Title: AN LED DRIVER, AN LED TUBE AND A LUMINAIRE HAVING THE TUBE

FIG. 2

Abstract: The present invention relates to an LED driver (2), characterized in that the LED driver (2) at least comprises a first LED driver module (3) and a second LED driver module (4), the first LED driver module (3) comprising a first electronic component (5) having a first characteristic, the second LED driver module (4) comprising a second electronic component (6) having a second characteristic different from the first characteristic, the first LED driver module (3) and the second LED driver module (4) being mechanically and electrically connected together. The present invention, by means of a modular design, enables an end user to rapidly replace the vulnerable electronic components in the LED driver, and can prolong the lifetime of the LED driver and the tube as well as corresponding luminaire. Moreover, using the modular concept makes it much easier in designing and manufacturing.
An LED Driver, an LED Tube and a Luminaire having the Tube

Technical Field

The present invention relates to an LED driver, an LED tube and a luminaire having the tube.

Background Art

LED is a widely used light source with a relatively long time usage. However, the lifetime of the LED driver varies very much, especially some vulnerable electronic components in the LED driver usually cause replacement of the whole LED driver, which reduces the whole lifetime of the LED driver, thus leads to unnecessary frequent replacement of the LED driver, and may even reduce the lifetime of the whole LED tube that is integrated with such an LED driver. In the prior art, in order to prolong the lifetime of the LED driven some electronic components having a relatively long lifetime are selected, which are, however, bulky and expensive. Therefore, though the lifetime of the LED driver is prolonged, the cost is high and the LED driver is bulky.

Therefore, it is an urgent demand to solve the above one or more shortcomings

Summary of the Invention

One technical problem to be solved by the present invention is to provide a modular designed LED driver. By means of the modular design of the LED driver, it is easy to arrange the electronic
components with different characteristics into different modules. Furthermore, the user can replace the module comprising electronic components having undesirable characteristics, further, an end user is enabled to maintain the usage lifetime of the whole LED driver by replacing modules with a relatively short lifetime in the LED driver.

In addition, the function of LED driver may be extended by adding the module which contains electronic components with certain characteristics. That is, the certain characteristics can be understood as the characteristics in achieving certain functionality.

The present invention provides an LED driver, wherein, the LED driver comprises a first LED driver module and a second LED driver module, the first LED driver module comprising a first electronic component having a first characteristic, the second LED driver module comprising a second electronic component having a second characteristic different from the first characteristic, the first LED driver module and the second LED driver module being mechanically and electrically connected together. The connection can be achieved by the conducting line or by the mechanical and electrical interface or in other way. By separating the electronic components with different characteristics into different modules, it is possible to replace the electronic components having undesirable characteristics by replacing a particular module therein. Also, the possibility to extend the functionality of LED driver by adding modules which contain the electronic component for achieving certain function is provided.

Preferably, the first characteristic is being vulnerable, and the second characteristic is not being vulnerable, thus, the vulnerable electronic components are comprised in one module, while the electronic components with stable property and a relatively long lifetime are comprised in the other module. Consequently, those vulnerable electronic components can be replaced by replacing the first module.
In one embodiment, the first electronic component is an E-capacitor, and the second electronic component is the remaining electronic components of the driver, then, the vulnerable E-capacitor in the driver can be separated in an individual module, and replaced by replacing the individual module, without influence on the whole lifetime of the LED driver. Certainly, the first electronic component can be some other vulnerable electronic components apart from the E-capacitor, such as fuse.

Preferably, the first LED driver module comprises an individual casing for accommodating the first electronic component, and the second LED driver module comprises an individual casing for accommodating the second electronic component. Preferably, individual casing for accommodating the first electronic component is "Starter-casing".

In the other example, the first characteristic is the characteristic which can achieve the extended functionality, and the second characteristic is the characteristic which can achieve the elementary functionality.

The present invention further relates to an LED tube, comprising the LED driver having the above features.

The present invention further correspondingly relates to a luminaire, comprising the LED tube having the above features.

By means of a modular design, the present invention enables the end user to replace the module comprising the electronic components having those undesirable characteristics, so that the electronic components having undesirable characteristics in the LED driver are replaced. Further, by replacing the module comprising vulnerable elements, the vulnerable elements in the LED driver are rapidly
replaced, which prolongs the lifetime of the LED driver and the tube as well as corresponding luminaire. Moreover, the function of LED driver may be extended by adding the module which contains electronic components with certain characteristics which can achieve said extended function. Besides, advantages are maintained in volume and cost of the LED driver. Besides, using the modular concept makes it much easier in designing and manufacturing.

**Brief Description of the Drawings**

The present invention will be further explained in connection with the drawings and the embodiments:

Figure 1 is a schematic diagram of a tube and a traditional integrated LED driver;

Figure 2 is a schematic diagram of a tube and an LED driver according to the present invention.

**Detailed Description of the Embodiments**

Figure 1 is a schematic diagram of a tube and a traditional integrated LED driver. Figure 2 is a schematic diagram of a tube and an LED driver according to the present invention.

From Figures 1 and 2 it could be seen that an LED tube 1 comprises a tube body 7 and an LED driver 2. The tube body 7 is supplied with power by the LED driver 2 for LED tube lighting.

