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(54) Title: EMERGENCY LIGHTING DRIVER WITH PROGRAMMABLE DIMMING LEVEL AND COLOR TEMPERATURE

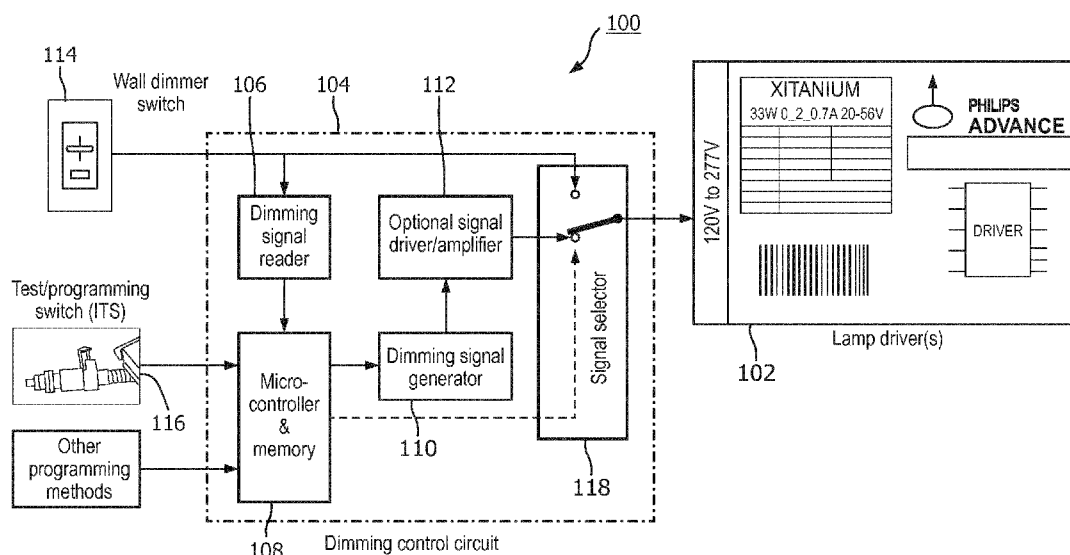


FIG. 1

(57) Abstract: A lighting system and method includes a programmable dimming level and/or color temperature. The system includes a lamp driver (102) configured to power a light source during a normal operating mode and at a desired dimming level during an emergency lighting mode. The system includes a control circuit (104) including a dimming signal reader (106) detecting the desired dimming level input via a dimming switch (114) and a controller (108) including a memory for storing the desired dimming level.



TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,
KM, ML, MR, NE, SN, TD, TG).

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- *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*
- *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

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Emergency lighting driver with programmable dimming level and color temperature

BACKGROUND

Lighting systems are capable of providing light output during both a normal operating condition and during an emergency lighting condition such as, for example, a power failure condition, a brownout condition and/or a demand response condition (e.g., as communicated from a utility or local controller). Some emergency lighting systems have dimming capabilities so that, when an emergency lighting condition occurs, light is output at a dimmed level. Currently available emergency lighting systems provide an AC current to operate normal lamp drivers with a dimming signal to reduce the light level down to a fixed percentage or power level that is specific to the system. A lighting system designer designs the entire lighting system around this fixed number during manufacturing of the system. This, however, may be a complicated and time-consuming process and, in many cases, produces inaccurate results. Light output may appear differently depending on factors such as, for example, a size of the space, a shape of the light fixture, a color of the walls/floors of the space and a reflectivity of the paint.

SUMMARY

The exemplary embodiments are directed to a lighting system, comprising: a lamp driver configured to power a light source during a normal operating mode and at a desired dimming level during an emergency lighting mode; and a control circuit including a dimming signal reader detecting the desired dimming level input via a dimming switch and a controller including a memory for storing the desired dimming level.

The exemplary embodiments are directed to a method, comprising: setting a desired dimming level at which light is to be output when a lighting system is in an emergency mode, the desired dimming level set via a dimming switch; detecting the desired dimming level set via the dimmer switch and sending the desired dimming level to a controller; initiating a storage of the desired dimming level in a memory of the controller; and storing the desired dimming level in the memory of the controller.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 shows a schematic view of a lighting system according to an exemplary embodiment.

Fig. 2 shows a flow diagram of a method according to an exemplary
5 embodiment.

Fig. 3 shows a schematic view of a lighting system according to another exemplary embodiment.

Fig. 4 shows a schematic view of a lighting system according to another exemplary embodiment.

Fig. 5 shows a schematic view of a lighting system according to yet another
10 exemplary embodiment.

DETAILED DESCRIPTION

The exemplary embodiments may be further understood with reference to the
15 following description and the related appended drawings, wherein like elements are provided with the same reference numerals. The exemplary embodiments are related to a system and method for providing emergency lighting. In particular, the exemplary embodiments describe a lighting system capable of producing a light output during both a normal operating mode and at a dimmed level during an emergency lighting mode, the dimming level being
20 programmable during an installation of the system. Thus, rather than having a predetermined dimming level specific to the system, the lighting installer may set a desired dimming level during installation of the system so that a dimmed light output during an emergency lighting mode may be set specific to an environment or space in which the system is being utilized. The installer may accurately set the dimming level in different areas according to
25 environmental factors such as, for example, a size of the space, a physical shape of the light fixture, a color of the floor/walls and/or a reflectivity of the paint.

