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Datasheet for the decision of 18 April 2023

Case Number: T 0463/21 - 3.4.02

Application Number: 11874070.3

Publication Number: 2778609

IPC: G01C19/5776, G01P21/00, G01C19/5691, G01C25/00

Language of the proceedings: EN

Title of invention:
METHOD FOR CALIBRATING THE SCALE FACTOR OF AN AXISYMMETRIC VIBRATORY GYROSCOPE

Patent Proprietor:
Innalabs Limited

Opponent:
SAFRAN ELECTRONICS & DEFENSE

Relevant legal provisions:
EPC Art. 54(1), 56, 100(a), 100(b), 100(c), 114(2)
EPC R. 116(1)
RPBA 2020 Art. 12(2), 12(4), 12(6)

Keyword:

Admission in appeal of an objection under Art. 100(c) EPC not admitted during the first-instance proceedings (yes)
Admission in appeal of a new document (yes)
Unallowable intermediate generalisation (no)
Sufficiency of disclosure (yes)
Inventive step (yes)

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Case Number: T 0463/21 - 3.4.02

D E C I S I O N
of Technical Board of Appeal 3.4.02
of 18 April 2023

Appellant: (Opponent)	SAFRAN ELECTRONICS & DEFENSE 18-20 Quai du Point du Jour 92100 Boulogne Billancourt (FR)
Representative:	Lavialle, Bruno François Stéphane Cabinet Boettcher 5 rue de Vienne 75008 Paris (FR)
Respondent: (Patent Proprietor)	Innalabs Limited 5th Floor Beaux Lane House Mercer Street Lower Dublin 2 (IE)
Representative:	Marks & Clerk LLP 15 Fetter Lane London EC4A 1BW (GB)
Decision under appeal:	**Decision of the Opposition Division of the European Patent Office posted on 24 February 2021 rejecting the opposition filed against European patent No. 2778609 pursuant to Article 101(2) EPC.**

Composition of the Board:

Chairman	R. Bekkering
Members:	F. J. Narganes-Quijano
	T. Karamanli

Summary of Facts and Submissions

I. The appellant (opponent) lodged an appeal against the decision of the opposition division rejecting the opposition against European patent No. 2778609.

The opposition filed by the appellant to the patent as a whole was based on the grounds for opposition of added subject-matter (Article 100(c) EPC), insufficiency of disclosure (Article 100(b) EPC), and lack of novelty (Article 100(a) together with Articles 52(1) and 54 EPC) and lack of inventive step (Article 100(a) together with Articles 52(1)and 56 EPC).

II. The following documents considered during the first-instance proceedings have been referred to by the parties during the appeal proceedings:

E1: US 7 628 069 B2
E2: WO 2008/090275 A2
E3: FR 2 958 029 B1, together with document WO 2011/116 941 A1 (E3*) of the same patent family
E4: "Lock-in amplifiers: principles and applications", M L Meade; e-edition, 2013 (*https://archive.org/details/Lock-inAmplifiersPrinciplesAndApplications/Lock-inAmplifiersMlMeade*); pages "Chapter 5-2" to "Chapter 5-4"; together with document E5 (Extract from *abebooks.com* printed on 2 June 2022) relating to the paper edition (Peter Peregrinus Ltd, London, 1983) of E4, and document E6 (Extract from *archive.org* printed on

2 June 2022) relating to E4 (electronic version) and E5 (paper edition).

In the decision under appeal the opposition division held that none of the grounds for opposition raised by the appellant prejudiced the maintenance of the patent as granted.

III. With the statement setting out the grounds of appeal the appellant filed the following document:

E7: IEEE Standard 1431-2004: IEEE Standard Specification Format Guide and Test Procedure for Coriolis Vibratory Gyros; IEEE Aerospace and Electronic Systems Society, 2004; front page, pages i to viii, and pages 1 to 69.

IV. With its letter of reply dated 19 November 2021 the respondent (patent proprietor) filed claims according to a first to seventh auxiliary requests and referred to the following document:

E2*: US 2010/0058831 A1, of the patent family of document E2.

V. Oral proceedings before the board were held on 18 April 2023.

The appellant requested that the decision under appeal be set aside and that the patent be revoked.

The respondent requested that the appeal be dismissed (main request) or, in the alternative, that the decision under appeal be set aside and that the patent be maintained as amended on the basis of the claims of

one of the first to seventh auxiliary requests filed by letter dated 19 November 2021.

At the end of the oral proceedings the chairman announced the decision of the board.

