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**Datasheet for the decision
of 25 May 2016**

Case Number: T 0558/12 - 3.4.03

Application Number: 00980036.8

Publication Number: 1343204

IPC: H01L23/467, H05K7/20, G06F1/20

Language of the proceedings: EN

Title of invention:
ELECTRONIC DEVICE UNIT

Applicant:
FUJITSU LIMITED

Headword:

Relevant legal provisions:
EPC 1973 Art. 56
EPC Art. 52(1), 123(2)

Keyword:
Inventive step - (yes)

Decisions cited:

Catchword:



Beschwerdekammern
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Case Number: T 0558/12 - 3.4.03

D E C I S I O N
of Technical Board of Appeal 3.4.03
of 25 May 2016

Appellant: FUJITSU LIMITED
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Decision under appeal: **Decision of the Examining Division of the
European Patent Office posted on 14 October 2011
refusing European patent application No.
00980036.8 pursuant to Article 97(2) EPC.**

Composition of the Board:

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

Summary of Facts and Submissions

- I. The application was refused on the ground that the subject-matter of claim 1 of the main request did not involve an inventive step within the meaning of Article 56 EPC.
- II. The appellant requested in writing that the decision under appeal be set aside, and that a patent be granted based on the following main request:

Description, Pages

1-5, 9-33

filed with entry into the regional phase before the EPO
7-8

filed with telefax on 19 August 2011

6

filed with the letter of 3 May 2016.

Claims, Numbers

1-11

filed with telefax on 19 August 2011.

Drawings, Sheets

1/21-21/21

filed with entry into the regional phase before the EPO.

Subsidiarily, it was requested that a patent be granted on the basis of an auxiliary request filed with the statement of grounds of appeal.

- III. The following documents cited by the Examining Division are referred to in this decision:

D1: WO 97/38566 A

D2: JP 05 206666 A

D3: US 5 077 601 A
D4: JP 04 133496 A
D5: WO 96/01035 A
D6: JP 61 129349 U
D6a: English translation of D6.

IV. Claim 1 of the main request reads as follows:

*"An electronics device unit (10, 10A, 10B, 10C, 10D, 10E, 10F, 10G), comprising:
a circuit board (11);
a plurality of semiconductor components (20-1 to 23) that are dispersedly mounted on the circuit board, the plurality of semiconductor components generating heat, heat sinks (30-1 to 33) being mounted on the plurality of semiconductor components, respectively; and
a cover member (13) that is provided over the heat sinks to form a tunnel (12) on the circuit board, a cooling medium flowing in the tunnel,
wherein the plurality of semiconductor components are cooled via the heat sinks by a flow of the cooling medium travelling through the tunnel in a flow direction,
and the plurality of semiconductor components are arranged on the circuit board in such an arrangement that in terms of a cross-section orthogonal to the flow direction, a ratio (U2) of a cross-sectional area of a clearance at a downstream part of the flow of the cooling medium to a cross-sectional area of the tunnel is smaller than a ratio (U1) of a cross-sectional area of a clearance at an upstream part of the flow of the cooling medium to the cross-sectional area of the tunnel, the cross-sectional area of the clearance at the upstream part being defined by subtracting from the cross-sectional area of the tunnel a cross-sectional area at the upstream part occupied by the heat sinks*

that block the flow of the cooling medium, the cross-sectional area of the clearance at the downstream part being defined by subtracting from the cross-sectional area of the tunnel a cross-sectional area at the downstream part occupied by the heat sinks that block the flow of the cooling medium, and wherein a place at which the plurality of the semiconductor components are mounted is divided into at least three regions with respect to a direction of the flow of the cooling medium, space parts (61, 60; 140, 141, 142) are formed between the at least three regions, respectively, and as the space part is located at the more downstream side, the space part becomes wider."

V. The Examining Division found essentially as follows:

Document D6 was the closest prior art. The subject-matter of claim 1 differed only in the features defined in the final paragraph of the claim ("*a place at which ...*").

The technical problem solved might be seen as: "How to improve the quality of the cooling fluid stream which is effective to cool semiconductor devices".

The distinguishing feature referred to the size of fluid mixing volumes provided in front of clusters of electronic components with their respective heat sinks to be cooled.

