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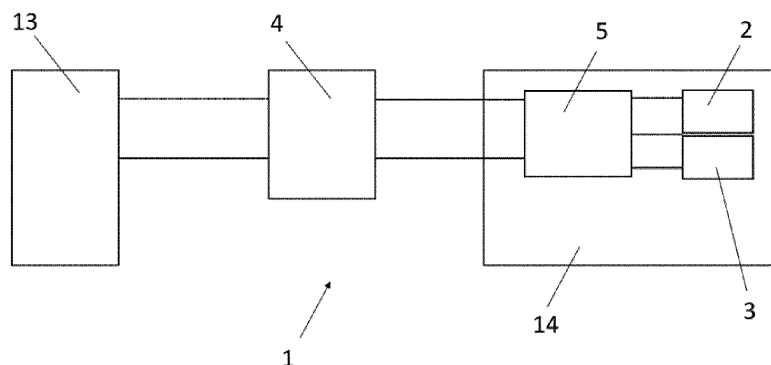
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(54) **ELECTRONIC ASSEMBLY AND AUTOMOTIVE LIGHTING DEVICE**

(57) The invention is referred to an electronic assembly (1) for an automotive lighting device (10). This electronic assembly (1) comprises a first light group (2) intended to perform a first light functionality, a second light group (3) intended to perform a second light functionality, a light driver (4) and a signal detector circuit (5). The light driver (4) is configured to receive at least a first signal and a second signal and to provide one output signal

which depends on them. The signal detector circuit (5) comprises a discriminator module (6) configured to receive the output signal of the light driver (4) and detect one parameter to the output signal, so the signal detector (5) is configured to provide an electrical feeding either to the first light group (2) or to the second light group (3), depending on the parameter of the output signal detected by the discriminator module (6).

[Fig. 1]



Description

[0001] This invention belongs to the field of lighting devices installed in automotive vehicles, and more specifically to the electronic assemblies used in these automotive lighting devices.

[0002] Current lighting devices need to control the operation of a big amount of solid-state light sources, such as LEDs. This control is performed by a driver element, which selectively provides electric feed to the LEDs.

[0003] However, these driver elements have limitations in terms of the number of channels, the available current and so on.

[0004] Managing the operation of the LEDs using the least number of driver channels would be beneficial for using cheaper drivers and for a better optimization of the automotive lighting device circuitry.

[0005] An alternative way of managing the driver's connections is therefore sought.

[0006] The invention provides an alternative solution for managing the managing the operation of LEDs by an electronic assembly and an automotive lighting device.

[0007] Unless otherwise defined, all terms (including technical and scientific terms) used herein are to be interpreted as is customary in the art. It will be further understood that terms in common usage should also be interpreted as is customary in the relevant art and not in an idealised or overly formal sense unless expressly so defined herein.

[0008] In this text, the term "comprises" and its derivations (such as "comprising", etc.) should not be understood in an excluding sense, that is, these terms should not be interpreted as excluding the possibility that what is described and defined may include further elements, steps, etc.

[0009] In a first inventive aspect, the invention provides an electronic assembly for an automotive lighting device, the electronic assembly comprising:

- a first light group, intended to perform a first light functionality;
- a second light group, intended to perform a second light functionality;
- a light driver, configured to receive at least a first signal and a second signal, and configured to provide one output signal which depends on the first signal and the second signal; and
- a signal detector circuit comprising a discriminator module configured to receive the output signal of the light driver and detect one parameter to the output signal, so the signal detector is configured to provide an electrical feeding either to the first light group or to the second light group, depending on the parameter of the output signal detected by the discriminator module.

[0010] With this structure, the light driver only needs one output to feed two different light groups. Therefore, a channel is saved and a cheaper driver may be used for managing the light functionalities. The signal detector circuit may be installed in the same printed circuit board as the light groups, without affecting the structure of drivers.

[0011] In some particular embodiments, the parameter of the output signal is the pulse width modulation rate, the light driver being configured to provide an output signal with different pulse width modulation rates depending on the first and second signals.

