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- (81) **Designated States** (*unless otherwise indicated, for every kind of national protection available*): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR,

KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

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**Declarations under Rule 4.17:**

- *as to applicant's entitlement to apply for and be granted a patent (Rule 4.1 7(H))*
- *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.1 7(in))*

**Published:**

- *with international search report (Art. 21(3))*
- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

[Continued on next page]

(54) **Title:** METHOD AND SYSTEM FOR DETERMINING THE POSITION OF A SYNCHRONOUS MOTOR'S ROTOR

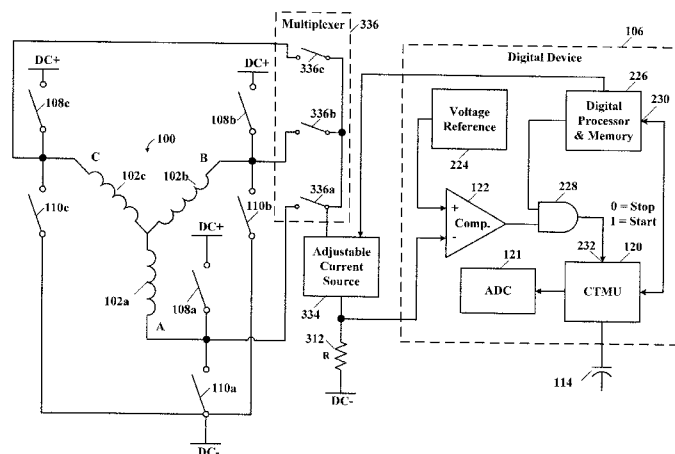


FIGURE 3

(57) **Abstract:** To establish an initial/resting position of a permanent magnet rotor, all motor stator windings are stimulated (voltage applied thereto) in sequence, the time it takes for current in the stimulated stator winding to rise to a specific current value is measured for each stator winding and these time measurement results processed. From the measured time results rotor position to within 60 degrees is determined and the position sector is known prior to starting/rotating the motor. Once the rotor position is known, the next commutation point in a six step sequence is known before actually starting/rotating the motor. Position measurement winding stimulation may be interleaved with commutation pulses, or the unexcited stator winding may be stimulated between commutation pulses to the other two excited stator, wherein one of the two stator windings remains connected to the power and provides a current return path to the unexcited but stimulated stator winding.

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**INTERNATIONAL SEARCH REPORT**

International application No  
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A. CLASSIFICATION OF SUBJECT MATTER  
**INV. H02P6/18**  
 ADD.  
 According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED  
 Minimum documentation searched (classification system followed by classification symbols)  
**H02P**

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
**EPO-Internal , WPI Data**

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 1 983 644 A2 (MELEXIS MICROELECTRONIC INTEGRATED SYSTE) 22 October 2008 (2008-10-22)	1-3 ,8,9 , 16-23 ,45
Y	paragraph [0017] - paragraph [0020] ; figure 1 paragraph [0001] - paragraph [0002] ----- -/--	6, 10-15 , 44

Further documents are listed in the continuation of Box C.

See patent family annex.

\* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

6 July 2015

Date of mailing of the international search report

21/09/2015

Name and mailing address of the ISA/

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# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US2014/017247

## Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1.  Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
  
2.  Claims Nos.:  
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
  
3.  Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1.  As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
  
2.  As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
  
3.  As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos. :
  
4.  No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos. :  
  
1-25 , 44, 45

### Remark on Protest

- The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No  
PCT/US2014/017247

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	<p>Padmaraja Yedamale ET AL: "See What You Can Do with the CTMU AN 1375", Application Notes, 11 May 2011 (2011-05-11), XP055047211, Internet</p> <p>Retrieved from the Internet: URL: <a href="http://www.microchip.com/downloads/en/AppNotes/CTMU_01375a.pdf">http://www.microchip.com/downloads/en/AppNotes/CTMU_01375a.pdf</a> [retrieved on 2012-12-10]</p> <p>abstract page 4; figure 4 page 3; figure 3</p> <p style="text-align: center;">-----</p>	10-15, 44
Y	<p>US 2004/113576 A1 (HEIDRICH TORSTEN [DE]) 17 June 2004 (2004-06-17) paragraph [0022]; figure 4</p> <p style="text-align: center;">-----</p>	6

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2014/017247

Patent document cited in search report	Publication date	Patent family member(s)	Publication date	
EP 1983644	A2	22-10-2008	EP 1983644 A2	22-10-2008
			US 2009108783 AI	30-04-2009
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US 2004113576	AI	17-06-2004	DE 10162380 AI	03-07-2003
			EP 1459436 A2	22-09-2004
			JP 4673553 B2	20-04-2011
			JP 2005513986 A	12-05-2005
			US 2004113576 AI	17-06-2004
			W0 03052919 A2	26-06-2003
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## FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

## 1. claims: 1-25, 44, 45

A method for determining a rotor position in a synchronous three phase motor, said method comprising the steps of: coupling combinations of two of three stator windings to a first voltage; coupling third ones of the three stator windings to a second voltage; measuring first times for currents through all combinations of the three stator windings to equal a reference current; and determining a rotor position from the measured first times .

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## 2. claims: 26-43, 46-49

A method for determining a rotor position in a synchronous three phase motor, said method comprising the steps of: coupling first ones of three stator windings to a first voltage; coupling second ones of the three stator windings to a second voltage; injecting first currents from the first voltage into third ones of the three stator windings when the first ones of three stator windings are not coupled to the first voltage and the second ones of the three stator windings remain coupled to the second voltage; measuring first times for the first currents to equal a reference current; and determining a rotor position from the measured first times .

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