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**Datasheet for the decision
of 26 May 2009**

Case Number: T 0049/07 - 3.4.02

Application Number: 97905605.8

Publication Number: 0817983

IPC: G02B 6/42

Language of the proceedings: EN

Title of invention:

Substrate system for optoelectronic/microwave circuits

Applicant:

Hughes Electronics Corporation

Headword:

-

Relevant legal provisions:

EPC Art. 123(2)

Relevant legal provisions (EPC 1973):

EPC Art. 56

Keyword:

"Added subject-matter (yes)"
"Inventive step (no)"

Decisions cited:

-

Catchword:

-



Case Number: T 0049/07 - 3.4.02

D E C I S I O N
of the Technical Board of Appeal 3.4.02
of 26 May 2009

Appellant: Hughes Electronics Corporation
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Representative: Witte, Weller & Partner
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Decision under appeal: Decision of the Examining Division of the
European Patent Office posted 28 July 2006
refusing European application No. 97905605.8
pursuant to Article 97(1) EPC 1973.

Composition of the Board:

Chairman: A. G. Klein
Members: F. J. Narganes-Quijano
B. Müller

Summary of Facts and Submissions

- I. The appellant (applicant) lodged an appeal against the decision of the examining division refusing European patent application No. 97905605.8 based on the International application No. PCT/US97/01090 (International publication No. WO 97/27508).

The following documents were considered during the first-instance examination proceedings:

- D2: EP-A-0638829
D3: EP-A-0517369
D4: Patent Abstracts of Japan, Vol. 18, No. 8, 1994, abstract of JP-A-5251629
D5: Patent Abstracts of Japan, Vol. 95, No. 6, 1995, abstract of JP-A-7074285.

In the decision under appeal the examining division held that claim 1 amended according to the request then on file did not comply with the requirements of Article 123(2) EPC 1973 and that the subject-matter of the claim further amended so as to overcome this objection would not involve an inventive step within the meaning of Article 56 EPC 1973 in view of the disclosure of documents D3 and D4.

- II. With the statement setting out the grounds of appeal the appellant submitted a new set of amended claims 1 to 8 and requested setting aside of the contested decision and the grant of a patent on the basis of the new set of claims. The appellant also requested oral proceedings on an auxiliary basis.

Claim 1 amended according to the request of the appellant reads as follows:

"A substrate system for carrying and interconnecting an optoelectronic/microwave circuit with the aid of a plurality of solder bumps (70; 137, 138), said optoelectronic/microwave circuit including an optical fiber (42, 43; 172, 173), an optoelectronic integrated circuit (24; 130) which has an optical port (38) and a plurality of bonding pads (86), and a microwave integrated circuit (26; 132, 134) which has a plurality of bonding pads, said microwave integrated circuit (26; 132, 134) being adapted for communication with said optoelectronic integrated circuit (24; 130) through a first microwave signal and adapted for communication externally from said optoelectronic/microwave circuit (24; 130) through a second microwave signal, said substrate system (20; 120) comprising:

a substrate (41; 124);

a groove (48, 49; 125, 126) formed in said substrate (41; 124);

a dielectric layer (50) positioned over at least a portion of an upper surface of said substrate (50);

a plurality of passive microwave components (64, 65) and microwave transmission members (54-57; 74; 115, 116; 160, 164, 166) fabricated directly on said dielectric layer (50) and configured to carry microwave signals;

a plurality of first bonding pads (76) formed on said substrate (41; 124); and

a plurality of second bonding pads formed on said substrate (41; 124);

wherein

said groove (48, 49; 125, 126) is configured to receive said fiber (42, 43; 172, 173);

said first bonding pads (76) are positioned to align with said bonding pads (86) of said optoelectronic integrated circuit (24; 130) and are configured to be connected to said bonding pads of said optoelectronic integrated circuit (24; 130) with a plurality of said solder bumps (70A; 137);

said second bonding pads are positioned to align with said bonding pads of said microwave integrated circuit (26; 132, 134) and are configured to be connected to said bonding pads of said microwave integrated circuit (26; 132, 134) with a plurality of said solder bumps (70B; 138);

the combination of said groove (48, 49; 125, 126) and said first bonding pads (76) are arranged to optically align said optical fiber (42, 43; 172, 173) and said optical port (38), and

one of said microwave transmission members (54, 55; 164, 166) is arranged to couple said first microwave signal between said optoelectronic integrated circuit (24; 130) and said microwave integrated circuit (26; 132, 134)."