[0012] The pulse width modulation (PWM) rate is used in some automotive lighting applications to provide a plurality of customized actual current values from a single nominal current value. By performing a pulse modulation of 40% or 60%, the effective current value, which determines the luminous intensity provided by the LED, is affected, while the nominal amplitude of the current value is not affected.

[0013] In some particular embodiments, the light driver is configured to emit an output signal with a pulse width modulation higher than 60% when the first signal is active and is configured to emit an output signal with a pulse width modulation lower than 40% when the second signal is active. In some particular embodiments, the first light group is configured to provide a daytime running light functionality and the second light group is configured to provide a position light functionality.

[0014] Some lighting functionalities, such as daytime running lights, use direct current (100% PWM) or may use 80% or 90% PWM. On the other hand, other lighting functionalities, such as position light, may use the same nominal amplitude value but with 20% PWM

[0015] In some particular embodiments, the discriminator module comprises:

- a capacitor receiving the output signal of the light driver;
- a comparator element receiving the signal of the capacitor; and
- a transistor receiving the signal of the comparator in the base and receiving the original output signal from the driver between the collector and the emitter.

[0016] This particular arrangement detects the level of the PWM and discriminates between a "high" level of PWM (that would correspond to the first light group) and a "low" level of PWM (that would correspond to the second light group).

[0017] In some particular embodiments, the signal detector circuit further comprises a CMOS inverter with a P-MOSFET and a N-MOSFET, arranged to control the current received by each one of the light groups.

[0018] In the CMOS inverter, the MOSFETs act as switches: depending on the signal received by the tran-

sistor, the signal will be forwarded to one of the light groups.

[0019] In some particular embodiments, each light group comprises at least one solid-state light source, such as light emitting diodes (LEDs).

[0020] The term "solid state" refers to light emitted by solid-state electroluminescence, which uses semiconductors to convert electricity into light. Compared to incandescent lighting, solid state lighting creates visible light with reduced heat generation and less energy dissipation. The typically small mass of a solid-state electronic lighting device provides for greater resistance to shock and vibration compared to brittle glass tubes/bulbs and long, thin filament wires. They also eliminate filament evaporation, potentially increasing the life span of the illumination device. Some examples of these types of lighting comprise semiconductor light-emitting diodes (LEDs), organic light-emitting diodes (OLED), or polymer light-emitting diodes (PLED) as sources of illumination rather than electrical filaments, plasma or gas.

[0021] In a second inventive aspect, the invention provides an automotive lighting device comprising an electronic assembly according to the first inventive aspect.

[0022] This lighting device is particularly useful in automotive applications, when many lighting functionalities are required.

[0023] In some particular embodiments, the lighting device further comprises:

- a first optical element arranged to receive light from the plurality of the first light group and to shape the light into a light pattern projected outside the lighting device; and
- a second optical element arranged to receive light from the plurality of the second light group and to shape the light into a light pattern projected outside the lighting device.

[0024] This lighting device provides the advantageous functionality of efficiently managing the colour performance of the light sources.

[0025] An optical element is an element that has some optical properties to receive a light beam and emit it in a certain direction and/or shape, as a person skilled in automotive lighting would construe without any additional burden.

[0026] In some particular embodiments, the optical element is at least one of a light guide, a lens, a reflector or a collimator.

[0027] These optical elements are useful to manage the light produced by the plurality of light sources and provide uniform output.

[0028] To complete the description and in order to provide for a better understanding of the invention, a set of drawings is provided. Said drawings form an integral part of the description and illustrate an embodiment of the invention, which should not be interpreted as restricting

the scope of the invention, but just as an example of how the invention can be carried out. The drawings comprise the following figures:

5 [Fig. 1] shows an electronic assembly according to the invention.

[Fig. 2] shows an example of a signal detector circuit installed in an electronic assembly according to the invention.

10 [Fig. 3] shows a lighting device comprising an electronic assembly according to the invention and installed in an automotive vehicle.

