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**Datasheet for the decision
of 3 July 2023**

Case Number: T 1768/20 - 3.5.07

Application Number: 18701137.4

Publication Number: 3472738

IPC: G06F17/50

Language of the proceedings: EN

Title of invention:
Method for characterization of standard cells with adaptive
body biasing

Applicant:
Racyics GmbH

Headword:
Characterization of standard cells/RACYICS

Relevant legal provisions:
EPC Art. 56
RPBA 2020 Art. 12(4), 13(2)

Keyword:

Amendment after summons - exceptional circumstances - main request (yes)
Amended claims filed with the statement of grounds of appeal - first and second auxiliary requests - admitted
Inventive step - all requests (no)

Decisions cited:

G 0001/19, T 0641/00, T 0914/02, T 0154/04, T 1227/05

Catchword:

see reasons 4.7 for exceptional cases in the sense of points 98 and 128 of G 1/19

Beschwerdekammern

Boards of Appeal

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Case Number: **T 1768/20 - 3.5.07**

D E C I S I O N
of Technical Board of Appeal 3.5.07
of 3 July 2023

Appellant:	Racyics GmbH
(Applicant)	Bergstr. 56
	01069 Dresden (DE)
Representative:	Lippert Stachow Patentanwälte Rechtsanwälte
	Partnerschaft mbB
	Krenkelstraße 3
	01309 Dresden (DE)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted on 12 March 2020 refusing European patent application No. 18701137.4 pursuant to Article 97(2) EPC**

Composition of the Board:

Chair	C. Barel-Faucheux
Members:	M. Jaedicke
	E. Mille

Summary of Facts and Submissions

I.   The appellant (applicant) appealed against the
        examining division's decision refusing European patent
        application No. 18701137.4, which was filed as
        international application PCT/EP2018/050947 (published
        as WO 2019/025030 A1).

II.   The documents cited in the contested decision were:
        D1   US 5,692,160 A, published on 25 November 1997;
        D2   US 2010/083193 A1, published on 1 April 2010;
        D3   US 2010/333057 A1, published on 30 December 2010.

III.   The examining division refused the application on the
        grounds that the subject-matter of independent claim 1
        of a main request and of each of a first and a second
        auxiliary request lacked an inventive step. *Obiter*, the
        examining division stated among other things that
        claim 14 of the main request was unclear and that the
        subject-matter of claim 14 lacked an inventive step.

IV.   In its statement of grounds of appeal, the appellant
        requested that the contested decision be set aside and
        that a patent be granted on the basis of a main request
        or, in the alternative, a first or second auxiliary
        request, all requests as submitted with the statement
        of grounds of appeal.

V.   In a communication under Article 15(1) RPBA 2020, the
        board expressed among other things its provisional
        opinion that the subject-matter of claim 1 of each of
        the main request and the first and second auxiliary
        requests lacked an inventive step in view of a
        notorious computer.

VI.   By letter of 2 June 2023, the appellant submitted a new main request corresponding to the main request considered in the contested decision. Moreover, it maintained its prior main request and first auxiliary request as its new first and second auxiliary requests, respectively. It also withdrew the previous second auxiliary request.

VII.   Oral proceedings were held as scheduled and the appellant was heard on relevant issues. At the end of the oral proceedings, the Chair announced the board's decision.

VIII.   The appellant's requests were that the contested decision be set aside and that a patent be granted on the basis of the main request filed with the letter of 2 June 2023 or either of the first and second auxiliary requests filed with the statement of grounds of appeal as main request and first auxiliary request, respectively.

