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**Datasheet for the decision  
of 3 May 2012**

**Case Number:** T 1795/08 - 3.5.02

**Application Number:** 00310183.9

**Publication Number:** 1104087

**IPC:** H02P 6/18

**Language of the proceedings:** EN

**Title of invention:**

Method and apparatus for controlling the supply of a dc motor  
for a disk drive to reduce acoustic noise

**Applicant:**

Texas Instruments Incorporated

**Opponent:**

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**Headword:**

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**Relevant legal provisions:**

EPC Art. 84, 123(2)

**Relevant legal provisions (EPC 1973):**

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**Keyword:**

"Clarity - no (main request and auxiliary request)"  
"Added subject-matter - yes (main request and auxiliary  
request)"

**Decisions cited:**

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**Catchword:**

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Case Number: T 1795/08 - 3.5.02

**D E C I S I O N**  
of the Technical Board of Appeal 3.5.02  
of 3 May 2012

**Appellant:**  
(Applicant)

Texas Instruments Incorporated  
7839 Churchill Way  
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Texas 75251 (US)

**Representative:**

Potter, Julian Mark  
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**Decision under appeal:**

Decision of the Examining Division of the  
European Patent Office posted 8 May 2008  
refusing European patent application  
No. 00310183.9 pursuant to Article 97(2) EPC.

**Composition of the Board:**

**Chairman:** M. Ruggiu  
**Members:** M. Rognoni  
P. Mühlens

## Summary of Facts and Submissions

- I. The appellant (applicant) appealed against the decision of the examining division refusing European patent application No. 00 310 183.9
- II. In the contested decision, the examining division came to the conclusion that the subject-matter of all claims then on file did not meet the requirements of Articles 83 and 84 EPC.
- III. With the statement of grounds of appeal, the appellant filed a set of amended claims 1 to 9.
- IV. In a communication dated 22 November 2011 summoning the appellant to oral proceedings, the Board raised some objections under Article 123(2) EPC and Article 84 EPC. Furthermore, the Board expressed the opinion that the application did not appear to contain subject-matter which could provide a basis for an allowable claim in the light of the following documents cited in the examination proceedings:  
  
D1: EP-A2-1 017 159  
D2: EP-A1-0 892 489.
- V. In response to the communication from the Board, the appellant filed with a letter dated 3 April 2012 two set of claims by way of main request and first auxiliary request, respectively.
- VI. In a further communication dated 17 April 2012, the Board informed the appellant that the new requests filed with letter dated 3 April 2012 still did not meet

- the requirements of Articles 84 and 123(2) EPC. Hence, it was not possible to grant a patent on the basis of the main request or of the auxiliary request.
- VII. On 2 May 2012, the representative of the appellant informed by telephone the registry of the Board, that they would not attend the oral proceedings.
- VIII. Oral proceedings were held as scheduled on 3 May 2012 in the absence of the appellant.
- IX. The appellant requested in writing that the decision under appeal be set aside and that a patent be granted on the basis of one of the main and first auxiliary requests, both filed with letter of 3 April 2012.
- X. Claim 1 according to the main request reads as follows:
- "A method for operating a polyphase dc motor (100), comprising the steps of:
- applying discontinuous sinusoidal drive voltages to the windings (102, 104, 106) of the motor in predetermined phases;
- detecting zero crossings of voltage in respective windings of the motor; and
- adjusting phases of the drive voltages to have zero crossings so as to have a substantially predetermined phase relationship with the detected zero crossings of the voltage in respective windings of the motor so a current of the respective windings and a back electromagnetic force of the respective windings are substantially in phase with each other;
- wherein said applying discontinuous sinusoidal drive voltages to the windings of the motor in

predetermined phases comprises applying a discontinuity of said detected zero crossings of voltage in respective windings of the motor, wherein said discontinuity has a fixed width of between one to four pulse width modulator cycles employed to apply said discontinuous sinusoidal drive voltages,

wherein calculating said discontinuity comprises:

a) receiving a logic value derived from a positive or negative voltage of an output of the first, second, and third phase drivers applied to the motor; and

b) employing a logical combination of those signals to drive one of a pair of current sources to drive an oscillator output,

c) wherein the oscillator output is logically combined to drive a pulse width modulator."