15 **[0029]** In these figures, the following reference numbers have been used:

- 20 1 Electronic assembly
- 2 First light group
- 3 Second light group
- 25 4 Light driver
- 5 Signal detector circuit
- 6 Discriminator module
- 7 Capacitor
- 8 Comparator element
- 30 9 Transistor
- 10 Automotive lighting device
- 11 MOSFET
- 40 12 Lens
- 13 BCM
- 45 14 PCB

[0030] The example embodiments are described in sufficient detail to enable those of ordinary skill in the art to embody and implement the systems and processes herein described. It is important to understand that embodiments can be provided in many alternate forms and should not be construed as limited to the examples set forth herein.

[0031] Accordingly, while embodiment can be modified in various ways and take on various alternative forms, specific embodiments thereof are shown in the drawings and described in detail below as examples. There is no intent to limit to the particular forms disclosed. On the

contrary, all modifications, equivalents, and alternatives falling within the scope of the appended claims should be included. Elements of the example embodiments are consistently denoted by the same reference numerals throughout the drawings and detailed description where appropriate.

[0032] Unless otherwise defined, all terms (including technical and scientific terms) used herein are to be interpreted as is customary in the art. It will be further understood that terms in common usage should also be interpreted as is customary in the relevant art and not in an idealised or overly formal sense unless expressly so defined herein.

[0033] In this text, the term "comprises" and its derivations (such as "comprising", etc.) should not be understood in an excluding sense, that is, these terms should not be interpreted as excluding the possibility that what is described and defined may include further elements, steps, etc.

[0034] Figure 1 shows an electronic assembly 1 according to the invention. This electronic assembly is suitable for being used in an automotive lighting device.

[0035] The electronic assembly 1 comprises the following elements:

- a first LED group 2, intended to perform a daytime running light functionality;
- a second LED group 3, intended to perform a position light functionality;
- a body control module 13;
- a light driver 4 receiving instructions from the body control module; and
- a signal detector circuit 5 located between the light driver and the LED groups.

[0036] The body control module 13 sends instructions to activate the position light or the daytime running light. These light functionalities are not active at the same time. There are other pairs of light functionalities which are not active at the same time (turning indicator and daytime running light, for example). The body control may send these instructions to the light driver 4 in the most suitable mode.

[0037] The light driver 4 receives the instruction to activate the daytime running light or to activate the position light. It deals internally with these instructions and provide an output signal. This output signal has always the same nominal amplitude, but has a different value of pulse width modulation (PWM). When the daytime running light is to be activated, a continuous signal (100% PWM) or a high-modulation signal (80-90% PWM) is output from the driver. On the contrary, when the position light is to be activated, a low-modulation signal (10-20% PWM) is sent. A single output channel is therefore needed to cre-

ate a signal for two different light groups, intended to provide two different functionalities.

[0038] The signal detector circuit 5 receives the output signal of the light driver 4. This signal detector circuit comprises a discriminator module, which is configured to receive the output signal of the light driver 4 and detect the PWM rate of the output signal. After detecting this PWM rate, the signal detector circuit is configured to provide the electric signal received from the light driver either to the first LED group or to the second LED group, depending on the PWM rate of the output signal detected by the discriminator module.

[0039] The signal detector circuit 5, together with the LED groups 2, 3 are arranged in the same printed circuit board 14.

[0040] Figure 2 shows an example of a signal detector circuit 5 installed in an electronic assembly according to the invention.

[0041] The output signal of the light driver is received by a capacitor 7, which has a different behaviour depending on the PWM rate of the received signal. This behaviour is captured by a comparator element 8, which provides a base signal to a transistor 9, arranged to modulate the output signal from the light driver 4.

[0042] This modulated output is received by the current derivator, which comprises a CMOS inverter with a P-MOSFET 11 and an N-MOSFET 11, which are configured to switch on or off depending on the received signal. Thus, the signal is sent either to the first LED group 2, configured to provide the daytime running light (if the output signal from the driver has a high PWM rate) or to the second LED group 3, configured to provide the position light (if the output signal from the driver has a low PWM rate)

[0043] Figure 3 shows an automotive lighting device 10 comprising an electronic assembly according to the invention. This lighting device provides the daytime running light and the position light by two different light groups 2, 3.