IX.   Claim 1 of the main request reads as follows: "Method for generating a design model with an improved characterization of a standard cell with adaptive body biasing in a circuit design process of said cells in digital circuits fabricated in a foundry, whereby the cell is defined by subject to variations due to the fabrication process P of said foundry, a supply voltage VDD_{nom} and an operating temperature T, the method comprising the following steps:
- considering static deviations in the supply voltage VDD_{nom} of the cell by a first pessimism +/- x%, resulting in $VDD_{c,PVT} = VDD_{nom}$ +/- x%, and obtaining thereof a set of PVT corners with $(Process, VDD_{c,PVT}, T_c)$ for said PVT corners,

- defining a set of PVTBB corners indicating the PVT corner with body bias voltages for each PVT corner with (Process, VDD_{PVTBB}, VPW, VNW, T) and
- providing the results of characterizing the cell with adaptive body biasing in a library file resulting in a design model for generating target VWN and VPN values for adaptive body biasing operation supported by a design implementation tool, **characterized in, [*sic*] that** the method is improved by
- simulating a cell set over P, V and T, and generating a data-set for a performance F of the cell set with F(VDD, T, VNW, VPW, Process(ss,tt,ff,sf,fs)) for a s-slow, t-typical and f-fast circuit property and VWN and VPW as body bias p-well and n-well voltages of the cell,
- simulating a performance monitor circuit for sensing a performance as a performance sensor over P, V and T, and generating a data-set for a hardware performance monitor value C from measurements with C(VDD, T VNW, VPW, Process(ss,tt,ff,sf,fs)) for a s-slow, t-typical and f-fast circuit property, further
- determining a reference performance F0 of a cell set at a particular PVT corner,
- determining a reference hardware performance monitor value C0 at the particular PVT corner,
- performing a virtual regulation and adapting of body bias voltages to VNW_{c0} and VPW_{c0} of the cell set such that said reference performance F0 of the cell set or said reference hardware performance monitor value C0 will be reached at each PVT corner of said set of PVT corners specified by (Process, $VDD_{C0,PVTBB}$, (VPW_{c0}, VNW_{c0}) T_{c0}) and for compensating the static deviation in the supply voltage."

X.   Claim 1 of the first auxiliary request differs from claim 1 of the main request in that

- "with an improved characterization of a standard cell with adaptive body biasing" has been amended to "with an improved characterization of a standard cell with adaptive body biasing by means of a design tool and the method is used",
- "resulting in a design model for generating target VWN and VPN values for adaptive body biasing operation supported by a design implementation tool, **characterized in, [sic] that**" has been amended to "resulting in the improved design model, wherein", and
- "and for compensating the static deviation in the supply voltage" has been amended to "and for compensating the static deviation in the supply voltage, whereas a closed loop regulation of the bias voltages which is regulated in a closed loop control, based on a performance sensor is used".

XI.   Claim 1 of the second auxiliary request differs from claim 1 of the first auxiliary request in that the following text has been added at the end of the claim: ", wherein
- dynamic deviations of the supply voltage VDD by a second pessimism +/- y%, resulting in $VDD_{c,PVTBB} = VDD_{nom}$ +/- (x+y)%".

XII.   The appellant's arguments relevant to the present decision are discussed in detail below.

Reasons for the Decision

1.   The application relates to generating a design model for a chip design by means of a design tool and simulation.

Admissibility of all the requests

2.   The current main request was filed in direct response
          to the board's communication under Article 15(1) RPBA
          2020, wherein the board raised a fresh line of argument
          against inventive step of the requests on file based on
          a notorious computer as prior art and decision of the
          Enlarged Board of Appeal G 1/19 of 10 March 2021. The
          appellant argued that decision G 1/19 had not been
          published when it filed its statement of grounds of
          appeal. Consequently, its main request and also its
          auxiliary requests should be admitted as a legitimate
          defence against the board's fresh line of argument. The
          board agrees that, in the present case, the board's
          fresh line of argument constitutes exceptional
          circumstances. Consequently, the board admits the main
          request under Article 13(2) RPBA 2020, even though this
          request re-introduces a former request that was not
          maintained in the statement of grounds of appeal.

