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**Datasheet for the decision
of 18 May 2022**

Case Number: T 0311/16 - 3.4.01

Application Number: 10195147.3

Publication Number: 2290381

IPC: G01R15/20, G01R33/02,
G01R33/06, G01R33/07,
G01R33/09, H01L43/06

Language of the proceedings: EN

Title of invention:

Arrangements for an Integrated Sensor

Patent Proprietor:

Allegro MicroSystems, LLC

Opponent:

Micronas GmbH

Headword:

Two magnetic sensors IV / ALLEGRO MICROSYSTEMS

Relevant legal provisions:

EPC Art. 56

Keyword:

Inventive step - (no)



Beschwerdekammern

Boards of Appeal

Chambres de recours

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Case Number: T 0311/16 - 3.4.01

D E C I S I O N
of Technical Board of Appeal 3.4.01
of 18 May 2022

Appellant: Micronas GmbH
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Decision under appeal: **Interlocutory decision of the Opposition
Division of the European Patent Office posted on
17 December 2015 concerning maintenance of the
European Patent No. 2290381 in amended form.**

Composition of the Board:

Chair P. Scriven
Members: B. Noll
D. Rogers

Summary of Facts and Submissions

- I. The Opposition Division decided that the patent in amended form meets the requirement of the EPC. The opponent appeals this decision.

- II. With the statement of grounds of appeal, the opponent submitted new documents, labelled as B1 to B3, and argued that claim 1, held allowable by the decision, lacked an inventive step (Article 56 EPC).

- III. With its response to the appeal, the proprietor submitted auxiliary requests 1 to 3. The proprietor argued that none of documents B1 to B3 should be admitted into the proceedings or, if any were admitted, that the case be remitted to the Opposition Division for further consideration.

- IV. In a communication, the Board indicated that it intended to consider B2 and that claim 1 as considered allowable and claim 1 of each of auxiliary requests 1 to 3 lacked an inventive step having regard to

D20: WO 2005/059967 A2, and
B2: FR 2 860 592.

- V. In a letter submitted in response to the Board's communication, the proprietor withdrew auxiliary request 2 and submitted a new auxiliary requests 1A.

VI. The opponent's final formulation of its request, at the end of oral proceedings, was that the decision under appeal be set aside and the patent revoked.

VII. The proprietor's final formulation of its requests was that, as a main request, the appeal be dismissed, or alternatively, that the decision under appeal be set aside and the patent maintained on the basis of one of auxiliary requests 1, 1A, or 3. The proprietor further requested that the case be remitted to the Opposition Division if any of documents B1, B2, or B3 were admitted into the proceedings.

VIII. Claim 1 of the main request (as maintained by the decision under appeal, reference signs omitted) reads:

*An integrated circuit, comprising:
a lead frame;
a base substrate having first and second opposing surfaces, wherein the base substrate is coupled to the lead frame such that the second surface of the base substrate is above the lead frame and the first surface of the base substrate is above the second surface of the base substrate;
a first substrate having first and second opposing surfaces, and a second substrate having first and second opposing surfaces, wherein the first and second substrates are each coupled to the base substrate such that either: (i) the first surface of the first substrate is above the first surface of the base substrate and the second*

surface of the first substrate is above the first surface of the first substrate, and the first surface of the second substrate is above the first surface of the base substrate and the second surface of the second substrate is above the first surface of the second substrate; or (ii) the second surface of the first substrate is above the first surface of the base substrate and the first surface of the first substrate is above the second surface of the first substrate, and the second surface of the second substrate is above the first surface of the base substrate and the first surface of the second substrate is above the second surface of the second substrate; and an electronic component disposed on the first surface of the first substrate; characterised in that the integrated circuit further comprises a first magnetic field sensing element disposed on the first surface of the second substrate; and a second magnetic field sensing element disposed on the first surface of the first substrate, wherein the first magnetic field sensing element has a first sensitivity to a magnetic field, the second magnetic field sensing element has a second different sensitivity to the magnetic field, and wherein the integrated circuit is configured to provide a first operating range responsive to the first magnetic field sensing element and a second

different operating range responsive to the second magnetic field sensing element.

- IX. Claim 1 of auxiliary request 1 adds (at the end of claim 1 of the main request):

... wherein the first substrate is comprised of a selected one of Si, GaAs, InP, InSb, InGaAs, InGaAsP, or Si Ge and the second substrate is comprised of a selected one of Si, GaAs, InP, InSb, InGaAs, InGaAsP, or SiGe.

- X. Claim 1 of auxiliary request 1A adds (at the end of claim 1 of the main request):

... wherein the first substrate is comprised of a selected one of Si, GaAs, InP, InSb, InGaAs, InGaAsP, or SiGe and the second substrate is comprised of a different selected one of Si, GaAs, InP, InSb, InGaAs, InGaAsP, or SiGe.

- XI. Claim 1 of auxiliary request 3 adds (at the end of claim 1 of the main request):

... wherein the first substrate is comprised of Si and the second substrate is comprised of GaAs.

- XII. The parties' submissions, insofar they are relevant for the decision, are discussed in the Reasons, below.

Reasons for the Decision

Admissibility issues

1. B2 was submitted under the Rules of Procedure of the Boards of Appeal 2007. The proprietor argued that it should not be considered in the appeal proceedings.
2. B2 was submitted as a reaction to the argument in the decision, at point 24, in which it was held that "operating range" referred to the strengths of the magnetic field a sensor could measure and that the prior art did not suggest such sensing arrangements. B2 is about applying separate sensors of different types (Hall-type, magnetoresistive type) in combination, for measuring over a larger range than either of the single sensors would be able to measure on its own. The filing of B2 is, therefore, a valid response to the feature that different operating ranges are provided. This feature was added to claim 1 during the oral proceedings before the Opposition Division, and B2 is a valid reaction to this amendment. For this reason, the Board decided to consider B2 in the appeal proceedings.