[0044] This lighting device comprises a projecting lens 12 which receives the light of the plurality of LEDs and shape it into a light pattern projected outside the lighting device.

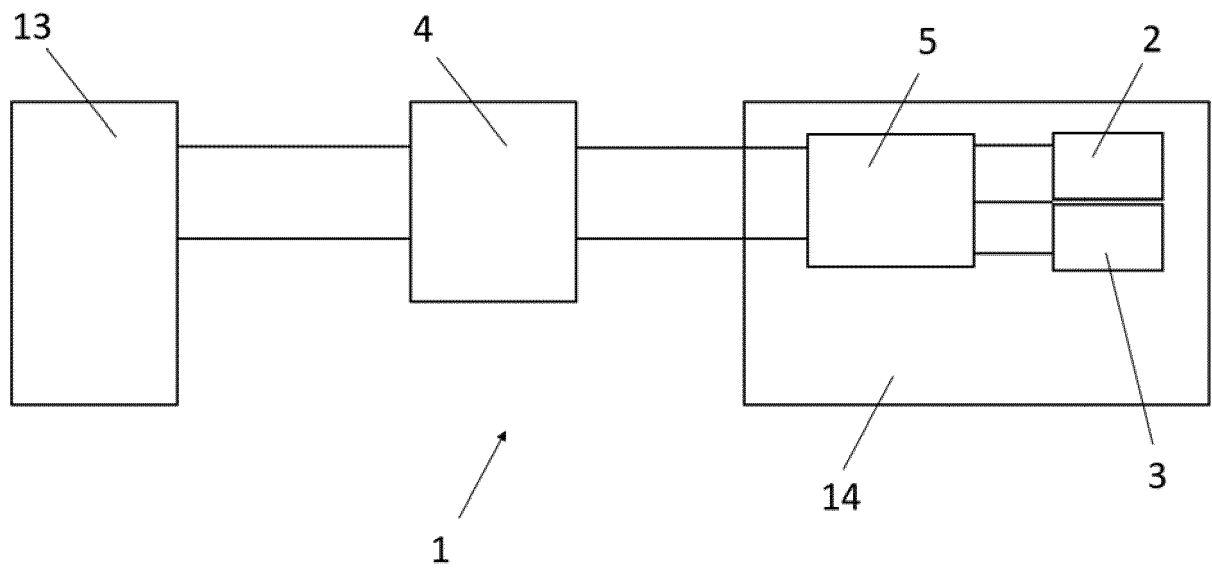
Claims

1. Electronic assembly (1) for an automotive lighting device (10), the electronic assembly (1) comprising:

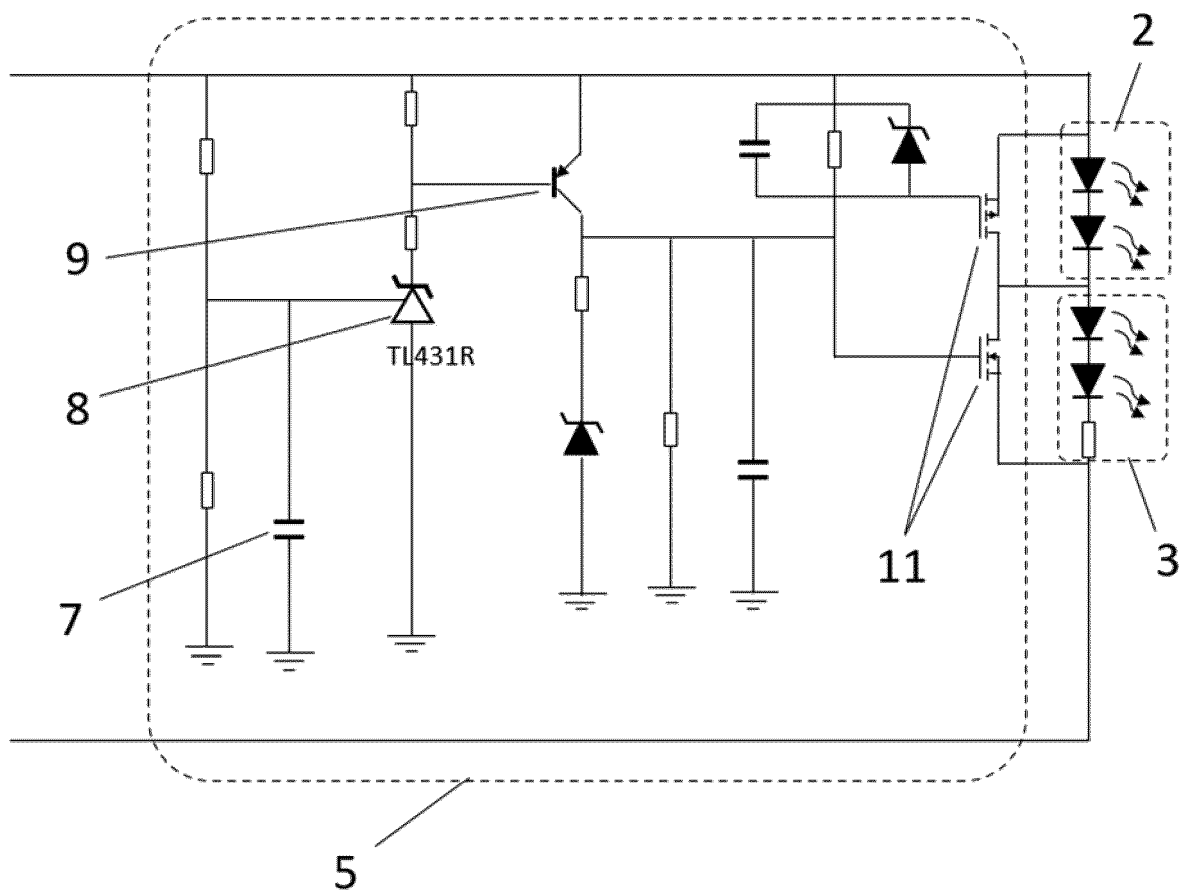
- a first light group (2), intended to perform a first light functionality;
- a second light group (3), intended to perform a second light functionality;
- a light driver (4), configured to receive at least a first signal and a second signal, and configured to provide one output signal which depends on the first signal and the second signal

- a signal detector circuit (5) comprising a discriminator module (6) configured to receive the output signal of the light driver (4) and detect one parameter to the output signal, so the signal detector (5) is configured to provide an electrical feeding either to the first light group (2) or to the second light group (3), depending on the parameter of the output signal detected by the discriminator module (6). 5
- 2. Electronic assembly (1) according to claim 1, wherein the parameter of the output signal is the pulse width modulation rate, the light driver (4) being configured to provide an output signal with different pulse width modulation rates depending on the first and second signals. 15
- 3. Electronic assembly (1) according to claim 1, wherein the light driver (4) is configured to emit an output signal with a pulse width modulation higher than 60% when the first signal is active and is configured to emit an output signal with a pulse width modulation lower than 40% when the second signal is active. 20
