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**D E C I S I O N**  
of 15 September 2000

**Case Number:** T 0734/97 - 3.4.3

**Application Number:** 91111754.7

**Publication Number:** 0467259

**IPC:** H01L 25/16

**Language of the proceedings:** EN

**Title of invention:**

Electronic device

**Applicant:**

Hitachi, Ltd.

**Opponent:**

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**Headword:**

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**Relevant legal provisions:**

EPC Art. 123(2), 84

**Keyword:**

"Essential features of the invention"

"Inventive step of an amended main claim accepted by the  
examining division"

"No reason for ex-officio examination of inventive step of the  
amended claim by the Board"

**Decisions cited:**

G 0010/93

**Catchword:**

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Boards of Appeal

Chambres de recours

**Case Number:** T 0734/97 - 3.4.3

**D E C I S I O N**  
**of the Technical Board of Appeal 3.4.3**  
**of 15 September 2000**

**Appellant:** Hitachi, Ltd.  
6, Kanda Surugadai 4-chome  
Chiyoda-ku  
Tokyo 101 (JP)

**Representative:** Beetz & Partner  
Patentanwälte  
Steinsdorfstrasse 10  
D-80538 München (DE)

**Decision under appeal:** Decision of the Examining Division of the  
European Patent Office posted 28 January 1997  
refusing European patent application  
No. 91 111 754.7 pursuant to Article 97(1) EPC.

**Composition of the Board:**

**Chairman:** R. K. Shukla  
**Members:** G. L. Eliasson  
M. J. Vogel

## Summary of Facts and Submissions

- I. European patent application No. 91 111 754.7 was refused in a decision of the examining division dated 28 January 1997. The ground for the refusal was that the subject matter of claim 1 lacked an inventive step with respect to the prior art documents
- D1: EP-A-0 015 053; and
- D2: DE-A-32 21 199.
- II. In the course of the examination of the application in suit, the examining division stated under point 4 of the communication dated 27 April 1994 that there was no hint in document D2 to interpose a composite material plate between the metal base and the insulating layer as in the application in suit. Document D2, on the contrary, was held to disclose a device where the composite material plate is inserted between a semiconductor chip and an insulating plate. As the examining division considered the solution given in the application in suit to be non-obvious, the applicant was invited to file a claim "including all the essential features of the present invention, i.e. all the plates and layers and their respective location in the claimed structure."
- III. The appellant (applicant) lodged an appeal on 4 April 1997 paying the appeal fee the same day. A statement of the grounds was filed on 9 June 1997 along with new claims 1 to 6 and amended pages of the description.

IV. In response to a communication from the Board, the appellant filed with the letter dated 23 May 2000, new claims 1 to 6 together with amended pages 5, 11, and 29 of the description. The appellant requested that the decision under appeal be set aside and a patent be granted on the basis of the following documents:

**Claims:** 1 to 6 filed with the letter dated 23 May 2000

**Description:** Pages 5, 11, 29 filed with the letter dated 23 May 2000  
Pages 1, 4, 4a, 6 to 10, 12 to 15 filed with the statement of grounds of the appeal dated 9 June 1997  
Pages 2, 3, 16 to 28, 30 to 37 as originally filed

**Drawings:** Sheets 1/8 to 8/8 as originally filed

Oral proceedings were requested in case the above request would not be granted.

V. Claim 1 of the above request reads as follows:

"An electronic device comprising:  
- a heat conductive base (4);  
- a composite material plate (3) soldered (5) on said base (4);  
- an insulating plate (2) formed of aluminum nitride (AlN) and soldered (5) on said composite material plate (3);  
- a plurality of power semiconductor chips (1) soldered to said insulating plate (2); and  
- a wiring plate mounted on said base (4), the wiring

plate (19) being connected to said chips (1) by wires (14b),

- wherein said composite material plate (3) comprises a layer (3A) of a first linear expansion coefficient and a layer (3B) of a second linear expansion coefficient different from said first linear expansion coefficient, such that the difference in thermal expansion between the base and the insulating plate is absorbed by the composite material plate."

VI. The appellant argued in the statement of the grounds of appeal that claim 1 as amended contains feature considered to be inventive by the examining division in the communication dated 27 April 1994.

### **Reasons for the Decision**

1. The appeal complies with Articles 106 to 108 and Rule 64 EPC, and is therefore admissible.
2. *Amendments (Article 123(2))*

Claim 1 corresponds to a combination of the features of claims 1 and 3 as filed together with the features disclosed on page 9, lines 5 to 10 (insulating plate absorbing difference in thermal expansion), page 16, lines 19 to 20 (aluminum nitride), and in Figures 1 to 4 (solder (5) between the layers, and wires(14b)) of the application as filed.

Claims 2 to 6 correspond to claims 2, 5, 7, 9, and 11, respectively, of the application as filed.

The claims therefore meet the requirements of

Article 123(2) EPC.

3. *Clarity (Article 84 EPC)*

The positive opinion regarding inventive step, of the examining division in the communication of 27 April 1994 referred to in item II above, was with the proviso that all essential features are present in a new main claim, i.e. that the requirements of Article 84 EPC are met. The application in suit relates to an electronic device consisting of power semiconductor chips mounted on an insulated plate and addresses the problem of stress on a solder produced by the materials of a base plate, an insulating plate, and a semiconductor chip having different coefficients of thermal expansion from each other, when the assembly of these components is subjected to repeated thermal cycling.

The above problem is solved in the application in suit by inserting a composite material plate between the base plate and the insulating layer. The composite material plate consists of a layered structure of two materials with different thermal expansion coefficients chosen in such a manner that the difference in thermal expansion between the base and the insulating plate is absorbed by the composite material plate.

Since claim 1 not only specifies the soldered layers and their relative position to each other, but also clearly defines the composite layer, all features essential for solving the above stated problem are present. Thus, the invention as defined in claim 1 is consistent with the invention as described, and is clear (Article 84 EPC).

4. *Novelty and inventive step (Articles 54 and 56 EPC)*

4.1 As referred to in item II above, the examining division found that an amended main claim incorporating the feature that a composite plate is soldered between the heat conductive base and the insulating plate would not be obvious having regard to the prior art. The examining division considered document D2 to be the closest prior art where, in contrast to the solution given in the application in suit, the composite plate is inserted between a semiconductor chip and an insulating plate.

4.2 With respect to claim 1 forming the basis of the decision under appeal, present claim 1 in addition specifies that the composite material plate is soldered between the heat conductive base and the insulating plate. In other words, present claim 1 contains subject matter which was regarded by the examining division as involving an inventive step having regard to the cited prior art. The Board has no reason to question or reexamine on its own motion the examining division's finding that the present set of claims would meet the requirements of Article 52(1) EPC (cf. G 10/93, OJ EPO 1995, 172, Reasons, item 4).

## Order

### For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The case is remitted to the first instance with the order to grant a patent on the basis of the following documents:

**Claims:** 1 to 6 filed with the letter dated  
23 May 2000

**Description:** Pages 5, 11, 29 filed with the letter  
dated 23 May 2000  
Pages 1, 4, 4a, 6 to 10, 12 to 15 filed  
with the statement of grounds of the  
appeal dated 9 June 1997  
Pages 2, 3, 16 to 28, 30 to 37 as  
originally filed

**Drawings:** Sheets 1/8 to 8/8 as originally filed

The Registrar:

The Chairman:

D. Spigarelli

R. K. Shukla