(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 2 911 481 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
11.07.2018 Bulletin 2018/28

(51) Int Cl.:
H05B 37/02 *(2006.01)*

(21) Application number: **14155784.3**

(22) Date of filing: **19.02.2014**

(54) **Method and device for calibrating a dimmer controller**

Verfahren und Vorrichtung zur Kalibrierung einer Dimmersteuerung

Procédé et dispositif pour étalonner une commande de gradateur

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(43) Date of publication of application:
26.08.2015 Bulletin 2015/35

(73) Proprietor: **One Smart Control NV**
2160 Wommelgem (BE)

(72) Inventors:
- **DE HAES, Bert Hendrik F.**
  2530 Boechout (BE)
- **THIELMAN, David**
  9100 Sint-Niklaas (BE)

(74) Representative: **IP HILLS NV**
Hubert Frère-Orbanlaan 329
9000 Gent (BE)

(56) References cited:
US-A1- 2013 010 018 **US-B1- 7 190 126**

EP 2 911 481 B1

Printed by Jouve, 75001 PARIS (FR)

Description

Field of the Invention

[0001] The invention relates to the calibration of a dimmer controller. Such a dimmer controller receives dimming commands from an input device and will on its turn control a dimmer by supplying it a dim level according to the dimming command. By calibrating a dimmer controller, the relation between the dimming commands and the dim level is configured for operation after the calibration.

Background of the Invention

[0002] A dimmer allows adapting the light output level of a light. By varying the dim level of the dimmer the luminance and thus the luminance intensity will vary with a varying dim level. The relationship between the supplied dim level and the light output level defines the dimming profile. This profile is determined by different factors, e.g. the type of dimming technology used, the type of light that is dimmed and the settings within the dimmer itself. As the varying brightness of a dimmed light, i.e., the intensity of a light as perceived by a person, is not linear with the emitted luminance of the light, the dimming profile is preferably also not linear and compensates for this kind of effect.

[0003] Whereas before dimmers were directly controlled by a dimmer switch, dimmers may now be controlled be a dimmer controller. Such a controller is typically located in a central location, for example in an electrical enclosure and is typically part of or embedded in a home automation system. The dimmers may also be located in this enclosure or may be remotely connected to the controller. The dimmer controller allows implementing more complex dimming schemes. With such a controller, a user may select from an input device from a range of dimming schemes such as for example "TV", "party", "dinner" or "meeting". Depending on the dimming scheme, the controller will then adjust the dimmers appropriately to create the preprogramed lighting scheme. A dimmer controller also allows using more input devices. Apart from traditional switches, the dimmer controller may also be controlled from a laptop, smartphone or tablet by a communication interface in the controller connecting it with a local or wide area network.

[0004] The use of dimmers and dimmer controllers have also opened the way for energy saving solutions as a dimmed light will consume considerably less power when not operating at its highest dim level, i.e. when not operating at its highest luminance.

[0005] One such solution uses photo sensors that measure the total light level in a room, i.e., the light level obtained by both daylight and artificial light. The lights are then dimmed by the controller in such a way that the total light output level corresponds to a preset level. This way, the lights do not continuously operate at their highest output level and, thus, energy is saved. Although very effective, this solution is complex to implement as sensors need to be installed permanently and their position is crucial in order to obtain the desired effect.

[0006] Another solution is suggested by the Alliance for Solid-State Illumination Systems and Technologies (ASSIST) in the 2013 publication "ASSIST recommends... Dimming: A technology-neutral Definition", Vol. 12, Iss. 1, Troy, N.Y.: Lighting Research Center. There, the dimming profile of a dimmer is discussed in more detail and it is suggested that by adjusting the highest dimming level in the dimmer energy savings may be obtained. The dimming profile is however also dependent on the type of light used and, therefore, when adjusting the highest dimming level of a dimmer during manufacturing, the highest brightness of the light may be compromised to some extent depending on the type of light used in combination with the dimmer.

[0007] US2013010018 (A1) discloses load control device able to receive radiofrequency (RF) signals from a Wi-Fi-enabled device, such as a smart phone, via a wireless local area network. The load control device comprises a controllably conductive device adapted to be coupled in series between an AC power source and an electrical load, a controller for rendering the controllably conductive device conductive and non-conductive, and a Wi-Fi module operable to receive the RF signals from the wireless network. The controller controls the controllably conductive device to adjust the power delivered to the load in response to the wireless signals received from the wireless network. The load control device may further comprise an optical module operable to receive an optical signal, such that the controller may obtain an IP address from the received optical signal and control the power delivered to the load in response to a wireless signal that includes the IP address.

[0008] US7190126 (B1) discloses system and device for and a method of programming and controlling light fixtures. The system includes a stationary controller unit that is electrically coupled to the light fixtures. The stationary controller unit is configured to be remotely programmed with a portable commissioning device to automatically control the lights fixtures. The stationary controller unit and the portable commissioning device include light sensors, micro-computers and transceivers for measuring light levels, running programs, storing data and transmitting data between the stationary controller unit and the portable commissioning device. In operation, target light levels selected with the portable commissioning device and the controller unit is remotely programmed to automatically maintain the target level.

[0009] It is therefore an object of the invention to alleviate the above drawbacks. It is also an object to provide energy savings in dimmed lights that are simple to implement and applicable in a wide range of situations. More generally, it is also an object to adjust the dimming profile of a dimmer in an easy and straightforward manner that takes into account the type of light.

Summary of the Invention

[0010] This object is achieved, in a first aspect, by a method for calibrating a dimmer controller by a portable device performing the following steps:

- Sending a varying dim level wirelessly to this dimmer controller thereby varying a light output level of a light controlled by a dimmer receiving this varying dim level from the dimmer controller. A highest dim level then corresponds to a highest light output level.
- Measuring the light output level.
- Selecting as a maximum dim level from the varying dim level the lowest dim level with a corresponding measured light output level that is not below a first threshold light output level.
- Programming the dimmer controller to use the maximum dim level as new upper limit for steering the dimmer during operation after the calibrating.

