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(54) LIGHT UNIT OF AN AUTOMOTIVE VEHICLE

(57) The invention relates to a light unit (100) of an automotive vehicle (1) comprising :
- at least one LED board (110, 120) comprising LEDs (111) and at least one LED driver (112), the LED board being connected to a first communication bus (150) for receiving driver commands,
- a control board (130) including a microcontroller (131) connected to a second communication bus (140) for receiving a control signal from the automotive vehicle (1), and to the first communication bus (150) for sending driver commands to the LED drivers, and the microcontroller (131) translating received light command into a driver command,
wherein the LED board (110, 120) comprises an identification information and wherein the microcontroller (131) is configured for reading the identification information at power on and for selecting a translation program, the selected translation program performing the translation of the received light commands into the driver commands

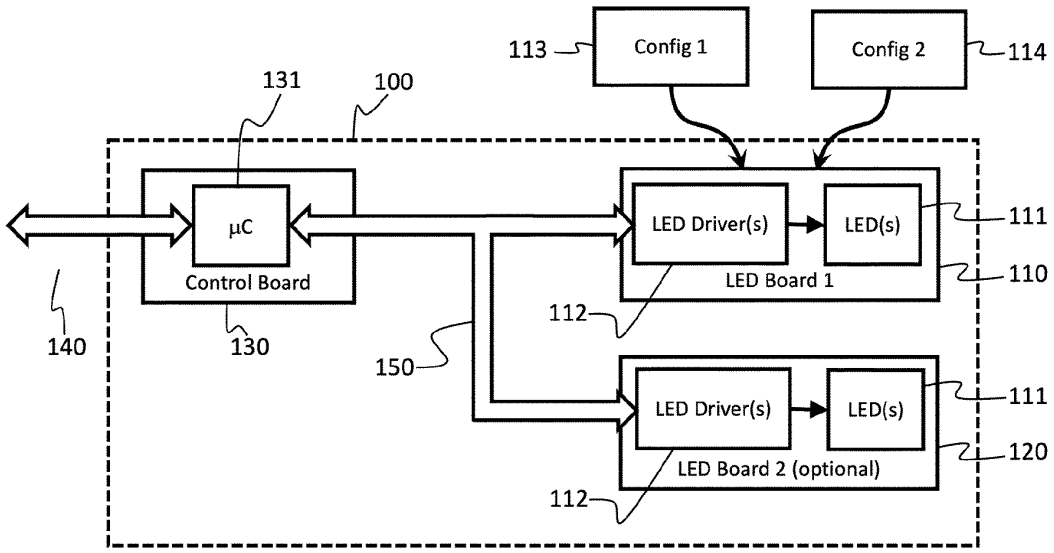

Figure 2

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Description

Technical Field

[0001] The invention relates to light unit of an automotive vehicle. More particularly, the invention relates to LED unit enabling to have lighting effect capabilities.

Background Art

[0002] An automotive vehicle comprises at least four light units, two headlight units at the front and two rear light units at the back of the vehicle, the lights unit being located on each side, two on left and two on right. The light unit is a single block element grouping together different lights of an automotive vehicle. For headlight, the light unit may include daytime running lights, low beam headlights, high beam headlights, turn indicator lights, welcome scenario lights, animation lights, fog lights or the like. For the rear, the light unit may include signaling lights, brake lights, rear fog lights, reversing lights, turn lights or the like. With light emitting diode (LED) technology, each light can have a dynamic lighting. Dynamic lighting consists in the division of each light in a plurality of sub-lights for providing different light patterns either for sending different light signals or for selecting the lighting area.

[0003] The light unit comprises a housing in which one or several LED boards are located and a control board. The housing is specific to the shape of one or several vehicles and to its position on the vehicle. A LED board comprises LEDs and LED drivers to be inserted at a specific position inside the housing for performing one or more light functions according to specific light options of the vehicle. For mass production reasons, it is preferred to reduce the number of LED board types. Different LEDs boards can be mounted in a same housing and a same LED board can also be used for several housing. For same reasons, a control board is manufactured for controlling one or more LED boards of different types. During the assembling of the light unit, an operator must select the housing and insert the LED boards and configure them depending on the housing (left or right) then the control board is inserted and should be configured as a function of the LED boards. Conventionally, the configuration of the control board is made by soldering or cutting resistors or jumpers before inserting the control boards in the housing. The resistors or jumpers acting as programmable switches for indicating to a microcontroller of the control board what kind of LED boards are connected. Such manual methods are relatively long and are a source of errors.

Summary of the Invention

[0004] The aim of the invention is to provide a light unit configured by software for avoiding any problem during the assembling.

[0005] The invention is a light unit of an automotive vehicle comprising at least one LED board and a control board. The at least one LED board comprises LEDs and at least one LED driver, the LED board being connected to a first communication bus for receiving driver commands. The control board includes a microcontroller connected to a second communication bus for receiving a control signal from the automotive vehicle, and to the first communication bus for sending driver commands to the LED drivers, the control signal comprising at least one light command related to control of the LEDs, and the microcontroller translating the received light command into a driver command. According to the invention, the LED board comprises at least one memory comprising an identification information. The microcontroller is configured for reading the identification information at power on and for selecting a translation program in response to the identification information, the selected translation program performing the translation of the received light commands into the driver commands.

