

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
13 September 2007 (13.09.2007)

PCT

(10) International Publication Number
WO 2007/102885 A3

(51) International Patent Classification:
G11B 5/33 (2006.01)

(74) Agents: **KING, Robert L.** et al.; 7700 W. Parmer Lane,
MD:PL02, Austin, Texas 78729 (US).

(21) International Application Number:
PCT/US2006/060208

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(22) International Filing Date: 25 October 2006 (25.10.2006)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
11/262,064 28 October 2005 (28.10.2005) US

(71) Applicant (for all designated States except US):
FREESCALE SEMICONDUCTOR INC. [US/US];
6501 William Cannon Drive West, Austin, Texas 78735 (US).

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

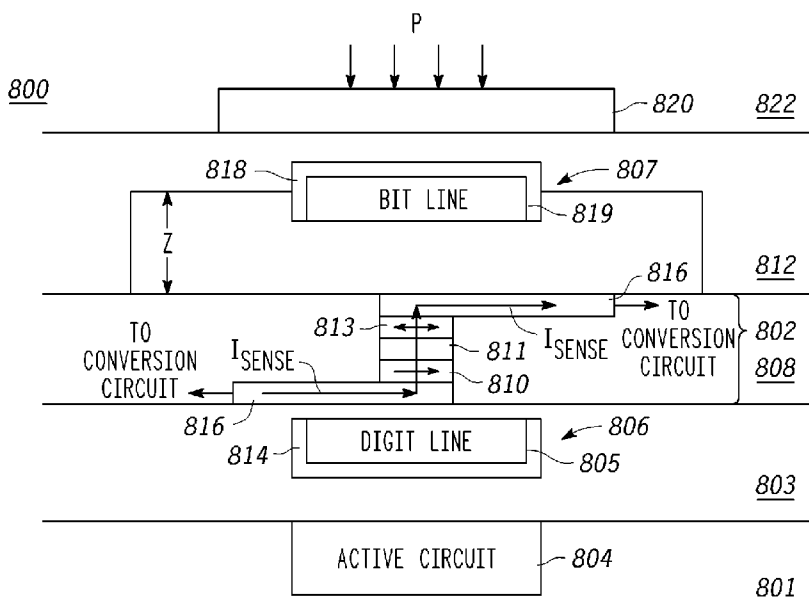
(72) Inventors; and

(75) Inventors/Applicants (for US only): **CHUNG, Young Sir** [KR/US]; 1283 E. Saragosa Street, Chandler, Arizona 85225 (US). **BAIRD, Robert W.** [US/US]; 1218 N. Sailors Way, Gilbert, Arizona 85234 (US). **ENGEL, Bradley N.** [US/US]; 5651 W. Gail Drive, Chandler, Arizona 85226 (US).

Published:
— with international search report

[Continued on next page]

(54) Title: MAGNETIC TUNNEL JUNCTION PRESSURE SENSORS AND METHODS



(57) Abstract: An integrated circuit device (800) is provided which comprises a substrate (801), a conductive line (807) configured to experience a pressure, and a magnetic tunnel junction ("MTJ") core (802) formed between the substrate and the current line. The conductive line (807) is configured to move in response to the pressure, and carries a current which generates a magnetic field. The MTJ core (802) has a resistance value which varies based on the magnetic field. The resistance of the MTJ core (802) therefore varies with respect to changes in the pressure. The MTJ core (802) is configured to produce an electrical output signal which varies as a function of the pressure.

WO 2007/102885 A3



— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

(88) Date of publication of the international search report:
17 April 2008

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 06/60208

<p>A. CLASSIFICATION OF SUBJECT MATTER IPC(8) - G11B 5/33 (2007.10) USPC - 360/324.2 According to International Patent Classification (IPC) or to both national classification and IPC</p>														
<p>B. FIELDS SEARCHED</p> <p>Minimum documentation searched (classification system followed by classification symbols) IPC(8)- G11B 5/3 (2007.10) USPC- 360/324.2</p> <p>Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched USPC- 428/815; 438/3, 48 (search terms below)</p> <p>Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) PubWest (USPT, PG, PB, EPAB, JPAB); DialogPRO (Engineering); Google Scholar, IEEE Explore Search Terms Used: magnetic tunnel junction, insulating layer, cavity, pressure sensor</p>														
<p>C. DOCUMENTS CONSIDERED TO BE RELEVANT</p> <table border="1"> <thead> <tr> <th>Category*</th> <th>Citation of document, with indication, where appropriate, of the relevant passages</th> <th>Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>Y</td> <td>US 2004/0185675 A1 (Lu et al.) 23 September 2004 (23.09.2004) (para [0017], [0034])</td> <td>1-13</td> </tr> <tr> <td>Y</td> <td>US 2005/0199072 A1 (Ganapathi) 15 September 2005 (15.09.2005) (para [0022], [0030], [0033], [0037], [0040-0042], [0046], [0049], [0051], [0055],[0060])</td> <td>1-13</td> </tr> <tr> <td>A</td> <td>Roehr et al. Memories of Tomorrow. IEEE Circuits & Devices Magazine, September 2002 (entire document)</td> <td>1-13</td> </tr> </tbody> </table>			Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	Y	US 2004/0185675 A1 (Lu et al.) 23 September 2004 (23.09.2004) (para [0017], [0034])	1-13	Y	US 2005/0199072 A1 (Ganapathi) 15 September 2005 (15.09.2005) (para [0022], [0030], [0033], [0037], [0040-0042], [0046], [0049], [0051], [0055],[0060])	1-13	A	Roehr et al. Memories of Tomorrow. IEEE Circuits & Devices Magazine, September 2002 (entire document)	1-13
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.												
Y	US 2004/0185675 A1 (Lu et al.) 23 September 2004 (23.09.2004) (para [0017], [0034])	1-13												
Y	US 2005/0199072 A1 (Ganapathi) 15 September 2005 (15.09.2005) (para [0022], [0030], [0033], [0037], [0040-0042], [0046], [0049], [0051], [0055],[0060])	1-13												
A	Roehr et al. Memories of Tomorrow. IEEE Circuits & Devices Magazine, September 2002 (entire document)	1-13												
<p><input type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/></p>														
<p>* Special categories of cited documents:</p> <table border="0"> <tr> <td>"A" document defining the general state of the art which is not considered to be of particular relevance</td> <td>"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</td> </tr> <tr> <td>"E" earlier application or patent but published on or after the international filing date</td> <td>"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</td> </tr> <tr> <td>"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)</td> <td>"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</td> </tr> <tr> <td>"O" document referring to an oral disclosure, use, exhibition or other means</td> <td>"&" document member of the same patent family</td> </tr> <tr> <td>"P" document published prior to the international filing date but later than the priority date claimed</td> <td></td> </tr> </table>			"A" document defining the general state of the art which is not considered to be of particular relevance	"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	"E" earlier application or patent but published on or after the international filing date	"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	"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)	"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	"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family	"P" document published prior to the international filing date but later than the priority date claimed			
"A" document defining the general state of the art which is not considered to be of particular relevance	"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													
"E" earlier application or patent but published on or after the international filing date	"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													
"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)	"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													
"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family													
"P" document published prior to the international filing date but later than the priority date claimed														
<p>Date of the actual completion of the international search 31 October 2007 (13.10.2007)</p>		<p>Date of mailing of the international search report 26 FEB 2008</p>												
<p>Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201</p>		<p>Authorized officer: <i>Lee W. Young</i> Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774</p>												