

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

PCT

**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**
(PCT Rule 43*bis*.1)

To:

see form PCT/ISA/220

Date of mailing
(day/month/year) see form PCT/ISA/210 (second sheet)

Applicant's or agent's file reference
see form PCT/ISA/220

FOR FURTHER ACTION
See paragraph 2 below

International application No.
PCT/US2017/050861

International filing date (day/month/year)
09.09.2017

Priority date (day/month/year)
02.12.2016

International Patent Classification (IPC) or both national classification and IPC
INV. G11C16/34 G11C16/16

Applicant
SANDISK TECHNOLOGIES LLC

1. This opinion contains indications relating to the following items:

- Box No. I Basis of the opinion
- Box No. II Priority
- Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- Box No. IV Lack of unity of invention
- Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- Box No. VI Certain documents cited
- Box No. VII Certain defects in the international application
- Box No. VIII Certain observations on the international application

2. FURTHER ACTION

If a demand for international preliminary examination is made, this opinion will usually be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA:



European Patent Office
P.B. 5818 Patentlaan 2
NL-2280 HV Rijswijk - Pays Bas
Tel. +31 70 340 - 2040
Fax: +31 70 340 - 3016


Date of completion of this opinion

see form
PCT/ISA/210

Authorized Officer

Knack, Steffen

Telephone No. +31 70 340-0



Box No. I Basis of the opinion

1. With regard to the **language**, this opinion has been established on the basis of:
 - the international application in the language in which it was filed.
 - a translation of the international application into , which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1 (b)).
2. This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43bis.1(a))
3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing:
 - a. forming part of the international application as filed:
 - in the form of an Annex C/ST.25 text file.
 - on paper or in the form of an image file.
 - b. furnished together with the international application under PCT Rule 13ter.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.
 - c. furnished subsequent to the international filing date for the purposes of international search only:
 - in the form of an Annex C/ST.25 text file (Rule 13ter.1(a)).
 - on paper or in the form of an image file (Rule 13ter.1(b) and Administrative Instructions, Section 713).
4. In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
5. Additional comments:

Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	<u>1-15</u>
	No: Claims	
Inventive step (IS)	Yes: Claims	<u>1-15</u>
	No: Claims	
Industrial applicability (IA)	Yes: Claims	<u>1-15</u>
	No: Claims	

2. Citations and explanations

see separate sheet

Box No. VII Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

see separate sheet

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1 Reference is made to the following documents:

D1 US 9 343 171 B1 (SUN YONGKE [US] ET AL) 17 May 2016
(2016-05-17)

D2 US 2014/160846 A1 (LEE JUN HYUK [KR] ET AL) 12 June 2014
(2014-06-12)

2 Independent Claims 1 and 12

Document D1 is regarded as being the prior art closest to the subject-matter of claim 1 and discloses (the references in parentheses referring to this document):

An apparatus (figure 1A), comprising:
a plurality of blocks (figure 1A (BLK0, BLK1)) of memory cells, the memory cells are arranged in strings (figure 11 (NS0A, NS0A-1)), each string comprising a source end (figure 11 (SGS1)), a drain end (figure 1 (SGD1_NS0)), a channel (figure 11 (ch_NS0A)) extending between the source end and the drain end, and a select gate transistor at the source end (figure 11 (SGS1));
a voltage source (figure 1B (112)) which comprises a pass gate and which provides a select gate voltage (column 18, lines 12-24);
a voltage source which provides a source end voltage (column 18, lines 21-24); and
a control circuit (figure 1B (122)), the control circuit configured to, in an erase operation for a selected block among the plurality of blocks, connect the select gate voltage (figure 1A (Vsg_er)) to the select gate transistors and connect the source end voltage (figure 10 A (Verase)) to the source ends to charge up the channel of each string of the selected block, wherein each select gate transistor has a positive channel-to-control-gate voltage (figure 10B (Vch)).

The subject-matter of claim 1 therefore differs from this known apparatus in that

a magnitude of the source end voltage minus the select gate voltage is based on an increasing function of a distance of the selected block from the pass gate.

During erase a transient coupling of the select gate voltage can be observed due to charging up of the channel. The coupling is discharged via the pass gate of the voltage source. This discharge time will be longer for blocks that are farther away from the voltage source. Without compensation the farther blocks will experience a shallower erase.

The solution proposed in claim 1 of the present application can be considered to involve an inventive step (Article 33(3) PCT), as there is no hint to this solution to be found in the state of the art. Document D2 (c.f. paragraphs [0049] -[0050]) discloses a scheme for compensating for the different distances of blocks to the read/write circuits. But as this regards the bit line pre-charge during read or write operations, the skilled person would not be prompted to adapt this scheme to the current technical problem regarding the transient coupling during an erase operation.

The problem to be solved by the present invention may therefore be regarded as providing a memory equalizes erase depth in different memory blocks by compensating for the transient coupling effect.

A similar reasoning applies to related method claim 12.

3 **Dependent Claims 2-11 and 13-15**

Claims 2-11 and 13-15 are dependent on claims 1 and 12, respectively, and as such also meet the requirements of the PCT with respect to novelty and inventive step.

Re Item VII

Certain defects in the international application

- 1 Independent claim is not in the two-part form in accordance with Rule 6.3(b) PCT, which in the present case would be appropriate, with those features known in combination from the prior art document D1 being placed in the preamble (Rule 6.3(b)(i) PCT) and the remaining features being included in the characterising part (Rule 6.3(b)(ii) PCT).

- 2 Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in documents D1 and D2 is not mentioned in the description, nor are these documents identified therein.

- 3 The application does not meet the requirements of Article 6 PCT, because claim 8 is not clear: The magnitude mentioned in claim 8 is not defined.

- 4 In claim 9, line 4, the word "voltage" appears to be missing behind "select gate".