[0006] Preferentially, the light unit can further comprise a housing including optics and fixing means for affixing the at least one LED board in front of the optics, and for affixing the control board.

[0007] According to a preferred embodiment, the LED board can comprise a programmable driver and wherein the memory is located inside the programmable driver.

[0008] According to different embodiments, the identification information can comprise a type of LED board, a type of light, or a bit indicating whether the light unit is to be placed on the right or on the left of the automotive vehicle.

[0009] The invention also relates to a method for controlling lights of a light unit of an automotive vehicle. Said light unit comprises at least one LED board comprising LEDs and at least one LED driver connected to a first communication bus for receiving driver commands, the LED board comprising at least one memory comprising an identification information, and a control board including a microcontroller connected to a second communication bus for receiving light commands of the automotive vehicle, and to the first communication bus for sending driver commands, the microcontroller comprising several translation programs for translating received light commands into driver commands. The microcontroller performs the following steps at power on:

- reading the identification information,
- selecting a translation program amongst the translation programs in response to the identification information,
- running the selected program for receiving one light command and translating said received light command into one or more driver commands according to the selected translation program.

[0010] According to another aspect, the invention is a method for manufacturing a light unit of an automotive

vehicle, the method comprising the steps of:

- providing a housing including optics and fixing means for affixing at least one LED board in front of the optics, and for affixing a control board,
- providing the at least one LED board comprising LEDs and one or more LED drivers and a connector for connecting a first communication bus,
- affixing the LED board into the housing,
- providing the control board including a microcontroller, a connector to a second communication bus for receiving control signals of the automotive vehicle, and a connector to the first communication bus,
- affixing the control board to the housing, and connecting the first communication bus between the LED board and the control board, wherein the method further comprises:

    - a step for writing an identification information in at least one memory of the at least one LED board, and
    - a step for loading a program in the microcontroller comprising several translation programs for translating received light commands into driver commands correspond to a plurality of LED boards, wherein said program comprises an initialization program for reading the identification information at power on and for selecting a translation program in response to the identification information, the selected translation program performing the translation of the received light commands into the driver commands.

[0011] According to a preferred embodiment, the step for writing an identification information can be made at least in part after the fixing of the LED board in the housing.

[0012] According to a preferred embodiment, the identification information written after the fixing of the LED board can comprise a bit indicating if the light unit is to be placed on the right or on the left of the automotive vehicle.

Brief description of the Drawings

[0013] The invention will be detailed with reference to the annexed drawings in which:

Figure 1 shows the back of the car having two light units according to the invention,
Figure 2 shows a function block diagram of a light unit of the invention,
Figure 3 shows an example of LED board according a first configuration,
Figure 4 shows an example of LED board according a second configuration,
Figure 5 shows a simplified flow chart of the program performed by a control board of the light unit of the invention,
Figure 6 shows a flow chart of the assembling of a light unit according to the invention.

Detailed Description of the invention

[0014] The figure 1 shows the rear of a vehicle 1 having two light units 100. Each light unit 100 can comprise different kind of lights, for example a position light, a breaking light, a turning light, a rear fog light, rear animation lights, rear welcome scenario lights, rear signature lights, a reversing light, or the like. Several configurations of light unit 100 are possible depending on the model of the vehicle 1 and on the position of the light unit 100.

[0015] As it can be seen on figure 2, each light unit 100 comprises a housing (not shown) enclosing a first and a second LED boards 110 and 120, and a control board 130. Each LED board 110 or 120 comprises LEDs 111 intended to be placed in front of optics of said housing. The control board 130 includes a microcontroller 131 connected to a second communication bus 140 for receiving a control signal from the automotive vehicle 1. The LED boards 110, 120 and the control board 130 can be made of a printed circuit board (PCB), a flexible printed circuit board, double sided PCB, single sided PCB, multilayer PCB or any related board technology. A first communication bus 150 links the control board 130 to the first and second LED boards 110 and 120 for sending driver commands to the LED drivers powering the LEDs 111 in such a way to turn on or off said LEDs. The first communication bus 150 and the second communication bus 140 can be formed by any conventional automotive communication protocols such as Local Interconnect Network (LIN), Controller Area Network (CAN), Media Oriented System Transport (MOST), FlesRay protocol, Automotive Ethernet, Peripheral Component Interconnect Express (PCIe) protocol, CAN-FD (Flexible Data-rate) or any other known communication protocol. The driver commands are elaborated by the microcontroller 131 in response to the control signal comprising at least one light command related to control of the lights of the vehicle 1. The microcontroller 131 translates the light command in one or more driver commands adapted to the LED boards.

[0016] In the invention, the light unit 100 can receive a first LED board 110 according to a first configuration 113 or to a second configuration 114, and the second LED board 120 can be optional. As an example, the first configuration 113 of the LED board 110 is shown on figure 3. The LED board 110 according to the first configuration 113 can comprise three groups of LEDs 311, 321 and 331 connected to three LED drivers 312, 322 and 332 corresponding to position light, stop light and turn light. The groups of LEDs 311 and 321 can comprise red LEDS and can correspond either to position light or stop light depending if the light unit 100 is placed on the left or right side. The power of LED drivers 312 and 322 is adapted to be more important for stop light than for position light. The group of LEDs 331 can comprise

yellow LEDs and can correspond to turn light.