3.   The current first and second auxiliary requests were
          filed as main request and first auxiliary request with
          the statement of grounds of appeal. Consequently, their
          admission is at the board's discretion under Article
          12(4) RPBA 2020. The appellant argued that these
          requests comprised amendments intended to overcome the
          objection of the examining division that certain method
          steps represented mental acts and did not make a
          technical contribution.

          The amendments made in the current auxiliary requests
          can be regarded as a legitimate defence against the
          board's new line of argument regarding inventive step
          as well. Moreover, the board admitted the appellant's
          main request as a legitimate defence and it would not
          be convincing, in the exceptional circumstances of the

present case, to deprive the appellant of the
opportunity to defend itself with its earlier filed
substantive requests. In this context it has to be
considered that these earlier filed substantive
requests at least in principle are suitable to address
the issues raised and the board can deal with these
requests in a straightforward manner. Consequently, the
board admits the current first and second auxiliary
requests into the appeal proceedings (Article 12(4)
RPBA 2020).

Main request

4.   *Inventive step*

4.1   The examining division considered that, even assuming
        that storing results in a library file implied the use
        of technical means, the method of claim 1 of the
        current main request lacked an inventive step for the
        following reasons: first, it was well known to store
        cell characterisation data in library computer files
        (see document D1, columns 17 and 18). Second, the
        further steps corresponded to non-technical user
        requirements that, according to the COMVIK approach
        (see decision T 641/00), were part of the objective
        technical problem (see contested decision, point 2).

4.2   In its statement of grounds of appeal, pages 4 to 8,
        the appellant submitted that the method of claim 1 was
        not a mental act as such but rather used a design tool
        as technical means. The claimed method generated a
        design model with improved characterisation of a
        standard cell. The results of said characterisation
        were stored in a library file containing library
        corners or so-called PVT corners. These data were used
        in the simulation process of standard cells for highly

integrated semiconductor components by the customers
and were needed to simulate how a designed circuit
might work later (see description, page 3, starting at
line 16).

The appellant argued that, according to decision
T 154/04 and in view of the objective of the invention
and the proposed solution, the claimed procedure could
not be reduced to the mere collection of data, e.g. in
a database, for the purpose of analysing design
parameters of said cells. Referring to decision
T 1227/05, the appellant argued that the method had a
technical character as it concerned the technical field
of chip manufacturing. Since the method was implemented
by design tools, this added to the technical character
in view of decision T 914/02. A direct use of
controllable natural forces was not necessary for an
invention (see statement of grounds of appeal, page 5,
first and second full paragraphs).

4.3   Regarding the issue of whether steps of the claimed
method encompass mere mental acts, the board accepts
the appellant's argument that the skilled person would
interpret the method of claim 1 as being computer-
implemented, since the method is specified as being
part of a circuit design process of a standard cell in
digital circuits fabricated in a foundry, i.e. it aims
to improve a design model for cells of a microchip. The
skilled person will understand that such a design, at
the filing date, was generated using computer-
implemented design tools. Consequently, the skilled
person would not interpret the steps of the method
according to claim 1 as encompassing merely mental
activities.

4.4   The board considers that the cited decision T 1227/05, which concerned computer-implemented methods for the numerical simulation of electronic circuits, is no longer relevant to the present case in view of the more recent decision G 1/19, which reconsidered the general approach for assessing the technical character of computer-implemented methods for simulation and design (see point 133). Consequently, decision G 1/19 is the essential case law that has to be considered when assessing inventive step in the current case, and the board summarises some relevant aspects of this decision below.

4.4.1   According to point 97 of G 1/19, "*calculated technical effects should be distinguished from potential technical effects which, for example when a computer program or a control signal for an image display device is put to its intended use, necessarily become real technical effects*".

