distinguishing feature of claim 1 of the main request.

The Board therefore considers that the objective problem solved by the principal distinguishing feature of claim 1 of the main request is to provide accurate control of the height, shape and distribution of the solder connection between a surface mount device and a substrate following the reflow step.

4.6 Document D2 is concerned with a different technical problem, relating to the formation of the solder ball itself. This problem is to provide a method which

"allows an interconnect ball of increased height to be formed on a pad" (column 6, lines 41 to 46). It should be noted that although the procedure of forming a solder ball also involves a reflow step (see column 5, line 58 to column 6, line 29 and figures 6,7), this is a quite different reflow step to that which occurs in relation to fixing the integrated circuit to the substrate.

A brief mention is made in document D2 of the registration and reflow steps whereby the integrated circuit and the substrate are mechanically and electrically connected (column 1, lines 11-19 and column 2, line 60 to column 3, line 19). However, nowhere in document D2 is there any reference or allusion to providing accurate control of the height, shape or distribution of the solder connection between the integrated circuit and the substrate following the reflow step.

Document D2 was the only document cited in the contested decision. It follows that no document cited in support of the finding of lack of inventive step mentions - or even hints at - the objective problem solved by the principal distinguishing feature of claim 1. This fact alone is considered to call into serious question the finding that the subject-matter of claim 1 does not involve an inventive step.

4.7 The Board's understanding of the argument of the Examining Division that the principal distinguishing feature of claim 1 is obvious is as follows:

According to the electrical interconnect method taught in document D2, the non-wetting/wettable (i.e. nonsolderable/solderable) pad may be formed either on

the integrated circuit or on the substrate (column 2, lines 57-67), with the interconnect ball (or "solder bump") then being formed on the pad (see e.g. figure 7).

However, document D2 also discloses details of prior art interconnect methods according to which "solder balls are formed on pads of either the integrated circuit, the substrate, or both" (column 1, lines 14-15). The final possibility ("or both") means that both the integrated circuit and the substrate have solder balls, and that the solder balls on one surface are brought into contact with the solder balls on the opposite surface during the registration step.

It would be obvious for the skilled person to adopt this prior art technique (providing solder balls on both surfaces) to the interconnect method taught in document D2 (having nonsolderable/solderable pads). The result would be an arrangement in which both the integrated circuit and the substrate have nonsolderable/solderable pads and associated solder balls, such that during the registration step each solder ball on the integrated circuit (i.e. the "surface mounted device") would contact a solder ball on the substrate. A solder ball on the substrate may be referred to as a "solderable conductor pillar", and hence, the skilled person would arrive in this manner at the principal distinguishing feature of claim 1 of the main request.

- 4.8 The Board is not convinced by this argument. According to the passage cited above describing the prior art (column 1, lines 14-15), "In general, solder balls are formed on pads of either the integrated circuit, the substrate, or both". There is, however, no explicit

disclosure in this passage of two solder balls coming into contact at the registration step, and it is notable that in the more detailed description of the techniques of the prior art provided in Document D2 (column 3, lines 1-11), the only possibility referred to involves solder balls contacting pads on the opposite substrate and being bonded to them by reflow.

Hence, the position of the Examining Division appears to be based on a speculative interpretation of the cited passage, rather than on the actual subject-matter disclosed.

- 4.9 Moreover, even if this interpretation were accepted, it would still remain to be demonstrated *why* a skilled person would modify the teaching of document D2 by adopting this particular prior-art arrangement.

The reference to solder balls of the prior art being formed on both the integrated circuit and the substrate merely appears as one possibility among others in the context of a very brief summary of the prior art. There is nothing in this passage or elsewhere in the document indicating any particular advantage associated with such an arrangement, or any reason why a skilled person would be motivated to select it.

- 4.10 The technical advantage actually disclosed in document D2 is that the nonsolderable/solderable pads allow solder balls "of increased height to be formed" (column 6, lines 41 to 46).

The Board can accept, therefore, that *if* a skilled person were to consider putting solder balls on both surfaces, it would be obvious to also provide

nonsolderable/solderable pads on both surfaces, as argued in the contested decision.

However, this observation is of no relevance for answering the question posed above, namely, *why* would a skilled person provide solder balls on both surfaces?

- 4.11 In view of the above considerations, no convincing reason can be seen why, starting from the electrical interconnect method taught in document D2, it would be obvious to a skilled person to add the principal distinguishing feature of claim 1 of the main request, either on the basis of the objective problem mentioned above or for any other reason.

The Board therefore judges that the subject-matter of claim 1 of the main request involves an inventive step within the meaning of Article 56 EPC 1973.

- 4.12 In the light of this conclusion it is not necessary for the Board to discuss the other feature in which claim 1 differs from document D2 (i.e. the shape of the pillar).
5. As the Board is satisfied that the other requirements of the EPC are complied with, a patent may be granted on the basis of the appellant's main request.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The case is remitted to the Examining Division with the order to grant a patent on the basis of:
 - claims 1 to 6 of the main request filed with the letter dated 23 March 2010 stating the grounds of appeal;
 - description pages 1, 2, 2a and 3-11 filed with the letter dated 4 February 2014; and
 - drawing sheets 1/2 to 2/2, as originally filed.

The Registrar:

The Chairman:



S. Sánchez Chiquero

G. Eliasson

Decision electronically authenticated