[0011] The dimmer is thus dimmable between a highest dim level and a lowest dim level. At the highest dim level, the light receives its highest power resulting in a highest light output level. The highest power may for example be the same power as there would be no dimmer and the light would be switched on by a light switch. At the lowest dim level, the light receives its lowest power from the dimmer resulting in a lowest light output level. In a typical dimmer, at the lowest light output level the light might not be observable any longer by a human eye.

[0012] The light output level of the light is measured by the portable device while the dim level is varied. These measurements may for example be performed by a photo sensor or camera comprised in the portable device. In order to do so, the portable device is positioned near the light such that the light output power can be measured. The portable device may for example be held under the light that is measured.

[0013] By programming the dimmer controller with the selected maximum dim level, the light's output level will not exceed the first threshold light output level any longer after the calibration and thus during normal operation by a user.

[0014] It is thus an advantage that energy is saved during operation as the light output level is limited. It is also an advantage that the combination of the light and the dimmer is taken into account as this makes the above procedure uniform to different types of lights and different types of dimmers.

[0015] It is a further advantage that the above steps are performed by a portable device as this allows the calibration to be performed by a technician in a fast, easy and automated way. No further hardware needs to be installed. Only the hardware needed for the normal use, i.e., operating the dimmer, is used for the calibration. For example, to calibrate all dimmed lights in a house it suffices to go from one light to the other with the portable device.

[0016] It should be understood that the light output level of a light refers to a measurable amount of light power that a light emits, i.e. the light power perceivable by a human eye. This may for example be expressed by the luminance intensity which is a measure of the wavelength-weighted power emitted by a light source in a particular direction per unit solid angle, based on the luminosity function, a standardized model of the sensitivity of the human eye. A photo-sensor or camera may provide a good measure of the luminous intensity or light output power in general.

[0017] Advantageously, the difference between the first threshold light output level and the highest light output level is not observable by an average human eye. The calibration of the dimmer by the maximum dim level thus has no noticeable effect on the perceived light by a person. This may be accomplished by choosing the first threshold light output level within 90% of the highest light output level, i.e., the measured highest light output level. More preferably, the first threshold light output level is within 95% of the highest light output level. An average human eye will not observe such a reduction within 10% to 5% of the light output level. In other words, the, first threshold light output level is calculated as a factor of the highest light output level where this factor is between 0.9 and 1, preferable between 0.95 and 1.

[0018] This has the advantage that an energy saving is accomplished without a noticeable effect to the observer of the light.

[0019] The first threshold light output level may also be determined as the measured highest light output level. The first threshold light output level then equals the highest light output level.

[0020] Depending on the type of dimmer, when decreasing the dim level from the highest dim level, it may take a while until the light output level starts to decrease correspondingly. While the measured light output level is not reduced, the power consumed by the dimmer and/or the light may already decrease. It is thus an advantage that an unmeasurable and thus unobservable change in the maximum dim level leads to an energy saving when operating the light after calibration. As this effect depends on the type of dimmer and on the type of light, the invention allows taking this variability into account leading to the highest energy saving without visible effect.

[0021] According to an embodiment, the varying dim level is a monotonously decreasing dim level from the highest dim level downwards. The selecting then comprises determining the maximum dim level from the monotonously decreasing dim level as the dim level used at a moment where the light output level drops below the first threshold light output level.

[0022] As the measurement of the light output level will start with the highest value, this value can be set as a reference. From this reference, the first threshold light output level can be directly obtained. This may for example be done by applying the above mentioned factor to

the measured reference level. As the dim level decreases monotonously, the measured light output level will drop below the first threshold light output level and the corresponding dim level is then set as the maximum dim level. It is thus an advantage that the maximum dim level is obtained in straightforward manner.

[0023] According to a further embodiment the portable device further performs the following steps:

- Selecting a minimum dim level from the varying dim level below which the varying light output level is unstable.
- Programming the dimmer controller to use this minimum dim level as new lower limit for steering the dimmer during operation after the calibrating.

[0024] A light output level of a light may become unstable upon dimming if the light output level no longer decreases monotonously with a monotonously decreasing dimming level. Typically, a light will start flickering or may fluctuate in light output level. The dimming level at which the light output level becomes unstable depends on the type of light used in combination with the dimmer. In the same way a maximum dim level is obtained, a minimum dim level is thus obtained thereby preventing a user to operate the dimmer below this minimum dim level. It is thus an advantage that a dimmer is prevented from being operated in a dimming range where the light output is unstable

[0025] According to a further embodiment, the method further comprises the following steps:

- Obtaining a dimming profile from the varying dim level and the varying light output level indicative for the relation between a dim level sent to the dimmer and the light output level.
- Deriving a correction profile indicative for a dimming correction to be applied to a first dimming level received at the dimmer controller thereby sending a corrected dimming level to the dimmer; and whereby a combination of the dimming profile and the correction profile corresponds to a preset dimming profile.
- Programming the dimmer controller to use this correction profile for correcting received dimmer commands thereby obtaining corrected dimmer commands and sending the corrected dimmer commands to the dimmer during operation after the calibrating.

[0026] A dimmer in combination with a certain light will exhibit a dimming profile, i.e. a relation between the input dim level applied to the dimmer and the actual light output level. This dimming profile may depend on the actual settings inside the dimmer, the type of dimmer technology and the type of light. This dimming profile may be different from the desired profile. The desired profile may for example be according to an S-shaped or inverse S-shaped curve while the measured and thus obtained dimming profile differs from this desired profile. An input dimming level received at the controller during operation will thus be corrected by the controller by looking up the corrected dimming level from the correction profile and steering the dimmer with this corrected dimming level. The combination of the corrected profile and the dimming profile thereby results in the desired or preset dimming profile. The correction profile may thus be obtained by the difference between the preset dimming profile and the obtained dimming profile.

[0027] It is thus an advantage that a preset dimming profile may be obtained in an easy and straightforward manner for every dimmer-light combination. When calibrating different dimmers according to the same preset dimming profile a uniform dimming experience or feel is obtained during operation.