The remaining claims 2 to 8 are dependent claims all referring back to claim 1.

III. Oral proceedings before the Board were appointed according to the auxiliary request of the appellant. In a communication pursuant to Article 15(1) of the Rules of Procedure of the Boards of Appeal (RPBA) annexed to the summons to oral proceedings, the Board introduced the following documents into the proceedings:

D5': JP-A-7074285 (publication date: 17.03.1995)

D5'':US-A-5510758 (publication date: 23.04.1996).

Document D5' is the Japanese patent application the English abstract of which is shown in document D5, and the post-published document D5'' belongs to the patent family of document D5'. Figure 1 of documents D5 and D5' is identical to Figure 1 of document D5'' and the disclosure in document D5'' with reference to Figure 1 (column 5, line 24 to column 6, line 11) corresponds to the English translation of the corresponding disclosure in document D5'. The appellant was informed that the cited passage of the post-published document D5'' could be used to interpret the corresponding disclosure in the Japanese patent application D5'.

In the aforementioned communication the Board gave a preliminary assessment of the case. The passages of the communication that are pertinent to the present decision read as follows:

1. "According to the application as published the plurality of first and second bonding pads arranged in the substrate system for connection to the bonding pads of the optoelectronic integrated circuit and of the microwave integrated circuit are formed not on the substrate, but on the dielectric layer (see lines 16 to 18 of claim 1, page 4, lines 22 to 24, and Figures 1 and 2 and the corresponding description). Amended claim 1, however, requires that the plurality of first and second bonding pads are formed "on said substrate". The compliance of this amendment with the

requirements of Article 123(2) EPC will be addressed during the oral proceedings."

2. "The appellant has not disputed the view of the examining division that the substrate system disclosed in document D3 with reference to Figure 4 constitutes the closest prior art. The document discloses a substrate system comprising a substrate (silicon substrate 41), a dielectric layer (layers 44 and 50) positioned thereon, a groove (42) formed in the substrate and configured to receive an optical fibre, a microwave transmission member (interconnect 46) fabricated on the dielectric layer and arranged to couple microwave signals between an optoelectronic integrated circuit (laser array 30) and a microwave integrated circuit (laser driver integrated circuit 47), and bonding pads (52) formed on the dielectric layer and arranged to be aligned with and connected to bonding pads of the optoelectronic integrated circuit by means of solder bumps, the groove and the bonding pads being arranged to optically align the optical fibre with an optical port of the optoelectronic integrated circuit (column 3, line 25 to column 4, line 5). According to document D3, the optoelectronic integrated circuit is mounted on the substrate system by means of solder bumps applied on corresponding ones of the alignment bonding pads of the substrate system (column 6, line 39 to column 7, line 27), and the microwave integrated circuit is mounted on the substrate system using epoxy (column 7, line 29)."

2.1 "As already found by the examining division, the subject-matter of claim 1 differs from the substrate system disclosed in document D3 in the following feature:

a) while in document D3 the substrate system also includes bonding pads configured to be connected to the bonding pads of a passive microwave component (element 53 in Figure 4), claim 1 requires that the passive microwave components are fabricated directly on the dielectric layer.

In the Board's view, the following constitutes a further distinguishing feature of the claimed subject-matter:

b) while in document D3 the substrate system includes a pad for electric connection (wire bond interconnection 60) with a microwave integrated circuit 47 to be mounted on the dielectric layer using epoxy (column 7, lines 30 to 33 together with Figure 4), claim 1 requires that the substrate system comprises bonding pads configured to align with and to be connected to the bonding pads of the microwave integrated circuit by means of solder bumps."

2.2 "The assessment of inventive step of the claimed subject-matter following the problem-solution approach requires the determination of the objective technical problem solved by the claimed subject-matter in terms of the technical effects achieved by the distinguishing features a) and b) identified above over the substrate system disclosed in document D3.

The appellant has submitted that, as already mentioned in the description of the application (page 4, lines 7 to 12), the claimed invention facilitates the optical alignment of optoelectronic devices and optical fibres. This aspect, however, has been already achieved in document D3 by means of an arrangement of grooves and bonding pads as claimed (see point [2] above) and none of the distinguishing features a) and b) identified above has an effect on the optical alignment of the elements mentioned above. Accordingly, the aspect relating to the optical alignment does not contribute to the formulation of the objective problem actually solved by the claimed invention over the disclosure of document D3.