As shown in Fig. 1, a lighting system 100 according to an exemplary
embodiment comprises a lamp driver 102 and a dimming control circuit 104 for transmitting
dimming signals to the lamp driver 102 to produce a light output during both a normal
30 operating mode and at a fixed dimmed level during an emergency lighting mode. A desired dimming level for the emergency lighting mode may be set by an installer (e.g., electrician) of the lighting system 100 so that the installer may determine the desired dimming level based on environmental factors (e.g., size of space, shape of light fixture, color of space, and reflectivity of surfaces) and/or other factors/preferences. The installer may program the

dimming control circuit 104 to include the desired dimming level by setting a light output at the desired dimmed level via, for example, a wall dimmer 114. Once the wall dimmer 114 has been set to produce the light output at the desired dimming level, the installer may store the desired dimming level in the dimming control circuit 104 by pressing a programming switch 116 (e.g., illuminated tactile switch (ITS) or using other programming methods. Upon storage of the desired dimming level, light will be output at the desired dimming level during the emergency mode, as will be described in further detail below. In this embodiment, the lighting system 100 may be switched between the normal operating mode and the emergency lighting mode via a signal selector 118. Although not shown, it will be understood by those of skill in the art that the lamp driver 102 drives power to a light source to produce the desired light output. The light source may include any of a variety of standard light sources including, for example, LED-based sources, incandescent sources, fluorescent sources, phosphorescent sources, etc.

The dimming control circuit 104 includes a dimming signal reader 106 (e.g., analog-to-digital converter (ADC)) for detecting the desired dimming level produced via the wall dimmer 114, a microcontroller 108 for storing the desired dimming level and a dimming signal generator 110 (e.g., digital-to-analog converter (DAC)) receiving the desired dimming level from the microcontroller 108 and converting the desired dimming level to a corresponding dimming signal for transmission to the lamp driver 102. The dimming circuit 104 may also comprise a dimming signal driver/amplifier 112 (e.g., power supply unit (PSU)) transmitting the converted dimming signal to the lamp driver 102. It will be understood by those of skill in the art, however, that the dimming signal may be transmitted directly from the dimming signal generator 110 to the lamp driver 102.

The microcontroller 108 includes any of a variety of devices relating to the operation of the lighting system 100. In an exemplary embodiment, the microcontroller 108 includes a processor which may be programmed by the installer to store the desired dimming level in a memory thereof. The microcontroller 108 may also be preprogrammed to perform other lighting-related functions such as, for example, a switching between the normal operating mode and the emergency lighting mode. For example, one or more emergency lighting conditions may be stored in the memory of the microcontroller 108 so that, when any of these conditions are met, the microcontroller 108 will switch the lighting system 100 from a default normal operating mode to the emergency mode so that the set desired dimming level is transmitted to the lamp driver 102 to produce a light output at the desired dimmed level during the emergency mode. The programming function along with switching between

normal and emergency modes may implemented by the microcontroller 108 as, for example, lines of code that are executed by the microcontroller 108, as firmware executed by the microcontroller 108, as a function of the microcontroller 108 being an application specific integrated circuit (ASIC), etc.

5 Fig. 2 shows a method 200 for programming the dimming control circuit 104 of the lighting system 100 to include a desired dimming level at which light is to be output during the emergency mode. During installation of the lighting system 100, in 210, the installer sets a desired dimming level using for example, the wall dimmer 114. The wall dimmer 114 may include any of a variety of standard dimming mechanisms including, for
10 example, a slider or rotary knob, that is movable to indicate a level of desired light output, or a digital dimmer including an input mechanism for indicating the desired light output. The installer may set the desired dimmed lighting output based on any of a number of factors and/or preferences including, for example, a size of space to be illuminated, a shape of a light fixture via which the light is output, a color of the space being illuminated, and reflectivity of
15 surfaces within the space.

 In 220, the dimming signal reader 106 detects a signal corresponding to the desired dimming level and sends the signal to the microcontroller 108. The dimming signal reader 106 may include an ADC, which detects an analog signal generated by the wall dimmer 114 and converts the signal to a digital signal for the microcontroller 108.

20 In 230, the installer may initiate a programming or storage of the desired dimming level via the programming switch 116. The programming switch may include any of a variety of electronic switches including, for example, an ITS which may be pressed to indicate to the microcontroller 108 that the desired dimming level should be stored. Although the exemplary embodiments show and describe a programming switch 116 such as the ITS, it
25 will be understood by those of skill in the art that other programing methods may be used to initiate storage/programming of the desired dimming level. For example, the microcontroller 108 may be programmed so that, when the power is cycled through the system three times, the desired dimming level is stored to the memory of the controller 108. In 240, the microcontroller 108 stores the desired dimming level to a memory thereof. Once the desired
30 dimming level has been programmed, installation of the lighting system 100 may be completed so that desired dimming level may be implemented during the emergency mode, as will be described in further detail below.

 As described above, the lighting system 100 includes the signal selector 118 for switching between the normal operating mode and the emergency lighting mode. The

lighting system 100 may be set so that, in a default configuration, the dimming control circuit is in the normal operating mode. In the normal operating mode, the signal selector 118 is set so that a signal from the wall dimmer 114 is directly transmitted to the lamp driver 102. A user of the lighting system 100 may set a desired light output using the wall dimmer 114. The lighting output may be changed at any time using the wall dimmer 114 and the signal is continuously transmitted directly to the lamp driver 102.

When one or more emergency conditions are detected, the signal selector 118 is switched to the emergency mode. The one or more emergency conditions are stored in the memory associated with the microcontroller 108. The emergency conditions may include, for example, a power failure/outage, a brownout and/or a demand/response condition. In the emergency mode, the lamp driver 102 receives the desired dimming level from the microcontroller 108 to provide light output at the desired dimmed level. In particular, the microcontroller 108 sends the stored desired dimming level to the dimming signal generator 110. The dimming signal generator 110 may include a DAC which converts the digital signal corresponding to the desired dimming level to an analog signal for the lamp driver 102. The converted signal, which corresponds to the desired dimming level, is then transmitted to the lamp driver 102 via the dimming signal driver 112 to produce the desired dimmed level light output. The dimming signal driver 112 may include, for example, a PSU. Although the exemplary embodiment shows and describes the dimming signal 112, however, it will be understood by those of skill in the art that, in some cases, the dimming signal driver 112 may be eliminated so that the converted signal corresponding to the desired dimming level may be transmitted directly to the lamp driver 102.

