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Case Number: T 1401/10 - 3.5.01

Application Number: 04784098.8

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Title of invention:
A SYSTEM AND METHOD FOR TESTING AND CONFIGURING SEMICONDUCTOR FUNCTIONAL CIRCUITS

Applicant:
NVIDIA Corporation

Headword:
Configuring semiconductor functional circuits/NVIDIA

Relevant legal provisions:
EPC 1973 Art. 54, 56

Keyword:
Novelty - (no)
Inventive step - (no)

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Case Number: T 1401/10 - 3.5.01

D E C I S I O N
of Technical Board of Appeal 3.5.01
of 12 December 2014

Appellant: (Applicant)	NVIDIA Corporation 2701 San Tomas Expressway Santa Clara, CA 95050 (US)
Representative:	Manley, Nicholas Michael WP Thompson 8th Floor 1 Mann Island Liverpool L3 1BP (GB)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted on 18 January 2010 refusing European patent application No. 04784098.8 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman	S. Wibergh
Members:	P. Scriven
	S. Fernández de Córdoba

Summary of Facts and Submissions

I. The appeal is against the decision of the Examining Division to refuse European Patent application 04784098.8 on grounds under Article 84 and Rule 137(4) EPC.

II. In the statement setting out the grounds of appeal, dated 28 May 2010, the appellant submitted claims according to a main and six auxiliary requests, and requested that the Examining Division's decision be set aside and that a patent be granted on the basis of one of those seven sets of claims. The appellant also requested that oral proceedings be held if the main request were not allowed.

III. The Board invited the appellant to attend oral proceedings, and set out its provisional view in a communication sent with the summons. In particular, the Board set out objections as to lack of novelty and inventive step on the basis of document D2 (US-A-5 956 252).

IV. The appellant presented no further comments, but informed the Board that it would not be represented at oral proceedings.

V. Oral proceedings were held on 12 December 2014. The applicant was not represented. The Board decided to dismiss the appeal.

VI. Claim 1 according to the main request reads as follows:

A processing unit formed as an integrated circuit (100, 150, 190, 1510) and

comprising:
a plurality of functional components (131-134, 195-199, 611-614, 831-834, 1111-1114, 311-314, 321-324, 331-334) for performing processing operations, wherein defective functional components included in said plurality of functional components are disabled and non-defective functional components are selectively enabled; and
a workflow control component (11O, 151, 191, 310, 631, 810, 1131, 1151) for dispensing workflow to said selectively enabled functional components and preventing distribution of workflow to said disabled functional components.

VII. Claim 1 according to the first auxiliary request reads identically, except that

... wherein defective functional component ... selectively enabled ...

is replaced by

... a functional component configuration control component (120, 152, 192, 350, 633, 820, 1133, 1517) for controlling enablement and disablement of one or more of said plurality of functional components, whereby defective functional components included in said plurality of functional components are disabled and non-defective functional components are selectively enabled ...

VIII. Claim 1 according to the second auxiliary request reads identically that according to the first, except that

... a functional component configuration control component (120, 152, 192, 350, 633, 820, 1133, 1517) ...

is replaced by

... a functional component configuration control component (120, 152, 192, 350, 633, 820, 1133, 1517) which includes a programmable register ...

and

... enablement and disablement of one or more of said plurality of functional components ...

is replaced by

... enablement and disablement of one or more of said plurality of functional components based upon the content of the register ...

IX. Claim 1 according to the third auxiliary request reads identically to that according to the first, except that

... whereby defective functional components ... selectively enabled ...

is replaced by

... said functional component configuration control component being adapted to selectively enable and disable each of said plurality of functional components based upon testing of each of said plurality of functional components ...

X. Claim 1 according to the fourth auxiliary request reads identically to that according to the first, except that the following is appended:

... wherein
said functional component configuration control component provides information to said workflow control component regarding which of said functional components is enabled and which disabled.