The appellant has further submitted that, as also mentioned in the application (page 4, lines 7 to 17 and paragraph bridging pages 4 and 5), the fabrication of microwave transmission members directly on the dielectric layer leads to structures having less loss and wider bandwidths than interconnect structures such as wire bonds and ribbons. However, document D3 already discloses the formation of low-microwave transmission members directly on the dielectric layer as claimed (see point [2] above), so that this aspect does not contribute to the determination of the objective problem either.

The further submission of the appellant that the claimed invention facilitates the use of hybrid integration techniques in which fabrication materials and processes can be independently

selected to enhance the performance of each device (page 5, lines 9 to 13 of the application) cannot be invoked with regard to the claimed invention because, first, the optoelectronic integrated circuit of document D3 is also mounted on the substrate as claimed (see point [2] above) and, second, the microwave integrated circuit of document D3, although mounted on the substrate using epoxy (see point [2] above) instead of aligning bonding pads as claimed, is also mounted following an hybrid integration technique having the advantages mentioned above.

The reduction of microwave-transmission losses associated with the use of a dielectric layer (page 9, lines 30 to 33 of the application) does not support either any improvement of the claimed invention over the disclosure of document D3 because this document also teaches the use of a dielectric layer on the substrate (see point [2] above).

The following aspects would however appear to contribute to the objective problem:

- the fabrication of passive microwave components directly on the dielectric layer as required by the distinguishing feature a) identified above leads, as submitted by the appellant and supported by the disclosure of the application (page 3, lines 34 to 36, page 4, lines 7 to 17 and 30 to 34, and page 13, lines 21 and 22), to structures having lower loss and greater bandwidth, using less area and being more compatible with high volume production than their chip-mounted counterparts, and

- the mounting of the microwave integrated circuit on the substrate by means of aligning bonding pads as required by the distinguishing feature b) instead of epoxy would eliminate the need for electrical wires for connecting the circuit to the substrate.

As no synergistic effect appears to result from these two aspects, they would have to be treated independently of each other.

Accordingly, the objective problem solved by the claimed invention over the closest prior art document D3 would appear to consist in the two following independent aspects:

i) improving the loss and the bandwidth of the passive microwave component and improving the characteristics of the mounting/integration process of the same on the substrate system, and

ii) simplifying the electrical connection of the microwave integrated circuit to the substrate."

2.3 "As regards the aspect i) of the objective problem, it is well known in the art to improve the loss, the bandwidth and the coupling characteristics of passive components coupled to a substrate by fabricating the passive microwave component in the substrate following the monolithic integration technique well known in the art. Indeed, according to the appellant the merits of the claimed invention would lie in the combination of the techniques - and therefore in the combination of the respective advantages and disadvantages - of the two different approaches known in the art for

the fabrication of electronic and optoelectronic devices, namely the monolithic integration technique (in which all active and passive components are formed on a same substrate and which presents the advantages of reduced overall circuit size and reduced parasitic inductances and capacitances) and the hybrid integration technique (in which discrete components are bonded to the substrate and presents the advantages that the materials and the fabrication processes can be selected independently for each device, thus enhancing the performance and the cost of each device). However, the independent selection for each of the devices to be integrated with the substrate of one or the other of these two known techniques in order to reach, in accordance with the particular circumstances, an optimum compromise between the advantages and the disadvantages associated with each of these techniques constitutes an approach well known in this art as illustrated by documents D4 and D5 (see also figures of D5') in which both hybrid and monolithic integration techniques are used for the different components of the same electronic device (D4: circuit chip 11 fixed on the substrate and spiral coil element formed in the substrate; D5: semiconductor chip 2 flip-chip bonded to the substrate and passive capacitor device constituted by layers 10, 11 and 13 formed on the substrate (see D5'', column 5, lines 43 to 46 and column 6, lines 3 to 7)). Thus, following this known approach, it appears obvious to solve the aspect i) of the problem formulated above by using the monolithic integration technique for the passive

microwave component when the known associated advantages are to be achieved, as it has been done for instance in each of documents D4 and D5 disclosing a hybrid integration substrate system including passive microwave elements monolithically manufactured in the dielectric layer of the substrate. It is also observed that, while the claimed invention is directed to an optoelectronic system, the devices of documents D4 and D5 are electronic devices without optical components; however, the objective problem formulated above pertains to the integration of the electronic subsystem and the skilled person would look for solutions in the field of electronic devices without confining its attention to solutions provided by the prior art only in the field of optoelectronic systems.