When one of the emergency conditions is no longer detected, the signal selector 118 may revert to the default configuration – the normal operating mode – so that the lighting output may once again be controlled via the wall dimmer 114, which sends a signal indicating the desired light output directly to the lamp driver 102.

As shown in Fig. 3, a lighting system 300 according to another exemplary embodiment may be substantially similar to the lighting system 100, as described above. The lighting system 300 comprises a lamp driver 302 and a dimming control circuit 304, which may be programmed by an installer of the lighting system 300 with a desired dimming level at which light is to be output during an emergency mode. Similarly to the lighting system 100, the desired dimming level may be set using a wall dimmer 314. Once the desired dimming level has been set using the wall dimmer 314, the installer may initiate a storage of the desired dimming level using a programming switch 316. It will be understood by those of

skill in the art that the dimming control circuit 304 may be programmed with the desired dimming level for the emergency mode using the method 200 as described above with respect to the lighting system 100.

Similarly to the dimming control circuit 104, the dimming control circuit 304 includes a dimming signal reader 306 for detecting a signal from the wall dimmer 314, a microcontroller 308 for storing the desired dimming level and a dimming signal generator 310 for generating a signal corresponding to the desired dimming level to the lamp driver 302. The dimming control circuit 304 may also include a dimming signal driver 312 for transmitting the signal corresponding to the desired dimming level to the lamp driver 302. It will be understood by those of skill in the art, however, that the signal may be transmitted directly from the dimming signal generator 310 to the lamp driver 302.

The dimming control circuit 304, however, does not include a signal switch for switching between the normal operational mode and the emergency lighting mode. Rather, in this embodiment, the dimming control circuit 304 continuously receives a light signal from the wall dimmer 314 so that, in the normal operating mode, the light signal is passed through the entire dimming control circuit 304 to drive the lamp driver 302. In other words, in the normal operating mode, a user sets a desired level of light output using the wall dimmer 314. A signal corresponding to the desired level of light is detected by the dimming signal reader 306, which sends the signal to the microcontroller 308. The microcontroller 308 then sends the desired level of light signal to the dimming signal generator 310, which converts the signal for the lamp driver 302. This converted signal may be transmitted to the lamp driver 302 via the dimming signal driver 312. In the normal operating mode, the desired level of light signal from the wall dimmer 314 is continuously passed through the dimming control circuit 304.

Similarly to the lighting system 100, the microcontroller 308 is preprogrammed with conditions indicating an emergency lighting condition. When any of these emergency lighting conditions are detected, the lighting system 300 is switched to the emergency mode. In the emergency mode, rather than transmitting the desired level of light signal from the wall dimmer 314, the microcontroller 308 transmits the previously programmed desired dimming level to the lamp driver 302 via the dimming signal generator 310 and/or the dimming signal driver 312, as described above with respect to the lighting system 100.

According to a further exemplary embodiment, as shown in Fig. 4, a lighting system 400 may be substantially similar to the lighting system 100 including features for

transmitting signals corresponding to a desired dimming level of a light output during both a normal operating mode and an emergency mode. The lighting system 400, however, further includes features for controlling a color temperature (e.g., soft white, bright white, etc.) during both the normal and emergency modes. In particular, the lighting system 400 allows an installer to program a desired dimming level and a desired color temperature of a light output during the emergency mode.

The lighting system 400 comprises a lamp driver 402 and a dimming/color control circuit 404 for controlling a dimming level and a color temperature of a light output. Similarly to the lighting system 100, the dimming/color control circuit 404 includes a dimming signal reader 406 for detecting a desired dimming level produced via, for example, a wall dimmer 414, a microcontroller 408 for storing the desired dimming level and a dimming signal generator 410 for receiving the desired dimming level from the microcontroller 408 and converting the desired dimming level to a corresponding dimming signal for transmission to the lamp driver 402. As described above with respect to the lighting system 100, the dimming/control circuit 404 may also include a dimming signal driver 412 for transmitting the converted signal to the lamp driver 402.

In this embodiment, the dimming/control circuit 404, however, further includes a color signal reader 420 for detecting a desired color temperature of the light output produced via, for example, a wall color switch 426. The wall color switch 426 may include any of a variety of standard color temperature controllers such as, for example, a slider or rotary knob that is movable to indicate a desired color temperature of the light output, or a digital color switch/tuner including an input mechanism for indicating the desired color temperature. The desired color temperature may be stored by the microcontroller 408 so that a color signal generator 422 receives the desired color temperature from the microcontroller 408 and converts the desired color temperature to a corresponding color signal for transmission to the lamp driver 402. The dimming/color control circuit 404 may also include a signal driver/amplifier 424 via which the converted color temperature signal may be transmitted to the lamp driver 402. It will be understood by those of skill in the art, however, that the color temperature signal may be transmitted directly from the color signal generator 422 to the lamp driver 402.

Similarly to the lighting system 100, the lighting system 400 also comprises a programming switch 416 or other programming methods for initiating programming of the desired dimming level and the desired color temperature of a light output in the emergency mode. The dimming/color control circuit 404 also comprises a signal selector 418 for

switching the lighting system 400 between the normal operating mode and the emergency mode. In the normal operating mode, the signal selector 418 is set so that a dimming signal and a color temperature signal are transmitted directly from the wall dimmer 414 and the wall color switch 426, respectively, to the lamp driver 402. In the emergency mode, the signal selector 418 is switched so that the programmed desired dimming level and color temperature, which have been stored in the microcontroller 408, are transmitted to the lamp driver 402. As described above with respect to the lighting system 100, the microcontroller 408 may be preprogrammed so that, when certain conditions are met, the signal selector 418 is switched from a default normal operating mode to the emergency mode.