VI. Claim 1 of the patent as granted (main request) reads as follows:

"A calibration method for the scale factor of an axisymmetric vibratory gyroscope functioning by application of an amplitude control signal (5), of a precession control signal (7) and of a quadrature control signal (6) to a resonator so as to set it into vibration at its resonant frequency, characterized in that the method comprises the following:

first pre-calibration steps consisting of:

applying the amplitude control signal, precession control signal and the quadrature control signal to the resonator so as to set it into vibration at its resonant frequency, and also applying a modulated quadrature control signal (8) having a constant modulation frequency above a passband of a quadrature control loop of the gyroscope;

measuring a resulting initial modulated quadrature detection signal (9) value and storing the initial measured modulated quadrature detection signal value in memory; and

measuring an initial scale factor of the resonator and storing the initial scale factor in memory;

second subsequent steps of:

applying the modulated quadrature control signal (8); measuring a resulting current modulated quadrature detection signal (9) value; and

calculating a corrected scale factor according to a relationship of proportionality including the initial scale factor, the initial measured modulated quadrature detection signal value and the current measured modulated quadrature detection signal value, according to the formula:

Corrected scale factor = Initial scale factor x Current measured quadrature detection signal value / Initial measured quadrature detection signal value."

Reasons for the Decision

1. The appeal is admissible.

2. *Preliminary remarks*

2.1 When considering the content of the application as filed, on which the patent in suit is based, the board will refer in the following to the English translation of the international application as filed (application PCT/RU2011/000806 filed in Russian language and published on 18 April 2013), which was filed with the EPO on 24 March 2014 upon entry into the regional phase before it.

2.2 The respondent, when referring to the French document E2, quoted the corresponding passages of the English document E2* belonging to the patent family of document E2. The board will in the following only refer to document E2.

While the appellant and the opposition division referred to document E3 published in French, the

appellant referred to the English document E3* belonging to the patent family of document E3. However, while document E3* was published on 29 September 2011, i.e. before the filing date (14 October 2011) of the patent in suit, document E3 is the French patent granted on the basis of the priority document of document E3* and was published on 20 April 2012, i.e. after the filing date of the patent in suit. Therefore, document E3 does not constitute state of the art within the meaning of Article 54(2) EPC and the board will in the following refer to document E3*.

3. *Main request (patent as granted) - Ground for opposition under Article 100(c) EPC*

3.1 During the first-instance proceedings, two different objections were raised by the appellant under Article 100(c) EPC in respect of the patent as granted, namely a first objection relating to the equation in paragraph [0039] of the description of the patent specification and a second objection relating to the features "applying a modulated quadrature control signal (8)" and "applying the modulated quadrature control signal (8)" of claim 1 as granted ("the second objection"). In its decision the opposition division

- held that the first objection was not persuasive and
- decided not to admit the second objection into the proceedings pursuant to Article 114(2) and Rule 116(1) EPC.

In its statement of grounds of appeal, the appellant only maintained the second objection. The question therefore arises whether the second objection is to be admitted into the appeal proceedings, in particular in view of Article 12 RPBA 2020, and, if admitted, whether

the ground for opposition under Article 100(c) EPC prejudices the maintenance of the patent as granted.

3.2 As regards the non-admission of the second objection by the opposition division, the appellant essentially submitted the following: In its communication annexed to the summons to oral proceedings, the opposition division expressed a preliminary opinion favourable to the respondent. The subsequent preparation of the case was hindered by a postponement of the oral proceedings which were then held, against the express request of the appellant, by videoconference. The discussion of the new second objection would have been equitable because it referred to an amendment made by the respondent during the examination proceedings. In addition, the opposition division did not exercise its discretion in an appropriate manner because the second objection was, contrary to the opposition division's view, *prima facie* relevant.

The respondent submitted that an admission of the second objection into the appeal proceedings would be contrary to Article 12(2) RPBA 2020, that the appellant's arguments constituted an amendment of the appellant's case within the meaning of Article 12(4) RPBA 2020, and that, in any case, none of the appellant's submissions justified the admission of the second objection into the appeal proceedings under Article 12(6) RPBA 2020.

3.2.1 The board first notes that the appellant contested with its statement of grounds of appeal the opposition division's decision not to admit the second objection into the proceedings. Consequently, the arguments submitted by the appellant in this respect are - contrary to the respondent's submissions -directed to

the "requests, facts, objections, arguments and evidence on which the decision under appeal was based" within the meaning of Article 12(3) RPBA 2020 and, therefore, they do not constitute an amendment to the appellant's case within the meaning of Article 12(4) RPBA 2020. Therefore, the appellant's submissions relating to the second objection are to be considered in the appeal proceedings.

3.2.2 As regards the question of whether the opposition division's decision not to admit the second objection into the proceedings suffered from an error in the use of their discretion, the board first notes that this objection was unconnected with the first objection and, in particular, it related to a feature different from that objected to with the first objection (see above point 3.1, first paragraph) and was based - as held by the opposition division - on a new allegation of facts. Therefore, the admission of this objection was - as accepted by the appellant during the oral proceedings - at the opposition division's discretion under Article 114(2) and Rule 116(1) EPC which refer to new "facts and evidence".

