



- (51) **International Patent Classification:**  
*H03K 17/16* (2006.01)    *H03K 19/003* (2006.01)  
*H03K 17/081* (2006.01)    *G05F 3/26* (2006.01)
- (21) **International Application Number:**  
PCT/US2011/035474
- (22) **International Filing Date:**  
6 May 2011 (06.05.2011)
- (25) **Filing Language:** English
- (26) **Publication Language:** English
- (30) **Priority Data:**  
12/789,005    27 May 2010 (27.05.2010)    US
- (71) **Applicant (for all designated States except US):** **Standard Microsystems Corporation** [US/US]; 80 Arkay Drive, Hauppauge, New York 11788 (US).
- (72) **Inventor; and**
- (75) **Inventor/Applicant (for US only):** **ILLEGEMS, Paul F.** [NL/US]; 5240 E. Camino Apolena, Tucson, Arizona 85718 (US).
- (74) **Agent:** **Meyertons, Hood, Kivlin, Kowert & Goetzel, P.C.;** HOOD, Jeffrey C., P.O. Box 398, Austin, Texas 78767-0398 (US).

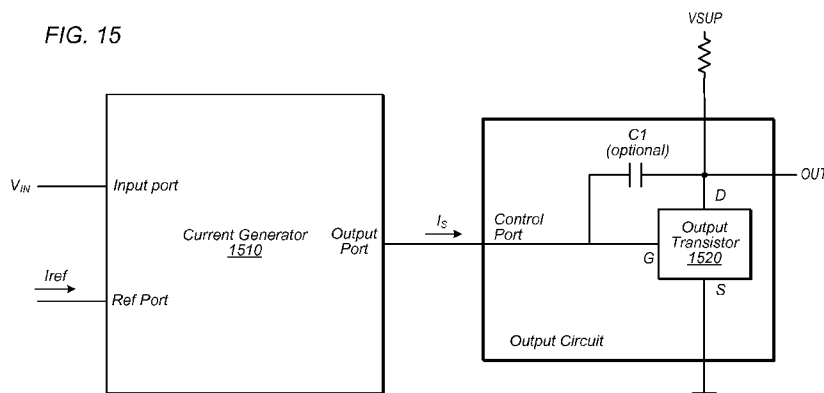
- (81) **Designated States (unless otherwise indicated, for every kind of national protection available):** AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, 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, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, 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))

- (88) **Date of publication of the international search report:**  
2 August 2012

(54) **Title:** DRIVER WITH ACCURATELY CONTROLLED SLEW RATE AND LIMITED CURRENT



(57) **Abstract:** A driver circuit, that provides slew rate control of its output voltage, including a current generator, an output transistor, and optionally, a capacitor. The current generator has an input port, an output port and reference port. The output port couples to the gate of the output transistor. The capacitor couples between the gate and drain of the output transistor. The current generator controls a current  $I_s$  flowing through the output port based on an input voltage at the input port. The current generator limits the absolute value of the current  $I_s$  to be less than or equal to a maximum determined by a reference current  $I_{ref}$  provided at the reference port. Modifications may be made to the driver circuit to limit the output current (e.g., as a function of the output voltage) and to make the slew rate limit independent of the gate-drain capacitance of the output transistor.

WO 2011/149632 A3

**INTERNATIONAL SEARCH REPORT**

International application No  
PCT/US2011/035474

**A. CLASSIFICATION OF SUBJECT MATTER**  
 INV. H03K17/16 H03K17/081 H03K19/003 G05F3/26  
 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)  
 H03K G05F

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 practical, 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 Y A	US 2004/135528 A1 (YASOHARA MASAHIRO [JP] ET AL) 15 July 2004 (2004-07-15) the whole document	1,13,18, 21-23 1,2,19, 20 14-17
X Y A	----- US 4 791 326 A (VAJDIC BRANISLAV [US] ET AL) 13 December 1988 (1988-12-13) column 6, line 50 - column 8, line 37; figures 7,8	14-17 1,2,19, 20 18
X A	----- US 2002/005743 A1 (TANAKA KENICHI [JP]) 17 January 2002 (2002-01-17) paragraph [0020] - paragraph [0067]; figures 2,4	14-17 1,2, 18-20
	----- -/--	

Further documents are listed in the continuation of Box C.

See patent family annex.

\* Special categories of cited documents :

<p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"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)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p>	<p>"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</p> <p>"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</p> <p>"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.</p> <p>"&amp;" document member of the same patent family</p>
--	--

Date of the actual completion of the international search  12 January 2012	Date of mailing of the international search report  30/03/2012
--	--

Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer  Jepsen, John
--	--

## INTERNATIONAL SEARCH REPORT

International application No  
PCT/US2011/035474

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 5 225 720 A (KONDOH HARLIFUSA [JP] ET AL) 6 July 1993 (1993-07-06)	14-17
A	column 7, line 4 - line 41; figure 6 column 8, line 12 - column 9, line 49; figure 9	1,2, 18-20
	-----	
A	US 2003/025541 A1 (HUMPHREY GUY HARLAN [US] ET AL) 6 February 2003 (2003-02-06) paragraph [0019] - paragraph [0035]; figure 3	1,2, 14-21
	-----	

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US2011/035474

## 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.:

2, 13-17, 19-23

### 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.

**FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210**

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

1. claims: 2, 13-17, 19-23

Current generator, driver and method of driving, pull up of driver output, H-bridge driver.

1.1. claims: 14-17

Current generator having four output transistors in series.

1.2. claims: 2, 19, 20

A driver using such a generator and a method of controlling a current having an absolute value.

1.3. claim: 13

The interconnection of one such driver to a resistor load and power supply.

1.4. claims: 21-23

The interconnection of four such drivers to form an H-bridge  
---

2. claims: 3, 4

Driver circuit using a current generator having just two output transistors connected in series.  
---

3. claims: 5-7

Driver circuit adapted for peak current limiting  
---

4. claims: 8-12

Driver circuit using capacitive feedback  
---

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2011/035474

Patent document cited in search report	Publication date	Patent family member(s)	Publication date	
US 2004135528	A1	15-07-2004	AU 2003269496 A1	14-07-2004
			CN 1934785 A	21-03-2007
			DE 60311316 T2	10-05-2007
			EP 1581999 A2	05-10-2005
			KR 20050085635 A	29-08-2005
			US 2004135528 A1	15-07-2004
			WO 2004057748 A2	08-07-2004
-----				
US 4791326	A	13-12-1988	NONE	
-----				
US 2002005743	A1	17-01-2002	JP 3597760 B2	08-12-2004
			JP 2002026712 A	25-01-2002
			US 2002005743 A1	17-01-2002
-----				
US 5225720	A	06-07-1993	JP 4146650 A	20-05-1992
			US 5225720 A	06-07-1993
-----				
US 2003025541	A1	06-02-2003	JP 4059387 B2	12-03-2008
			JP 2003069415 A	07-03-2003
			SG 123533 A1	26-07-2006
			US 2003025541 A1	06-02-2003
-----				