A method for programming the desired dimming level and color temperature for a light output in the emergency mode may be substantially similar to the method 200, shown in Fig. 2 and described above. The desired dimming level and the desired color temperature, however, are individually controllable via the wall dimmer 414 and the wall color switch 426, respectively. Once the desired dimming level and color temperature have been set via the wall dimmer 414 and the wall color switch 426, the installer may press the programming switch 416, or use other programming methods, to store the desired dimming level and color temperature to the microcontroller 408.

As shown in Fig. 5, a lighting system 500 according to another exemplary embodiment may be substantially similar to the lighting system 400 described above, including features for programming a desired dimming level and a desired color temperature of a light output during an emergency mode. Similarly to the lighting system 200, however, the lighting system 500 switches between the normal operating mode and the emergency mode without the use of a signal selector. In particular, similarly to the lighting system 400, the lighting system 500 comprises a lamp driver 502 and a dimming/color control circuit 504, which may be programmed during installation of the lighting system 500 with a desired dimming level and a desired color temperature at which light is to be output during an emergency mode. The desired dimming level and the desired color temperature may be set using a wall dimmer 514 and a wall color switch 520, respectively. Once the desired dimming level and color temperature have been set, the installer may initiate a storage of the desired dimming level and color temperature via a programming switch 516 or other programming methods. It will be understood by those of skill in the art that programming the dimming/color control circuit 504 with the desired dimming level and color temperature for light output during the emergency mode is substantially similar to the method described above with respect to the lighting system 400.

Similarly to the dimming/color control circuit 404, the dimming/color control circuit 505 includes features for programming and producing a desired dimming level for a light output of the emergency mode comprising a dimming signal reader 506 for detecting a desired dimming level produced via the wall dimmer 514, a microcontroller 508 for storing the desired dimming level, a dimming signal generator 510 for receiving the desired dimming level from the microcontroller 508 and converting the desired dimming level to a corresponding dimming signal for transmission to the lamp driver 502. As described above with respect to the lighting system 400, the dimming/control circuit 504 may also include a dimming signal driver 512 for transmitting the converted signal to the lamp driver 502.

For programming and producing the desired color temperature, the dimming/color control circuit 504 includes a color signal reader 520 for detecting the desired color temperature of the light output produced via the wall color switch 526. The desired color temperature may be stored to the microcontroller 508. A color signal generator 522 receives the desired color temperature from the microcontroller 508 and converts the desired color temperature to a corresponding color signal for transmission to the lamp driver 502. The dimming/color control circuit 504 may also include a signal driver/amplifier 524 via which the converted color temperature signal may be transmitted to the lamp driver 502. It will be understood by those of skill in the art, however, that the color temperature signal may be transmitted directly from the color signal generator 522 to the lamp driver 502.

As noted above, the dimming/color control circuit 504 does not include a signal switch for switching between the normal operating mode and the emergency mode. In this embodiment, the dimming/color control circuit 504 continuously receives signals from the wall dimmer 514 and the wall color switch 526. In the normal operating mode, a normal dimming level signal set via the wall dimmer 514 is received by the dimming signal reader 506 and transmitted through the microcontroller 508 and the dimming signal generator 510 to the lamp driver 502. Similarly, a normal color temperature signal set via the wall color switch 526 is received via the color signal reader 520 and transmitted through the microcontroller 508 and the color signal generator 522 to the lamp driver 502. In the normal operating mode, the dimming level signal and the color temperature signal from the wall dimmer 514 and the wall color switch 526, respectively, are continuously passed through the dimming/color control circuit 504 to the lamp driver 502.

When the microcontroller 508 determined that emergency conditions are met and switches the lighting system 500 to the emergency mode, however, the microcontroller 508 transmits the previously programmed desired dimming level signal and the desired color

temperature signal to the lamp driver 502 via the dimming signal generator 510 and the color signal generator 522, respectively.

Those skilled in the art will understand that the above-described exemplary embodiments may be implemented in any suitable software or hardware configuration or combination thereof. In a further example, the exemplary embodiments of the above described method may be embodied as a computer program product containing lines of code stored on a computer readable storage medium that may be executed on a processor or microprocessor. The storage medium may be, for example, a local or remote data repository compatible or formatted for use with the above noted operating systems using any storage operation.

It will be apparent to those skilled in the art that various modifications may be made in the present disclosure, without departing from the spirit or the scope of the disclosure. Thus, it is intended that the present disclosure cover modifications and variations of this disclosure provided they come within the scope of the appended claims and their equivalent.

CLAIMS:

1. A lighting system, comprising:

a lamp driver configured to power a light source during a normal operating mode and at a desired dimming level during an emergency lighting mode; and

a control circuit to transmit respective dimming signals, while in the normal operating and emergency lighting modes, to the lamp driver, wherein the control circuit includes a dimming signal reader to detect a desired dimming level input and a controller including a memory for storing the desired dimming level;

wherein the desired dimming level input for the normal operating mode is controlled by an external dimming switch and the desired dimming level input for the emergency lighting mode is received from the external dimming switch while in the normal operating mode of the lighting system and stored the memory for use in the emergency mode.

2. The lighting system of claim 1, wherein the memory of the controller includes one or more emergency lighting conditions stored thereon so that, when one or more of the emergency lighting conditions is detected via the controller, the control circuit is switched from the normal operating mode to the emergency lighting mode.

3. The lighting system of claim 1, wherein the control circuit further includes a dimming signal generator receiving the desired dimming level from the controller and generating a dimming signal corresponding to the desired dimming level for the lamp driver, when in the emergency mode.

