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**Datasheet for the decision  
of 4 May 2023**

**Case Number:** T 2309/19 - 3.5.02

**Application Number:** 05786208.8

**Publication Number:** 1917710

**IPC:** H02M3/155

**Language of the proceedings:** EN

**Title of invention:**  
Step-down voltage converter

**Applicant:**  
Micro Motion, Inc.

**Relevant legal provisions:**  
EPC Art. 56

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



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Case Number: T 2309/19 - 3.5.02

**D E C I S I O N**  
**of Technical Board of Appeal 3.5.02**  
**of 4 May 2023**

**Appellant:** Micro Motion, Inc.  
(Applicant) 7070 Winchester Circle  
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**Representative:** Ellis, Christopher Paul  
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**Decision under appeal:** **Decision of the Examining Division of the  
European Patent Office posted on 1 April 2019  
refusing European patent application No.  
05786208.8 pursuant to Article 97(2) EPC.**

**Composition of the Board:**

**Chairwoman** J. Hoppe  
**Members:** C.D. Vassoille  
G. Flyng

## Summary of Facts and Submissions

- I. The appeal of the applicant lies against the decision of the examining division to refuse European patent application No. 05 786 208.8, published as international publication No. WO 2007/018498 A1.
- II. The following document is relevant for the present decision:  
  
D6: JP H03 11388 U and the corresponding English computer translation dated 6 March 2019 annexed to the decision under appeal.
- III. In the decision under appeal, the examining division, *inter alia*, came to the conclusion that the subject-matter of claim 1 did not involve an inventive step in view of document D6.
- IV. In a communication under Article 15(1) RPBA 2020, the board informed the appellant that the subject-matter of claim 1 appeared not to involve an inventive step in view of document D6.
- V. Oral proceedings took place before the board on 4 May 2023 and were, at the request of the appellant, conducted as a videoconference.
- VI. The appellant (applicant) requested that the decision under appeal be set aside and that a patent be granted based on the set of claims filed with letter dated 28 January 2019. This claim-request corresponded to the set of claims underlying the decision under appeal, which was filed in electronic form on 28 January 2019

with a letter that was erroneously pre-dated 28 February 2019.

VII. Claim 1 of the sole request reads as follows:

"A step-down voltage converter (100) for generating a direct current output voltage ( $V_{OUT}$ ) from a direct current input voltage ( $V_{IN}$ ), comprising:

a single field-effect transistor (FET) (Q1) switch (111) comprising a drain terminal (112) and a source terminal (114), wherein the source terminal (114) of the switch (111) is electrically coupled with the output voltage ( $V_{OUT}$ );

a diode (117) comprising an anode (118) and a cathode (120), wherein the cathode (120) of the diode (117) is electrically coupled with the output voltage ( $V_{OUT}$ );

a first inductor (124) electrically coupling the drain terminal (112) of the switch (111) with the input voltage ( $V_{IN}$ );

a second inductor (126) magnetically coupled with the first inductor (124), the second inductor (126) electrically coupling the anode (118) of the diode (117) with a voltage reference (128); and

a direct current switching controller (110) coupled with the output voltage ( $V_{OUT}$ ) and configured to control the switch (111) by way of a gate terminal (216) of the FET (Q1), based on the output voltage ( $V_{OUT}$ ) and a current at the output voltage ( $V_{OUT}$ )."

## **Reasons for the Decision**

### *1. Inventive step (Article 56 EPC)*

1.1 The subject-matter of claim 1 of the sole request does not involve an inventive step in view of document D6.

#### Closest prior art

1.2 The appellant has not explicitly disputed that, as the examining division found in the decision under appeal, document D6 may be considered as the prior art document closest to the subject-matter of claim 1. The board sees no reason to deviate from this finding. Figures 1 and 2 can be established as a suitable starting point for the assessment of inventive step because figure 3 of the application shows a converter similar to figure 1 of D6. This was also confirmed by the appellant in their letter dated 4 April 2023 (last sentence on the second page).

#### Distinguishing feature

1.3 In the decision under appeal, the examining division concluded that document D6 disclosed that the switching controller (see reference number 7 in figures 1 and 2) was configured to control the switch based on the output voltage. Thus, the only distinguishing feature the examining division considered was that the switching controller was configured to additionally control the switch based on the current at the output voltage.

1.4 The appellant contested this, arguing that further to the difference identified by the examining division,

document D6 did not disclose any feedback control at all, and in particular also no control of the switch based on the output voltage. Consequently, the appellant was of the opinion that the step-down converter of document D6 differed from the subject-matter of claim 1 in that the direct current switching controller was configured to control the switch by way of a gate terminal of the FET (see reference number 15 in figures 1 and 2) **based on the output voltage  $V_{OUT}$  and a current at the output voltage.**

- 1.5 In particular, the appellant argued that not only did document D6 not disclose any type of feedback control, but that it was "highly likely" that the switching controller in document D6 was a "time-based controller that does not flip a switch based on the output current and the output voltage".