Obviously the density of the arrangement of electronic components and their heat sinks influenced the level of mixture of various cooling fluid streams. The plurality thereof consisted of streams which got into direct contact to heat sinks located in the upstream direction and others not getting into such contact. The later ones

were less preheated when arriving at a downstream portion of the device. In extreme cases, no mixing at all might take place and some of the devices at the downstream end of a cooling fluid stream would only receive fluids already preheated from heat-sinks at the upstream portion of the fluid stream while others would receive cooling streams having a temperature which is almost identical to the environmental temperature. In a situation like this those components which did not receive the required cooling fluid with a correspondingly low temperature might suffer from overheating. It belonged to the standard tasks of a device designer who was considered to be the relevant person skilled in the art to control and guide the circulation and spread of cooling fluid streams inside a device.

In this process the person skilled in the art would also take into account the mixing capabilities for various cooling fluid streams inside a device.

Larger volumes of mixing chambers or mixing boxes were one of a limited number of well known options to provide a better mixing of inhomogeneous streams. This was just because those larger volumes naturally allow a more intense interaction of the various fluids. Other well known means to enforce the fluid mixing were turbulence creating baffles or guiding plates. Given that a desired miniaturization of an overall device didn't make the use of large empty mixing volumes impossible, this means was obviously very cost effective.

In the device design as disclosed in the present application as well as in D6, the density of components increased in the direction from the input port of the fluid stream to the respective output port. Hence the

common fluid stream at the input port was divided into an increasing number of sub streams while traveling through the device. Thereby the required mixing capability which was necessary to provide an homogenous temperature in the fluid streams effective to components in the downstream direction increased as well.

Therefore in order to provide a consistent cooling for all the electronic components of the device a better mixing capacity for those fluid flows at the downstream portion of the device was obviously required.

When searching for technical means providing the correspondingly increased mixing capabilities the person skilled in the art would use one of the limited number of well known options. Thereby she would balance design criteria like a desired overall device size versus cost and functional requirements. Whenever it was possible to use a technically simple and cheap means, like the use of large empty mixing volumes, she would give preference to such means even at the expense of a larger device volume.

Hence the person skilled in the art starting from D6 (in particular from its general teaching applied to the embodiment as disclosed by figure 7) and trying to solve the technical problem as given above, would arrive at the subject-matter of present claim 1 by applying her common general knowledge only. Therefore the subject-matter of claim 1 was not inventive.

VI. The appellant argued essentially as follows.

The subject-matter of claim 1 of the main request differed from the closest prior art (document D6) in the

features defined in the final paragraph of the claim ("*and wherein a place at which ...*").

A further difference was the feature: "*a cover member (13) that is provided over the heat sinks to form a tunnel (12) on the circuit board, a cooling medium flowing in the tunnel*". The finding of the Examining Division that this feature was implicitly disclosed in document D6 was incorrect.

In relation to the undisputed distinguishing features (the final paragraph of claim 1), the technical effect was improved overall cooling of the mounted semiconductor components, and the objective technical problem might be formulated as to adapt the D6 electronic device to improve overall cooling of the mounted heat-generating bodies.

The skilled person, routinely reviewing D6 and considering the objective technical problem, would not arrive at an embodiment of the present invention. For instance, D6 did not discuss space parts between regions of mounted semiconductor components (heat-generating bodies). D6 itself therefore would not incite the skilled person to arrive at the present invention. Indeed, D6 taught the skilled person to focus on the design of fins fitted to heat-generating bodies in order to improve cooling. The skilled person would inevitably take on board the focus of a document when routinely reviewing it, and the focus of D6 on fin design and high-performance fins would lead the skilled person away from the present invention.

Additionally, the concentration in D6 on "higher density" mounting of electronic components, and on making devices "smaller and more compact" with "the

greater miniaturization achievable" would also lead the skilled person away from the present invention.

None of the documents D1 to D5 discussed space parts between regions of mounted semiconductor components (heat-generating bodies) either, and hence the skilled person would not arrive at the present invention starting from D6 by turning to one of D1 to D5.

It was also not accepted that mere "common general knowledge" would lead the skilled person from D6 directly to the present invention, as alleged by the Examining Division.

Firstly, no evidence of such alleged common general knowledge (e.g. textbooks) had been produced by the Examining Division. Secondly, the lengthy and complicated nature of the reasoning set out at sections 2.3 to 2.6 of the decision under appeal was evidence itself of the non-obvious nature of the present invention. Thirdly, D1 to D6 constituted a range of teachings in the relevant art, and none of them considered space parts between regions of mounted semiconductor components.