[0017] An example of the second configuration 114 is shown on figure 4. The LED board 110 according to the second configuration 114 can comprise two groups of LEDs 311 and 321 connected to two LED drivers 312 and 322 corresponding to position light and stop light. The two groups of LEDs 311 and 321 can correspond either to position light or stop light depending if the light unit 100 is placed on the left or right side. The second configuration 114 can further comprise six groups of LEDs 431a, 431b, 431c, 431d, 431e and 431f respectively driven by six LEDs drivers 432a, 432b, 432c, 432d, 432e and 432f in such a way to provide a dynamic turn light. The dynamic turn light consists in lighting sequentially from right to left or from left to right the groups of LEDs 431a to 431f. The groups of LEDs 431a to 431f are driven two by two.

[0018] The second LED board 120 can comprise two groups of LEDs, one group being a group of white LEDs for reversing light and the other group of LEDs being a group of LEDs for fog light. As indicated, the second LED board 120 is optional because only one unit 100 can have the second LED board 120.

[0019] Whatever the LED board 110 or 120, several drivers 312, 322, 332, and 432a to 432f are used on each LED board. In addition, for warranting the lights are operational even in case of an LED failure, the big groups of LEDs 311 and 321 can be divided into several groups of LEDs driven by several drivers 312 and 322 controlled in parallel. For reducing the number of components in a LED board, it is well known to use multichannel drivers, i.e., an integrated circuit (IC) comprising several drivers addressed through a single bus. Considering that such an IC further comprises a programmable non-volatile memory, the invention proposes to record an identification information in said memory for identifying the LED board in such a way that the microcontroller can read this identification information through the first communication bus 150. The microcontroller can send the driver commands to the LED driver corresponding to the group of LEDs to switch on or off after having read the identification information.

[0020] Alternatively, in case the person skilled in the art prefers not to use a multichannel driver, the invention requires that a programmable non-volatile memory accessible by the microcontroller 131 through the communication bus should be mounted on each LED board 110 or 120. The non-volatile memory should contain the identification information.

[0021] According to the invention the microcontroller 131 comprises several translation programs for translating a light command in one or more driver commands. Each translation program contains instructions for translating light commands into driver commands for each LED board 110 and 120, for each possibility of configuration 113 and 114 and for each of the location (right or left). For that purpose, the identification information can comprise the type of LED boards and/or the type of light. The identification information can further comprise a bit indicating whether the light unit is to be placed on the right or on the left of the automotive vehicle 1 if the LED board should be addressed differently depending on its location on the vehicle 1. The identification information is not limited to the above functions and can be used to contain one or more information related to control of the LEDs for performing one or more functions either alone or in combination such as welcome scenarios, low beam and high beam adaptation according to left hand/right hand drive, type of variant of a car such as high end variant, mid level variant, low level variant, entry level variant, signature lighting, ambient lighting, animation lighting or the like.

[0022] The controlling of the light unit 100 is summarized in figure 5 which corresponds to steps performed by the microcontroller 131. When the microcontroller 131 is powered in a first step 510, a boot program is launched for starting a reading step 520. The reading step 520 comprises the discovery of all LED boards connected to the first communication bus 150 and the reading of identification information contained in the memory of each connected LED board. Then, the microcontroller 131 a selection of a translation program in a step 530. The selection of the translation program is made according to the one or two identification information read during the step 520. The selected translation program is loaded in the memory of the microcontroller 131, to be run in a step 540.

[0023] As an example, during the step 520, the microcontroller can detect only the presence of the first LED board 110. The reading of the identification information can indicate the first LED board 110 corresponds to the first configuration 113 and that the position of the light unit 100 is on the right side of the automotive vehicle. The selected translation program can comprise instructions for translating light instructions into driver instructions in such a way that:

- a switch-on command of position light triggers a switch-on command for the LED driver 322 at a first power level,
- a switch-off command of position light triggers a switch-off command for the LED driver 322,
- a switch-on command of stop light triggers a switch-on command for the LED driver 312 at a second power level higher than the first power level,
- a switch-off command of stop light triggers a switch-off command for the LED driver 312,
- a switch-on command of right turn light triggers an alternate sequence of switch-on and switch-off commands for the LED driver 332,
- a switch-off command of right turn light triggers a switch-off command for the LED driver 332,
- All other light commands are ignored by the microcontroller 131.

[0024] As another example, during the step 520, the microcontroller can detect the presence of the first LED

board 110 and of the LED board 120. The reading of the identification information of the first LED board can indicate the first LED board 110 corresponds to the second configuration 114 and that the position of the light unit 100 is on the left side of the automotive vehicle. The reading information of the second LED board 120 can indicate that the second LED board contains a LED driver for reversing light and a LED driver for fog light. The selected translation program can comprise instructions for translating light instructions into driver instructions in such a way that:

- a switch-on command of position light triggers a switch-on command for the LED driver 312 at a first power level,
- a switch-off command of position light triggers a switch-off command for the LED driver 312,
- a switch-on command of stop light triggers a switch-on command for the LED driver 322 at a second power level higher than the first power level,
- a switch-off command of stop light triggers a switch-off command for the LED driver 322,
- a switch-on command of left turn light triggers the repetition of the following sequence of driver commands:
    - ◦ switch-on for the LED drivers 432e and 423f,
    - ◦ switch-on for the LED driver 432d and switch-off for the LED driver 432f,
    - ◦ switch-on for the LED driver 432c and switch-off for the LED driver 432e,
    - ◦ switch-on for the LED driver 432b and switch-off for the LED driver 432d,
    - ◦ switch-on for the LED driver 432a and switch-off for the LED driver 432c,
    - ◦ switch-off for the LED drivers 432a and 423b,
- a switch-off command of left turn light triggers a switch-off command for the LED drivers 432a to 432f,
- a switch-on command of reversing light triggers a switch-on command for the LED driver corresponding to reversing light of the second LED board 120,
- a switch-off command of reversing light triggers a switch-off command for the LED driver corresponding to reversing light of the second LED board 120,
- a switch-on command of rear fog light triggers a switch-on command for the LED driver corresponding to fog light of the second LED board 120,
- a switch-off command of rear fog light triggers a switch-off command for the LED driver corresponding to fog light of the second LED board 120,
- All other light commands are ignored by the microcontroller 131.

[0025] The most important advantage of the invention is to prevent assembling errors during the manufacturing of the light unit. The figure 6 illustrate a flow chart of a manufacturing method for light unit according to the invention. Before the assembling of the light unit 100, the LED board(s) 110 (and 120) and the control board must be manufactured. In a first step 610, the physical manufacturing of LED board(s) 110 (and 120) is performed. The first step 610 is made according to known prior art with the furniture of a printed circuit board (PCB), and the placement and soldering of the different electronics components. In the preferred embodiment, the drivers 112, 312, 322, 332 and 432a to 432 f being programmable multi channel drivers. In a second steps 620, a software is loaded in the programmable multichannel drivers. During the second step 620, the identification information can be loaded in the memory of the programmable multi channel drivers. The identification information written during this second step 620 can be limited to the type of LED board or to the type of lights of said LED board. At the end of the second step 620, the LED board can be provided to the assembly line of the light unit.

[0026] Alternately, if non-programmable drivers are mounted on the LED board, a memory is mounted on the PCB during the first step 610. Then, the identification information is written in the memory during the second step 620.

[0027] In a third step 630, the physical manufacturing of control board 130 is performed. The third step 630 is made according to known prior art with the furniture of a PCB, and the placement and soldering of the different electronics components including the microcontroller 131. In a fourth step 640, a software is loaded in a non-volatile memory of the microcontroller 131. The software loaded in the microcontroller comprises several translation programs for translating received light commands into driver commands according to a plurality of LED boards that could be connected to the control board 130. In addition, said software comprises an initialization program for reading the identification information of LED boards connected to control board, and for selecting the translation program corresponding to the connected LED board(s) in response to the read identification information. At the end of the fourth step 640, once software is loaded, the control board can be provided to the assembly line of the light unit.

[0028] In a fifth step 650, a housing is manufactured. The housing can be made in transparent plastic by injection molding. The housing can include optics and fixing means for affixing the LED boards 110 and 120 in front of the optics and for affixing the control board 130. Some other optics elements, like reflection can be also affixed to the housing before providing the housing to the next sixth step 660. The sixth step 660 consists in the positioning and affixing of the LED board(s) 110 (and 120) into said housing in such a way that the LEDs 111, 311, 321, 331 and 431a to 431f are placed in front of the optics means. The first communication 150 bus can be connected to the LED board(s) 110 (and 120).

[0029] Then a seventh step 670 can be performed for writing a last identification information into the memory of the LED board 110. The last identification information can

be limited only to comprise a bit indicating whether the light unit 100 is to be placed on the right or on the left of the automotive vehicle 1. It should be noted by the man of the art, that a programming mask containing only one bit located at a specific place in the memory can be used for making a second programming operation without erasing the information previously written in the memory.

[0030] Alternatively, the programming of the second step 620 can also be made during the seventh step 670. Nevertheless, it is preferable not to do it because the operator must program the memory with a selection of program corresponding to the type of light board and may introduce wrong information.

[0031] The separation of the writing information in two parts is better because the manufacturing of the LED board is made by an operator (or a subcontractor) which makes only the LED board, avoiding any writing error in identification information related to the type of LED board. The writing of the bit indicating the placing side of the light unit can only be recorded when the led board is mounted in the light unit because a same type of LED board can be mounted either on left side or on right side. The risk of error is quite limited because the operator can see if the housing should be mounted on left side or on right side.

[0032] Once the last information is recorded in the LED board(s) 110 (and 120), an eighth step 680 is performed for affixing the control board 130 to the housing and for connecting the first communication bus 150 to the control board 130. Then a ninth step 690 can be performed for closing the housing and packaging the light unit 100.

[0033] With such a manufacturing method of light unit, there is no more configuration of the control board 130 because configuration is made directly on the LED boards 110 and 120. So, the risk of a wrong manual configuration of the control board is suppressed.

[0034] The invention is not limited by the disclosed embodiment and many other variants are possible without departing of the scope of the claims. As an example, the described embodiment of the invention discloses a light unit having one or two LED boards and only one LED board can receive two possible configurations. As well known by a person skilled in the art, the number of LED board can be more important and the number of configurations for each LED board can be also more important. An increasing of the number of LED board configuration needs to increase the number of translation programs that can be selected by the microcontroller.