The question therefore arises whether, in the light of the principles established by the case law for reviewing first-instance discretionary decisions (see Case Law of the Boards of Appeal of the European Patent Office "Case Law", 10th edition, 2022, V.A.3.5.1), the opposition division applied its discretion according to the wrong principles, or without taking into account the right principles, or in an unreasonable way.

During the first-instance oral proceedings the opposition division expressed the view that the objection under consideration was not admissible

because "it was late filed and not prima facie relevant" (page 5 of the minutes, sixth paragraph). In view of this statement the board is satisfied that the opposition division took into account the right principles in the exercise of its discretion under Article 114(2) and Rule 116(1) EPC. However, neither the decision under appeal nor the minutes contain any reason as to why the opposition division considered that the objection was not *prima facie* relevant. In particular, the decision under appeal contains the reasons why the opposition considered that the objection was late filed and it was not triggered by previous submissions of the respondent (point 3.7 of the reasons), but no statement from which it could be derived why the opposition division considered that the objection was not *prima facie* relevant. In the absence of such reasons, the board is not in a position to review the contested discretionary decision in this respect, and in particular to evaluate whether or not the opposition division applied its discretion in a reasonable way when it concluded that the objection was not *prima facie* relevant.

In these exceptional circumstances, the board considers appropriate to exercise its own discretion under Article 12(6), first sentence, RPBA 2020. This provision stipulates that the board "shall not admit [...] objections [...] which were not admitted in the proceedings leading to the decision under appeal, unless the decision not to admit them suffered from an error in the use of discretion or unless the circumstances of the appeal case justify their admittance".

3.2.3 The appellant submitted in support of the admission of the second objection that this objection was *prima*

facie relevant because claim 1 as granted resulted in an unallowable intermediate generalisation of the content of the application as filed. In particular, the appellant submitted that the claimed features "applying a modulated quadrature control signal (8)" and "applying the modulated quadrature control signal (8)" were incorporated into claim 1 as granted without other features of the modulated quadrature control signal disclosed, for instance, in dependent claim 2 as originally filed and also in the embodiment disclosed in the application as filed in connection with Fig. 4, and relating to how, and more particularly where, the mentioned modulated quadrature control signal was applied.

The board notes that, among the calibration approaches disclosed in Figs. 4 to 7 of the application as filed, only Fig. 4 represents an embodiment of the claimed invention, and that the mentioned amendment is relatively broad, and in particular broader than dependent claim 2 as originally filed specifying that the modulated quadrature control signal is specifically applied to the output of a quadrature control loop, and also broader than what the particular embodiment of Fig. 4 would allow in view of the fact that in Fig. 4 the modulated quadrature control signal (signal 8) is specifically applied to the output of a quadrature control loop upstream of a modulator. In view of these considerations, the board is of the opinion that the objection is *prima facie* relevant for the outcome of the case. For this reason - and irrespective of the additional circumstances submitted by the appellant in support of the admission of the objection, see above point 3.2, first paragraph - the board considers appropriate, in the exercise of its discretion under

Article 12(6) RPBA 2020, to admit the second objection into the appeal proceedings.

3.3 As regards the question of whether the objection is persuasive, the appellant essentially submitted the following: The feature of claim 1 as granted relating to the application of the modulated quadrature control signal without specifying where the signal was actually applied was not disclosed in the application as filed and constituted an unallowable intermediate generalisation (see above point 3.2.3, first paragraph). In addition, the claimed "second subsequent steps" of calibration did not necessarily involve the application of the same three control signals applied in the claimed "first pre-calibration steps" and, in particular, the application of a quadrature control signal. As a consequence, claim 1 as granted encompassed embodiments in which the claimed "second subsequent steps" did not include the application of a quadrature control signal and, more particularly, it encompassed embodiments in which the modulation quadrature control signal was applied to the amplitude control signal or to the precession control signal, and it also encompassed embodiments in which the modulation quadrature control signal was applied at the input of the demodulator or at the input of the correcting loop of the quadrature control loop of Fig. 4. None of these embodiments was disclosed in the application as filed.

The board first notes that the skilled person would - as submitted by the respondent and as held by the opposition division in its decision - understand that the "second subsequent steps" specified in claim 1 as granted include, in its context, the application of the same control signals applied in the "first pre-calibration steps" specified in the claim, and

therefore the application of the quadrature control signal (see also in this respect the board's considerations in point 4.2 below). Moreover, the claimed "modulated quadrature control signal (8) having a constant modulation frequency above a passband of a quadrature control loop" would be understood by the skilled person as a signal added to the "quadrature control signal", and not to the amplitude or to the precession control signal, because - as submitted by the respondent - the skilled person would recognise that the quadrature control signal constitutes the carrier signal of the modulated quadrature control signal specified in the claim (see also in this respect point 4.2 below).

