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Datasheet for the decision of 29 April 2016

Case Number: T 0450/12 - 3.5.03

Application Number: 01900102.3

Publication Number: 1247426

IPC: H04R25/00

Language of the proceedings: EN

Title of invention:
A DIGITAL HEARING AID WITH A VOLTAGE CONVERTER

Patent Proprietor:
Widex A/S

Opponent:
Sivantos GmbH

Headword:
Voltage converter/WIDEX

Relevant legal provisions:
EPC Art. 54, 56, 84
RPBA Art. 13(1)

Keyword:

Novelty - (no) main request and fifth auxiliary request
Inventive step - (no) second auxiliary request
Claims - clarity (no) fourth auxiliary request
Late-filed auxiliary requests - admitted (no) first, third and sixth auxiliary requests

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Case Number: T 0450/12 - 3.5.03

D E C I S I O N
of Technical Board of Appeal 3.5.03
of 29 April 2016

Appellant: (Patent Proprietor)	Widex A/S Nymøllevej 6 3540 Lynge (DK)
Representative:	Betten & Resch Patent- und Rechtsanwälte PartGmbB Maximiliansplatz 14 80333 München (DE)
Respondent: (Opponent)	Sivantos GmbH Henri-Dunant-Straße 100 91058 Erlangen (DE)
Representative:	FDST Patentanwälte Nordostpark 16 90411 Nürnberg (DE)
Decision under appeal:	**Decision of the Opposition Division of the European Patent Office posted on 20 December 2011 revoking European patent No. 1247426 pursuant to Article 101(3)(b) EPC.**

Composition of the Board:

Chairman	F. van der Voort
Members:	B. Noll
	S. Fernández de Córdoba

Summary of Facts and Submissions

I. European patent No. 1247426 was revoked on the grounds that the subject-matter of claim 1 as granted (main request) lacked novelty (Article 54 EPC), that the subject-matter of claim 1 of a first auxiliary request lacked inventive step (Article 56 EPC), that claim 1 of a second auxiliary request lacked clarity (Article 84 EPC), and that claim 1 of a third auxiliary request contained subject-matter which extended beyond the content of the application as filed (Article 123(2) EPC).

II. With the statement of grounds of appeal, the appellant (patent proprietor) filed sets of claims of three auxiliary requests, the first and second auxiliary requests respectively corresponding to the first and second auxiliary requests on which the impugned decision was based.

III. In a communication accompanying the summons to oral proceedings, the board gave a preliminary opinion, *inter alia* regarding novelty as regards claim 1 as granted, inventive step as regards claim 1 of the first auxiliary request, clarity as regards claim 1 of the second auxiliary request, and both clarity and inventive step as regards claim 1 of the third auxiliary request.

IV. With a letter dated 7 April 2016, the appellant filed, by way of replacement, revised sets of claims for the first to sixth auxiliary requests. The second, fourth and fifth auxiliary requests corresponded, with minor modifications, to the previous first to third auxiliary requests.

V. Oral proceedings before the board were held on 29 April 2016.

The appellant (patent proprietor) requested that the decision under appeal be set aside and that the opposition be rejected (main request) or, in the alternative, that the patent be maintained in amended form on the basis of the claims of one of the first to sixth auxiliary requests as filed with the letter dated 7 April 2016.

The respondent (opponent) requested that the appeal be dismissed.

At the end of the oral proceedings, after the debate was closed and the board had deliberated, the board's decision was announced.

VI. The following document is referred to in this decision:

E1: Neuteboom, H. *et al.*, "A DSP-Based Hearing Instrument IC", IEEE JOURNAL OF SOLID-STATE CIRCUITS, VOL. 32, NO. 11, November 1997, pages 1790-1806.