Claims

1. A light unit (100) of an automotive vehicle (1) comprising :

- at least one LED board (110, 120) comprising LEDs (111) and at least one LED driver (112), the LED board being connected to a first communication bus (150) for receiving driver commands,
- a control board (130) including a microcontroller (131) connected to a second communication bus (140) for receiving a control signal from the automotive vehicle (1), the control board (130) further being connected to the first communication bus (150) for sending driver commands to the LED drivers, the control signal comprising at least one light command related to control of the LEDs, and the microcontroller (131) translating received light command into a driver command,
- wherein the LED board (110, 120) comprises at least one memory comprising an identification information and wherein the microcontroller (131) is configured for reading the identification information at power on and for selecting a translation program in response to the identification information, the selected translation program performing the translation of the received light commands into the driver commands.

2. The light unit of claim 1, wherein the light unit (100) further comprises a housing including optics and fixing means for affixing the at least one LED board (110, 120) in front of the optics, and for affixing the control board (130).

3. The light unit of one of the claims 1 or 2, wherein the LED board (110, 120) comprises a programmable driver and wherein the memory is located inside the programmable driver.

4. The light unit of one of the claims 1 to 3, wherein the identification information comprises a type of LED board (110, 113, 114, 120).

5. The light unit of one of the claims 1 to 3, wherein the identification information comprises a type of light.

6. The light unit of one of the claims 1 to 5, wherein the identification information comprises a bit indicating whether the light unit is to be placed on the right or on the left of the automotive vehicle (1).

7. Method for controlling lights of a light unit (100) of an automotive vehicle (1), the light unit having:

- at least one LED board (110, 120) comprising LEDs (111) and at least one LED driver (112) connected to a first communication bus (150) for receiving driver commands, the LED board comprising at least one memory comprising an identification information, and
- a control board (130) including a microcontroller (131) connected to a second communication bus (140) for receiving light commands of the automotive vehicle (1), and to the first commu-

nication bus (150) for sending driver commands, the microcontroller (131) comprising several translation programs for translating received light commands into driver commands,

wherein the microcontroller (131) performs the following steps at power on:

- reading (520) the identification information,

- selecting (530) a translation program amongst the translation programs in response to the identification information,

- running (540) the selected program for receiving one light command and translating said received light command into one or more driver commands according to the selected translation program.

8. The method of claim 7, wherein the identification information comprises a type of LED board.

9. The method of one of the claims 7 or 8, wherein the identification information comprises type of light.

10. The method of the claims 7 to 9, wherein the identification information comprises a bit indicating whether the light unit is intended to be placed on the right or on the left of the automotive vehicle (1).

11. A manufacturing method for manufacturing a light unit (100) of an automotive vehicle (1), the method comprising the steps of:

- providing (650) a housing including optics and fixing means for affixing at least one LED board (110, 120) in front of the optics, and for affixing a control board (130),
- providing (610, 620) the at least one LED board (110, 120) comprising LEDs and one or more LED drivers (112) and a connector for connecting a first communication bus (150),
- affixing (660) the LED board (110, 120) into the housing,
- providing (630, 640) the control board (130) including a microcontroller (131), a connector to a second communication bus (140) for receiving control signals of the automotive vehicle, and a connector to the first communication bus (150),
- affixing (680) the control board to the housing, and connecting the first communication bus (150) between the LED board (110, 120) and the control board (130),

wherein the method further comprises:

- a step (620, 670) for writing an identification information in at least one memory of the at least one LED board (110, 120), and
- a step (640) for loading a program in the microcontroller (131) comprising several translation programs for translating received light commands into driver commands correspond to a plurality of LED boards (110, 113, 114, 120), wherein said program comprises an initialization program for reading the identification information at power on and for selecting a translation program in response to the identification information, the selected translation program performing the translation of the received light commands into the driver commands.

12. The manufacturing method of claim 11, wherein the step (670) for writing an identification information is made at least in part after the fixing (660) of the LED board (110, 120) in the housing.

13. The manufacturing method of claim 12, wherein the identification information written after the fixing of the LED board comprises a bit indicating if the light unit is to be placed on the right or on the left of the automotive vehicle.