The appellant did not provide any further explanation of what was meant by a "time-based controller" and how the skilled person could derive this information from the overall disclosure of D6. Therefore, the board is not convinced by the appellant's argument.

- 1.6 However, accepting, for the sake of argument, the appellant's contention that there is no feedback control derivable from D6, the subject-matter of claim 1 would still not involve an inventive step in view of document D6.

The question whether document D6 at least implicitly discloses that the switch is controlled based on the output voltage, as assumed by the examining division, can therefore remain unanswered.

1.7 Consequently, for the purposes of carrying out the "problem and solution approach", the board will assume in the following that the distinguishing feature, as put forward by the appellant, is that the switching controller is configured to control the switch based on the output voltage and a current at the output voltage.

Technical effect / objective technical problem

1.8 The appellant conceded in the oral proceedings that no synergistic effect would be achieved by using both, the output voltage and a current at the output voltage. In writing, they essentially argued that in the specific case of the patent application it would be advantageous to control the switch using both the output voltage and the current at the output voltage. In particular, it was argued that the current would be more responsive to changing conditions and the response would be faster, whereas the output voltage would be less dynamic but would be the desired measured output.

According to the appellant, the objective technical problem is therefore how to provide faster and more responsive control of the switch.

1.9 On the basis of document D6 and taking into account the above-mentioned distinguishing feature (see point 1.7), the board does not consider the technical effect and the corresponding objective technical problem proposed by the appellant to be correct.

In particular, according to the appellant's core argument, document D6 does not disclose any type of feedback control. Therefore, the technical effect cannot be a faster and more dynamic control compared to

a control based only on the output voltage. For this to be the case, it would have to be assumed that document D6 disclosed a switching controller configured to control the switch based on the output voltage alone. However, this is precisely what the appellant has argued is not the case in document D6.

- 1.10 Since the board assumes, following the appellant's argumentation, that document D6 does not disclose either an output voltage-based control or a combined output current- and output voltage-based control of the switch, the objective technical problem can reasonably be seen only in how to implement the switching controller.

In formulating the objective technical problem, the board also took into account the breadth of the distinguishing feature, which does not include any details with regard to the implementation of the actual control of the switch, in particular, with regard to the practical use of the output voltage and the current. Therefore, within the claimed subject-matter, no effect of the distinguishing feature is discernible for the skilled person, nor was it disclosed in the patent.

In writing, the appellant presented several further alleged advantages of the invention, but none of them was linked to the distinguishing feature. As already set out in the board's preliminary opinion, alleged advantages or effects which are not present or at least not linked to the distinguishing feature, cannot be used for the assessment of inventive step.

The appellant argued that an advantage of the present invention would be that little voltage difference was



required to operate the switch and that document D6 failed to account for this as it used the input voltage to drive the switch circuit.

This is not convincing. As already stated in the board's preliminary opinion, a corresponding advantage of the invention is in fact described in the application, see page 10, lines 1 to 7. There it is however not linked to the coupling of the switch controller to the output voltage but to the coupling between the power source of the switch and output voltage. Moreover, the board cannot agree with the appellant that a corresponding advantage does not emerge from the technical teaching of document D6. To the contrary, document D6 clearly discloses in fig. 1 that the source of the switch is coupled directly to the output voltage. This was not contested by the appellant. In addition, claim 1 does neither explicitly nor implicitly include any feature reflecting the powering of the switch by the output voltage, so that the advantages allegedly connected thereto cannot be used to establish an improvement over the prior art.

Against this background, a narrower definition of the problem to be solved is not justified.

#### Obviousness

- 1.11 The distinguishing feature is obvious to the person skilled in the art when starting from document D6 and in view of the objective technical problem of how to implement the switching controller.
- 1.12 In the statement setting out the grounds of appeal, the appellant has essentially summarised the teaching of document D6 correctly as follows:

The conventional power supply circuit as shown in figure 6 of document D6 is disadvantageous in that it becomes difficult to control the output voltage  $V_{OUT}$  if electric power consumed by a load is small, resulting in an increase in output voltage  $V_{OUT}$  (see figure 7). The invention according to document D6 has been proposed to solve the above described problem. Figures 1 and 2 show an embodiment of a power supply circuit 30, according to which the output of commercial power source 3 is rectified by diodes 31, 32 and is smoothed by capacitor 33. The smoothed voltage is supplied to drive circuit 7 via resistor 35. As a result, load current  $I_{DR}$  of drive circuit 7 is separated from output current  $I_{OUT}$  and fed back to the power source 3.

Consequently, as shown in figure 2, first power source E1 comprising diodes 31, 32 and capacitor 33 solely drives the drive circuit 7, and second power source E2 comprising commercial power source 3, diode bridge 4 and capacitor 5 supplies power to FET 15 and switching transformer 18. Since the power supply circuit is configured such, it is possible to avoid load current  $I_{DR}$  from being supplied to a load along with output current  $I_{OUT}$  and to control a drive signal provided to FET 15 even if small power is consumed in the load to keep the output voltage  $V_{OUT}$  at a predetermined value.