The request for remittal

3. There is no need to remit the case to the Opposition division. The Board is in a position to consider B2 without having an assessment by the first instance. B2 does not create an fresh case, since it is a reaction to an amendment made late in the opposition proceedings. For this reason, the request for remitting the case to the Opposition division is refused.

Main request, claim 1, inventive step

4. D20 discloses a module with multiple semiconductor chips or dies, packaged as a stack. Figure 6 shows an embodiment in which two dies, 614 and 624, are arranged above a further die, 214, which is arranged above a substrate 12. The substrate 12 has a patterned metal layer. Its purpose is to provide circuitry (paragraph 7). The substrate 12 is, therefore, a lead frame. A second surface of die 214 is coupled to the substrate 12, a first surface of die 214 having electronic bond pads is above the second surface. Figure 6 shows an arrangement of dies, 614 and 624, in an "upside-down" configuration in which a first side of die 624 is above the first surface of die 214, and a second side of die 624 is above the first surface of die 624, and a first side of die 614 is above the first surface of die 214, and a second side of die 614 is above the first surface of die 614. This configuration is arranged according to the first alternative (i) in claim 1 of the contested patent. D20, therefore, discloses vertically arranging several dies on a single substrate and a lead frame in the same way as defined in claim 1.
5. D20 further discloses that the dies may have various types of circuit, e.g. a memory array or a DSP (description, [0005]), or different memory types (see [0100]). D20 further discloses that a die may comprise a sensor (photo sensor, see [0104], [0105]).
6. The parties agree that D20 discloses an integrated circuit with the above features.
7. The integrated circuit as claimed differs from that described in D20 by the following features:

(a) it comprises a first magnetic field sensing element disposed on the first surface of the second substrate; and a second magnetic field sensing element disposed on the first surface of the first substrate;

(b) the first and second magnetic field sensing elements have different sensitivities to a magnetic field; and

(c) the integrated circuit is configured to provide a first operating range responsive to the first magnetic field sensing element and a second different operating range responsive to the second magnetic field sensing element.

8. The proprietor argued that, starting from D20, the technical problem to be solved might be formulated, as in the Board's communication, as identifying different sensing applications for the integrated circuit; or as providing a sensor having magnetic field sensing capability. In the proprietor's view, both formulations would be valid as there was no substantial difference.
9. The Board considers the first formulation of the technical problem as the most appropriate, since it contains no direct pointer to magnetic field sensors and, hence, to features defining the invention.
10. In seeking applications for the integration of circuits in a module disclosed in D20, the skilled person would have considered known electrical circuit arrangements in which sensors are mounted on substrates. In particular, the skilled person would therefore also have considered B2. B2 discloses a circuit with two sensor elements as a magnetic field current sensor for a large dynamic range and high accuracy (page 1, lines 24 to 28) , wherein the magnetic field sensor is formed

from two different groups of sensor elements, namely Hall elements for measuring relatively strong magnetic fields and magnetoresistive sensors for measuring weak fields (page 2, lines 1 to 8). The skilled person would have considered the circuit described in B2 as a sensor application of the module described in D20.

11. The proprietor argued that D20 was not concerned with magnetic field sensing and that there would have been no incentive for the skilled person to use the stacking technique described therein to realise magnetic field sensors.
12. The Board does not agree. The integrated circuit of claim 1 is limited by no more than a juxtaposition of, on the one hand, the arrangement of the substrates on the lead frame and the sensors on either side of a substrate and, on the other hand, features defining the function of sensor elements and distinct operating ranges without synergistic interaction. On the basis of D20, the skilled person would, therefore, have had no reason to consider only sensor applications for the detection of certain physical quantities. Rather, the skilled person would have considered a wide range of sensor applications for the detection of physical quantities as potential applications. Amongst these, the skilled person would have considered the magnetic field current sensor described in B2.
13. The circuit of claim 1 does, therefore, not involve an inventive step (Article 56 EPC).

Auxiliary request 3, inventive step

14. According to claim 1, the integrated circuit comprises a combination of two substrates, one of which is silicon and the other of which is GaAs.
15. The proprietor argued that it was not known, from the prior art, to use these materials for the two substrates in an integrated circuit having magnetic field sensors. This choice of materials allowed a highly sensitive sensing element to be produced in GaAs and a less sensitive sensing element together with the electronic circuit element to be produced cost-effectively in Si technology.
16. The selection of these materials does not provide any particular technical effect. It is not apparent that the selection of substrate materials is directly associated with costs. There is no discernible relationship between the sensitivity of a magnetic field sensor and the substrate material, as the type of magnetic field sensor and, hence, its interaction with the substrate remains undefined. Thus, the selection is merely an arbitrary one from a group of materials commonly known as semiconductor substrate materials.
17. Therefore, and for the reasons given above for the main request, the integrated circuit of claim 1 of auxiliary request 3 does not involve an inventive step (Article 56 EPC).

Auxiliary requests 1 and 1A, inventive step

18. Claims 1 of auxiliary requests 1 and 1A are broader in scope than that of auxiliary request 3. Therefore, the

reasons for lack of inventive step of auxiliary request
3 equally apply to auxiliary requests 1 and 1A.

Order

For these reasons it is decided that:

The decision under appeal is set aside.
The patent is revoked.

The Registrar:

The Chair:



H. Jenney

P. Scriven

Decision electronically authenticated