In addition, the passage on page 6, lines 32 to 38, of the application as filed specifies that the "first embodiment of the method of the invention", i.e. the invention subsequently defined in claim 1 as granted, is based on "the value of the modulated quadrature detection signal that results from a modulated quadrature generator control signal added to the actual quadrature control signal, taking into account that the modulation frequency is above the passband of the quadrature control loop". The skilled person would - as submitted by the respondent - understand that, as long as the modulated quadrature control signal is added to the quadrature control signal, this passage does not contain any restriction as to where the modulated quadrature control signal is specifically applied - in particular, no restriction to the signal being specifically applied "to the output of a quadrature control loop" as defined in dependent claim 2 of the application as filed, or "to the output of the quadrature loop upstream of the modulator" as subsequently specified on page 8, lines 23 to 26, of

the application as filed in respect of the particular embodiment represented in Fig. 4.

For these reasons the board is of the opinion that the mentioned passage on page 6, lines 32 to 38, of the application as filed constitutes a basis for the mentioned amendments and that claim 1 as granted does not constitute an unallowable intermediate generalisation of the content of the application as filed. Therefore the second objection is not found persuasive by the board.

3.4 Since the second objection raised by the appellant under Article 100(c) EPC is not persuasive and the appellant has not contested in the appeal proceedings the opposition division's view that the first objection was not convincing (see above point 3.1, first paragraph), the board concludes that the ground for opposition under Article 100(c) EPC does not prejudice the maintenance of the patent as granted.

4. *Main request (patent as granted) - Ground for opposition under Article 100(b) EPC*

4.1 The appellant submitted that the "second subsequent steps" defined in claim 1 as granted required the application of the modulated quadrature control signal, but not the application of the quadrature control signal previously specified in the claim. As a consequence, claim 1 as granted included embodiments in which in the claimed "second subsequent steps" no quadrature control signal was applied together with the modulated quadrature control signal, and the application as filed did not disclose how these embodiments could be implemented. The appellant also noted in this respect that the patentee would not have

specified in claim 1 that the claimed "second subsequent steps" comprised the application of the modulated quadrature control signal if they would have considered implicit that the second subsequent steps comprised the application of the signals applied in the first pre-calibration steps. Therefore, the disclosure of the invention was - contrary to the opposition division's view - insufficient to enable the skilled person to perform the claimed invention over the whole scope of claim 1.

4.2 The board notes that the appellant's objection relating to the ground for opposition under Article 100(c) EPC is based on an interpretation of claim 1 as granted according to which the claim requires the application of the modulated quadrature control signal in the second subsequent steps, but not necessarily the application of the quadrature control signal, the mentioned objection involving the embodiments in which no quadrature control signal is applied in the second subsequent steps. However, as already noted above in point 3.3, second paragraph, in the board's view the appellant's interpretation of claim 1 is at variance with the interpretation of the terms of claim 1 by a person skilled in the technical field under consideration. In particular, the claimed "second subsequent steps" require "measuring a resulting current modulated quadrature detection signal". The skilled person would understand that the measurement of such a signal requires that the gyroscope is functioning and involves the application of the quadrature control signal because according to lines 1 to 3 of claim 1, the gyroscope "function[s] by application of [...] a quadrature control signal (6) to a resonator". In addition or alternatively, the first pre-calibration steps involve "measuring a resulting

initial modulated quadrature detection signal (9) value", this value being measured while "applying [...] the quadrature control signal to the resonator", and the second subsequent steps require "measuring a resulting current modulated quadrature detection signal (9) value" [*emphasis added by the board*]. Therefore, the skilled person would understand that the "resulting current modulated quadrature detection signal (9) value" relates to the same signal as the "resulting initial modulated quadrature detection signal (9) value" [*emphasis added by the board*], but measured during the mentioned subsequent steps, and that therefore also the "resulting current modulated quadrature detection signal (9) value" is measured while the three control signals specified in the claimed "first pre-calibration steps", and in particular the quadrature control signal, are being applied to the resonator.

It follows from these considerations that irrespective of whether gyroscopes, as submitted by the appellant during the oral proceedings before the board, did not generally require a precession control signal or the same control signals during their normal operation and during calibration, the skilled person would not interpret the method defined in claim 1 as submitted by the appellant, and would understand that claim 1, as submitted by the respondent, implicitly requires that the quadrature control signal is also applied during the claimed "second subsequent steps" as the carrier signal of the modulation quadrature control signal. Therefore, the appellant's objection of insufficiency of disclosure is based on embodiments that are not actually encompassed by the claimed subject-matter and for this reason the objection is not persuasive.

4.3 In view of these considerations, the board concludes that the ground for opposition under Article 100(b) EPC does not prejudice the maintenance of the patent as granted.