[0028] According to a second aspect, the invention relates to a portable device for calibrating a dimmer controller comprising:

- A wireless interface configured to communicate wirelessly with this dimmer controller controlling a dimmer for dimming a light.
- A photo sensor configured to measure a light output level from this light.
- A processor configured to execute the following steps:
  - generate a varying dim level and send it by the wireless interface to the dimmer thereby varying the light output level of the light; and
  - receive measurements of the light output level from the photo sensor; and
  - select as a maximum dim level from the varying dim level the lowest dim level with a corresponding measured light output level that is not below a first threshold light output level;
  - program the dimmer controller to use the maximum dim level as new upper limit for steering the dimmer during operation after the calibrating.

[0029] Such a portable device may for example be a tablet, smartphone or portable computer comprising a separate photo sensor or a camera functioning or used as a photo sensor. It is an advantage that these devices are readily available on the market and may be easily configured to execute the above steps. The processor may then be configured by a software application or app providing instructions to the processor to execute these steps.

[0030] Advantageously, the processor is further configured to also program the dimmer controller wirelessly over the wireless interface.

[0031] According to a third aspect, the invention relates to a computer program product comprising computer-executable instructions for performing the method according to the first aspect when the program is run on a

computer.

[0032] According to a fourth aspect, the invention relates to a computer readable storage medium comprising the computer program product according to the third aspect.

[0033] According to a fifth aspect, the invention relates to a data processing system programmed for carrying out the method according to the first aspect.

Brief Description of the Drawings

[0034]

Fig. 1 illustrates a portable device for calibrating a dimmer controller according to an embodiment of the invention; and

Fig. 2 illustrates a monotonously decreasing dim level and corresponding measured light output level as a function of time; and

Fig. 3 illustrates a dimming profile of a dimmer; and

Fig. 4 illustrates a correction profile for calibrating a dimmer controller according to an embodiment of the invention; and

Fig. 5 illustrates a corrected dimming profile for a combination of a dimming controller, a dimmer and a light according to an embodiment of the invention.

Detailed Description of Embodiment(s)

[0035] Fig. 1 illustrates a portable device 1 that is held under a dimmable light 3 for calibrating a dimmer controller 2 according to an embodiment of the invention. Some lights 3 in a building 8 are dimmable by respective dimmers 4 installed in an electrical cabinet 7. Each dimmer 4 dims one or more lights by varying the power supplied to the lights 3. Each dimmer is again controlled by the dimmer controller 2 which is preferable also installed in the electrical cabinet. The communication between the dimmer and dimmer controller may be done according to available standards depending on the type of dimmer used.

[0036] In new installations, the dimmers 4 are typically centralized in the electrical cabinet 7. Alternatively, the dimmers may also be installed remotely, i.e., closer to the lights 3, for example together with the switch 6 that provides input to the dimmer controller 2. This is useful in renovations where existing traditional on-off lighting is replaced be dimmed lighting and where it is not possible to install separate wiring form the lights 3 to the electrical cabinet 7. The control signals of the dimmer may then run over a separate signal wire or over the original electrical wires. A remote dimmer may also operate wirelessly over a wireless connection between the dimmer 4 and the dimmer controller 2.

[0037] The dimmer controller 2 controls on one hand the dimmers 4 by sending a dim level command which specifies the dim level at which the respective dimmers 4 should operate and thus dim the lights 3. On the other hand, the controller 2 receives input signals from various input devices. One such an input device is for example a dim switch 6 for controlling one or more of the dimmers and thus the lights 3. Also more sophisticated input devices may be provided that allow to set all sort of lighting schemes. The dimmer controller will then control one or more of the dimmers 4 with a preprogramed dim level according to the selected lighting scheme.

[0038] The dimmer controller 2 is remotely controllable and programmable over a wireless connection. For that, the controller 2 may comprise a wireless network interface or a wired network interface which is connected to a wireless access point. A portable device 1 comprising a wireless network interface then communicates with the controller 2 in order to calibrate a combination of a dimmer 4 and a light 3. After this calibration, the new settings are saved and thus programmed in the controller 2.

[0039] In a first step of this calibration procedure, the portable device 1 supplies a varying dim level to the dimmer 4 steering the light 3 under which the portable device 1 is positioned. The varying dim level is thus supplied to the controller 2 which, on its turn, forwards the varying dim level to the selected dimmer. Such a varying dim level 30 is illustrated in Fig. 2. There the normalized value of the dim level 30 is represented on the Y-axis with circles as a function of time on the X-axis. At the highest dim level with a value of 100%, the dimmer 4 supplies the highest output power to the light 3 resulting in the highest normalized light output level 21 of the light of 100%. The value of the light output level is represented by crosses. In Fig. 2 the varying dim level is decreasing linearly from 100% towards 0%. It is preferred that the varying dim level 30 is monotonically decreasing.

[0040] At the same time, the portable device measures the corresponding varying light output level 31 which is a result of the varying dim level 30. Depending on the type of dimmer 4 and/or the type of light 3, the relation between the supplied dim level 30 and the measured light output level 31 will be non-linear. During the measuring, the light output level 31 will drop below a predetermined light output level 24. In Fig. 2 this occurs between time step t5 and t6. The portable device 1 then selects the corresponding dim level where the varying light output level 31 crosses this predetermined light output level as the maximum dim level. In Fig. 2, the maximum dim level may be approximated by the dim level at time step t5 or the dim level at time step t6. Alternatively, the maximum dim level may be determined by an interpolation of the dim levels at time step t5 and t6.

[0041] In a last step, the portable device 1 then programs the controller 2 to use the selected maximum dim level as the new highest dim level for controlling the respective dimmer 4. In other words, after the calibrating and thus during operation the controller 2 will no longer

supply a dim level higher than this maximum dim level to the dimmer 4.

[0042] The purpose and advantage of this calibration is a reduction in used power when using a light at its highest output power. As the dim level is related to the electrical power provided to the dimmed light, the light will consume less power after the calibration when used at its highest light output level. Typically, when a light is dimmed from its highest dim level downwards, the reduction in light output level will not be directly visible by a person. Therefore, the predetermined light output level 24 or threshold light output level 24 is preferably chosen such that the light output level is not visibly different between the highest dim level and the selected maximum dim level, i.e., not observable by an average human eye.