VII. Claim 1 as granted reads as follows:

"A digital hearing aid comprising
a microphone (2),
an output transducer (3),
a digital signal processor (5) interconnected between the microphone (2) and the output transducer (3) and
a power source (7) including a standard hearing aid battery for the supply of operation voltage for said digital signal processor,
characterized in that

said digital signal processor comprises at least one integrated circuit signal processing part capable of operating at a reduced power supply voltage within a range substantially below a nominal voltage of said battery and above a defined minimum voltage without significant change of performance, and
that a switched step-down voltage converter is connected between the power source and said at least one signal processing part for providing said reduced power supply voltage."

Claim 1 of the first auxiliary request differs from claim 1 as granted in that the wording "wherein said reduced power supply voltage is an unstabilized voltage" is added at the end of the claim.

Claim 1 of the second auxiliary request differs from claim 1 as granted in that the wording "whereby said reduced power supply voltage is equal to, or lower than, 0.8 volt" is inserted between "performance" and "and that a switched step-down voltage converter ...".

Claim 1 of the third auxiliary request differs from claim 1 as granted in that the wording "whereby said converter is a capacitive charge pump converter and said charge pump converter is designed to deliver two or more output voltages, at least one of which is said reduced power supply voltage" is added at the end of the claim.

Claim 1 of the fourth auxiliary request differs from claim 1 as granted in that the first paragraph following "characterized in that" reads as follows:

"said digital signal processor comprises at least one integrated circuit signal processing part with circuits

that are not stressed with respect to processing speed and capable of operating at a reduced power supply voltage within a range substantially below a nominal voltage of said battery and above a defined minimum voltage without significant change of performance, whereas more stressed circuits are supplied with a higher operation voltage, and".

Claim 1 of the fifth auxiliary request differs from claim 1 as granted in that the wording "said reduced power supply voltage being obtained as a fraction of the voltage of the hearing aid battery" is added at the end of the claim.

Claim 1 of the sixth auxiliary request differs from claim 1 as granted in that the first paragraph following "characterized in that" reads as follows:

"said digital signal processor comprises at least one integrated circuit signal processing part with digital filter circuits capable of operating at a reduced power supply voltage within a range substantially below a nominal voltage of said battery and above a defined minimum voltage without significant change of performance, whereas an output D/D converter is supplied with a higher operation voltage, and".

Reasons for the Decision

1. The patent in suit is concerned with reducing the electrical power consumption in a digital hearing aid (cf. paragraph [0010] of the patent specification).

A digital hearing aid is typically supplied with electrical power by a battery. The battery typically has a nominal voltage of about 1.3 V (cf. paragraph

[0003]). Several stabilised voltages, which may be higher or lower than the nominal battery voltage, may be generated from the single battery voltage. This is acknowledged in the patent specification as being known in the art (cf. paragraph [0005]).

The invention is said to be based on the recognition that, as long as the operation voltage does not fall below a defined minimum voltage, some integrated circuit signal processing parts of a digital hearing aid are less sensitive to variations in the operation voltage in the sense that said variations do not result in "any significant change of performance" (cf. paragraph [0009]). The sole example mentioned in the patent specification of such signal processing parts is digital filters (paragraphs [0009] and [0013]). These parts can therefore be operated at a reduced power supply voltage, which results in a reduction of the overall power consumption of the digital hearing aid.

In Figs 2 to 7 of the patent specification, exemplary embodiments of voltage step-down converters of a specific type are shown, which essentially are switched capacity voltage dividers. The converter shown in Fig. 2 has two capacitors which are charged in series and discharged in parallel for providing the reduced power supply voltage. This converter effectively divides the voltage applied to its input by a factor of 2 (cf. paragraph [0023]). Fig. 5 shows another converter of higher complexity, having three capacitors and seven transistors and switch circuits. This converter reduces the voltage applied to its input by a factor of 2/3 (cf. paragraph [0027]).

The board notes, however, that the digital hearing aid according to claim 1 as granted is defined in broad

functional terms indicating effects to be achieved. The claim is thus not limited by structural features of the switched step-down voltage converter. Neither is the claim limited by structural features of the at least one integrated circuit signal processing part to which the reduced power supply voltage is to be applied.