- 4. Electronic assembly (1) according to any of the preceding claims, wherein the first light group (2) is configured to provide a daytime running light functionality and the second light group (3) is configured to provide a position light functionality. 25
- 5. Electronic assembly (1) according to any of the preceding claims, wherein the discriminator module (6) comprises 30
 - a capacitor (7) receiving the output signal of the light driver; 35
 - a comparator element (8) receiving the signal of the capacitor (7); and
 - a transistor (9) receiving the signal of the comparator element (8). 40
- 6. Electronic assembly (1) according to any of the preceding claims, wherein the signal detector circuit (5) further comprises a CMOS inverter with a P-MOSFET (11) and a N-MOSFET (11), arranged to control de current received by each one of the light groups. 45
- 7. Electronic assembly (1) according to any of the preceding claims, wherein each light group (2, 3) comprises at least one solid-state light source, such as light emitting diodes or LEDs. 50
- 8. Automotive lighting device (10) comprising an electronic assembly (1) according to any of the preceding claims. 55
- 9. Automotive lighting device (10) according to claim 8, further comprising
 - a first optical element (12) arranged to receive light from the plurality of the first light group (2) and to shape the light into a light pattern projected outside the lighting device; and
 - a second optical element arranged to receive light from the plurality of the second light group (3) and to shape the light into a light pattern projected outside the lighting device.
- 10. Automotive lighting device (10) according to claim 9, wherein the first and/or second optical element (12) is at least one of a lens, a light guide, a reflector or a collimator.