[0043] According to an embodiment, the threshold light output level 24 is chosen to be equal to the measured highest light output level 21. In other words, when the portable device 1 measures a light output level below the highest light output level 21, the corresponding dim level at that moment is selected as the maximum dim level. In the example of Fig. 2 this corresponds to the dim level at the time t4, t5 or an interpolated value of the dim level between t4 an t5.

[0044] The light output level observed by a human eye is not linear with the light output level of a light but shows a square law relationship. For example, if the light output level is at 90% of its highest output level, the perceived brightness will be at 95% of the brightness perceived at the highest output level. This effect is caused by the dilation of the pupil, also referred to as mydriasis, as a reaction to the decreased light output level. Due to this effect, a small reduction in light output level will also not be notified by a human eye. Therefore, according to an alternative embodiment, the threshold light output level 24 is determined as between 90% and 100% of the measured highest light output level.

[0045] Depending on the type of light and the type of dimmer, the light output level may become unstable near the minimal dim levels, i.e., near the minimal light output level. Therefore, complementary to the above embodiment and as also illustrated in Fig. 2 , this may be avoided by selecting a minimum dim level corresponding to a minimum light output level 22 below which the light output level is unstable. The dimmer controller 2 is then programmed to use this minimum dim level as new lower limit for controlling or steering the dimmer during operation, i.e., after the calibration. To determine the minimum dim level, the portable device 1 measures the light output level corresponding to the decreasing dim level until it is unstable. The light output level is determined as unstable when it starts to flicker, i.e., when the device 1 measures different light output levels at the same dim level, or when the device 1 measures a higher light output level when the dim level was actually decreased. This latter effect is shown as an example in Fig. 2 at time step 14 and, hence, the minimum dim level is set as the dim level at time step t13.

[0046] According to a further embodiment, also the dimming profile of the dimmer is calibrated by the portable device 1. An uncalibrated dimmer profile 20 is shown as an example in Fig. 3. Such a profile shows the relation between the dim level of the dimmer 4 and the light output power or level emitted by and measured from the light 3. In Fig. 3 the light output power is shown as a percentage of the highest light output level 21 on the Y-axis and the dim level is shown as a percentage of the highest dim level 23 on the X-axis. This dimming profile is obtained from the measurements as shown by Fig. 2, i.e. by applying a varying dim level from 100% till 0% and measuring the corresponding light output level. Also the maximum dim level 27 with the corresponding threshold light output level 24 and the minimum dim level 26 with corresponding minimum light output level 22 are shown as obtained by the above embodiments. After calibration by the minimum and maximum dim level, the dimming profile might still follow an undesirable curve. It might for example be desired that the dimming profile follows an S- or inverted S-curve or, more general, a target or preset dimming profile.

[0047] Such a target dimming profile 60 is shown in Fig. 5 where the light output level is shown on the Y-axis against the dim level of the controller on the X-axis. As the calibration is done in the controller, the target dimming profile 60 is shown for the dim level of the controller, i.e. , the dim level requested internally in the controller or by an input device connected to the controller 2. After calibration, the controller 2 will then translate or correct a requested dim level to a dim level command for the actual dimmer. In order to do so, a correction profile is derived from the measured dimming profile 20 and the target dimming profile 60. An example of such a curve 40 is shown by Fig. 4. There it is shown how a requested dim level for the controller on the X-axis is to be corrected to a dim level command for the actual dimmer. By the selecting of the maximum dim level 27 for the dimmer, a 100% dim level for the controller will correspond to a maximum dim level 27 for the dimmer. In the same way, by the selecting of the minimum dim level 26 for the dimmer, a 0% dim level for the controller will correspond to a minimum dim level 26 for the dimmer.

[0048] In other words, after the portable device 1 has obtained the dimming profile 20 from the varying dim level and the corresponding measured varying light output level, it derives the correction profile 40 from the obtained dimming profile 20 and the preset or target dimming profile 60. The correction profile then represents a correction to be applied to an input dim level received at the controller 2 in order to obtain a corrected dim level and thus dimming command for the dimmer. The correction profile is then uploaded to the controller, preferably over the wireless interface, and programmed into the controller 2. From that moment on, i.e,. during operation, the dimming profile of the combination dimmer controller 2 - dimmer 4 and light 3 will be according to the preset or target dimmer profile 60.

[0049] With a portable device 1 a multitude of dimmer-light combinations may be calibrated according to the above embodiments. This may for example be performed by a technician before the first use of the electrical installation. Every time a dimmer-light combination is to be calibrated, the technician holds the portable device 1 under the respective light and initiates the device 1 to perform the calibrating steps according to the above embodiments. In the same way, also a recalibration may be performed; for example after the installation of a new light bulb or a new type of light bulb. Both during a calibration or a recalibration, the controller 2 should be put in a mode where no calibration settings are used, i.e. neither a maximum or minimum dim level or correction profile are used. In other words, during a calibration procedure, the dim level commands received by the controller should be forwarded unaltered to the respective dimmer.

[0050] In order to perform the measurements of the light output level, the portable device 1 is equipped with a photo sensor 5 as illustrated by Fig. 1. Such a photo sensor is capable of measuring the light output level of a light, for example it may measure the luminous intensity of a light.

[0051] According to a preferred embodiment the portable device is a portable communication device such as for example a tablet computer, a smartphone or laptop computer. In this case, the sending of the varying dim level and the programming of the controller 2, may be performed by a wireless network interface using for example a wireless LAN protocol or a cellular network protocol connecting directly or indirectly via an access point or base station to the dimmer controller 2. The portable communication device is then equipped with a camera which is used as the photo sensor. The steps used to perform the calibration according to the above embodiments may then be provided as a software application running on a processor comprised in this portable communication device 1.