XI. Claim 1 according to the fifth auxiliary request reads identically to that according to the main request, except that the following is appended:

... wherein:
the non-defective functional components are directed to ignore information form [sic] said defective component.

XII. Claim 1 according to the sixth auxiliary request reads as follows:

A processing unit formed as an integrated circuit (100, 150, 190, 1510) and comprising:
a plurality of functional components (131-134, 195-199, 61 1-614, 831-834,

1111-1114, 311-314, 321-324, 331-334) for performing processing operations,
a functional component configuration control component (120, 152, 192, 350, 633, 820, 1133, 1517) which includes a programmable register which is programmed on the basis of testing of each of said plurality of functional components, the functional component configuration control component serving to selectively enable and disable each of said plurality of functional components based upon the content of the register thereby to disable defective functional components and to selectively enable non-defective functional components, and
a workflow control component (110, 151, 191, 310, 631, 810, 1131, 1151) for dispensing workflow to said selectively enabled functional components and preventing distribution of workflow to said disabled functional components, said functional component configuration control component being adapted and arranged to provide information to said workflow control component regarding which of said functional components is enabled and which disabled, and said non-defective components being directed to ignore information from said defective components.

XIII. The appellant's arguments, in the statement setting out the grounds of appeal, addressed the issues of clarity, and of inventive step in consideration of document D6 (WO-A 02054224).

Reasons for the Decision

The invention

1. The invention concerns integrated circuits which comprise many functional components. The latter term is to be taken broadly, to cover relatively simple things such as a single memory cell (paragraph [0006] of the published application) as well as complex things such as a floating point accelerator (paragraph [0007]). The functional components form part of a single die.

2. The manufacture of such a die is difficult. Sometimes, a particular component may not work. It may turn out that a die designed to hold eight NAND gates has in fact only seven that work.

3. In order to increase the probability of a die with eight NAND gates, a manufacturer might design a die with nine. If one of the gates is defective, the ninth can take its place. This is set out in paragraph [0006] of the published application, with reference to memory cells. The problem with this is that some of the die is necessarily wasted.

4. It is also possible to identify faulty components and disconnect them, leaving a die which is still usable, but without the full functionality that was intended. Paragraph [0007] of the published application sets that out in terms of a processor with a defective floating-point accelerator.

5. The invention seeks to allow a die to be used even if some of its components are defective, and to make

effective use of as much of a die as possible.

6. The core idea is that defective components are disabled, while other components can be selectively enabled; and that a "workflow component" distributes tasks only to those components that have been enabled (see claim 1 according to the main request).

The main request

7. Claim 1 according to this request is directed to a processing unit, formed as an integrated circuit, that implements the core idea set out above.

8. D2 discloses (D2, column 2, line 16 - 36) an integrated circuit on a die with two functional components ("a first circuit", "a second circuit"), in which defective components are left disconnected, and in which "workflow" is sent only to components which are not defective. In more detail (D2, column 3, lines 35 - 50), there are multiplexors that connect only the non-defective component to input/output pins, while connections to the defective component are in a high-impedance state.

9. The Board considers that the integrated circuit disclosed in D2 is a "processing unit formed as an integrated circuit", that it has a "plurality of functional components", that defective components are disabled, that functioning components are "selectively enabled" (by virtue of being selected to be connected to the input/output pins), and that workflow is directed solely to the "selectively enabled functional components".

10. In the communication sent with the summons to oral proceedings, the Board set out its provisional view that D2, on the basis of the passages cited above, seemed to take away novelty. The appellant has not presented any argument against that view, and the Board sees no reason to depart from the view expressed.

11. The main request, therefore, cannot be allowed because of lack of novelty (Article 54 EPC 1973).

The first auxiliary request

12. The reformulation of claim 1 amounts to the stipulation that disabling and enabling functional components is carried out by a "functional component configuration control component".

13. The arrangement of multiplexors disclosed in D2 (see paragraph 8., above) constitutes a configuration control component.

14. Again, the appellant was informed of the Board's provisional view that this version of the processing unit lacked novelty in the light of D2, and presented no arguments against it. Again, the Board sees no reason to change its view.