5. *Main request (patent as granted) - Ground for opposition under Articles 100(a) and 54 EPC - Lack of novelty*

The appellant did not contest in the appeal proceedings the opposition division's conclusion that the ground for opposition of lack of novelty (Articles 100(a) and 54 EPC) did not prejudice the maintenance of the patent as granted and, therefore, the board sees no reason for departing from the opposition division's view in this respect.

6. *Main request (patent as granted) - Ground for opposition under Articles 100(a) and 56 EPC - Lack of inventive step*

6.1 The appellant contested the opposition division's view that the method defined in claim 1 involved an inventive step. It argued that the claimed method was obvious in view of document E1 or E2 in combination with the common general knowledge as exemplified by document E7, or in combination with document E3*.

6.2 Admittance of document E7 - Article 12(4) RPBA 2020

6.2.1 The appellant submitted document E7 with the statement of grounds of appeal as evidence of the common general knowledge. The respondent requested that document E7 not be admitted into the proceedings pursuant to Article 12(6), second sentence, RPBA 2020. The respondent essentially argued that document E7 should

and could have been submitted already in the first-instance proceedings. The appellant essentially argued that there had been no reason for it to submit document E7 in the first-instance proceedings due to the course of these proceedings.

6.2.2 The appellant has convinced the board that due to the course of the proceedings before the opposition division there was no reason for the appellant to submit document E7 in the first-instance proceedings. Therefore, Article 12(6), second sentence, RPBA 2020 does not apply.

However, since document E7 constitutes an amendment to the appellant's appeal case within the meaning of Article 12(4), first sentence, RPBA 2020, this document may be admitted only at the discretion of the board (Article 12(4), second sentence, RPBA 2020).

Document E7 is an IEEE standard relating to CVG (Coriolis vibratory gyros). According to the document, an amplitude-control loop is required in all force-rebalance and whole-angle CVGs, and in higher-accuracy CVGs a control loop is put in place to restrict the quadrature, usually driving it to zero (page 60, sections "Amplitude-control loop" and "Quadrature-control loop"). The appellant submitted that document E7 was filed in support of its view that, contrary to the view expressed by the opposition division in its decision, the skilled person would, in view of the common general knowledge in this technical field, conclude that the gyroscopes of documents E1 and E2 implicitly contained a quadrature control loop.

The board considers that document E7 is suitable to address the opposition division's remark in the

contested decision (see point 5.2 of the reasons; see also point 7.2.1, first sentence, of the reasons) that the appellant did not provide evidence that three control signals, namely amplitude, precession and quadrature control signals, were standardly used in gyroscopes of the type under consideration. In addition, document E7 was only cited by the appellant in support of the common general knowledge, and the passage of document E7 referred to by the appellant (page 60, sections "Amplitude-control loop" and "Quadrature-control loop") is simple to understand and its consideration is not detrimental to procedural economy. For these reasons, the board, in the exercise of its discretion under Article 12(4) RPBA 2020, decided to admit document E7 into the appeal proceedings.

6.3 Document E1 as closest prior art

6.3.1 The closest prior art referred to by the appellant is constituted by the method of correction of the scale factor of a gyroscope disclosed, and referred to as prior art, in the passage in column 2, lines 41 to 62, of document E1.

The respondent disputed that the prior-art method mentioned in document E1 could be considered as closest prior art and submitted that, in any case, the corresponding disclosure did not represent an enabling disclosure.

The board, however, does not see why the disclosure of document E1 relating to the mentioned prior-art method cannot be considered as closest prior art on its own in the evaluation of inventive step according to the problem-solution approach. As regards the question of

whether the mentioned passage in column 2, lines 41 to 62, of document E1 represents an enabling disclosure, the board notes that, in view of the board's considerations and conclusions in points 6.3.2 to 6.3.8 below, and more particularly, in point 6.3.9 below, this issue is not pertinent for the outcome of the case and that, therefore, there is no need for the board to assess to what extent the mentioned passage represents an enabling disclosure for the person skilled in the technical field under consideration.

6.3.2 The board first notes that the mentioned passage of document E1 refers to "[p]rior art inertial reference unit (IRU) systems" including a gyro, but fails to specifically refer to axisymmetric vibratory gyroscopes as claimed. The remaining disclosure of document E1 refers to hemispherical resonator gyros (HRG) that "may" be employed in known inertial reference units (IRU) (column 1, lines 11 to 14), but there is no clear and unambiguous disclosure of the application of the method in column 2, lines 41 to 62, to a HRG. Therefore, the claimed axisymmetric configuration of the gyroscope constitutes a first distinguishing feature of the method of claim 1 over the method disclosed in the mentioned passage of document E1.