[0052] Although the present invention has been illustrated by reference to specific embodiments, it will be apparent to those skilled in the art that the invention is not limited to the details of the foregoing illustrative embodiments, and that the present invention may be embodied with various changes and modifications without departing from the scope thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein. In other words, it is contemplated to cover any and all modifications, variations or equivalents that fall within the scope of the basic underlying principles and whose essential attributes are claimed in this patent application. It will furthermore be understood by the reader of this patent application that the words "comprising" or "comprise" do not exclude other elements or steps, that the words "a" or "an" do not exclude a plurality, and that a single element, such as a computer system, a processor, or another integrated unit may fulfil the functions of several means recited in the claims. Any reference signs in the claims shall not be construed as limiting the respective claims concerned. The terms "first", "second", third", "a", "b", "c", and the like, when used in the description or in the claims are introduced to distinguish between similar elements or steps and are not necessarily describing a sequential or chronological order. Similarly, the terms "top", "bottom", "over", "under", and the like are introduced for descriptive purposes and not necessarily to denote relative positions. It is to be understood that the terms so used are interchangeable under appropriate circumstances and embodiments of the invention are capable of operating according to the present invention in other sequences, or in orientations different from the one(s) described or illustrated above.

Claims

1. A method for calibrating a dimmer controller (2) by a portable device (1) performing the following steps:

   - sending a varying dim level (30) wirelessly to said dimmer controller (2) thereby varying a light output level (31) of a light (3) controlled by a dimmer (4) receiving said varying dim level (30) from said dimmer controller (2); and wherein a highest dim level (23) corresponds to a highest light output level (21); **characterised by**:
   - measuring said light output level (31);
   - selecting as a maximum dim level (27) from said varying dim level (30) the lowest dim level with a corresponding measured light output level that is not below a first threshold light output level (24); and programming said dimmer controller (2) to use said maximum dim level (27) as new upper limit for steering said dimmer during operation after said calibrating.

2. A method according to claim 1 wherein said varying dim level (30) is a monotonously decreasing dim level (30) from said highest dim level (23) downwards; and wherein said selecting comprises determining said maximum dim level (27) from said monotonously decreasing dim level (30) as dim level used at a moment where said light output level drops below said first threshold light output level (24).

3. A method according to claim 1 or 2 wherein said first threshold light output level (24) equals said highest light output level (21).

4. A method according to claim 1 or 2 wherein said first threshold light output level (24) is calculated as a factor of said highest light output level (24); and

wherein said factor is between 0.9 and 1.

5. A method according to any one of claims 1 to 4 wherein said portable device (1) further performs the following steps:

- selecting a minimum dim level (26) from said varying dim level (30) below which said varying light output level is unstable;
- programming said dimmer controller (2) to use said minimum dim level (26) as new lower limit for steering said dimmer during operation after said calibrating.

6. A method according to any one of claims 1 to 5 further comprising the following steps:

- obtaining a dimming profile (20) from said varying dim level (30) and said varying light output level (31) indicative for the relation between a dim level sent to said dimmer and said light output level;
- deriving a correction profile (40) indicative for a dimming correction to be applied to a first dimming level received at said dimmer controller (2) thereby sending a corrected dimming level to said dimmer (4); and whereby a combination of said dimming profile (20) and said correction profile (40) corresponds to a preset dimming profile (60);
- programming said dimmer controller (2) to use said correction profile (40) for correcting received dimmer commands thereby obtaining corrected dimmer commands and sending said corrected dimmer commands to said dimmer (4) during operation after said calibrating.

7. A portable device (1) for calibrating a dimmer controller (2) comprising:

- a wireless interface configured to communicate wirelessly with said dimmer controller (2) controlling a dimmer (4) for dimming a light (3); characterised
- a photo sensor (5) configured to measure a light output level (31) from said light; and
- a processor configured to execute the following steps:

  - generate a varying dim level (30) and send it by said wireless interface to said dimmer (4) thereby varying said light output level (31) of said light (3); and
  - receive measurements of said light output level from said photo sensor (5); and
  - select as a maximum dim level (27) from said varying dim level (30) the lowest dim level with a corresponding measured light output level that is not below a first threshold light output level (24);
  - program said dimmer controller (2) to use said maximum dim level (27) as new upper limit for steering said dimmer (4) during operation after said calibrating.

8. A portable device (1) according to claim 7 wherein said photo sensor (5) is a camera.

9. A portable device (1) according to claims 7 or 8 wherein said processor is further configured to program said dimmer controller (2) wirelessly over said wireless interface.

10. A computer program product comprising computer-executable instructions which perform the method according to any one of the claims 1 to 6 when the program is run on a computer.

11. A computer readable storage medium comprising the computer program product according to claim 10.

12. A data processing system comprising means programmed for carrying out the method according to any one of the claims 1 to 6.

Patentansprüche

1. Verfahren zum Kalibrieren einer Dimmersteuerung (2) durch eine portable Vorrichtung (1), das die folgenden Schritte ausführt:

- kabelloses Senden eines variierenden Dimmwerts (30) an die Dimmersteuerung (2), wodurch ein Lichtleistungswert (31) eines durch einen Dimmer (4) gesteuerten Lichts (3) variiert wird, der den variierenden Dimmwert (30) von der Dimmersteuerung (2) empfängt; und wobei ein höchster Dimmwert (23) einem höchsten Lichtleistungswert (21) entspricht; **gekennzeichnet durch**:
- Messen des Lichtleistungswerts (31);
- Auswählen des niedrigsten Dimmwerts mit einem entsprechenden gemessenen Lichtleistungswert, der nicht niedriger ist als ein erster Lichtleistungsschwellenwert (24) als einen maximalen Dimmwert (27) aus dem variierenden Dimmwert (30);
und
- Programmieren der Dimmersteuerung (2) zur Verwendung des maximalen Dimmwerts (27) als neue Obergrenze zur Steuerung des Dimmers während dem Betrieb nach dem Kalibrieren.

2. Verfahren nach Anspruch 1, wobei der variierende

Dimmwert (30) ein monoton abnehmender Dimmwert (30) von dem höchsten Dimmwert (23) nach unten ist; und wobei das Auswählen das Bestimmen des maximalen Dimmwerts (27) aus dem monoton abnehmenden Dimmwert (30) als Dimmwert umfasst, der in einem Moment verwendet wird, wenn der Lichtleistungswert unter den ersten Lichtleistungsschwellenwert (24) fällt.