- 1.13 The appellant has essentially argued that, in view of the teaching outlined above, document D6 taught away from implementing a feedback control, in particular from one which is based on the output voltage and the current at the output voltage.

More specifically, it was argued that there was no requirement for the switching controller in document D6

to have a feedback loop and that this was specifically omitted. The appellant further argued that the coupling between the switching controller of document D6 and the output voltage did nothing other than assuring that variations in the output current do not effect the operation of the switch and that such a coupling taught against the claimed subject-matter.

- 1.14 The board does not agree with the above argument. Nothing in document D6 suggests that control of the switch based on a feedback loop of output voltage and output current would have a negative effect on the switch control circuit 7. On the contrary, the purpose of document D6 is to separate the load current  $I_{DR}$  of the switch control circuit 7 from the output current  $I_{OUT}$  in order to prevent the load current  $I_{DR}$  of the switching controller from being added to the output current  $I_{OUT}$  with the result of increasing the output voltage  $V_{OUT}$ .
- 1.15 Contrary to the appellant's argument, this circumstance rather indicates that the output current is taken into account when controlling the switch 15. In particular, with the invention according to document D6, the current  $I_{OUT}$  at the output voltage  $V_{OUT}$  can be used precisely for a feedback loop because, even at low load consumption, the separation of the currents provides a "pure" output current  $I_{OUT}$  which can thus be used in a suitable manner in combination with the output voltage to control the switch.

Thus, document D6 does not teach away from the invention, but rather the skilled person recognises that the separation of the currents is particularly suitable for a feedback loop of both the output voltage and the current at the output voltage.

- 1.16 It should also be noted that the appellant has argued that document D6 does not disclose details of the switch control. In fact, the invention according to D6 relates essentially to the way in which the switching controller 7 is supplied with power.

The primary objective of a step-down converter is to provide a constant output voltage from a (variable) DC input voltage source. Therefore, the skilled person would aim for a switching of the FET adapted to the external conditions, in particular the load conditions and the input voltage in order to provide a constant output voltage.

- 1.17 An additional argument of the appellant was that document D6 relied on the input voltage and not on the output voltage  $V_{OUT}$ , which needed to be known in order to determine the pseudo duty cycle of the first inductor L. Since the appellant has not provided any evidence for their assertion based on document D6, i.e. that it is the input voltage that is taken into account when controlling the switch, the board does not consider this argument to be convincing.

- 1.18 In summary, the board sees nothing in the overall disclosure of D6 which would have prevented the skilled person from implementing the distinguishing feature, i.e. providing a DC switching controller 7 such that it is configured to control the switch 15 via a gate terminal of the FET based on the output voltage  $V_{OUT}$  and the current  $I_{OUT}$  at the output voltage.

- 1.19 On the contrary, in order to solve the objective technical problem, the person skilled in the art not only could but would have modified the step-down/buck

converter of document D6 in an obvious manner and thus arrived at the claimed subject-matter.

- 1.20 In the present case, the appellant's objection that the examining division did not provide proof of the alleged common general knowledge of the skilled person is irrelevant. In any event, the application itself acknowledges that it was known at the filing date of the application to use the relevant combination of current and voltage at the output for controlling the switch. Thus, as already set out in the board's communication, the skilled person starting from D6, figures 1 and 2 would also achieve the claimed configuration when combining this teaching with the prior art converter as described in the application.

More specifically, the application itself is based on a known buck converter, which is explicitly described to drive the switch based on the output voltage and output current. Reference is made to figure 1 and to page 1, lines 31 to 34 of the international publication WO 2007/018498 A1, which describes that converter as follows:

"The gate of the switch Q is driven by a switch controller 2, which turns the switch Q ON and OFF **depending on the voltage level of the output voltage  $V_{OUT}$**  compared to the desired or target output voltage  $V_{OUT}$  level. **Some other measurable quantity at the output, such as current, may be employed by the switch controller 2 alternatively or additionally.**" (emphasis added by the board)

It is therefore clear that the application itself is based on prior art comprising feedback control based on current and voltage at the output of the buck

converter, according to the distinguishing feature over document D6.

- 1.21 Against this background, the board has come to the conclusion that the application itself proves that the distinguishing feature was state of the art in the sense of Article 54(2) EPC at the filing date.
- 1.22 In order to solve the objective technical problem, i.e. to implement the switching controller in an appropriate manner, a person skilled in the art would have considered and implemented a combined control based on the output voltage and the current at the output voltage, as this is one of only a limited number of generally known ways of implementing the switching controller.
- 1.23 In the light of the foregoing, the board has arrived at the conclusion that the distinguishing feature was obvious to the person skilled in the art. The subject-matter of claim 1 therefore does not involve an inventive step within the meaning of Article 56 EPC. Hence, the board could not accede to the appellant's sole request.

**Order**

**For these reasons it is decided that:**

The appeal is dismissed.

The Registrar:

The Chairwoman:



U. Bultmann

J. Hoppe

Decision electronically authenticated