The correction of the scale factor according to the method disclosed in the mentioned passage of document E1 is based on a "a priori SF [scale factor] knowledge" (column 2, lines 55 to 59), and there is no disclosure on how this *a priori* knowledge is obtained. The appellant's arguments that this *a priori* knowledge necessarily presupposed a pre-calibration method including the same steps of the scale factor correction method disclosed in document E1 cannot be followed by the board, among other reasons because the mentioned

value could be obtained by other means such as, for instance, a theoretical model. Therefore, the features of the "first pre-calibration steps" of claim 1 as granted are not directly and unambiguously derivable from the disclosure of document E1 and, therefore, all these features are new over document E1.

It also follows from these considerations that the method referred to in document E1 does not involve the measurement of the "resulting initial modulated quadrature detection signal (9) value" defined in claim 1 and that, therefore, the claimed correction of the scale factor according to the formula defined in claim 1 is, at least for this reason, also new over document E1. In particular, the scale factor is corrected in document E1 on the basis of a correction factor equal to the ratio between a "measured angle" (i.e. the "arc-tangent (atan)" calculated on the basis of the in-phase node read-out signal "ndcos" and the in-phase antinodal signal "ancos", see column 2, lines 47 to 56) and an "expected angle" (column 2, lines 56 to 59) which is "based on a priori SF knowledge" (column 2, lines 55 and 56), and not on the basis of a measured value as claimed, i.e. on the claimed "initial measured quadrature detection signal value".

While claim 1 requires in the claimed "second subsequent steps" the application of a modulated quadrature control signal, document E1 discloses "adding a square wave modulation on top of a force to rebalance (FTR) feedback signal" (column 2, lines 41 to 44). As held by the opposition division in its decision and as also submitted by the respondent, the FTR feedback signal mentioned in document E1 (column 2, lines 41 to 44, together with column 1, lines 11 to 17) corresponds to the precession control signal defined in

claim 1 (see also patent specification, paragraph [0015], first sentence) and, in any case, there is no disclosure in document E1 from which it could directly and unambiguously be derived that the mentioned signal constitutes a quadrature control signal. Therefore, it cannot be derived from document E1 that the step of "adding a square wave modulation on top of a force to rebalance (FTR) feedback signal" involves a quadrature control signal, let alone that the "square wave modulation" is added to a quadrature control signal. In particular, even assuming that - as submitted by the appellant - the skilled person would understand that the inertial reference unit of document E1 would implicitly require the application of an amplitude control signal, of a precession control signal and of a quadrature control signal to the gyro as claimed, there is no disclosure in document E1 that the "square wave modulation [added] on top of" the FTR feedback signal would then constitute or include a modulated quadrature control signal as claimed, let alone that this signal has a constant modulation frequency above a passband of a quadrature control loop of the gyroscope and that the correction of the scale factor would then be based on the corresponding measurement of the resulting current modulated quadrature detection signal value as claimed.

Therefore, the claimed method differs from the method mentioned in the passage in column 2, lines 41 to 62, of document E1 in the following features:

- the axisymmetric configuration of the gyroscope,
- the features of the claimed "first pre-calibration steps", and
- the features of the claimed "second subsequent steps" mentioned in the two former paragraphs.

6.3.3 In the board's view - and as agreed upon by the appellant during the oral proceedings - the distinguishing features identified in point 6.3.2 above solve the objective technical problem of increasing precision in the correction or the re-calibration of the scale factor of the resonator while it is in use (patent specification, paragraph [0010]), i.e. without disturbing its function.

6.3.4 Document E1 in combination with the common general knowledge exemplified by document E7

In the board's view, even assuming that, as submitted by the appellant during the appeal proceedings,

- the skilled person would apply the method disclosed in document E1 to a gyroscope of the axisymmetric type,

- the skilled person would consider determining the scale factor associated to the "a priori SF knowledge" referred to in document E1 by applying as a pre-calibration step the same steps of the scale factor correction method disclosed in the document, and

- the skilled person would understand on the basis of the common general knowledge, in particular as exemplified by document E7 relating to higher-accuracy Coriolis Vibratory Gyros using an amplitude-control loop and a quadrature-control loop (see above point 6.2.2, second paragraph), that the inertial reference unit of document E1 would require, or would be improved by, the application of an amplitude control signal, of a precession control signal and also of a quadrature control signal,

the skilled person would then still not arrive in an obvious way at the claimed method. In particular, under the assumptions mentioned above, the skilled person would not arrive at the application of a modulated

quadrature control signal as claimed, at the measurement of the resulting current modulated quadrature detection signal value, and at the correction of a pre-calibrated scale factor on the basis of this specific measured value and of the corresponding value measured during pre-calibration as claimed. More particularly, neither document E1 alone nor document E1 in combination with document E7 suggest solving the objective technical problem by multiplying an initial scale factor previously measured as claimed with any quantity, let alone with the ratio of the current and the initial measured quadrature detection signal values as claimed.