3. Verfahren nach Anspruch 1 oder 2, wobei der erste Lichtleistungsschwellenwert (24) dem höchsten Licht leistungswert (21) entspricht.

4. Verfahren nach Anspruch 1 oder 2, wobei der Lichtleistungsschwellenwert (24) berechnet wird als ein Faktor des höchsten Lichtleistungswerts (24); und wobei der Faktor zwischen 0,9 und 1 liegt.

5. Verfahren nach einem der Ansprüche 1 bis 4, wobei die portable Vorrichtung (1) die folgenden Schritte ausführt:

- Auswählen eines minimalen Dimmwerts (26) aus dem variierenden Dimmwert (30), unter dem der variierende Lichtleistungswert instabil ist;
- Programmieren der Dimmersteuerung (2), so dass diese den minimalen Dimmwert (26) als neue Untergrenze zur Steuerung des Dimmers während dem Betrieb nach dem Kalibrieren verwendet.

6. Verfahren nach einem der Ansprüche 1 bis 5, ferner die folgenden Schritte umfassend:

- Erhalten eines Dimmprofils (20) aus dem variierenden Dimmwert (30) und dem variierenden Licht leistungswert (31) als Indikator für das Verhältnis zwischen einem an den Dimmer gesendeten Dimmwert und dem Lichtleistungswert;
- Ableiten eines Korrekturprofils (40), das eine an einem an der Dimmersteuerung (2) empfangenen anzuwendende Dimmkorrektur anzeigt, wodurch ein korrigierter Dimmwert an den Dimmer (4) gesendet wird; und wobei eine Kombination aus dem Dimmprofil (20) und dem Korrekturprofil (40) einem voreingestellten Dimmprofil (60) entspricht;
- Programmieren der Dimmersteuerung (2) zur Verwendung des Korrekturprofils (40) zur Korrektur empfangener Dimmerbefehle, wodurch korrigierte Dimmerbefehle erhalten werden, und wobei die korrigierten Dimmerbefehle während dem Betrieb nach dem Kalibrieren an den Dimmer (4) gesendet werden.

7. Portable Vorrichtung (1) zum Kalibrieren einer Dimmersteuerung (2), umfassend:

- eine Funkschnittstelle, die so gestaltet ist, dass sie kabellos mit der Dimmersteuerung (2) kommuniziert, wobei ein Dimmer (4) zum Dimmen eines Lichts (3) gesteuert wird; **gekennzeichnet durch**:
- einen Photosensor (5), der so gestaltet ist, dass er den Lichtleistungswert (31) des Lichts misst; und
- einen Prozessor, der so gestaltet ist, dass er die folgenden Schritte ausführt:

  - Erzeugen eines variierenden Dimmwerts (30) und Senden des Werts durch die Funkschnittstelle an den Dimmer (4), wodurch der Lichtleistungswert (31) des Lichts (3) variiert wird; und
  - Empfangen von Messungen des Lichtleistungswerts von dem Photosensor (5); und
  - Auswählen des niedrigsten Dimmwerts mit einem entsprechenden gemessenen Lichtleistungswert, der nicht niedriger ist als ein erster Lichtleistungsschwellenwert (24) als einen maximalen Dimmwert (27) aus dem variierenden Dimmwert (30);
  und
  - Programmieren der Dimmersteuerung (2) zur Verwendung des maximalen Dimmwerts (27) als neue Obergrenze zur Steuerung des Dimmers (4) während dem Betrieb nach dem Kalibrieren.

8. Portable Vorrichtung (1) nach Anspruch 7, wobei der Photosensor (5) eine Kamera ist.

9. Portable Vorrichtung (1) nach Anspruch 7 oder 8, wobei der Prozessor ferner gestaltet ist zur kabellosen Programmierung der Dimmersteuerung (2) über die Funkschnittstelle.

10. Computerprogrammprodukt, das durch einen Computer ausführbare Anweisungen umfasst, die das Verfahren nach einem der Ansprüche 1 bis 6 ausführen, wenn das Programm auf einem Computer ausgeführt wird.

11. Computerlesbares Speichermedium, welches das Computerprogrammprodukt nach Anspruch 10 umfasst.

12. Datenverarbeitungssystem, das Mittel umfasst, die programmiert sind zur Ausführung des Verfahrens nach einem der Ansprüche 1 bis 6.

Revendications

1. Procédé d'étalonnage d'un dispositif de commande de gradateur (2) par un dispositif portatif (1) exécu-

tant l'étape consistant à :

- envoyer un niveau de gradation variable (30) sans fil audit dispositif de commande de gradateur (2), faisant ainsi varier un niveau de sortie de lumière (31) d'une lumière (3) commandée par un gradateur (4) recevant ledit niveau de gradation variable (30) dudit dispositif de commande de gradateur (2) ; et un niveau de gradation le plus élevé (23) correspondant à un niveau de sortie de lumière le plus élevé (21) ; **caractérisé par** les étapes consistant à :
- mesurer ledit niveau de sortie de lumière (31) ;
- sélectionner comme niveau de gradation maximal (27) à partir dudit niveau de gradation variable (30), le niveau de gradation le plus bas avec un niveau de sortie de lumière mesuré correspondant qui n'est pas inférieur à un premier niveau de sortie de lumière seuil (24) ; et
- programmer ledit dispositif de commande de gradateur (2) pour utiliser ledit niveau de gradation maximal (27)

comme nouvelle limite supérieure pour diriger ledit gradateur pendant le fonctionnement après ledit étalonnage.

2. Procédé selon la revendication 1, ledit niveau de gradation variable (30) étant un niveau de gradation décroissant de façon monotone (30) dudit niveau de gradation le plus élevé (23) vers le bas ; et ladite sélection comprenant l'étape consistant à déterminer ledit niveau de gradation maximal (27) à partir dudit niveau de gradation décroissant de façon monotone (30) comme niveau de gradation utilisé à un moment où ledit niveau de gradation de sortie de lumière tombe en dessous dudit premier niveau de sortie de lumière seuil (24).