15. The first auxiliary request, therefore, cannot be allowed because of lack of novelty (Article 54 EPC 1973).

The second auxiliary request

16. This version of claim 1 is the same as according the first auxiliary request, except that the configuration control component must now include a programmable register, upon the basis of the contents of which functional components are enabled or disabled.

17. A programmable register is mentioned, for example, in paragraphs [0051], [0078], and [0113] of the published application. The Board understands a register to be no more than a programmable memory that provides a suitable store for settings. At first sight, one might consider that a programmable register provides possibilities of re-configuration that hard-wiring would not; but paragraph [0078] seems to suggest that both a programmable register and hard-wired configuration may be part of the same embodiment. Nothing turns on this, however. It is sufficient to consider the register is just a convenient store of information on what should be enabled and what disabled.

18. The Board's provisional view, set out in the communication sent with the summons to oral proceeding, was that a register would have been an obvious implementation. Again, the appellant has not argued against that view, and the Board sees no reason to change its view. The Board also notes that the application suggests, particularly in paragraphs [0051] and [0078], that a register is simply one possibility amongst several equally valid ones.

19. The second auxiliary request, therefore, cannot be allowed because the processing unit defined by claim 1 lacks inventive step (Article 56 EPC 1973).

The third auxiliary request

20. This version of claim 1 is the same as that according to the first auxiliary request, except that enabling and disabling is defined as being *based upon testing of each of said plurality of functional components*.

21. D2 discloses the setting of its multiplexors as a result of testing the components. It follows that this version of the processing unit is no more novel than the version according to the first auxiliary request.

22. The third auxiliary request, therefore, cannot be allowed because of a lack of novelty (Article 54 EPC 1973).

The fourth auxiliary request

23. This version of claim 1 adds to that according to the first auxiliary request a stipulation that the configuration control component provides information on what is enabled and what is disabled to the workflow control component.

24. In the processing unit disclosed in D2, the workflow control component comprises the multiplexors; the configuration control component also comprises the multiplexors. On this interpretation, it is inevitable that the latter "provide information" to the former. For that, it is sufficient that the information is available to the multiplexors; and that is necessarily the case. This suggests a lack of novelty.

25. However, the Board indicated, when setting out its provisional view, that it seemed obvious to provide

information on what is enabled and what disabled. The appellant has presented no counter-argument, and the Board remains of the same view. After all, the workflow control component must somehow obtain the information it needs to control the flow.

26. The Board, therefore, rejects the fourth auxiliary request, because of a lack of inventive step (Article 56 EPC 1973).

The fifth auxiliary request

27. This version of claim 1 adds, to that according to the main request, the stipulation that components that are not defective are directed to ignore information from those that are defective.

28. The Board indicated its provisional view that this additional stipulation seemed obvious, and the appellant has presented no argument on the issue.

29. In cases in which components (for example the NAND gates referred to in paragraphs 2. and 3.) either are or are not connected to input-output pins, there are no internal connections and the functioning components are not affected by what defective components might be doing. The same goes when components are physically disconnected, or disabled such that they cannot "generate spurious traffic" (paragraph [0078] of the published application). In other cases, however, a defective component may produce some output that could affect a functioning component. The skilled person who is aware of that would want to ensure that the functioning component does not react to "spurious traffic". The Board, therefore, sees no reason to

depart from the view it expressed in the communication accompanying the summons to oral proceedings.

30. The fifth auxiliary request, therefore, cannot be allowed because of a lack of inventive step (Article 56 EPC 1973).

The sixth auxiliary request

31. This version of claim 1 is a combination of those according to the second, fourth, and fifth auxiliary requests. In the absence of a synergetic effect the arguments set out above with respect to those requests apply without modification.

32. The sixth auxiliary request, therefore, cannot be allowed because of a lack of inventive step (Article 56 EPC 1973).

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

T. Buschek S. Wibergh

Decision electronically authenticated