6.3.5 The appellant submitted that claim 1 did not specify to which of the signals the modulated signal was applied. In addition, the skilled person would not have considered adding the modulation to the amplitude or to the precession control signal in order not to perturbate the operation of the gyroscope, and would therefore have considered adding the modulation either to the stiffness signal controlling the vibration phase or to the quadrature signal controlling the eccentricity of the vibration, and the claimed invention constituted only the result of an obvious selection between these two possibilities.

In the board's view, however, none of these arguments is convincing. First, the skilled person would - as already noted above in point 3.3, second paragraph, and in point 4.2 - understand in the formulation of claim 1 and also in its technical context that the claimed "modulated quadrature control signal" relates, or is added to the "quadrature control signal". Second, the remaining appellant's arguments are insufficient to

render obvious the claimed correction of the scale factor for the reasons given in point 6.3.4 above.

6.3.6 Therefore, the method of claim 1 does not result in an obvious way from document E1 in combination with the common general knowledge as exemplified by document E7.

6.3.7 Document E1 in combination with document E3*

Document E3* discloses an axisymmetric vibratory gyroscope sensor operating by application of an amplitude control signal, of a precession control signal and of a quadrature control signal to a resonator (page 1, lines 4 to 11, page 2, lines 1 to 13, and page 6, lines 22 to 35; see also claim 3). The document also discloses the application of a modulation to the precession control signal (page 4, lines 1 to 18, page 4, line 28, to page 5, line 9, page 7, lines 12 to 25, and page 8, lines 4 to 8; see also claim 1) and observing a trend in the vibrations of the gyroscope (page 5, lines 10 to 17, page 7, line 35, to page 8, line 3) in order to fit the parameters of an error model and to compensate for errors (page 5, lines 18 to 29, page 7, lines 26 to 34, page 8, line 20, to page 9, line 1; see also claim 2), in particular for scale factor errors (page 3, lines 1 to 7, together with page 9, lines 2 to 7, and lines 17 to 20). In addition, according to document E3* the mentioned modulation can also be applied to the quadrature control signal (page 5, lines 10 to 17, and page 7, line 35, to page 8, line 3; see also claim 3).

In the board's view document E3* would, at the most, suggest the skilled person to apply the method of document E1 to vibratory gyroscopes of the axisymmetric type and to apply, in addition to the precession

control signal, also a quadrature control signal, but not to add the square wave modulation mentioned in document E1 to this quadrature control signal. Document E3* discloses that the modulation mentioned in the document can also be applied to the quadrature control signal, but at the same time the document contains a warning as to the complications associated with this possibility (page 8, lines 12 to 19). Document E3* contains no disclosure as to how these complications could be addressed and overcome, and this would dissuade the skilled person from considering and implementing this possibility.

In any case, even assuming that the skilled person confronted with the objective problem formulated above would - possibly incited, as submitted by the appellant, by the disclosure of document E3* (page 3, first paragraph) relating to the scale factor being proportional to the product of the gains projected in the direction orthogonal to the vibration - consider implementing the teaching of document E3* relating to the application of a modulation to the quadrature control signal, neither document E1, nor document E3*, nor the combination of these two documents would suggest, first, measuring a resulting current modulated quadrature detection signal as claimed and, second, re-calibrating a previously calibrated value of the scale factor as a function of the mentioned measured value and of the corresponding value measured during the mentioned previous calibration of the scale factor as claimed. In particular, in document E3* the scale factor is determined on the basis of gain matrices modelling the transfer functions of the sensor (page 3, lines 1 to 7) and the corresponding scale factor error is determined by fitting the error model (page 7, line, 26, to page 8, line 3, together with page 8, line 20,

to page 9, line 20), and a re-calibration of the scale factor value as claimed is neither disclosed nor suggested in document E3*.

6.3.8 Therefore, the method of claim 1 does not result in an obvious way from document E1 in combination with document E3*.

6.3.9 It follows that, to the extent that the prior-art method disclosed in document E1 constitutes an enabling disclosure (see above point 6.3.1, second paragraph), the method of claim 1 involves an inventive step over the mentioned prior-art method as closest prior art (Article 56 EPC).

6.4 Document E2 as closest prior art

6.4.1 Document E2 discloses a method of calibrating the scale factor of an axisymmetric vibratory gyroscope (title) functioning by application of an amplitude control signal and of a precession control signal to the resonator (abstract, and the sentence bridging pages 4 and 5). The method comprises a pre-calibration step of calculating a gain reference ratio (Gmx/Gmy) between the motor gain in a first (x) and a second (y) direction that are in modal quadrature relative to each other, and a calibration step of calculating a corrected scale factor on the basis of the gain reference ratio and a measurable magnitude variable (abstract and page 2, line 23, to page 3, line 14). More particularly, according to the embodiment disclosed on page 5, line 3, to page 7, line 20, and referred to by the appellant, the measurable magnitude variable is the vibration frequency variation (V) measured upon application of an alternate stiffness control signal to the resonator (page 3, lines 23 to

35, and page 5, lines 3 to 21), and the corrected scale factor (Gfe) is given by (Gmy/Gmx) V/Ac (see formula (9) on page 6, and page 7, lines 1 to 13), where Ac is the amplitude of vibration in the first direction (x).