        Moreover, according to point 98 of the decision, "*[c]alculated status information or physical properties concerning a physical object are information which may reflect properties possibly occurring in the real world. However, first and foremost, they are mere data which can be used in many different ways. There may exist exceptional cases in which such information has an implied technical use that can be the basis for an implied technical effect. Still, in general, data about a calculated technical effect is just data, which may be used, for example, to gain scientific knowledge about a technical or natural system, to take informed decisions on protective measures or even to achieve a technical effect.*"

Point 128 of decision G 1/19 summarised that calculated data "*reflecting the physical behaviour of a system modelled in a computer usually cannot establish the technical character of an invention in accordance with the COMVIK approach, even if the calculated behaviour adequately reflects the behaviour of a real system underlying the simulation. Only in exceptional cases could such calculated effects be considered implied technical effects (for example, if the potential use of such data is limited to technical purposes, see point E.I.f above)*". Point E.I.f comprises points 97 and 98.

4.4.2   Finally, the Enlarged Board of Appeal saw no difference regarding the technicality of a simulated physical system in the event that the computer-implemented simulation was claimed as part of a design process, in particular for verifying a design (see decision G 1/19, point 138 and order, point 3).

4.5   The board considers that, in the current case, the result of the calculations effected by the method steps of claim 1 is a design model with an "improved" characterisation that is obtained by simulation (see characterising part of claim 1, for example) of a standard cell which is provided in a library file. Such a library file is, at least according to the description, used by customers in later stages of the overall design process (see description of the published application, page 5, lines 12 to 17 and page 10, lines 3 to 11), but the method of claim 1 does not contain steps specifying the use of the produced library file in later design or manufacturing steps. A use of the design model in a manufacturing step would have been particularly relevant since the Enlarged

Board of Appeal considered the inclusion of a
manufacturing step to be an argument in favour of
patentability (see point 134 of decision G 1/19).

4.5.1   The board is aware that claim 1 refers to "a circuit
        design process of said cells in digital circuits
        fabricated in a foundry" and thus specifies the
        ultimate aim of using the improved design model of a
        standard cell for fabricating integrated chips (digital
        circuits) in a foundry. However, the manufacturing of a
        designed digital circuit using the improved design
        model is neither specified as being part of the method
        of claim 1 nor implied by specifying the ultimate aim
        of the design process.

4.5.2   Since the result of the method of claim 1 is calculated
        data for an improved design that is obtained using
        simulation, it follows from points 97, 98 and 138 of
        decision G 1/19 that the improved design does not
        contribute to inventive step since no "further"
        technical effect, such as controlling a machine in the
        foundry during a manufacturing process, is derivable.

4.5.3   The board is aware that a "further" technical effect
        relating to the internal operation of the computer
        system could also be achieved by the claimed method.
        However, the only feature of the claimed method that
        concerns details of its implementation in a computer
        system is that results are provided in a library file,
        i.e. that result data are stored in a file. However,
        the examining division considered that it was well
        known to store such data in a file (see point 2.8 of
        the contested decision), and the appellant did not
        dispute this finding. Moreover, since the data is as
        such non-technical, only the storing of the data in a
        file could be regarded as being technical, but this is

known in the context of a notorious general-purpose
computer and cannot be the basis for an inventive step.

4.5.4   Consequently, the steps of the claimed method, apart
        from their straightforward implementation by means of a
        computer, do not contribute to inventive step, but
        rather represent a non-technical algorithm underlying
        the method of claim 1.

4.6   In response to the board's line of argument against
        inventive step based on decision G 1/19, the appellant
        argued that the current invention was "*an 'exceptional
        case' in the sense of decision G 1/19 for which the
        calculated behaviour of components (standard cells) of
        a physical system (microchip), exclusively for the
        purpose of manufacturing the microchip is the basis for
        a technical contribution*" (letter of 2 June 2023,
        page 5, fourth full paragraph). The properties of
        standard cells calculated during characterisation were
        specifically and exclusively calculated, provided and
        used for production purposes. While this was not
        explicitly stated in the claims, this followed from the
        context of microchip fabrication and the skilled
        person's common general knowledge.