2. *Claim 1 as granted - novelty (Article 54 EPC)*

2.1 E1 discloses a digital hearing aid which includes a single-chip integrated circuit, in which all electric signal processing functions are integrated (cf. the functional blocks inside the dashed rectangle in Fig. 1), and peripheral components, including a microphone as an acoustic input, an output transducer ("Earphone") as an acoustic output, and a battery as a power source for supplying electrical power. The battery has an unloaded terminal voltage of about 1.3 V over most of its lifetime (cf. the first paragraph in section "III. BATTERY MANAGEMENT" and Fig. 2), which corresponds to the value mentioned in paragraph [0003] of the present patent specification. Therefore, the battery of the digital hearing aid of E1 is a "standard hearing aid battery" within the meaning of claim 1. Further, in E1, digital circuits, which implement a down-sample filter, the actual digital signal processor DSP, and an up-sample filter (cf. Fig. 9), are interconnected between the microphone and the output transducer. The digital circuits thus correspond to the digital signal processor of claim 1. The digital circuits of the hearing aid IC are specifically designed to operate at a voltage as low as 1.1 V ± 0.05 V, at which "the worst-case speed requirements are met for all process and temperature variations" (cf. page 1791, the sentence bridging the two columns). The digital circuits of the integrated circuit are also

operable at a higher voltage. Operation at a higher voltage is, however, not desirable, since it would only lead to higher power consumption ("A higher supply voltage, on the other hand, would only lead to unnecessary power consumption", cf. the sentence following the sentence referred to above). Hence, the digital circuits in the digital hearing aid of E1 are capable of operating at an operating voltage which is within a range (1.1 ± 0.05 V) and which is substantially below the nominal voltage of the battery (1.3 V) and above a defined minimum voltage (1.1 - 0.05 V). Further, this range is substantially below the nominal voltage of the battery, since it results in a considerable reduction of electrical power consumption, i.e. as much as 25% (see page 1792, second paragraph, the last sentence).

E1 further discloses a switched voltage converter to which the battery voltage is applied as an input, for generating the reduced power supply voltage (Figs 1 and 3). The voltage converter essentially consists of three sections. The first section (including the capacitor immediately following the battery, the "switch" (cf. Fig. 3), and capacitor C_2) constitutes a switched step-down voltage converter which down-converts the battery voltage (nominal about 1.3 V) to 1.1 V, for providing the reduced power supply voltage ("Digital supply", cf. Fig. 3). The second section consists of a voltage doubler in the lower right-hand part of Fig. 3, which is responsible for generating a further supply voltage of 2.15 V. The third section, formed by the voltage doubler in the lower left-hand part of Fig. 3, is not relevant here.

E1 therefore discloses all of the features of the digital hearing aid according to claim 1.

2.2 The appellant argued as follows:

(a) E1 disclosed a switched-mode regulator, but not a switched step-down voltage converter. A switched-mode regulator required complex regulator circuitry which increased the overall power consumption. On the contrary, a switched step-down voltage converter was simple as regards the electrical circuitry and did not require a voltage regulator.

(b) The concept of the claimed digital hearing aid was based on a selective, but substantial, reduction in the power supply voltage for those parts of the digital signal processor which were capable of operating at a very low voltage. This very low power supply voltage for selected parts resulted in a considerable saving of power consumption. Although these circuit parts might not be operated at the lowest possible operation voltage due to fluctuations in the battery voltage and the absence of a voltage regulator, the reduction in power consumption would still be considerable. Therefore, a considerable saving in power consumption was obtained by the claimed digital hearing aid without requiring a complex voltage converter circuit as in E1. Further, in E1 a single supply voltage of 1.1 V was applied to all digital circuits of the digital signal processor. No hint was given in E1 to selectively apply an even lower supply voltage to selected circuits thereof only.

(c) E1 would not motivate the skilled person to apply a power supply voltage range by means of a switched step-down voltage converter instead of a single, constant voltage. Further, the use of a voltage doubler in E1 would dissuade the skilled person from considering a

voltage converter which supplied an unstabilized supply voltage.