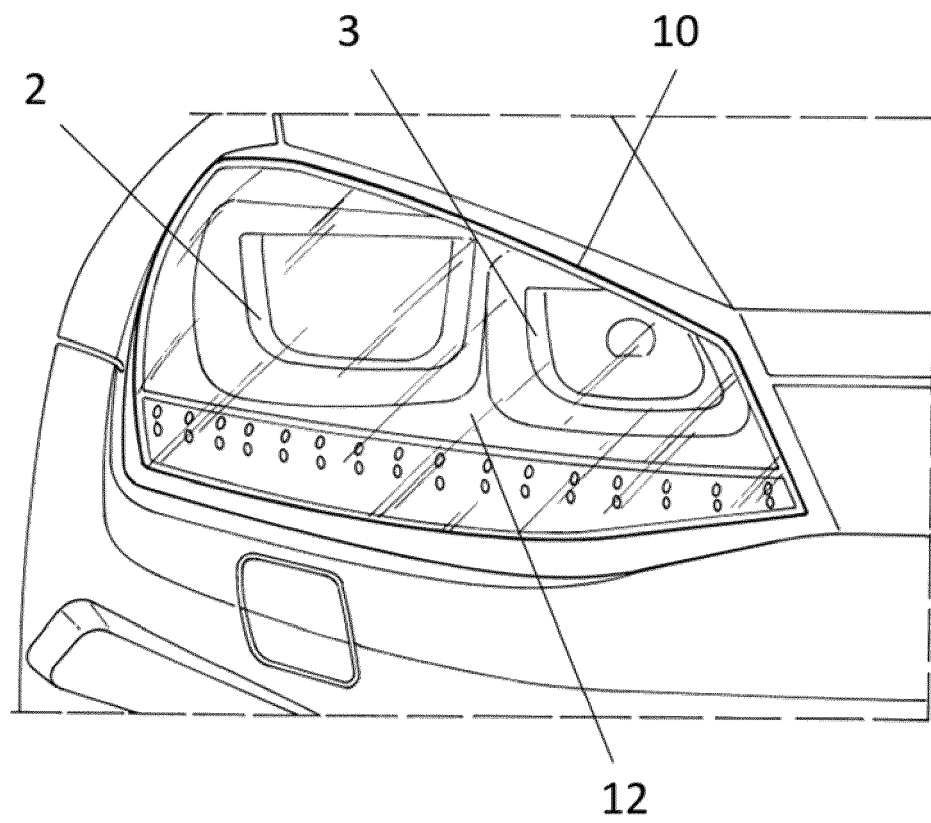
[Fig. 1]



[Fig. 2]



[Fig.3]





EUROPEAN SEARCH REPORT

Application Number

EP 22 18 0531

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2019/061607 A1 (WIECZOREK ROMEO [DE] ET AL) 28 February 2019 (2019-02-28) * paragraph [0101] - paragraph [0104]; figures 21, 22 *	1-10	INV. H05B47/105 H05B45/335 H05B45/48 H05B45/20
X	US 2019/364648 A1 (YOKOBORI TOSHIO [JP]) 28 November 2019 (2019-11-28) * paragraph [0058] - paragraph [0088]; figures 4, 5A, 5B *	1, 2, 4-10	H05B45/325 H05B45/10
			TECHNICAL FIELDS SEARCHED (IPC)
			H05B
The present search report has been drawn up for all claims			

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EPO FORM 1503 03.82 (P04C01)

Place of search	Date of completion of the search	Examiner
Munich	8 November 2022	Beaugrand, Francois
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 22 18 0531

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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10	Patent document cited in search report	Publication date	Patent family member(s)	Publication date
	US 2019061607 A1	28-02-2019	NONE	
15	US 2019364648 A1	28-11-2019	JP 7150472 B2	11-10-2022
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