

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
26 August 2010 (26.08.2010)

(10) International Publication Number  
**WO 2010/096705 A3**

- (51) **International Patent Classification:**  
*H03F 3/217* (2006.01)
- (21) **International Application Number:**  
PCT/US2010/024805
- (22) **International Filing Date:**  
19 February 2010 (19.02.2010)
- (25) **Filing Language:** English
- (26) **Publication Language:** English
- (30) **Priority Data:**  
12/390,333 20 February 2009 (20.02.2009) US
- (71) **Applicant (for all designated States except US):**  
**CONEXANT SYSTEMS, INC.** [US/US]; 4000  
Macarthur Blvd., Newport Beach, CA 92660 (US).
- (72) **Inventors; and**
- (75) **Inventors/Applicants (for US only):** **CRESPI, Lorenzo**  
[IT/US]; 3488 Queens Court, Costa Mesa, CA 92626  
(US). **PATEL, Ketan, B.** [US/US]; 26172 Owl Court,  
Lake Forest, CA 92630 (US).
- (74) **Agents:** **LU, Haw-minn** et al.; Conexant Systems, Inc. -  
IP Legal Department, 4000 Macarthur Blvd., Newport  
Beach, CA 92660 (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, 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, PE, PG, PH, PL, PT, RO, RS, RU, 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, 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, HR, HU, IE, IS, IT, LT, LU, LV,  
MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, SM,  
TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,  
ML, MR, NE, SN, TD, TG).

**Declarations under Rule 4.17:**

— as to the identity of the inventor (Rule 4.17(i))

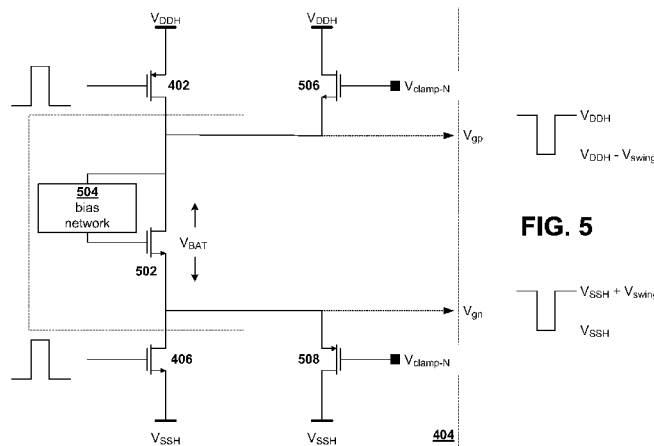
**Published:**

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

(88) **Date of publication of the international search report:**

27 January 2011

(54) **Title:** SYSTEMS AND METHODS FOR DRIVING HIGH POWER STAGES USING LOWER VOLTAGE PROCESSES



**FIG. 5**

(57) **Abstract:** In today's environment class-D amplifiers are used to provide an integrated solution for applications such as powered audio devices due to their advantages in power consumption and size over more traditional analog amplifiers. Due to power output requirements, the output stages of power drivers such as class-D amplifiers require a supply voltage in excess of the technologically allowed voltage for the switches in the output stage. A level shifter is used to ensure voltages supplied to the output switches do not exceed the technological limits. An ideal level shifter should provide the optimal voltage swing to output switches under all process, supply voltage and temperature (PVT) variations. The ideal level shifter should also provide fast transitions when the control signal changes from high to low and low to high.

WO 2010/096705 A3

**A. CLASSIFICATION OF SUBJECT MATTER****H03F 3/217(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)

H03F 3/217; H03K 19/0175; H03L 5/00; H03K 19/094; G11C 5/14

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) &amp; Keywords:level shifter,class D amplifier,pull-down,pull-up,control signal,bias network,high supply voltage,low supply voltage,clamping transistor,current source,battery transistor

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	US 2005-0017755 A1 (CHIANG CHIA-LIANG) 27 January 2005 See Fig.2, claims 1-18	1-6, 15 7-14, 16-21
Y A	US 6285233 B1 (RIBELLINO; CALOGERO et al.) 04 September 2001 See Fig.3, claims 1-19	1-6, 15 7-14, 16-21
A	US 6184716 B1 (DEPETRO; RICCARDO et al.) 06 February 2001 See Fig.4, claims 1-20	1-21
A	WO 2005-078729 A2 (KONINKLIJKE PHILIPS ELECTRONICS N.V. et al.) 25 August 2005 See Fig.8, claims 1-14	1-21

 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

"&amp;" document member of the same patent family

Date of the actual completion of the international search

28 SEPTEMBER 2010 (28.09.2010)

Date of mailing of the international search report

**28 SEPTEMBER 2010 (28.09.2010)**

Name and mailing address of the ISA/KR

Korean Intellectual Property Office  
Government Complex-Daejeon, 139 Seonsa-ro, Seo-gu, Daejeon 302-701, Republic of Korea

Facsimile No. 82-42-472-7140

Authorized officer

JUNG, BYEONG HONG

Telephone No. 82-42-481-5752



**INTERNATIONAL SEARCH REPORT**

Information on patent family members

International application No.

**PCT/US2010/024805**

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2005-0017755 A1	27.01.2005	TW 223921 A	11.11.2004
		TW 223921 B	11.11.2004
		US 6963226 B2	08.11.2005
US 6285233 B1	04.09.2001	DE 69825755 D1	23.09.2004
		EP 0999644 A1	10.05.2000
		EP 0999644 B1	18.08.2004
US 6184716 B1	06.02.2001	DE 69731088 D1	11.11.2004
		EP 0913925 A1	06.05.1999
		EP 0913925 B1	06.10.2004
		JP 11-205122 A	30.07.1999
WO 2005-078729 A2	25.08.2005	AT 417348 T	15.12.2008
		CN 1918659 A	21.02.2007
		DE 602005011574 D1	22.01.2009
		EP 1714286 A2	25.10.2006
		EP 1714286 B1	10.12.2008
		JP 2007-524181 A	23.08.2007
		JP 2007-524181 T	23.08.2007
		KR 10-2006-0114008 A	03.11.2006
		KR20060114008A	03.11.2006
		KR20060114008A	03.11.2006
		US 2007-0170958 A1	26.07.2007
		US 7746125 B2	29.06.2010
		WO 2005-078729 A3	16.02.2006
WO 2005-078729 A3	25.08.2005		