4. The lighting system of claim 1, wherein the control circuit further includes a signal selector for switching between the normal operating mode and the emergency lighting mode, the lamp driver receiving a light signal corresponding to a desired light output directly from the dimmer switch in the normal operating mode.

5. The lighting system of claim 4, wherein, in the normal operating mode, the dimming signal reader detects a desired light output from the dimmer switch and sends the

desired light output to the controller, the dimming signal generator generates a normal dimming signal corresponding to the desired light output and transmits the normal dimming signal to the lamp driver.

5 6. The lighting system of claim 1, the control circuit further including a color signal reader detecting a desired color temperature level input via a color switch, the desired color temperature storable in the memory of the controller.

10 7. The lighting system of claim 6, wherein the control circuit further includes a color signal generator receiving the desired color temperature level from the controller and generating a color temperature signal corresponding to the desired color temperature for the lamp driver, when in the emergency mode.

15 8. The lighting system of claim 7, wherein, in the normal operating mode, the color signal reader detects a desired color temperature of a light output from the color switch and sends the desired color temperature to the controller, the color signal generator generates a normal color signal corresponding to the desired color temperature of the light output and transmits the normal color signal to the lamp driver.

20 9. A method of controlling a lamp driver configured to power a light source during a normal operating mode and at a desired dimming level during an emergency lighting mode, comprising:

25 while in the normal mode, setting a desired dimming level at which light is to be output when a lighting system is in an emergency mode, the desired dimming level set via an external dimming switch;

 detecting the desired dimming level set via the external dimmer switch and sending the desired dimming level to a controller;

 initiating a storage of the desired dimming level in a memory of the controller; and

30 storing the desired dimming level in the memory of the controller for use in the emergency mode.

10. The method of claim 9, further comprising:
 determining when one or more emergency lighting conditions are met; and

switching the lighting system from a normal operating mode to the emergency mode.

11. The method of claim 10, further comprising, when in the normal operating mode:

detecting a desired light output from the dimmer switch and sending the desired light output to the controller; and

generating a normal dimming signal corresponding to the desired light output and transmitting the normal dimming signal to the lamp driver to provide the desired light output.

12. The method of claim 9, further comprising, when in the emergency mode: receiving the desired dimming level and generating a dimming signal corresponding to the desired dimming level; and

transmitting the dimming signal to the lamp driver to provide light output at the desired dimming level.

13. The method of claim 9, wherein switching from the normal operating mode to the emergency mode includes switching a signal selector and, when in the emergency mode, the signal selector is set so that the lamp driver receives a light signal corresponding to a desired light output directly from the dimmer switch.

14. The method of claim 9, further comprising:

setting a desired color temperature at which light is to be output when the lighting system is in the emergency mode, the desired color temperature set via a color switch;

detecting the desired color temperature set via the color switch and sending the desired color temperature to the controller; and

storing the desired dimming level in the memory of the controller, when storage is initiated.

15. The method of claim 14, further comprising, when in the emergency mode: receiving the desired color temperature and generating a color temperature signal corresponding to the desired color temperature; and

transmitting the color temperature signal to the lamp driver to provide light output at the desired color temperature.