The objection of lack of inventive step seemed unjustified when the features on which the objection focused had not been identified anywhere in the documented prior art.

Reasons for the Decision

1. The appeal is admissible.

2. *Article 123(2) EPC*

Claim 1 of the main request is based on claim 1 as originally filed (with minor clarifications) and claim 13 as filed. Dependent claims 2-11 are based on claims 3-5, 7-12 and 14 as originally filed. The Board is therefore satisfied that the requirements of Article 123(2) EPC are met.

3. *Inventive Step*

3.1 In the contested decision, document D6 (together with translation D6a) was seen as the closest prior art. The Board also sees this document, in particular Fig. 7 and the associated text, as a reasonable starting point for deciding on inventive step.

3.2 The subject-matter of claim 1 of the main request differs from the closest prior art at least in the following feature:

- *"and wherein a place at which the plurality of the semiconductor components are mounted is divided into at least three regions with respect to a direction of the flow of the cooling medium, space parts (61, 60; 140, 141, 142) are formed between the at least three regions, respectively, and as the space part is located at the more downstream side, the space part becomes wider."*

3.3 The appellant sees the problem solved by this feature as improving the overall cooling of the mounted heat-generating bodies, and the Board considers this to be reasonable. The technical problem proposed by the Examining Division ("How to improve the quality of the

cooling fluid stream which is effective to cool semiconductor devices") is not considered appropriate, as the "quality of the cooling fluid stream" contains pointers to the solution, i.e. arranging the space parts for optimum mixing and temperature uniformity (see e.g. page 8, line 18 to page 9, line 1 of the description as originally filed).

3.4 The appellant argues that there is no disclosure of the distinguishing feature in any of the prior art documents (D1-D6) cited in the procedure. The Board sees no reason to question this assessment, and the Examining Division did not assert otherwise.

3.5 The Examining Division nevertheless found that, starting from the arrangement of Fig. 7 of document D6, the skilled person "would arrive at the subject-matter of present claim 1 by applying her common general knowledge only."

This conclusion was supported by arguments which have been fully set out under point V above, and will not be repeated at length here. However, it was essentially argued that the skilled person would be aware that providing larger volumes of mixing chambers is one of a limited number of well known options to provide a better mixing of inhomogeneous streams. Furthermore, the skilled person would appreciate that in document D6, the requirement for a better mixing capacity increases in the downstream direction.

3.6 In the opinion of the Board, while these general considerations might possibly have formed part of the chain of reasoning which led the inventors to devise the present invention, they do not represent a persuasive argument that the skilled person, devoid of imagination,

would arrive at the claimed invention in an obvious manner.

- 3.7 An argument denying inventive step based on common general knowledge ordinarily involves identifying a feature by which the claimed subject-matter differs from the closest prior art, determining the problem solved by the feature, and then plausibly asserting (and proving, if challenged) that the feature is commonly used to solve the problem.

In the present case, the problem is improving the overall cooling of the mounted heat-generating bodies, and the claimed feature solving the problem is essentially to divide the place at which the semiconductor components are mounted into at least three regions with respect to a direction of the flow of the cooling medium, with space parts formed between them, such that as the space part is located at the more downstream side, the space part becomes wider.

In the contested decision, not only is no proof offered that this arrangement is a commonly known solution to the problem of improving cooling, it is not even asserted that this is the case.

In fact, far from being established as a solution which is commonly known, there is no evidence in the available prior art that the claimed arrangement has ever been used to solve the above problem, or indeed that it has ever been contemplated for any purpose.

- 3.8 The Board is therefore not persuaded that the skilled person would arrive at the claimed subject-matter on the basis of the available prior art, even when taking common general knowledge into account, and consequently

the subject-matter of claim 1 of main request is judged to involve an inventive step within the meaning of Articles 52(1) EPC and 56 EPC 1973. Claims 2-11 are directly or indirectly dependent on claim 1.

Order

For these reasons it is decided that:

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

Description, Pages

1-5, 9-33

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7-8

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6

filed with the letter of 3 May 2016.

Claims, Numbers

1-11

filed with telefax on 19 August 2011.

Drawings, Sheets

1/21-21/21

filed with entry into the regional phase before the EPO.

The Registrar:

The Chairman:



S. Sánchez Chiquero

G. Eliasson

Decision electronically authenticated