Title: FAULT TOLERANT LED DISPLAY

Abstract: Zener diodes Z1, Z2 are connected in parallel with sets 201a, 201b of series-connected light emitting diodes L1-L4 with a reverse forward bias orientation. The threshold voltage of the zener diodes Z1, Z2 is matched to equal, or be just slightly greater than, the forward voltage drops for the light emitting diodes L1-L4 at maximum current. During normal operation, therefore, the zener diodes Z1, Z2 draw virtually no current. Upon failure of one of the light emitting diodes L1-L4, the associated zener diode Z1 or Z2 conducts without increase in the applied voltage, providing an alternate current path maintaining circuit integrity so that other set 201a or 201b of light emitting diodes L1-L2 or L3-L4 connected in series within the circuit 200 continues to illuminate.
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.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7: 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)

IPC 7: H05B

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, PAJ

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>
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<tbody>
<tr>
<td>X</td>
<td>DE 198 41 490 A (SIEMENS AG) 23 March 2000 (2000-03-23) column 1, line 53-column 4, line 45; figures 1,2</td>
<td>1-14</td>
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<td>X</td>
<td>US 6 203 180 B1 (FLEISCHMANN WALTER) 20 March 2001 (2001-03-20) column 3, line 5 - line 25; figure 3</td>
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<td>X</td>
<td>US 5 939 839 A (WEISS ACHIM ET AL) 17 August 1999 (1999-08-17) column 3, line 26 - line 48; figure 2</td>
<td>1-14</td>
</tr>
</tbody>
</table>

Further documents are listed in the continuation of box C.

Patent family members are listed in 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 document 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.

**"A"** document member of the same patent family

Date of the actual completion of the international search

4 November 2002

Date of mailing of the international search report

18.02.03

Name and mailing address of the ISA

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Fax: (+3170) 340-3016

Authorised officer

VILLAFUERTE ABR... L
INTERNATIONAL SEARCH REPORT

Box I  Observations where certain claims were found unsearchable (Continuation of Item 1 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 8.4(a).

Box II  Observations where unity of invention is lacking (Continuation of Item 2 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.:

   1-14

Remark on Protest

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

X No protest accompanied the payment of additional search fees.

Form PCT/S/210 (continuation of first sheet (1)) (July 1998)
This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-14
   LED string with parallel threshold protection devices.

2. Claims: 15-20
   Voltage controlled dimming of LEDs with switching circuit.
<table>
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<tr>
<th>Patent document cited in search report</th>
<th>Publication date</th>
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<tr>
<td></td>
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<td>EP 0989026 A2</td>
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