



- (51) **International Patent Classification:**
H01L 21/8238 (2006.01)
- (21) **International Application Number:**
PCT/US20 12/059007
- (22) **International Filing Date:**
5 October 2012 (05.10.2012)
- (25) **Filing Language:** English
- (26) **Publication Language:** English
- (30) **Priority Data:**
13/269,367 7 October 2011 (07.10.2011) US
- (71) **Applicant:** TRANSPHORM INC. [US/US]; 115 Castillian Drive, Goleta, California 93117 (US).
- (72) **Inventors:** LAL, Rakesh K.; 115 Castillian Drive, Goleta, California 93117 (US). COFFIE, Robert; 115 Castillian Drive, Goleta, California 93117 (US). WU, Yifeng; 528 Fireside Lane, Goleta, California 93117 (US). PARIKH, Primit; 115 Castillian Drive, Goleta, California 93117 (US). DORA, Yuvaraj; 115 Castillian Drive, Goleta, California 93117 (US). MISHRA, Umesh; 115 Castillian Drive, Goleta, California 93117 (US). CHOWDHURY, Srabanti; 115 Castillian Drive, Goleta, California 93117 (US). FICHTENBAUM, Nicholas; 35 Romaine Dr. # B, Santa Barbara, California 93105 (US).
- (74) **Agents:** BROWNING, Matthew E. et al; Fish & Richardson P.C., P.O. Box 1022, Minneapolis, Minnesota 55440-1022 (US).

- (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, IS, JP, KE, KG, KM, 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, 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.
- (84) **Designated States** (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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))

- (88) **Date of publication of the international search report:**
6 June 2013

(54) **Title:** HIGH POWER SEMICONDUCTOR ELECTRONIC COMPONENTS WITH INCREASED RELIABILITY

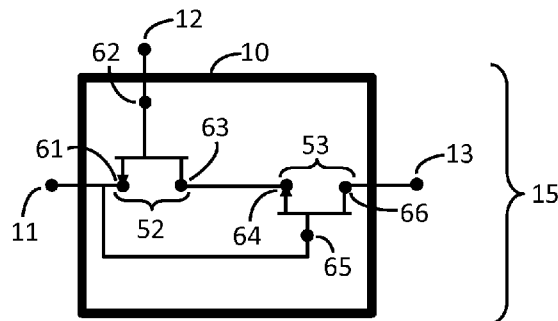


Figure 4A

(57) **Abstract:** An electronic component includes a depletion-mode transistor, an enhancement-mode transistor, and a resistor. The depletion-mode transistor has a higher breakdown voltage than the enhancement-mode transistor. A first terminal of the resistor is electrically connected to a source of the enhancement-mode transistor, and a second terminal of the resistor and a source of the depletion-mode transistor are each electrically connected to a drain of the enhancement-mode transistor. A gate of the depletion-mode transistor can be electrically connected to a source of the enhancement-mode transistor.

WO 2013/052833 A3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2012/059007**A. CLASSIFICATION OF SUBJECT MATTER****HOIL 21/8238(2006.01)i**

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)

HOIL 21/8238; H03K 5/12; H03K 17/16; H03K 19/094; H03K 17/687; HOIL 29/78; G11C 11/40; H03K 19/003; H03K 19/0948; H01L 29/872

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

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & Keywords: depletion-mode, enhancement-mode, breakdown, resistor

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5051618 A (PERRY w. LOU) 24 September 1991 See column 1, line 34-column 4, line 2, claims 1-3 and figure 1.	1-85
A	WO 2005-036749 A1 (SEMICONDUCTOR COMPONENTS INDUSTRIES L.L.C. et al.) 21 April 2005 See abstract, pages 3-5, 11, claims 1-3 and figures 1-2.	1-85
A	KR 10-2011-0033584 A (SAMSUNG ELECTRO-MECHANICS CO., LTD.) 31 March 2011 See abstract, paragraphs [0033]-[0048], claim 1 and figures 1-2b.	1-85
A	US 2003-0030484 A1 (SUNG-MO RANG et al.) 13 February 2003 See abstract, paragraphs [0006]-[0057], claims 1-3 and figures 1-9.	1-85
A	US 4532439 A (HIDEHARU KOIKE) 30 July 1985 See abstract, column 2, line 34-column 4, line 42 and figure 4.	1-85

 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 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

25 MARCH 2013 (25.03.2013)

Date of mailing of the international search report

26 MARCH 2013 (26.03.2013)

Name and mailing address of the ISA/KR

Korean Intellectual Property Office
189 Cheongsu-ro, Seo-gu, Daejeon Metropolitan
City, 302-701, Republic of Korea

Facsimile No. 82-42-472-7140

Authorized officer

CHOI, Sang Won

Telephone No. 82-42-481-8291



INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2012/059007

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 505 16 18 A	24 .09 . 199 1	None	
Wo 2005-036749 A1	2 1 .04 .2005	US 2005-0068068 A1 US 69305 17 B2	3 1 .03 ,2005 16 .08 ,2005
KR 10-20 11-0033584 A	3 1 .03 .20 11	None	
US 2003-0030484 A1	13 .02 .2003	US 2004-01 13672 A1 US 2005-0190633 A1 US 6693484 B2 US 6900690 B2 US 6946901 B2 US 7 190209 B2	17 .06 ,2004 0 1 .09 ,2005 17 .02 ,2004 3 1 .05 ,2005 20 .09 ,2005 13 .03 ,2007
US 4532439 A	30 .07 . 1985	EP 0 103236 A2 EP 0 103236 A3 EP 0 103236 B1 JP 59-049020 A	2 1 .03 , 1984 25 .02 , 1987 04 . 0 1 , 1989 2 1 .03 , 1984