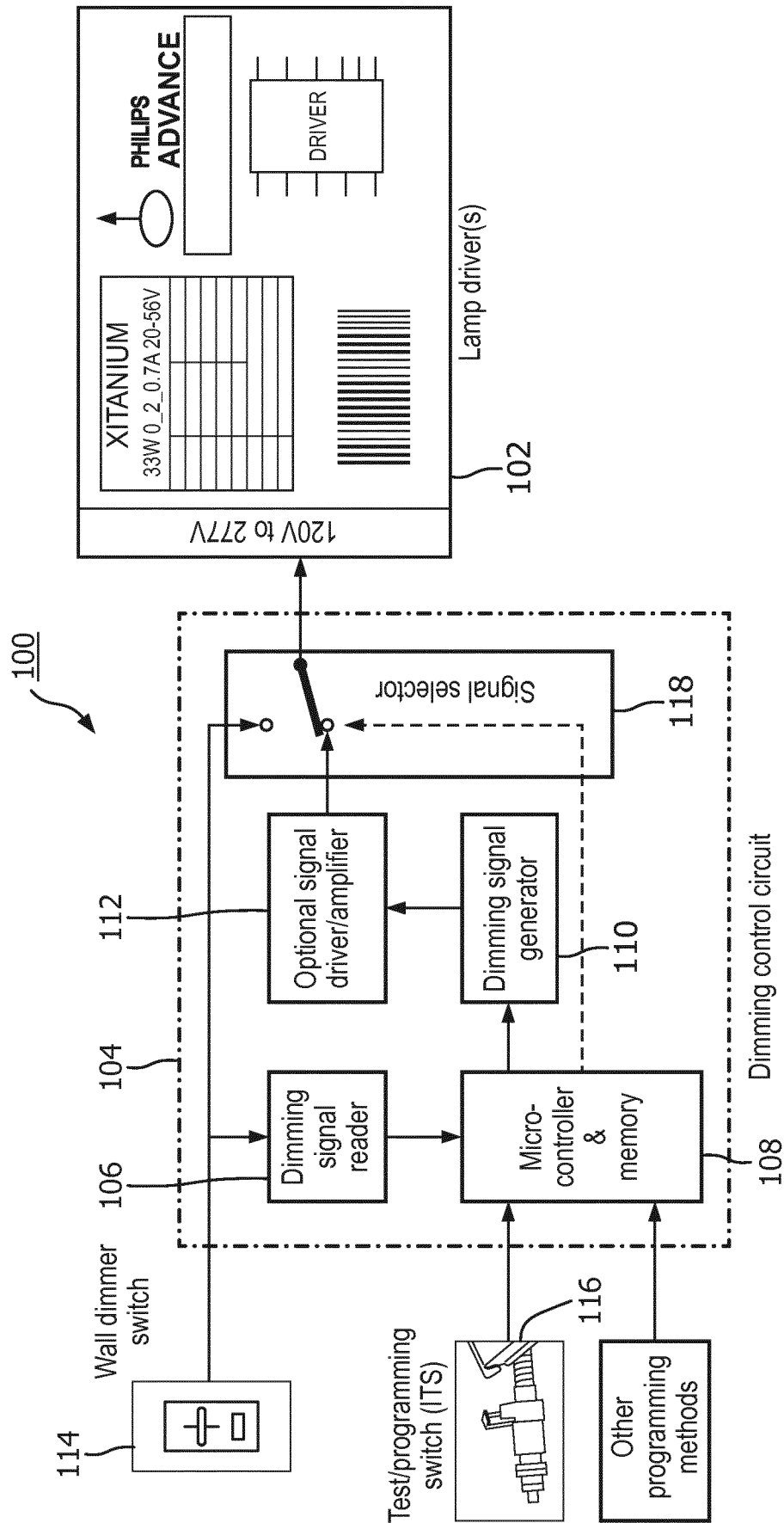


FIG. 1

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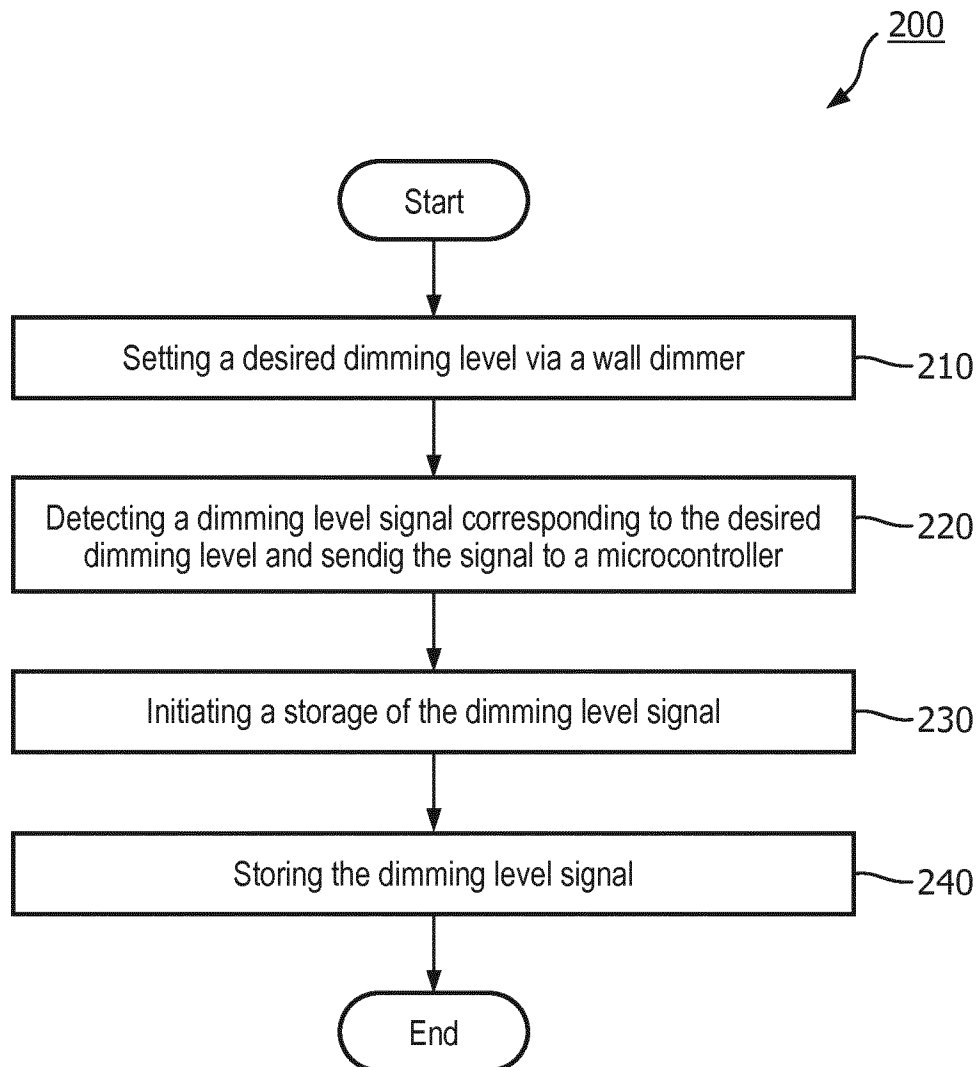


