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D E C I S I O N
of 13 May 1997

Case Number: T 0746/93 - 3.4.1

Application Number: 87304510.8

Publication Number: 0248566

IPC: H01L 21/58

Language of the proceedings: EN

Title of invention:

Process for controlling solder joint geometry when surface mounting a leadless integrated circuit package on a substrate

Applicant:

AT&T Corp.

Opponent:

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Headword:

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Relevant legal provisions:

EPC Art. 123(2), 56

Keyword:

"Subject-matter extending beyond the content of the application as filed"

Decisions cited:

G 0011/91, T 0194/84

Catchword:

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Case Number: T 0746/93 - 3.4.1

D E C I S I O N
of the Technical Board of Appeal 3.4.1
of 13 May 1997

Appellant: AT&T Corp.
32 Avenue of the Americas
New York, NY 10013-2412 (US)

Representative: Johnston, Kenneth Graham
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Decision under appeal: Decision of the Examining Division of the
European Patent Office dated 29 March 1993
refusing European patent application
No. 87 304 510.8 pursuant to Article 97(1) EPC.

Composition of the Board:

Chairman: G. D. Paterson
Members: U. G. O. Himmler
H. J. Reich

Summary of Facts and Submissions

- I. The Appellant lodged an appeal against the decision of the Examining Division which refused the application No. 87 304 510.8.

The statement setting out the Grounds of Appeal was received on 29 July 1993 together with a new set of claims 1-2 replacing the set of claims on file.

The Examining Division held that the application did not meet the requirements of Articles 52(1) and 56 EPC in that the subject-matter of the then valid claim 1 lacked inventive step.

- II. The contested decision was based on the state of the art having regard to the following documents:

D1: EP-A-0 147 576

D2: IBM Technical Disclosure Bulletin, Vol. 16, No. 3, August 1973, page 767, New York, US; V.D.Coombs: "Chip mounting with prestretched joints"

D3: Patent Abstracts of Japan, Vol. 9, No. 47(E-299) [1770], 27 February 1985; & JP-A-59 188 155

- III. The Appellant requested that the contested decision be set aside and a patent granted on the basis of the set of claims filed with the Grounds of Appeal.

- IV. The wording of the only independent claim 1 reads as follows:

"1. A method of forming solder joints for joining a package and a substrate, characterized by the steps of:

depositing predetermined and controlled first volumes of solder all having a common specific melting point and in the form of spherical bumps on individual pads of a package, each of these pads having a predetermined and controlled size and shape,

depositing predetermined and controlled second volumes of solder all having a common melting point equal to the common specific melting point and in the form of spherical bumps on individual pads of a substrate, each of these pads having a predetermined and controlled size and shape,

the first and second solder volumes equalling the total volume of the solder joint to be formed,

laterally positioning the substrate and package adjacent to each other with individual pads of the package in registration with associated individual pads of the substrate,

establishing an initial vertical separation between the package and the substrate which is small enough to allow the predetermined and controlled volumes of solder on each associated pair of pads to touch and coalesce when molten, applying sufficient heat to an assembly of the package and substrate to achieve a predetermined reflow temperature, such that the first and second volumes of solder on each associated pair of pads all become molten at the common specific melting point and coalesce to form a solder joint between a pad on the package and an associated pad on the substrate with a vertical separation between the package and the substrate consistently monotonically decreasing during solder joint formation until a final separation is attained and always being within a range defined by the initial vertical separation and the final vertical separation less than

the initial vertical separation, and maintaining a predetermined and a controlled final vertical separation between package and substrate selected to achieve a specific solder joint shape in combination with preselected solder volumes and pad sizes by application of a mechanical apparatus having a fixed dimension equalling the final vertical separation which fixed dimension is selected to be less than the initial vertical separation after molten solder joints form in order to control a solidified shape of each of the solder joints,

the first and second volumes, pad sizes on the package and pad sizes on the substrate in combination with the fixed dimension being selected in accord with parameter interrelations to yield an elongated and nearly cylindrical solder joint of a height significantly greater than a width of the pads on the package and wherein said controlled vertical separation is selected knowing variations in ball sizes and pad sizes and warpage of the substrate relative to the package to provide sufficient overlap between the molten solder bumps on the package and substrate so as to assure formation of desired solder joints with a high yield."