2.3 The board does not find these arguments convincing for the following reasons:

Re (a): The switched step-down voltage converter in claim 1 is only specified in functional terms ("for providing said reduced power supply voltage"). This neither requires nor excludes the presence of a voltage regulator, nor does this functional definition restrict the claim any further than that the battery voltage is stepped down by switching. This conversion principle is, however, also used in the voltage converter of E1 (see point 2.1 above).

Re (b): Claim 1 does not require that a reduced power supply voltage be selectively applied to a subset of the digital circuits of the digital signal processor only. Due to the term "at least" in "at least one integrated circuit signal processing part", the claim explicitly covers, *inter alia*, an embodiment in which only one part of the digital signal processor is supplied with the reduced power supply voltage as well as an embodiment in which all parts of the digital signal processor are supplied with the reduced power supply voltage.

Re (c): The board notes that, in use, the claimed digital hearing aid would operate such that at any point in time, the reduced power supply voltage provided by the voltage converter has a certain, single value, in which this value is within the range referred to in the claim, i.e. there would be no application of a range of voltages at any particular point in time.

2.4 The subject-matter of claim 1 therefore lacks novelty (Article 54 EPC). The ground for opposition pursuant to Article 100(a) EPC thus prejudices the maintenance of the patent as granted.

3. *Claim 1 of the second auxiliary request - inventive step (Article 56 EPC)*

3.1 The reduced power supply voltage as specified in E1 is 1.1 V. E1 does not disclose, neither explicitly nor implicitly, a reduced power supply voltage which is equal to or lower than 0.8 V.

The subject-matter of claim 1 (see point VI above) is therefore novel having regard to the disclosure of E1. This finding was not contested by the parties.

3.2 However, in the board's judgement, the additional feature does not contribute to inventive step.

Firstly, the skilled person would generally investigate further possibilities to reduce the power consumption of a hearing aid, since it was well-known at the priority date that by reducing power consumption the battery life time could be extended, which was beneficial in terms of ease of use of the hearing aid for the user.

Secondly, and more specifically, when starting out from E1 and, in particular, taking account of the statements in E1 according to which "The power consumption of a digital circuit is approximately quadratically dependent on its supply voltage" and "Lowering the supply voltage as much as possible is therefore essential in low power design" (cf. page 1796, section D, first two sentences), the skilled person would

realise that the power consumption may be further reduced by further lowering the power supply voltage, whenever possible, i.e. whenever a digital circuit of the integrated circuit would permit operation at a power supply voltage which is even lower than 1.1 V. Hence, the skilled person would consider reducing the power supply voltage for one or more individual circuits to a value which is solely determined by the technical specifications of the individual circuits, which, depending on their actual implementation, may be equal to or lower than 0.8 V. The skilled person would thereby arrive at a digital hearing aid which includes all the features of claim 1, without the exercise of inventive skill.

3.3 The appellant argued that the inventor had recognized that selected portions of a DSP in a digital hearing aid satisfactorily operated at a voltage which was considerably lower, i.e. 0.8 V or lower, than the voltage applied to other parts, and that this voltage could be provided by an unregulated voltage converter.

3.4 The board notes, however, that claim 1 does not specify any particular technical features of those portions of the DSP which may satisfactorily operate at a power supply voltage of 0.8 V or lower. Specifying a power supply voltage value which is not disclosed in E1 without specifying any corresponding technical features of the relevant circuits of the digital hearing aid which would actually enable it to operate at this low voltage value is tantamount to expressing a desire, rather than exercising inventive skill.

3.5 The subject-matter of claim 1 therefore lacks an inventive step (Article 56 EPC). The ground for opposition pursuant to Article 100(a) EPC thus

prejudices the maintenance of the patent in amended form according to the second auxiliary request.