Claim 1 according to the first auxiliary request reads as follows:

"A method for operating a polyphase dc motor (100), comprising the steps of:

applying discontinuous sinusoidal drive voltages to the windings (102, 104, 106) of the motor in predetermined phases using one or more phase drivers;

pulse-width modulating the discontinuous sinusoidal motor drive voltages with a pulse width modulator prior to the application thereof to the windings;

detecting zero crossings of voltage in respective windings of the motor; and

adjusting phases of the drive voltages to have zero crossings so as to have a substantially predetermined phase relationship with the detected zero crossings of the voltage in respective windings of the

motor so a current of the respective windings and a back electromagnetic force of the respective windings are substantially in phase with each other;

wherein said applying discontinuous sinusoidal drive voltages to the windings of the motor in predetermined phases comprises applying a discontinuity to said detected zero crossings of voltage in respective windings of the motor, wherein said discontinuity has a predetermined fixed width corresponding to an integer number of pulse width modulator cycles, the integer number being from 1 to 4,

wherein applying said discontinuity comprises:

a) deriving a logic value from a positive or negative voltage of an output of the one or more phase drivers as applied to the motor;

b) generating a logical combination of the logic values so as to generate a drive signal to drive one of a pair of current sources (1010, 1042) to drive an oscillator output used in generation of the discontinuous sinusoidal drive voltages; and

c) wherein the oscillator output is logically combined with control signals to drive the pulse width modulator."

Both the main request and the first auxiliary request comprise further independent claims in different categories. However, such claims have no bearing of the outcome of the appeal.

XI. The Appellant submitted in writing the following arguments relevant to the decision:

In response to the summons to oral proceedings, claim 1 had been amended to specify that the drive voltages

were adjusted to have zero crossing so as to have a substantially pre-determined phase relationship with the detected zero crossing of the voltage in respective windings of the motor so a current of the respective winding and a back electromagnetic force of the respective winding were substantially in phase with each other.

Additionally, claim 1 had been amended to include details of the width of the discontinuity and how the discontinuity was calculated. Basis for these amendments could be found throughout the application as filed and at least at page 15, lines 9 to 19, and page 12, line 11 to page 14, line 26.

Some further details of the generation of the discontinuity had been added to the independent claims according to the first auxiliary request. Basis for the amendments could be found throughout the application as filed and at least at page 15, lines 9 to 19, and page 12, line 11 to page 14, line 26.

In summary, the claims as amended according to the main request or the first auxiliary request found clear basis in the application as filed and complied with the requirements of Article 84 EPC.

## **Reasons for the Decision**

1. The appeal is admissible.
- 2.1 It is pointed out at page 5, lines 12 to 23 of the application as originally filed, that, due "to the

*inductance of motor windings, such as illustrated in Figure 1, the drive voltages tend to lead the winding current in phase. The amount of lead of the phase depends on the value or magnitude of the inductance. The circuit of an embodiment of the present invention synchronizes the drive voltages so they have a specific or predetermined phase lead with respect to the back electromagnetic force (BEMF). If the phase lead is maintained in accordance with the predetermined phase lead, the winding current will essentially be in phase with the BEMF. The predetermined phase lead can be modified slightly to compensate for differences between the motor voltage observed during the high-impedance discontinuities and the actual back EMF of the motor" (emphasis added).*

2.2 Hence, the problem addressed in the present application consists essentially in driving a polyphase dc motor so that the current induced by the drive voltage in the windings has zero crossings essentially aligned with the zero crossings of the back electromagnetic force (BEMF) (see application, page 12, lines 17 to 19). This is achieved by maintaining a predetermined phase difference between the BEMF, which is indicative of the rotor's angular position with respect to the stator, and the drive voltage.

Main request

3.1 Claim 1 is directed to a method for operating a polyphase dc motor comprising the following steps:



- (a) applying discontinuous sinusoidal drive voltages to the windings of the motor in predetermined phases;
- (b) detecting zero crossings of voltage in respective windings of the motor;
- (c) adjusting phases of the drive voltages to have zero crossings
  - (c<sub>1</sub>) so as to have a substantially pre-determined phase relationship with the detected zero crossings of the voltage in respective windings of the motor
  - (c<sub>2</sub>) so a current of the respective windings and a back electromagnetic force of the respective windings are substantially in phase with each other;
- (d) wherein said applying discontinuous sinusoidal drive voltages to the windings of the motor in predetermined phases comprises
  - (d<sub>1</sub>) applying a discontinuity of said detected zero crossings of voltage in respective windings of the motor,
- (e) wherein said discontinuity has a fixed width of between one to four pulse width modulator cycles employed to apply said discontinuous sinusoidal drive voltages,

- (f) wherein calculating said discontinuity comprises:
  - a) receiving a logic value derived from a positive or negative voltage of an output of the first, second, and third phase drivers applied to the motor; and
  - b) employing a logical combination of those signals to drive one of a pair of current sources to drive an oscillator output,
  - c) wherein the oscillator output is logically combined to drive a pulse width modulator.