        The appellant also argued that the library file
        contained data that was used by the machines in the
        foundry. For example, the layout of a standard cell was
        later used as part of the overall layout of the digital
        circuit that was produced. At the oral proceedings, the
        appellant explained that the customers assembled
        digital circuits using the standard cells as building
        blocks. The information contained in the library files
        was important for the resulting chip layout. For
        example, the timing information for the standard cells
        contained in the library file directly influenced the

later "Timing Driven Place and Route" design step. The claimed invention solved the problem of improving the data in the library files provided to the customer. The improved data allowed the customer to produce a design of a microchip using a lesser silicon area for the production of the microchip and to reduce energy consumption during operation of the microchip. Consequently, the library file was an indispensable input for optimising the microchip.

The data in the library files was not directly used to control the machines for the microchip production, and further human input was still needed to specify the design goals, which were then implemented using the library file. However, there was no intermediate step where a human judged the provided design model or library file as being good or bad, for example. While there were further intermediate steps before the microchip manufacturing step, these intermediate steps were straightforward.

4.7   Regarding the appellant's argument that the claimed invention was an exceptional case according to points 98 and 128 of decision G 1/19, it is important to consider whether the design produced by the method has a potential technical effect in the sense of point 97 of decision G 1/19 (e.g. because the design is produced as a computer program or a television control signal). The exceptional cases mentioned in points 98 and 128 of decision G 1/19 are to be understood only as cases where the simulation and/or design result, when put to its intended use, without any further human interaction, achieves a technical effect such as controlling a technical device. Such a strict approach is desirable to establish legal certainty by drawing a clear line for the technicality of design processes

producing a design. A design consisting merely of geometrical data such as a layout mask cannot be said to have a potential technical effect in the sense of decision G 1/19.

Since the library file is not directly used to control the machines in the foundry and even further human input is necessary before its use in a manufacturing step, the library file produced by the method of claim 1 cannot be considered to have an implied technical effect. In this context, the board also observes that the Enlarged Board of Appeal considered that the decision to build or not build a prototype is a business decision made by humans (see point 123 of G 1/19). Similarly, the decisions on whether and how to use the layout data in the library file and whether or not to manufacture a digital circuit are human decisions.

Consequently, the board is not convinced that the current case is an "exceptional case" in the sense of decision G 1/19.

4.8   From the above reasoning, it follows that the method of claim 1 lacks an inventive step (Article 56 EPC).

First and second auxiliary requests

5.   The first and second auxiliary requests add details about the simulation and the use of tools (see above, points X. and XI.). The first auxiliary request essentially adds that "*a closed loop regulation of the bias voltages which is regulated in a closed loop control, based on a performance sensor is used*". The second auxiliary request adds the feature of considering "*dynamic deviations of the supply voltage*

VDD by a second pessimism +/- y%, resulting in
$VDD_{C,PVTBB} = VDD_{nom} +/- (x+y)\%$".

5.1   The appellant argued essentially as for the main
        request in favour of an inventive step for the subject-
        matter of claim 1 of the auxiliary requests.

5.2   The amendments made in the first and second auxiliary
        requests do not overcome the board's objections against
        inventive step for the main request. The result of the
        method of claim 1 according to the auxiliary requests
        is limited to an improved design model stored in a
        library file, i.e. is essentially the same as for the
        main request. The amendments made concern only further
        improvements to the model, but that is not relevant in
        the context of the board's objection. Moreover, none of
        the amendments made specifies particular details
        concerning the implementation of the method in a
        computer system. Consequently, the amendments made to
        the auxiliary requests do not give rise to a further
        technical effect relating to the internal operation of
        the computer.

5.3   Consequently, the subject-matter of claim 1 of the
        first and second auxiliary requests lacks an inventive
        step (Article 56 EPC).

Conclusion

6.   Since none of the appellant's requests can form the
        basis for the grant of a patent, the appeal is to be
        dismissed.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chair:

S. Lichtenvort   C. Barel-Faucheux

Decision electronically authenticated