The LED tube 1 comprises parts, such as a tube lamp casing and an LED assembly (not shown) contained in the tube lamp casing, necessary for LED lighting. Since the improvement of the present invention does not lie in the parts such as the LED assembly contained in the tube lamp casing, they will not be described in detail.
The present invention distinguishes from the prior art in the design of the LED driver 2.

In the prior art, the LED driver 2 is an integrated module which comprises parts, such as a driver casing 8 and electronic components 5 and 6 of the driver having different characteristics arranged in the same driver casing 8, an end cover 12 and a base of the lamp 13, etc., necessary for driving the tube body 7 for lighting. (Since the improvement of the present invention does not lie in the electronic components, their specific working modes and some other contents will not be described in detail.)

In the LED driver of the present invention, the LED driver is modular designed. As shown in FIG 2, the LED driver at least comprises a first LED driver module 3 and a second LED driver module 4. Different LED driver modules comprise electronic components having different characteristics, respectively. Particularly, the electronic components having undesirable characteristics are put in, for example, the first LED driver module 3 which is mechanically and electrically connected with the second LED driver module 4 to accomplish the function of a whole LED driver.

In the embodiment shown in FIG 2, the first LED driver module 3 comprises a vulnerable electronic component 5, and the second LED driver module 4 comprises an electronic component 6 that is not vulnerable and has a stable lifetime. Herein, the 'Vulnerable' means "relative vulnerable", take the "E-capacitor" as an example, which can be regarded as "vulnerable" if its life time is 20K hours in well-designed Lamp. The "stable lifetime" means "relative stable lifetime", for example, the life time of electronic component with stable is more than 20K hours, i.e. 40K or 50K hours. That is, the electronic component 6 is not vulnerable comparing with the vulnerable electronic component 5 in the first LED driver module 3. The first LED driver
module 3 and the second LED driver module 4 further comprise an individual casing, respectively, namely, the first LED driver module 3 comprises a casing 9, and the second LED driver module 4 comprises a casing 10. The two modules are mechanically connected by means of a connection portion 11 and also electrically connected, jointly functioning as an LED driver.

In this embodiment, the vulnerable electronic component 5 comprised in the casing 9 of the first LED driver module 3 is an E-capacitor, and what is comprised in the casing 10 of the second LED driver module 4 is the remaining electronic components.

In an example of an LED fluorescent lamp, the E-capacitor can be arranged in a "Starter" casing. Said "Starter" casing resembles the shape and/or electrical connection means of a starter for regular fluorescent lamps.

In another example, a casing 9 of first LED driver module 3 can accommodate the first electronic component 5, which can achieve certain extended function. A casing 10 of the second LED driver module 4 comprises second electronic component 6, which can achieve elementary function. The first LED driver module 3 can extend the functionality. For example, second LED driver module 4 is 24V constant voltage source, first LED driver module 3 can transfer to constant current output. Another example, second LED driver module 4 is 24V constant voltage source, first LED driver module 3 have some switch, which can support dimming function.

In general, the first LED driver module 3 and second LED driver module 4 can be connected by the conducting line or by the mechanical and electrical interface. It is easier to replace the electronic components having undesirable characteristics or to extend the functionality of LED driver.
Though the present invention is described in combination with exemplary embodiments currently regarded as practical, the person skilled in the art could understand that the present invention is not limited to the exemplary embodiments disclosed herein. Any modification, equivalent substitution and improvement, etc., within the spirit and principle of the present invention should be comprised within the scope of protection of the present invention.
Reference signs

1 LED tube
2 LED driver
3 first LED driver module
5 4 second LED driver module
5 electronic component
6 electronic component
7 tube body
8 driver casing
10 9 casing
10 casing
11 connection portion
12 end cover
13 base of the lamp
1. An LED driver (2), characterized in that the LED driver (2) at least comprises a first LED driver module (3) and a second LED driver module (4), the first LED driver module (3) comprising a first electronic component (5) having a first characteristic, the second LED driver module (4) comprising a second electronic component (6) having a second characteristic different from the first characteristic, the first LED driver module (3) and the second LED driver module (4) being mechanically and electrically connected together.

2. The LED driver (2) according to Claim 1, characterized in that the first characteristic is being vulnerable, the second characteristic is not being vulnerable.

3. The LED driver (2) according to Claim 1 or 2, characterized in that the first LED driver module (3) comprises an individual casing (9) for accommodating the first electronic component (5), the second LED driver module (4) comprises an individual casing (10) for accommodating the second electronic component (6).

4. The LED driver (2) according to Claim 3, characterized in that individual casing (9) for accommodating the first electronic component (5) is "Starter-casing**".

5. An LED tube, comprising the LED driver (2) according to any one of Claims 1-4.

6. A luminaire, comprising the LED tube according to Claim 5.
A. CLASSIFICATION OF SUBJECT MATTER

INV. H05B33/08
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)
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 database and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<td>US 2008/211369 AI (ZHANG ZHI KUAN [CN] ET AL) 4 September 2008 (2008-09-04) paragraph [0052] - paragraph [0081]; figure 1a</td>
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Further documents are listed in the continuation of Box C. See patent family annex.

* Special categories of cited documents:

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Morris, Ian
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