3. Procédé selon la revendication 1 ou 2, ledit premier niveau de sortie de lumière seuil (24) étant égal audit niveau de sortie de lumière le plus élevé (21).

4. Procédé selon la revendication 1 ou 2, ledit premier niveau de sortie de lumière seuil (24) étant calculé comme un facteur dudit niveau de sortie de lumière le plus élevé (24) ; et ledit facteur étant compris entre 0,9 et 1.

5. Procédé selon l'une quelconque des revendications 1 à 4, ledit dispositif portatif (1) exécutant en outre les étapes consistant à :

- sélectionner un niveau de gradation minimal (26) à partir dudit niveau de gradation variable (30) en dessous duquel ledit niveau de sortie de lumière variable est instable ;
- programmer ledit dispositif de commande de gradateur (2) pour utiliser ledit niveau de gradation minimal (26) comme nouvelle limite inférieure pour diriger ledit gradateur pendant le fonctionnement après ledit étalonnage.

6. Procédé selon l'une quelconque des revendications 1 à 5, comprenant en outre les étapes consistant à :

- obtenir un profil de gradation (20) à partir dudit niveau de gradation variable (30) et dudit niveau de sortie de lumière variable (31) indiquant la relation entre un niveau de gradation envoyé audit gradateur et ledit niveau de sortie de lumière ;
- dériver un profil de correction (40) indiquant une correction de gradation à appliquer à un premier niveau de gradation reçu au niveau dudit dispositif de commande de gradation (2), envoyant ainsi un niveau de gradation corrigé audit gradateur (4) ; et une combinaison dudit profil de gradation (20) et dudit profil de correction (40) correspondant à un profil de gradation prédéfini (60) ;
- programmer ledit dispositif de commande de gradateur (2) pour utiliser ledit profil de correction (40) pour corriger les commandes de gradateur reçues, obtenant ainsi des commandes de gradateur corrigées et envoyant lesdites commandes de gradateur corrigées audit gradateur (4) pendant le fonctionnement après ledit étalonnage.

7. Dispositif portatif (1) pour étalonner un dispositif de commande de gradateur (2) comprenant :

- une interface sans fil conçue pour communiquer sans fil avec ledit dispositif de commande de gradateur (2) commandant un gradateur (4) pour la gradation d'une lumière (3) ; **caractérisé par** :
  - un photodétecteur (5) conçu pour mesurer un niveau de sortie de lumière (31) à partir de ladite lumière ; et
  - un processeur conçu pour exécuter les étapes suivantes :
    - générer un niveau de gradation variable (30) et l'envoyer par ladite interface sans fil audit gradateur (4), faisant ainsi varier ledit niveau de sortie de lumière (31) de ladite lumière (3) ; et
    - recevoir des mesures dudit niveau de sortie de lumière dudit photodétecteur (5) ; et
    - sélectionner comme niveau de gradation maximal (27) à partir dudit niveau de gradation variable (30), le niveau de

gradation le plus bas avec un niveau de sortie de lumière mesuré correspondant qui n'est pas inférieur à un premier niveau de sortie de lumière seuil (24) ;
- programmer ledit dispositif de commande de gradateur (2) pour utiliser ledit niveau de gradation maximal (27) comme nouvelle limite supérieure pour diriger ledit gradateur (4) pendant le fonctionnement après ledit étalonnage.

8. Dispositif portatif (1) selon la revendication 7, ledit photodétecteur (5) étant un appareil photo.

9. Dispositif portatif (1) selon la revendication 7 ou 8, ledit processeur étant en outre conçu pour programmer ledit dispositif de commande de gradateur (2) sans fil sur ladite interface sans fil.

10. Produit programme informatique comprenant des instructions exécutables par ordinateur qui exécutent le procédé selon l'une quelconque des revendications 1 à 6 lorsque le programme est exécuté sur un ordinateur.

11. Support d'informations lisible sur ordinateur, comprenant un produit programme informatique selon la revendication 10.

12. Système de traitement de données comprenant un moyen programmé pour exécuter le procédé selon l'une quelconque des revendications 1 à 6.