The method of claim 1 differs from the method disclosed in document E2 in the following features:

- the operation of the gyroscope by application of a quadrature control signal,

- the application of a modulated quadrature control signal as claimed and the measurement of the resulting initial modulated quadrature detection signal value and of the initial scale factor during the pre-calibration step, and

- the determination of the corrected scale factor by the claimed "second subsequent steps".

6.4.2 The objective technical problem solved by the distinguishing features identified in point 6.4.1 above resides in the same objective technical problem formulated in point 6.3.3 above in respect of the prior-art method mentioned in document E1 as closest prior art.

6.4.3 Document E2 in combination with the common general knowledge exemplified by document E7

The board first notes that, contrary the appellant's submissions, document E2 does not disclose modulating any of the control signals with a constant modulation frequency above a passband of a control loop as claimed. In addition, the calculation of the corrected scale factor according to document E2 (formula (9) on page 6) is disclosed in the document not as a correction of a scale factor previously determined by calibration, but as a new calibration - i.e. the

calculation of a new value of the scale factor - independent of any specific value of the scale factor that might have been previously determined, and in particular independent of an initial value of the scale factor and also independent of the value of the vibration frequency variation (V) measured at a previous stage.

Furthermore, the appellant's submissions that document E2 involves the memorisation of a ratio of the drive gains and that this ratio is representative of the scale factor is insufficient to conclude that the claimed correction of the scale factor is obvious. More particularly, the mere fact that formula (9) (V/Gfe = Ac Gmx/Gmy) of document E2 can be mathematically transformed into another formula relating the value of the corrected scale factor (Gfe) to a value of the scale factor at a previous stage together with the value of the vibration frequency variation at that stage does not *per se* suggest the determination of the corrected scale factor as a function of the stored value of an initial scale factor as claimed.

It is also noted that document E2 discloses the calibration of the scale factor on the basis of the stiffness control signal - and, in an alternative embodiment, on the basis of the amplitude control signal (page 7, line 21 *et seq*.) -, but the document is silent as to the use of a quadrature control signal.

In addition, even assuming that the skilled person would - as submitted by the appellant - consider on the basis of the common general knowledge as exemplified, for instance, by document E7 the use of a quadrature control signal when operating the gyroscope (see above point 6.3.4, second paragraph, third sub-paragraph),

there is no suggestion in document E2 and in document E7 towards using this signal, let alone a modulated quadrature control signal having the claimed features, for re-calibrating the scale factor by a correction factor as claimed.

With the statement of grounds of appeal the appellant referred to document E4 as evidence reflecting the common general knowledge and contested the opposition division's view that there was no motivation for the skilled person to consult document E4. However, as submitted by the respondent, document E4 (see section 5.2.1 on pages "Chapter 5-2" to "Chapter 5-3") discusses A. C. bridge balancing of a four-arm bridge (Fig. 5.3) and the document mentions neither gyroscopes, nor scale factors, nor quadrature control loops. The board concurs with the respondent's view that document E4 is irrelevant for the issue of inventive step of the claimed invention.

Therefore, the method of claim 1 does not result in an obvious way from document E2 in combination with the common general knowledge.

6.4.4 Document E2 in combination with document E3*

As regards the combination of document E2 with document E3*, the board refers to the above considerations in point 6.4.3, first to third paragraphs, and notes that considerations analogous to those put forward in point 6.3.7 above in respect of the combination of documents E1 and E3* also apply to the combination of document E2 with document E3*. More particularly, the combination of document E2 with document E3* would not result in an obvious way in the claimed re-calibration of the scale

factor at least for reasons similar to those set forth above in point 6.3.7, last paragraph.

Therefore, the subject-matter of claim 1 as granted does not result in an obvious way from document E2 in combination with document E3*.

6.4.5 It follows that the method of claim 1 involves an inventive step over document E2 as closest prior art (Article 56 EPC).

6.5 In view of the considerations in points 6.1 to 6.4 above, the board is of the opinion that the prior art considered during the appeal proceedings does not render obvious the method defined in claim 1 as granted (Article 56 EPC) and that, therefore, the ground for opposition of lack of inventive step (Article 100(a) together with Article 56 EPC) does not prejudice the maintenance of the patent as granted.

7. It follows from the conclusions in points 3 to 6 above that none of the grounds for opposition raised by the appellant prejudices the maintenance of the patent as granted and that, therefore, the appeal is to be dismissed.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

L. Gabor R. Bekkering

Decision electronically authenticated