As regards the aspect ii) of the objective problem formulated above, the Board considers that it falls within the normal practice of the skilled person working in this field to select the most appropriate technique for mounting a microwave integrated circuit on a substrate system, the use of aligning bonding pads being already known in the prior art (see for instance Figure 9 of document D2 and the corresponding description in page 11, line 35 to page 12, line 17, in particular page 12, lines 6 to 13) and the advantages associated therewith being also known, in particular those related with the elimination of electrical wiring (D2, page 12, lines 10 and 11). Therefore, the distinguishing feature b) identified above appears to constitute an obvious

alternative to the use of epoxy disclosed in document D3."

2.4 "In view of the above considerations, the subject-matter of claim 1 would not appear to involve an inventive step over the prior art."

3. "As regards the different features defined in the dependent claims, the Board notes that

- the features defined in claims 2 and 4 are also disclosed in document D3 (column 4, lines 40 to 52, column 5, line 57 and column 6, line 16),

- the features defined in claims 3 and 5, if not inherent or implicitly required by document D3, constitute obvious technical measures in the implementation of the disclosure of document D3, and

- it is conventional in this art to form portions of transmission members as defined in claims 6 to 8 in order to enhance the transmission of signals (see for instance the spiral capacitors represented in the figure of document D4).

Therefore, the combination of the features defined in the dependent claims with the subject-matter of claim 1 would not appear to involve an inventive step with regard to the prior art."

IV. In reply to the summons to oral proceedings, the appellant's representative informed the Board by letter dated 17.03.2009 that he would not attend the oral proceedings and that the request for oral proceedings was withdrawn.

In a communication of the Registry of the Board the appellant was informed that the oral proceedings would take place as scheduled.

Oral proceedings were held before the Board on 26 May 2009 in the absence of the appellant and its representative. At the end of the oral proceedings the Board announced its decision reported in the order below.

- V. In the letter dated 17.03.2009 the appellant did not make any substantive submission in reply to the preliminary opinion of the Board given in the communication annexed to the summons. The sole substantive arguments advanced by the appellant were developed in the statement setting out the grounds of appeal and concerned the issue of lack of inventive step raised by the examining division. These arguments, however, pre-date and have no bearing on the issues subsequently raised by the Board in the aforementioned communication.

Reasons for the Decision

1. The appeal is admissible.
2. *Procedural matters*

With its letter dated 17.03.2009 the representative of the appellant informed the Board that he would not attend the oral proceedings and that the request for oral proceedings was withdrawn. In the circumstances of the case, the Board found it appropriate to maintain

the oral proceedings as scheduled and the absence of the appellant and its representative at the oral proceedings did not prevent the Board from coming to a final decision at the end of the oral proceedings (Article 15(3) RPBA).

3. In the communication pursuant to Article 15(1) RPBA annexed to the summons to oral proceedings the Board explained in detail why in its preliminary opinion
 - the subject-matter of claim 1 does not satisfy the requirements of Article 123(2) EPC (point III.1 above) and
 - the subject-matter of claim 1 and of dependent claims 2 to 8 does not involve an inventive step over the prior art within the meaning of Article 56 EPC 1973 (points III.2 to III.3 above).

In the course of the appeal proceedings, the appellant made no substantive submission in reply to the detailed objections raised by the Board in the aforementioned communication. In particular, the appellant chose neither to attend the oral proceedings nor to take a written position on the matters raised by the Board. The appellant has therefore not availed itself of the opportunity to reply to the preliminary assessment of the Board expressed in the aforementioned communication.

After consideration of the assessment advanced in the communication under Article 15(1) RPBA, and in the absence of any attempt by the appellant to refute or to overcome the objections raised by the Board with regard to the application documents on file (see point V above), the Board saw no reason during the oral

proceedings to depart from the preliminary opinion expressed in the aforementioned communication, which therefore becomes final. Accordingly, noting that the appellant has had, and has failed to use, the opportunity to present comments on the objections raised by the Board in the aforementioned communication (Article 113(1) EPC 1973), the Board concludes that the application documents according to the request of the appellant do not comply with the requirements of Article 123(2) EPC and those of Article 52(1) EPC together with Article 56 EPC 1973.

The appeal must therefore be dismissed for the reasons already communicated to the appellant and reproduced in points III.1 to III.3 above (Rule 66(2) (g) EPC 1973).

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chairman:

M. Kiehl

A. G. Klein