4. *Claim 1 of the fourth auxiliary request - clarity (Article 84 EPC)*

4.1 The added wording "stressed with respect to processing speed" (cf. point VI above) is in the context of digital circuits unclear. Neither does the patent specification give a clear explanation of what is meant. From the passages in paragraphs [0012] and [0013] of the patent specification, the skilled person can only derive that in a digital hearing aid circuits exist which are not stressed with regard to processing speed and output power demand and other circuits which are more stressed. However, no clear criterion is available to distinguish between a circuit which is deemed to be stressed and one which is not. Consequently, the wording "circuits that are not stressed with respect to processing speed" and "more stressed circuits are supplied with a higher operation voltage" in claim 1 render the claim unclear.

4.2 The appellant argued that the skilled person reading paragraph [0007] of the patent specification ("...further lowering of the operation voltage has been considered inconvenient, since it would result in loss of processing speed") would understand that the operation speed of a circuit would be reduced on decreasing the operation voltage and that a circuit which is not stressed would not have its processing speed significantly lowered on applying a reduced power supply voltage.

4.3 This argument is not convincing, since it merely replaces the unclear term "stressed" by a description,

i.e. without significant loss in processing speed, which is equally unclear.

4.4 Claim 1 does not therefore meet the requirements of Article 84 EPC as to clarity and, hence, the patent cannot be maintained in amended form on the basis of the fourth auxiliary request.

5. *Claim 1 of the fifth auxiliary request - novelty (Article 54 EPC)*

5.1 The additional wording (see point VI above) according to which the reduced power supply voltage is obtained as a fraction of the voltage of the hearing aid battery does not distinguish the claimed subject-matter from the hearing aid as disclosed in E1, since the power supply voltage of about 1.1 V in E1 is a fraction (1.1/1.3) of the voltage of the hearing aid battery (1.3 V).

5.2 The appellant argued that the added wording in claim 1 served to clarify that the reduced power supply voltage was generated by a step-down voltage converter which divided the instantaneous battery voltage by a fixed, predetermined fraction, whereas in E1 the reduced power supply voltage was not obtained as a fraction of the battery voltage, but was kept at a fixed value.

5.3 This argument is not convincing. The reduced power supply voltage obtained as a fraction of the battery voltage only specifies a result to be achieved which does not imply any corresponding distinguishing technical features of the switched step-down voltage converter. Further, as explained above, the same is, at least during most of the lifetime of the battery, also

achieved by the step-down voltage converter disclosed in E1.

5.4 The subject-matter of claim 1 therefore lacks novelty (Article 54 EPC). The ground for opposition pursuant to Article 100(a) EPC thus prejudices the maintenance of the patent in amended form according to the fifth auxiliary request.

6. *The first, third and sixth auxiliary requests - admissibility*

The first, third and sixth auxiliary requests were submitted after the summons to oral proceedings had been issued by the board. None of these requests was admitted to the proceedings for the reasons set out below.

6.1 Claim 1 of the first auxiliary request is a combination of claims 1 and 8 as granted, i.e. the feature that the reduced power supply voltage is an unstabilized voltage was added, see point VI above.

The appellant argued that this amendment was in response to the board's preliminary opinion as set out in the communication accompanying the summons to oral proceedings. The additional feature expressed more clearly what was anyway believed to have been claimed in claim 1 as granted and, hence, did not constitute a fresh case. Further, the amendment resulted in a prima facie allowable claim 1, since it clearly established novelty and inventive step of the claimed hearing aid over E1, a simplification of the voltage converter disclosed in E1 having been achieved, without E1 suggesting this simplification.

The board notes, however, that in the board's communication the issue of whether or not the reduced power supply voltage was stabilized was not addressed at all. More specifically, in points 4.2 and 4.3, which concern claim 1 as granted, only the question of "whether or not the digital circuits in E1 [...] are capable of operating at a reduced power supply voltage within a range substantially below a nominal voltage of the battery" was raised and discussed. Similarly, in point 5, which concerned the then pending auxiliary requests, only other issues were addressed.