3.2 The wording of the claim does not show any link between the adjustment of the phases of the drive voltages (step (c)) and the application of discontinuous drive voltages to the windings (steps (a) and (d)). As to feature (d<sub>1</sub>), the meaning of the expression "*...comprises applying a discontinuity of said detected zero crossings...*" is obscure. In particular, neither the claim nor the description explains what could be meant by "*a discontinuity of said detected zero crossings*".

3.3 Step (f) appears to reflect some of the operations of the phase detector 440 shown in Figure 10 of the application. However, it is not clear what "*calculating said discontinuity*" should mean and, in particular, which parameter of the discontinuity should be "calculated".

- 3.4 As claim 1 does not specify in a clear manner the subject-matter for which protection is sought, it does not comply with Article 84 EPC.
- 4.1 For the sake of completeness it is further noted that according to the appellant features (e) and (f) included details of the width of the discontinuity and how the discontinuity was calculated which were disclosed throughout the application as filed and in particular at page 15, lines 9 to 19, and page 12, line 11 to page 14, line 26.
- 4.2 According to feature (e), the discontinuity has "*a fixed width of between one to four pulse width modulator cycles*". On page 15, lines 12 to 14 of the application as filed, it is specified that "*the user selects the width of the discontinuity by HIZ which selects a discontinuity width of 1, 2, 3 or 4 PWM cycles*". The expression "*one to four pulse width modulation cycles*" includes, however, not only integer values and thus extends beyond the content of the application as filed (Article 123(2) EPC).
- 4.3 As to the combination of steps for calculating a discontinuity according to feature (f), it may indeed reflect the operation of the particular phase detector shown in Figure 10. However, in the general form now claimed, feature (f) finds no direct and unambiguous support in the application as filed.
- 4.4 In summary, claim 1 according to the main request contains subject-matter which extends beyond the content of the application as originally filed and thus offends against Article 123(2) EPC.

First auxiliary request

5.1 Claim 1 according to the first auxiliary request differs from claim 1 of the main request in that it further comprises the step of *"pulse-width modulating the discontinuous sinusoidal motor drive voltages with a pulse width modulator prior to the application thereof to the windings"*.

Furthermore, claim 1 specifies that the discontinuity has a predetermined width *"corresponding to an integer number of pulse width modulator cycles, the integer number being from 1 to 4"* (cf. feature (e) of the main request).

5.2 Although feature (e) as amended according to the first auxiliary request, finds support on page 15, lines 12 to 14, it is disclosed in the application as filed in the context of a particular embodiment and not as generally applicable to all the embodiments covered by claim 1. This generalization of the applicability of this feature does not comply with Article 123(2) EPC.

5.3 As to feature (f), its wording has been amended by replacing "calculating" with "applying", "receiving a logic value derived from" with "deriving a logic value from" and "employing a logical combination of those signals to drive" with "generating a logical combination of the logic values so as to generate a drive signal to drive".

Apart from the fact that these amendments fail to specify any link between the application of

discontinuous sinusoidal drive voltages to the motor windings and the step of adjusting the phases of the drive voltages (Article 84 EPC), feature (f) according to the first auxiliary request reflects only some of the steps which would be necessary for defining the operation of the particular phase detector shown in Figure 10. It is thus an arbitrary generalisation of the subject-matter disclosed in the application as filed (cf. Article 123(2) EPC).

5.4 Hence, as far as the requirements of Articles 84 and 123(2) EPC are concerned, the first auxiliary request shows essentially the same deficiencies as the main request.

6. In the result, the Board comes to the conclusion that none of the appellant's requests is allowable. Consequently the application has to be refused.

## **Order**

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

The appeal is dismissed.

The Registrar:

The Chairman:

U. Bultmann

M. Ruggiu