FIG. 2

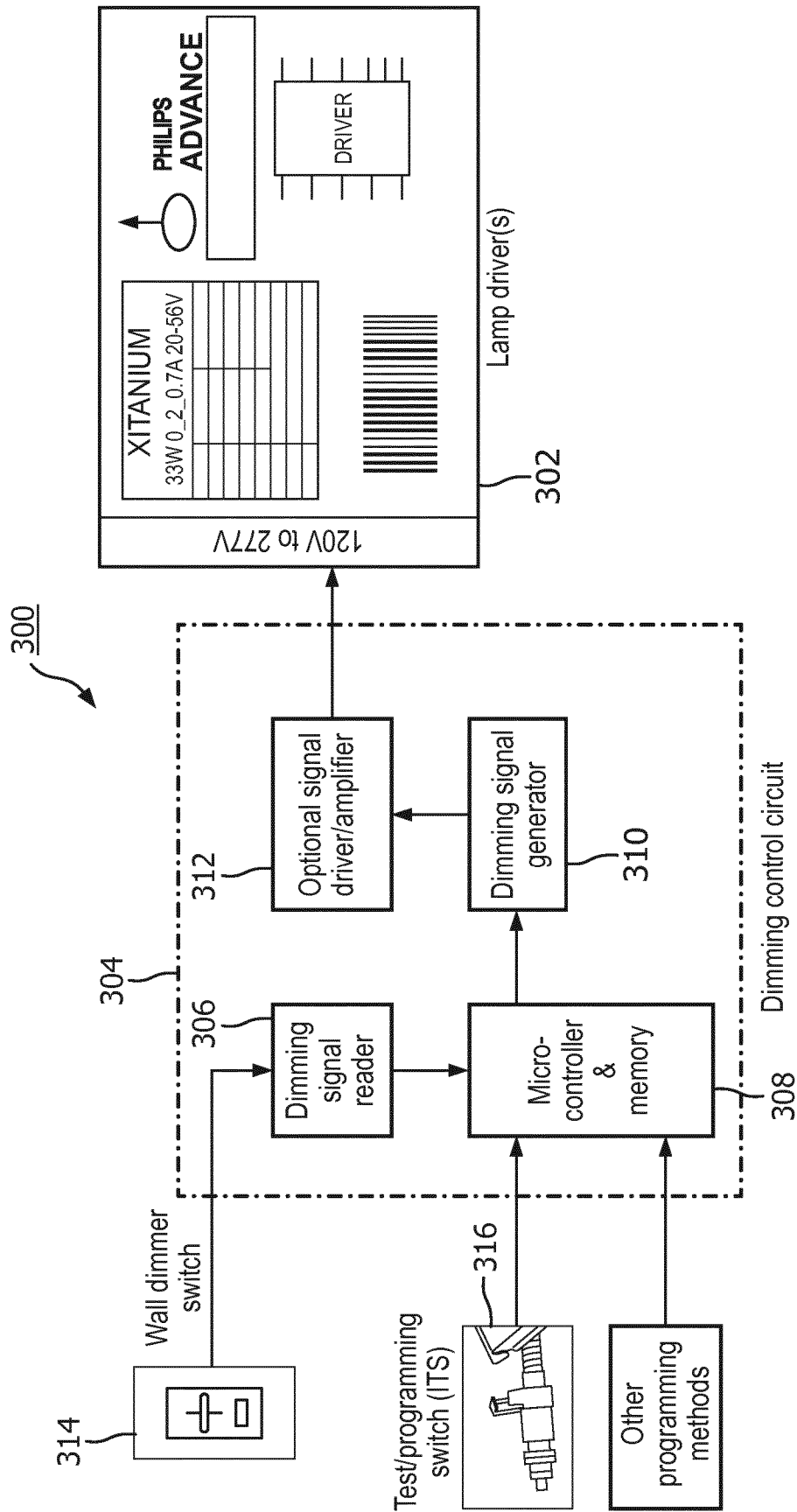


FIG. 3

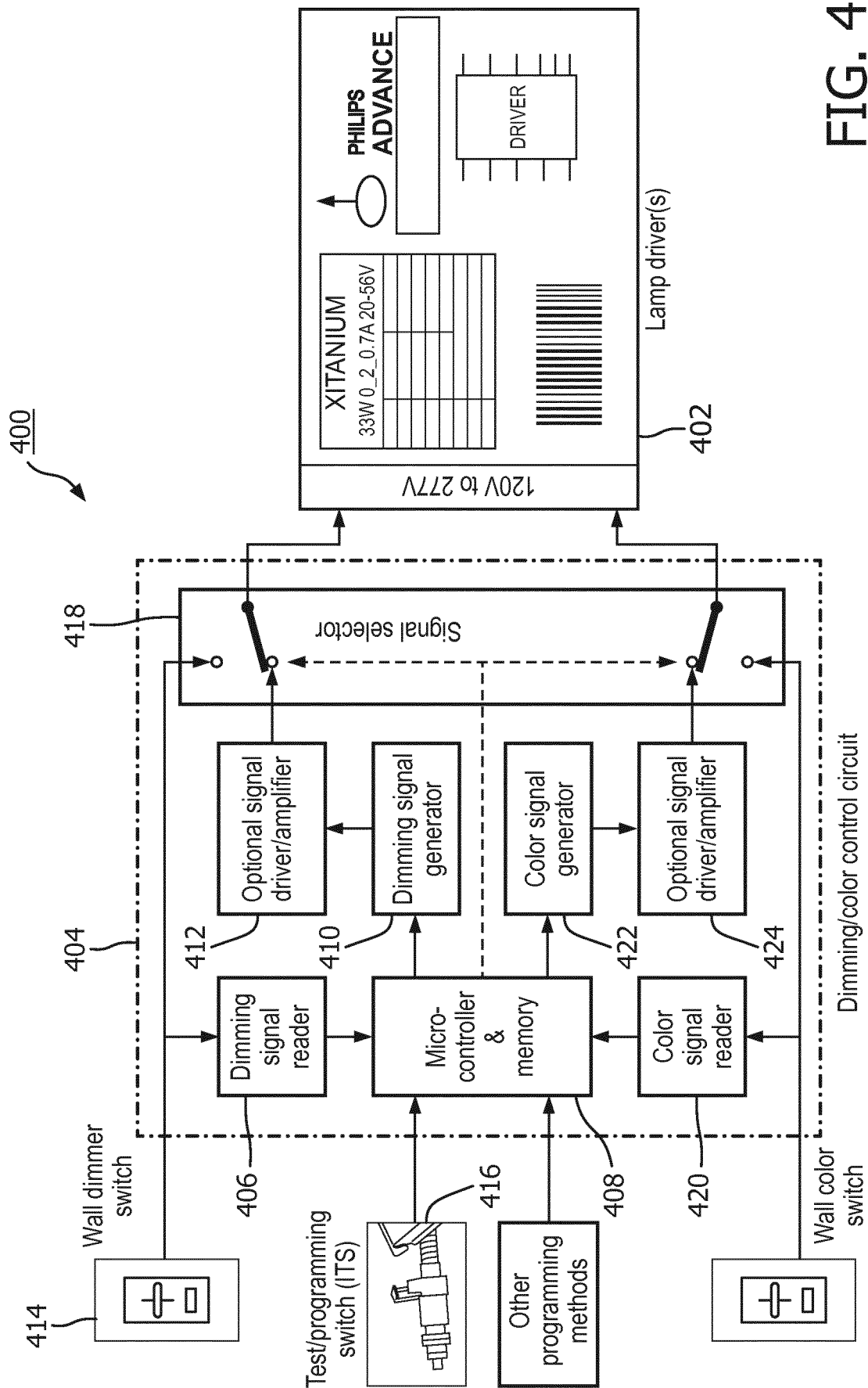


FIG. 4

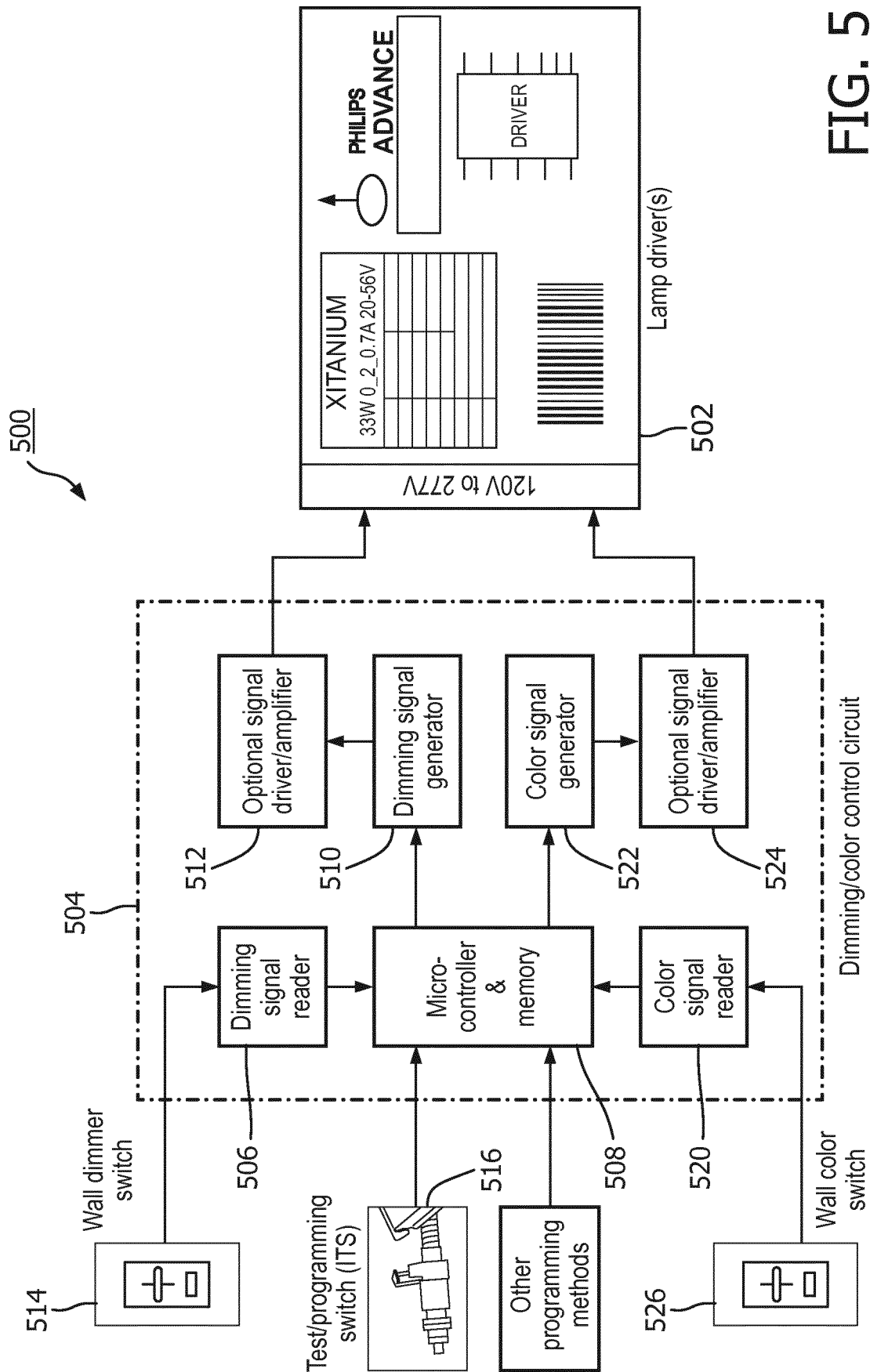


FIG. 5

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2019/064857

A. CLASSIFICATION OF SUBJECT MATTER
INV. H05B33/08 H05B37/02 H02J9/06
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 H02J

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 practicable, search terms used)

EP0-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2015/296586 A1 (WILLIAMS NICOLAS [GB]) 15 October 2015 (2015-10-15) paragraphs [0063] - [0115]; figures 1-3 paragraphs [0160], [0190] -----	1-15
X	DE 21 2014 000113 U1 (TRIDONIC GMBH & CO KG [AT]) 8 December 2015 (2015-12-08) the whole document -----	1-5,9-13
X	US 2018/092191 A1 (SIEFER MICHAEL J [US] ET AL) 29 March 2018 (2018-03-29) paragraphs [0021] - [0030]; figures 1-3 -----	1-5,9-13

☐

Further documents are listed in the continuation of Box C.

☒

See patent family annex.

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"E" earlier application or patent but published on or after the international filing date

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Information on patent family members

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