(54) Title: METHODS AND APPARATUSES FOR OPERATING GROUPS OF HIGH-POWER LEDS

(57) Abstract: The object of the invention is to implement an energy-efficient, compact and cost-effective solution for driving a number of high-power LED groups for lighting applications, by using a single switching power supply together with LEDs connected in series and/or in parallel and pulse width-controlled switches in parallel across the individually controllable LED groups. If the switch of an LED group is ON, the LED group will not light up. If the switch is in the OFF position, the full current of the power supply will pass through the corresponding LED group. Another aspect of the invention is the restriction within the drive protocol, according to which but a single switch is actuated at any one time within a particular time interval. This aspect guarantees a minimum time interval between each individual actuation event.

Another aspect is the derating of the power supply in those phases where not a single LED group is ON. In the event of all the switches being closed (all LED groups OFF) the power supply can be derated (or turned off). A further aspect is the use of an elevated current setting of the power supply with the simultaneous restriction of the ON cycle by means of pulse width modulation. The power supply is set to the maximum instantaneous peak current of the LED, while maximum pulse width drive guarantees a maximum of the average LED current, cycle time being left over as a result, thus enabling more LEDs to be driven at a given supply voltage.
— before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

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

18 January 2007
**INTERNATIONAL SEARCH REPORT**

**A. CLASSIFICATION OF SUBJECT MATTER**

INV. H05B33/08

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)

H05B

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

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

<table>
<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>X</td>
<td>WO 2004/100612 A (KONINKLIJKE PHILIPS ELECTRONICS N.V.; XU, PENG) 18 November 2004 (2004-11-18) page 6, line 12 - page 9, line 14; figures 1-11</td>
<td>1,26,29</td>
</tr>
<tr>
<td>A</td>
<td>EP 0 967 590 A (HEWLETT-PACKARD COMPANY) 29 December 1999 (1999-12-29)</td>
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</table>

Further documents are listed in the continuation of Box C. See patent family annex.

Date of the actual completion of the international search: 18 August 2006

Date of mailing of the international search report: 16.11.2006

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk

Tel. (+31-70) 340-3040, Tx. 31 681 eapo nl, Fax. (+31-70) 340-3013

Authorized officer: Albertsson, Gustav
INTERNATIONAL SEARCH REPORT

Box 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 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 fee, this Authority did not invite payment of any additional fee.

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.:

   1-30

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

Form PCT/ISA/210 (continuation of first sheet (2)) (January 2004)
This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-30

Method of driving, by means of single power supply, a number of high power light-emitting diodes (LEDs), said number of LEDs being divided into two or more groups, each group being separately energizable, said method comprising:
   a) energizing or deenergizing of a supply current from the power supply into a first one of the groups;
   b) waiting during a predetermined wait time period; and
   c) repeating step a) and b) for a second one of the groups.

2. claim: 31

Lighting unit comprising one or more LEDs, a supply unit for feeding the LEDs and a network interface, characterized in that the network interface is provided with a first network connection for communicating with an upstream lighting unit in the network and a second network connection for communicating with a downstream lighting unit in the network.

3. claims: 32,33,34

Method of operating, using one or more power supplies, a number of high power light-emitting diodes (LEDs), said number of LEDs being distributed over two or more groups, each group being separately energizable, wherein the time at which the groups are energized and/or deenergized is determined by means of one or more modulation techniques among pulse width modulation (PWM), frequency modulation (FM), pulse code modulation (PCM), and time division modulation (TDM).

4. claim: 35

Lighting System comprising a plurality of lighting units which are each provided with one or more LEDs and a central processing unit for driving the LEDs, wherein the central processing units are each provided with a memory for storing instructions for energizing and deenergizing the LEDs of the lighting unit in question, and wherein the lighting system comprises a communications network for transmitting, during operation, synchronization messages to one or more of the processing units, for the purpose of temporal matching of an energization and deenergization scenario of the LEDs of the lighting units.

5. claims: 36,37
Lighting System comprising one or more lighting units, wherein driving of the lighting units, for example via a network, takes place by means of instructions for presenting an operational status of a switch and/or an operational status of a display segment or display point.
<table>
<thead>
<tr>
<th>Patent document cited in search report</th>
<th>Publication date</th>
<th>Patent family member(s)</th>
<th>Publication date</th>
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<tbody>
<tr>
<td>WO 2004100612 A</td>
<td>18-11-2004</td>
<td>CN 1784931 A</td>
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Form PCT/ISA/10 (patent family annex) (April 2005)