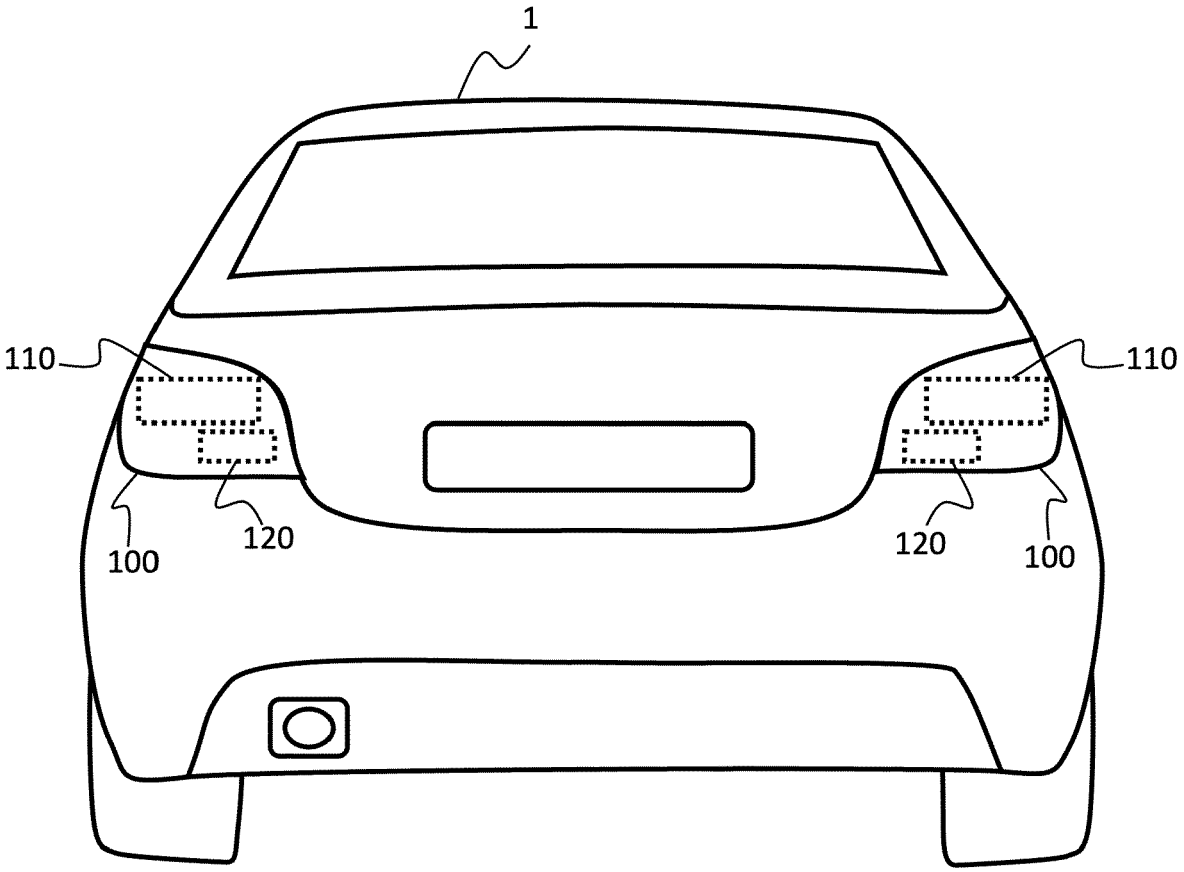

Figure 1

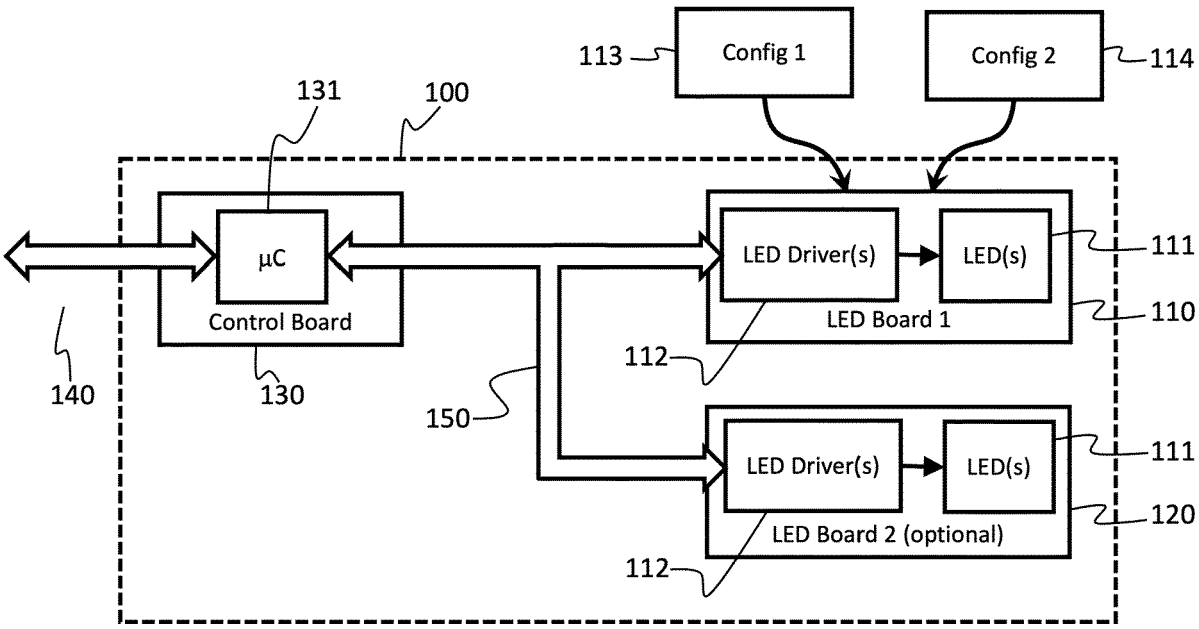

Figure 2

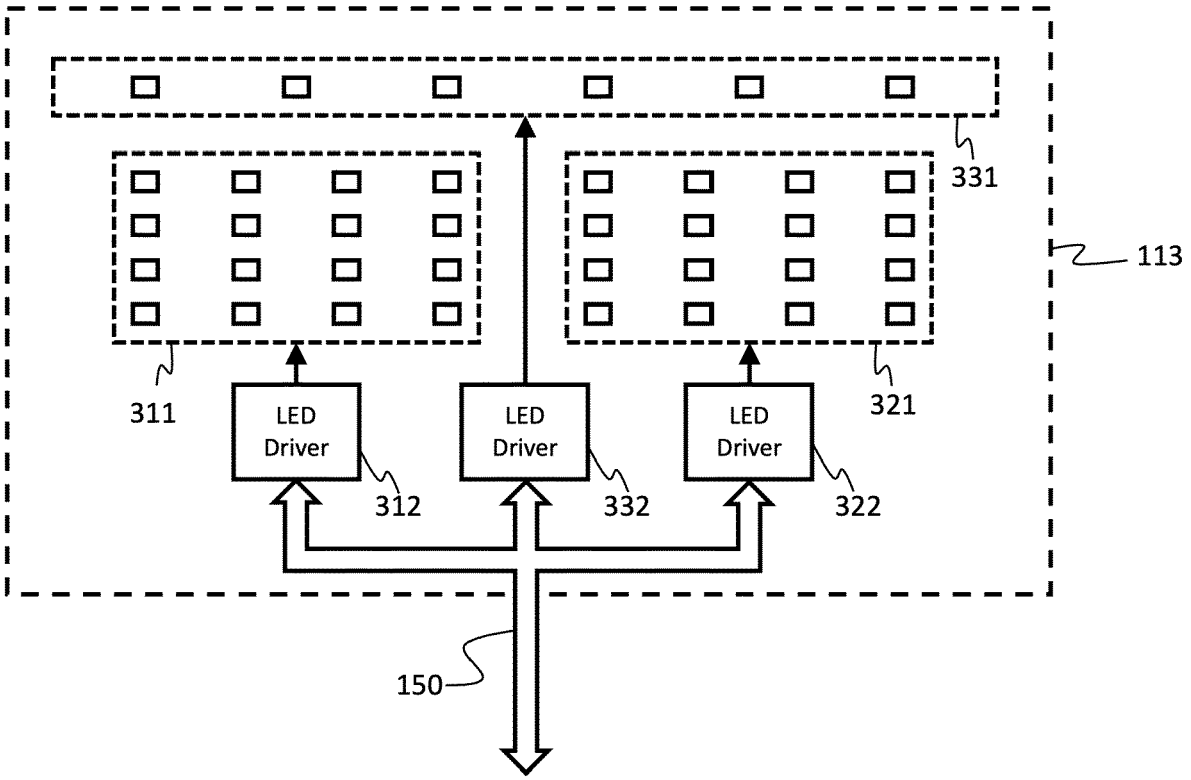

Figure 3

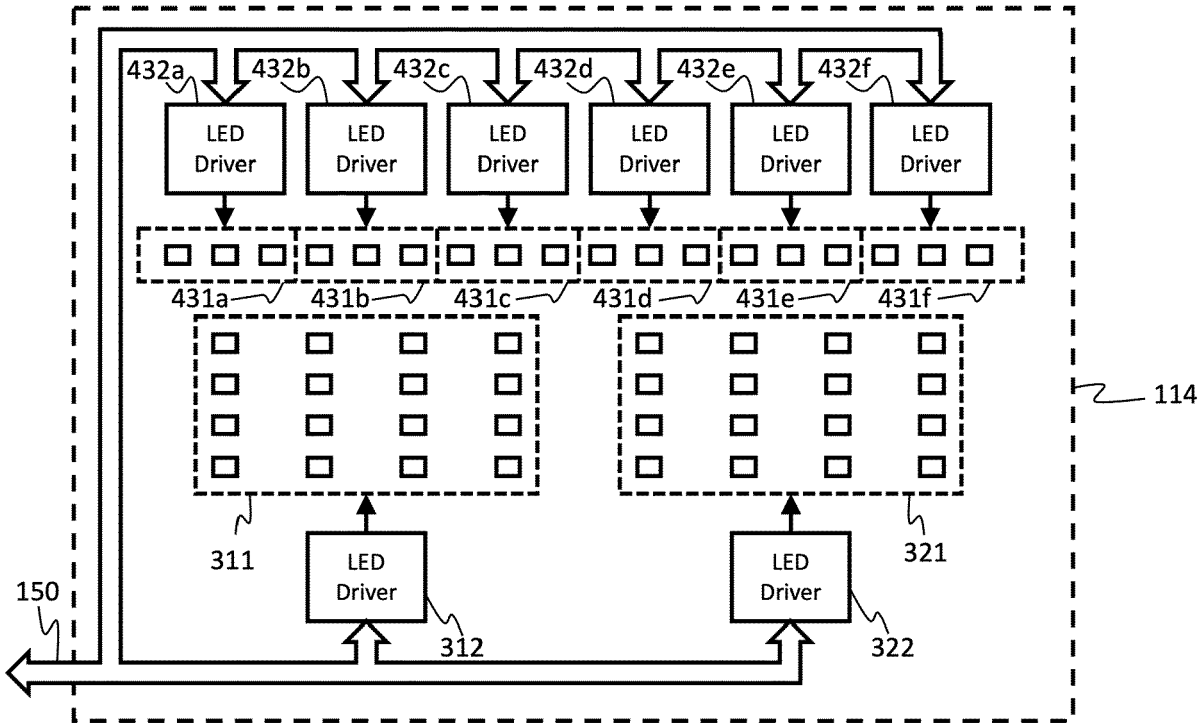

Figure 4

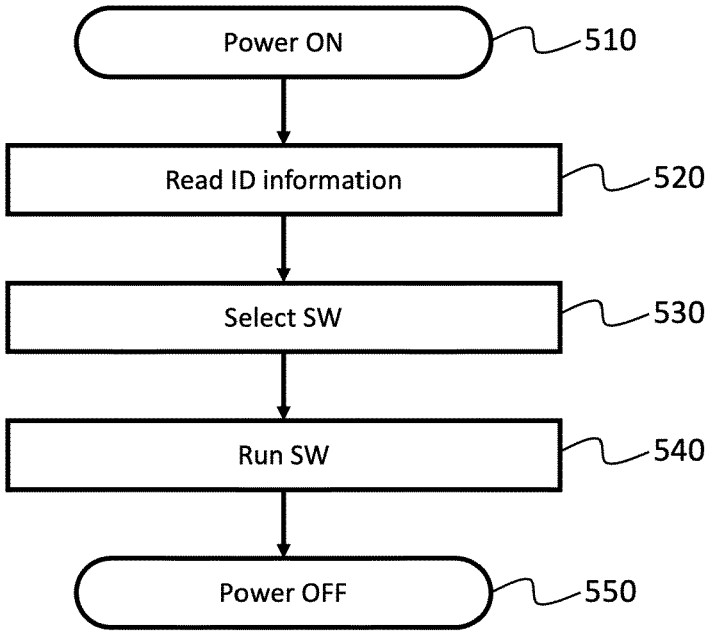

Figure 5

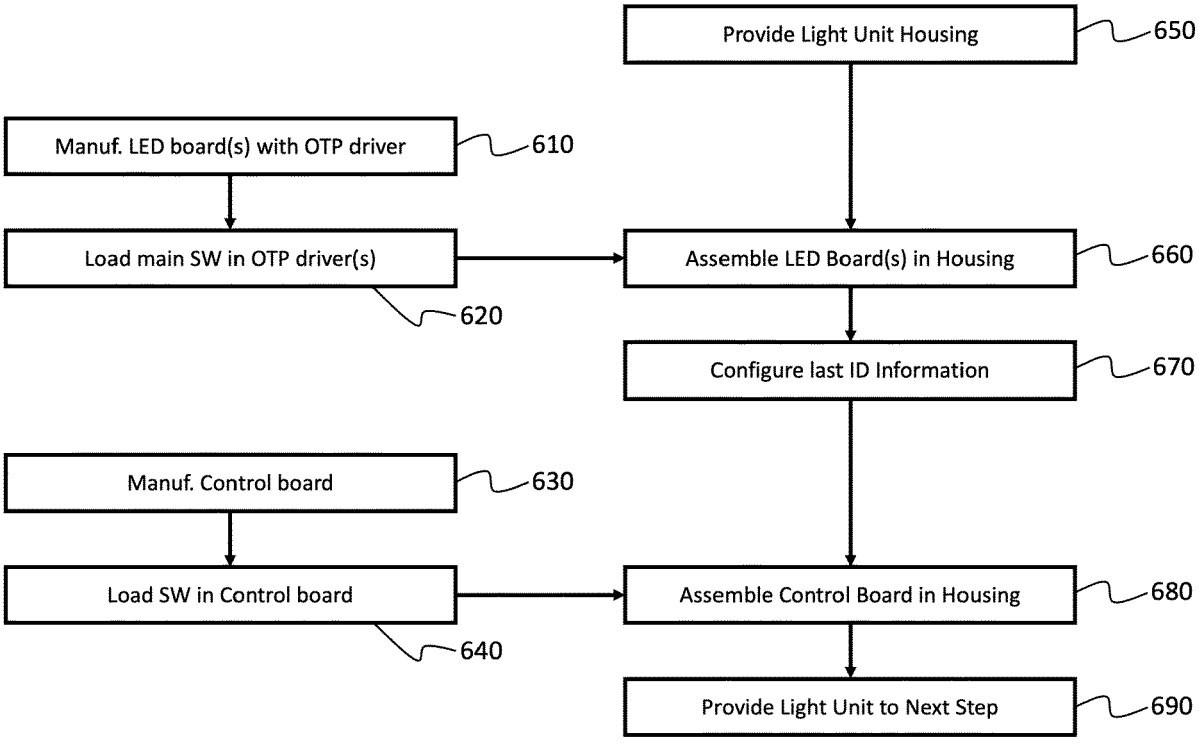

Figure 6

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EUROPEAN SEARCH REPORT

Application Number
EP 23 21 0186

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 2021/274615 A1 (GHEDIN DAVIDE [IT] ET AL) 2 September 2021 (2021-09-02) * paragraphs [0013] - [0059]; figures 1-5 * -----	1-13	INV. H05B47/135 H05B47/18 H05B45/10 ADD. H05B45/44

TECHNICAL FIELDS SEARCHED (IPC)

H05B

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	9 April 2024	Waters, Duncan

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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T : theory or principle underlying the invention
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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