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Declarations under Rule 4.17:

- as to applicant's entitlement to apply for and be granted a
 patent (Rule 4.17(ii))
- as to the applicant's entitlement to claim the priority of the
 earlier application (Rule 4.17(iii))

Published:

- with international search report (Art. 21(3))

[Continued on next page]

(54) Title: INTEGRATED CIRCUIT DEVICE FEATURING AN ANTIFUSE AND METHOD OF MAKING SAME

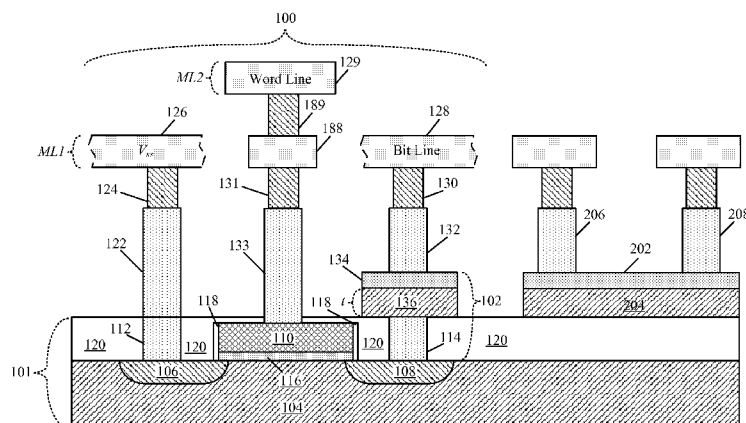


FIG. 2

(57) Abstract: An integrated circuit, e.g. an OTP or MTP memory circuit, comprises an access transistor (10) and an antifuse (102). The access transistor includes at least one source/drain region (106, 08), and the antifuse has a conductor-insulator-conductor structure. The antifuse includes a first conductor that acts as a first electrode (134), and also includes an antifuse dielectric (136), and a second conductor (114, 304). A first surface of the first electrode is coupled to a first surface of the antifuse dielectric, a second surface of the antifuse dielectric is coupled to a first surface of the second conductor. The second conductor is electrically coupled to the access transistor's source/drain region. The antifuse is adapted to transition from an open circuit state to a closed circuit state if a programming voltage V_{pp} greater than or equal to an antifuse dielectric breakdown voltage is applied between the first electrode and the second conductor. A resistor (202) can also be provided and is formed from the same layer as the first electrode (134) of the antifuse. The resistor is located on an insulating layer (204) that is made from the same layer as the antifuse dielectric,



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- *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))* (88) **Date of publication of the international search report:**
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INTERNATIONAL SEARCH REPORT

International application No
PCT/US2013/048088

A. CLASSIFICATION OF SUBJECT MATTER
INV. H01L27/112 G11C17/16 H01L23/522 H01L23/525 H01L49/02
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)
H01L

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	US 2010/001330 A1 (CHIEN WEI-CHIH [TW] ET AL) 7 January 2010 (2010-01-07)	1-12, 16-19, 21-29, 33-42
A	paragraphs [0005], [0019] - [0024], [0029] - [0031]; figure 1	13-15, 20, 30-32, 43
X	----- WO 2006/126110 A1 (KONINKL PHILIPS ELECTRONICS NV [NL]; VAN DER SLUIS PAUL [NL]; MIJIRITS) 30 November 2006 (2006-11-30)	1-12, 16, 18, 19, 21-23, 25-29, 33-42
A	page 1, line 16 - page 8, line 5; figures 1-6 ----- -/-	13-15, 17, 20, 30-32, 43



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

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2013/048088

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.:

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/US2013/048088

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2006/097325 A1 (YANG CHING-SUNG [TW] ET AL) 11 May 2006 (2006-05-11)	1-12,16, 18,19, 21-29, 33-42
A	paragraphs [0012] - [0018], [0037] - [0043], [0055] - [0059]; figures 2A,5	13-15, 17,20, 30-32,43
X	----- US 2004/087098 A1 (NG CHIT HWEI [SG] ET AL) 6 May 2004 (2004-05-06) paragraphs [0027] - [0054]; figures 1-16 -----	1-43

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2013/048088

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
US 2010001330	A1	07-01-2010	CN	101621034 A	06-01-2010
			CN	103094215 A	08-05-2013
			TW	201003853 A	16-01-2010
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			US	2004087098 A1	06-05-2004

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

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

1. claims: 1-12, 16-19, 21-29, 33-42

PROM comprising a transistor and an antifuse

2. claims: 13-15, 20, 30-32, 43

PROM integrated with a resistor