Further, in the board's judgement, the additional feature does not merely express more clearly what was already claimed in claim 1 as granted. Rather, it further limits the claim, since claim 1 as granted only generally refers to "reduced power supply voltage" and, hence, covers both an embodiment in which the reduced output voltage is a stabilized voltage and one in which it is unstabilized, see also point 2.3, Re (a), above. The appellant also seemed to have shared this interpretation until now, since the arguments submitted earlier in respect of novelty and inventive step vis-à-vis E1 were consistently only based on the notion that in E1 the reduced power supply voltage of 1.1 V was applied to all digital components, i.e. not to selected ones, and that this voltage was not substantially lower than the nominal battery voltage (cf. pages 2 and 3 of the proprietor's letter dated 16 December 2005 in response to the notice of opposition; point II.1 of the communication of the opposition division dated 13 July 2011; the second paragraph of the proprietor's further letter dated 26 October 2011; and points 4.1 and 4.5 of the statement of grounds of appeal).

The board therefore concludes that by including the additional feature of granted claim 8 in claim 1 a fresh case is created.

Further, the inclusion of the additional feature in claim 1 does not lead to a prima facie allowable claim. Firstly, it is noted that the feature is merely a statement of a result to be achieved. Secondly, if a skilled person starting out from E1 were faced with the technical problem of simplifying the known circuitry, which is a common aim which in itself does not contribute to inventive step, any solution according to which a simplification merely results in a lower quality, in this case an unstabilized voltage, and which does not define specific structural features of the means achieving the result, in this case the switched step-down voltage converter, would not contribute to inventive step.

Consequently, the inclusion of the additional feature of claim 8 as granted in claim 1 not only created a fresh case but, at least prima facie, did not lead to an allowable claim. The board therefore decided not to admit the first auxiliary request to the proceedings (Article 13(1) RPBA).

6.2 As regards the third auxiliary request, the added feature (see point VI above) at least prima facie does not render the claimed hearing aid novel over the hearing aid disclosed in E1, since in E1, Fig. 3, the combination of the electric components, including the capacitor directly succeeding the battery, the "switch", the capacitors C_2 and C'_2, and the voltage doubler in the lower right-hand part of Fig. 3, forms a capacitive charge pump converter which is designed to

deliver two output voltages (1.1 V and 2.15 V), wherein the 1.1 V is the reduced power supply voltage.

Further, the board notes that the third auxiliary request was filed late in the proceedings.

Since claim 1 of the third auxiliary request at least prima facie did not overcome the objection of lack of novelty and the request was filed late, the board decided not to admit the third auxiliary request to the proceedings (Article 13(1) RPBA).

6.3 As regards the sixth auxiliary request, the amendments give rise to objections at least under Article 84 EPC, due to the added term "output D/D converter", in terms of its technical meaning, being unclear.

The board also notes that the patent specification does not provide any definition of "output D/D converter". Nor did the appellant provide any evidence in support of this term being well-known in the art at the priority date. Rather, the appellant merely argued that a combination of a D/A converter and an output amplifier circuit which directly converted binary data to a driver signal for the acoustic transducer of a hearing aid was commonly referred to as an output D/D converter in the art of hearing aids.

Even if, for the sake of argument, an output D/D converter were understood in the sense as argued by the appellant, it would not, at least prima facie, be apparent that this feature contributed to inventive step. According to claim 1, the output D/D converter is supplied with a higher operation voltage, i.e. higher than the reduced power supply voltage. E1 discloses that the audio output stage ("analog backend", cf.

Fig. 19) is supplied with a power voltage of 2.15 V, which is higher than the reduced power supply voltage (1.1 V) for the digital circuits. It therefore appears that it would have been obvious to the skilled person that, in the case of the output stage being alternatively implemented by means of a commonly known output D/D converter, the higher voltage would be supplied to the output stage in the same way.

Further, the board notes that the sixth auxiliary request was filed late in the proceedings.

Since claim 1 of the sixth auxiliary request at least prima facie lacked clarity (Article 84 EPC) and the request was filed late, the board decided not to admit the sixth auxiliary request to the proceedings (Article 13(1) RPBA).

7. Since there is no allowable request on the basis of which the patent can be maintained, the appeal is to be dismissed.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

M. Cañueto Carbajo F. van der Voort

Decision electronically authenticated