

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
29 May 2008 (29.05.2008)

PCT

(10) International Publication Number
WO 2008/063454 A3

(51) International Patent Classification:
G09G 1/04 (2006.01)

(21) International Application Number:

PCT/US2007/023721

(22) International Filing Date:

13 November 2007 (13.11.2007)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

11/603,689 21 November 2006 (21.11.2006) US

(71) Applicant (for all designated States except US):
EXCLARA, INC. [US/US]; 2560 Mission College Blvd., Suite 103, Santa Clara, CA 95054 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **SHTEYNBERG, Anatoly** [US/US]; 1191 Quail Creek Circle, San Jose, CA 95120 (US). **RODRIGUEZ, Harry** [US/US]; 10525 Foothill Avenue, Gilroy, CA 95020 (US).

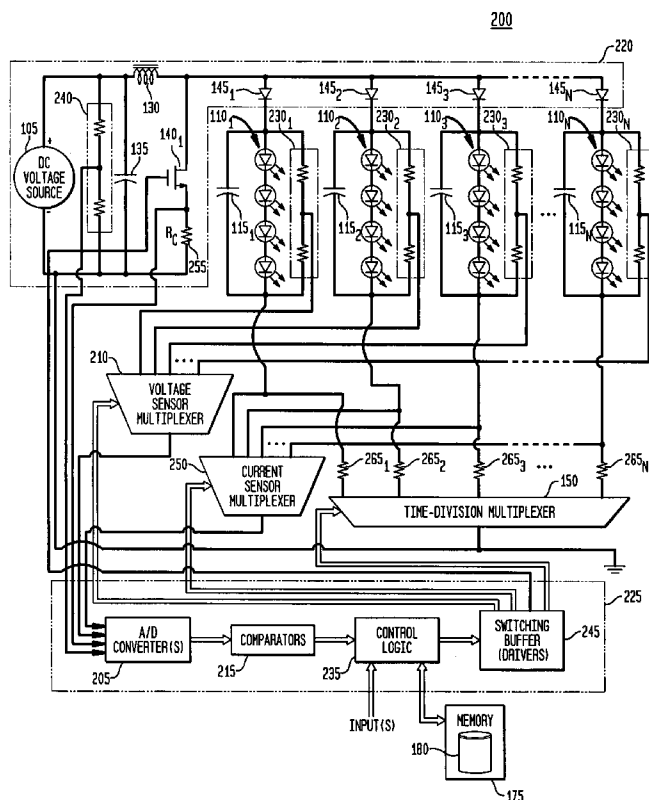
(74) Agent: **GAMBURD, Nancy, R.**; Gamburd Law Group LLC, 600 West Jackson Blvd., Suite 625, Chicago, IL 60661 (US).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, 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, 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.

(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, MT, NL, PL,

[Continued on next page]

(54) Title: CURRENT CONTROL OF ARRAYS OF LIGHT EMITTING DIODES



(57) Abstract: Exemplary apparatus, method and system embodiments provide for separately and independently sourcing current to a series of light emitting diodes of a plurality of series of light-emitting diodes. An exemplary apparatus comprises a power converter which generates a current, a first multiplexer, and a controller. The controller provides for sequential and separate switching of the current through the first multiplexer to each of the series of light-emitting diodes for a corresponding period of time. An average current provided by the power converter is determined as substantially equal to a sum of the corresponding currents through the plurality of series of light-emitting diodes. A total period for switching current to all of the series of light-emitting diodes is also determined. A corresponding time period for switching current to a selected corresponding series of light-emitting diodes is substantially equal to a proportion of the total period determined as a ratio of the corresponding current for the selected corresponding series of light-emitting diodes to the average current provided by the power converter.



PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM,
GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report*

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

18 September 2008

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 07/23721

A. CLASSIFICATION OF SUBJECT MATTER IPC(8) - G09G 1/04 (2008.04) USPC - 315/371 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) USPC: 315/371 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched USPC: 315/300, 302, 371 (text searched) Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) PubWEST(USPT,PGPB,EPAB,JPAB); Google Scholar Search Terms - LED, series, multiplexer, memory, switch, voltage divider, current sensor, controller, converter		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X — Y	US 2005/0151489 A1 (Lys et al.) 14 July 2005 (14.07.2005), entire document, especially para [0095], [0101], [0103], [0121], [0125], and [0136]	1-8, 17, 19-30, 39, 41-44, 63, 64, and 67-70 9-16, 18, 31-38, 40, 65, 66
Y	US 2006/0220571 A1 (Howell et al.) 05 October 2006 (05.10.2006), entire document, especially para [0022]	9 and 31
Y	US 2006/0211055 A1 (Hafeman et al.) 21 September 2006 (21.09.2006), entire document, especially para [0068]	10, 11, 32, 33, and 65
Y	US 4,302,712 A (Pritchard) 24 November 1981 (24.11.1981), entire document, especially col 1, ln 10-20	11, 33, and 65
Y	US 2006/0192663 A1 (Bryan et al.) 31 August 2006 (31.08.2006), entire document, especially para [0115]	12, 13, 34, 35, and 66
Y	US 5,694,208 A (Ichikawa) 02 December 1997 (02.12.1997), entire document, especially (Abstract)	14-16, 18, 36-38, and 40
<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/>		
* 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 11 June 2008 (11.06.2008)		Date of mailing of the international search report 24 JUN 2008
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		Authorized officer: Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 07/23721

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 extra 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 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.:
1-44 and 63-70

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

Information on patent family members

International application No.

PCT/US 07/23721

Box No. III: Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I: claims 1-44 and 63-70: directed to an apparatus for providing current independently to a series of light emitting diodes, the apparatus comprising: a power converter couplable to the plurality of series of light-emitting diodes, the power converter adapted to generate a current; a first multiplexer couplable to the plurality of series of light-emitting diodes; and a controller coupled to the power converter and to the first multiplexer, the controller adapted to provide for sequential and separate switching of the current through the first multiplexer to each of the series of light-emitting diodes, of the plurality of series of light-emitting diodes, for a corresponding period of time.

Group II: claims 45-62: directed to a method of selectively and independently providing power to a series of light emitting diodes, the method comprising: generating an input DC current having a first average level; and sequentially and separately switching the DC current to each of the series of light-emitting diodes, of the plurality of series of light-emitting diodes, for a corresponding period of time.

The inventions listed as Groups I - II do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

Group I does not include the inventive concept of generating an input DC current having a first average level; and sequentially and separately switching the DC current to each of the series of light-emitting diodes, of the plurality of series of light-emitting diodes, for a corresponding period of time, of Group II.

Group II does not include the inventive concept of a power converter for generating current coupled to the plurality of series of light-emitting diodes; a first multiplexer coupled to the plurality of series of light-emitting diodes; and a controller coupled to the power converter and to the first multiplexer, the controller adapted to provide for sequential and separate switching of the current through the first multiplexer to each of the series of light-emitting diodes, of the plurality of series of light-emitting diodes, for a corresponding period of time, of Group I.

Providing current independently to a series of light emitting diodes is the only concept shared by all the groups. US 5,765,940 A to Levy et al., published June 16, 1998, teaches providing current independently to a series of light emitting diodes (see claim 1 and FIG. 3, where current is provided independently to each string of LED's). As the above current providing system for a series of light emitting diodes was known at the time, as evidenced by the teaching of Levy, this cannot be considered a special technical feature that would otherwise unify the groups.

Groups I and II therefore lack unity under Rule 13.1 because, under Rule 13.2, they lack the same or corresponding special technical feature.