- V. The Appellant argued essentially in support of his requests that the Examining Division had misinterpreted the state of the art in D3 with respect to the claimed invention. Appellant's method uses a controlled overlap with substantially equal volumes of solder on the package and substrate in order to achieve the elongated joint with an hourglass shape and to achieve a high yield. Contrary to the application in suit the method according to the state of the art of D3 does not achieve these objectives but results in solder deposits on the package and the substrate which are different in volume.

- VI. The Rapporteur issued on behalf of the Board a communication with a preliminary opinion indicating that with respect to certain features the newly filed claim 1 extended beyond the content of the application as filed, contrary to Article 123(2) EPC, and that certain expressions in the claim are not clear and therefore the claim contravenes Article 84 EPC.
- VII. In response to the Rapporteur's communication the Appellant gave arguments in his letter of 26 November 1996 why he considered the features in question to have been originally disclosed. The Appellant maintained claim 1 as filed with the Grounds of Appeal as his main and sole request.

Reasons for the Decision

1. *Amendments*

- 1.1 The particular feature that the volumes of solder all have a "common melting point" is not clearly and unambiguously disclosed for the following reasoning:

According to the original description at page 6, lines 17 to 30, at least one embodiment of the invention comprises solder spheres of predetermined and controlled volume which are reflowed onto fluxed metallized pads of a package. Further, a predetermined amount of solder paste is deposited on lands of the substrate. The package is placed over the substrate footprint so that the solder bumps (of the package) are aligned with the associated solder paste covered pads

of the substrate. The assembly is subjected to reflow soldering so that the solder paste initially melts and tends to form a molten spherical shape and thereby joins with the associated solder sphere of the package to form a solder joint with controlled geometry.

According to this example the solder of the package and the solder of the substrate have different melting points. That the solder of the package and the substrate have different melting points is not an exceptional situation as it is clear from the description (column 4, lines 35 to 36 and line 58) that different melting points for package and substrate are not unusual. Therefore the Board cannot accept the arguments of the Appellant put forward in the letter dated 26 November 1996 that neither the drawings nor the specification state that the solder bumps on the package have a different melting point than the solder on the substrate. As there is not one embodiment for which it is positively stated in the description that the solder on the package and the solder on the substrate have a "common melting point", whereas at least one embodiment explicitly states that the solder bumps on the package and the solder on the substrate have different melting points, as the solder paste (on the substrate) "initially melts" (page 6, line 24 of the original description) and then tends to form a molten spherical shape and thereby joins with the associated solder sphere of the package to form a solder joint (page 6, lines 24 to 30 of the original description). Therefore the feature of a "common melting point" cannot be derived "directly and unambiguously" by a skilled person from the originally filed documents as required by the consistent jurisprudence of the Boards of Appeal; see e.g. point 3

of the reasons in G 11/91 (OJ EPO 1993, 125) as well as point 2.4 of the reasons in T 194/84 (OJ EPO 1990, 59). Consequently, the feature of a "common melting point" contravenes Article 123(2) EPC.

- 1.2 The Board also cannot accept the arguments presented by the Appellant concerning the original disclosure of the feature that the vertical separation between the package and the substrate is "consistently monotonically" decreasing due to gravity which causes the package to sink towards the substrate.

As any movement caused by gravity only is an uniformly accelerated movement, the vertical separation between the package and the substrate is decreasing with the second power of time, i.e. not consistently monotonically decreasing. Nowhere in the originally filed documents is a "consistently monotonically" decreasing separation of the package and the substrate explicitly disclosed; on the contrary, the decreasing separation of the package and the substrate due to gravity has explicitly been disclosed (see page 6, lines 12 to 13 and page 10, lines 19 to 22). Therefore also this feature contravenes Article 123(2) EPC.

2. For the above reasons the valid claim 1 does not comply with the requirements of Article 123(2) EPC and the claim therefore is not allowable.
3. Furthermore, even if the proposed amendments discussed above were allowable under Article 123(2) EPC, in the Board's judgment the claimed invention does not involve an inventive step having regard to the state of the art disclosed in documents D1 and D3, essentially for the reasons set out in the decision of the Examining Division. Thus the application would be refused under Article 52(1) and 56 EPC.

Order

For these reasons it is decided that:

The appeal is dismissed

The Registrar:

The Chairman:

M. Beer

G. D. Paterson