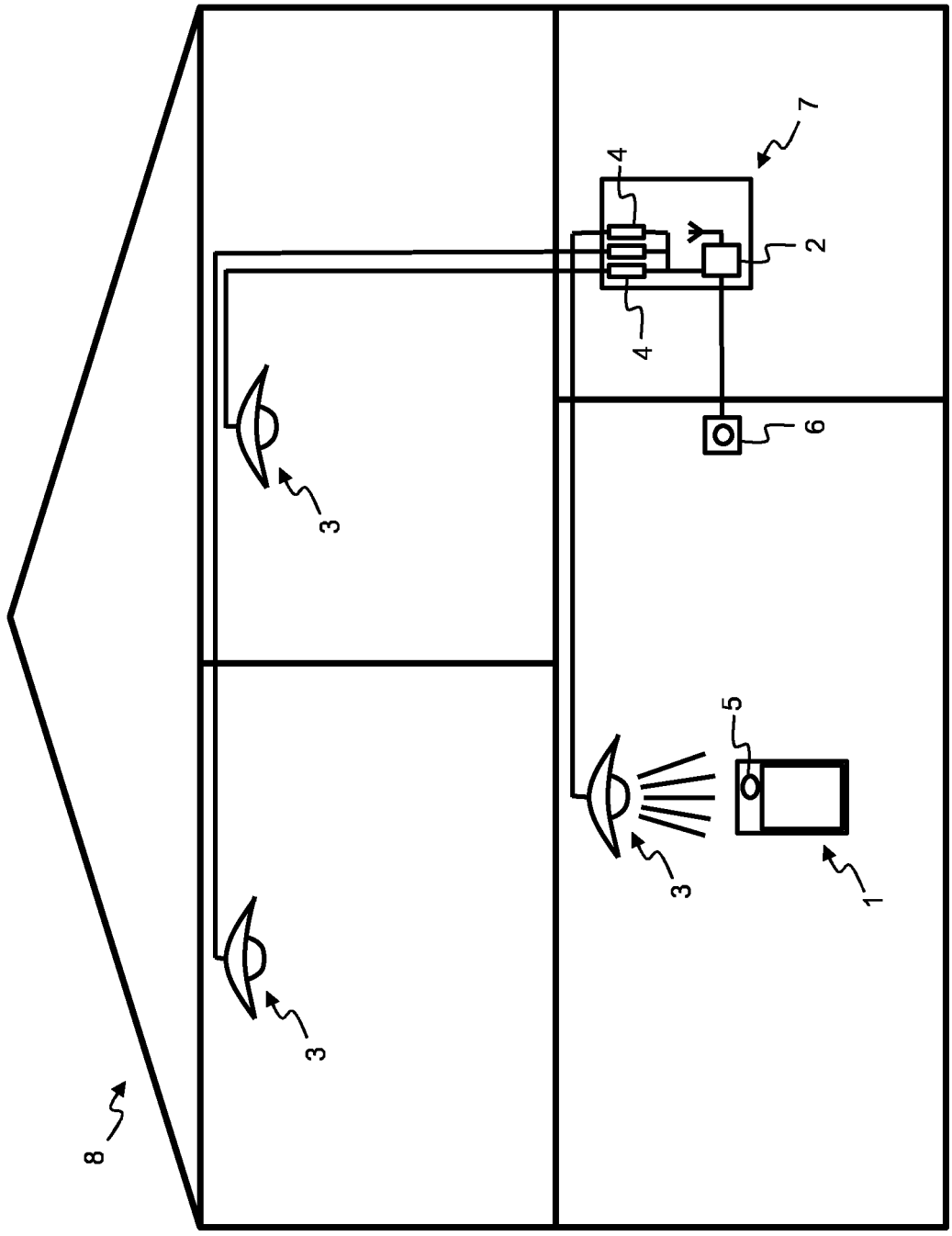

Fig. 1

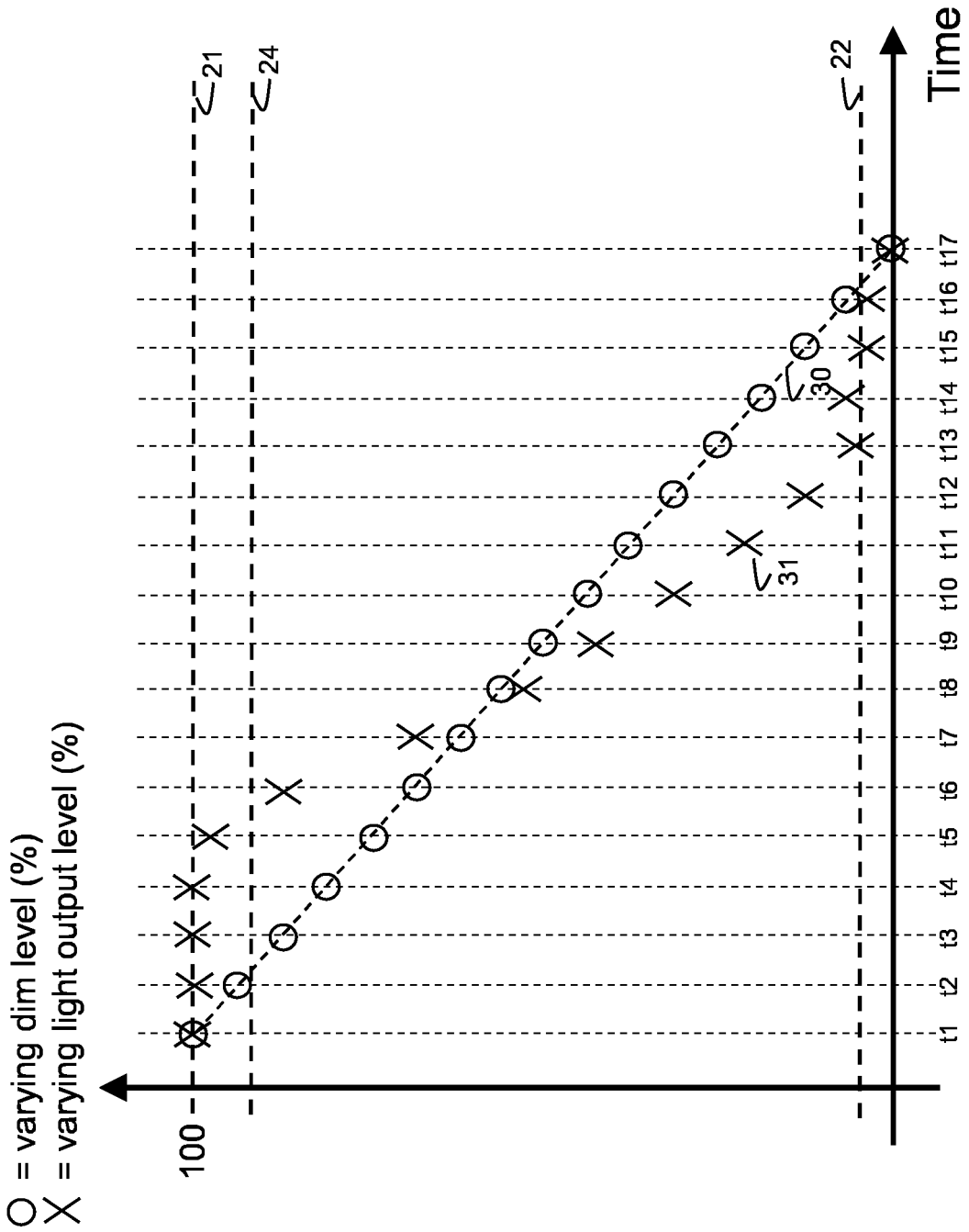
O = varying dim level (%)
X = varying light output level (%)
100
21
24
22
30
31
Time
t1
t2
t3
t4
t5
t6
t7
t8
t9
t10
t11
t12
t13
t14
t15
t16
t17

Fig. 2

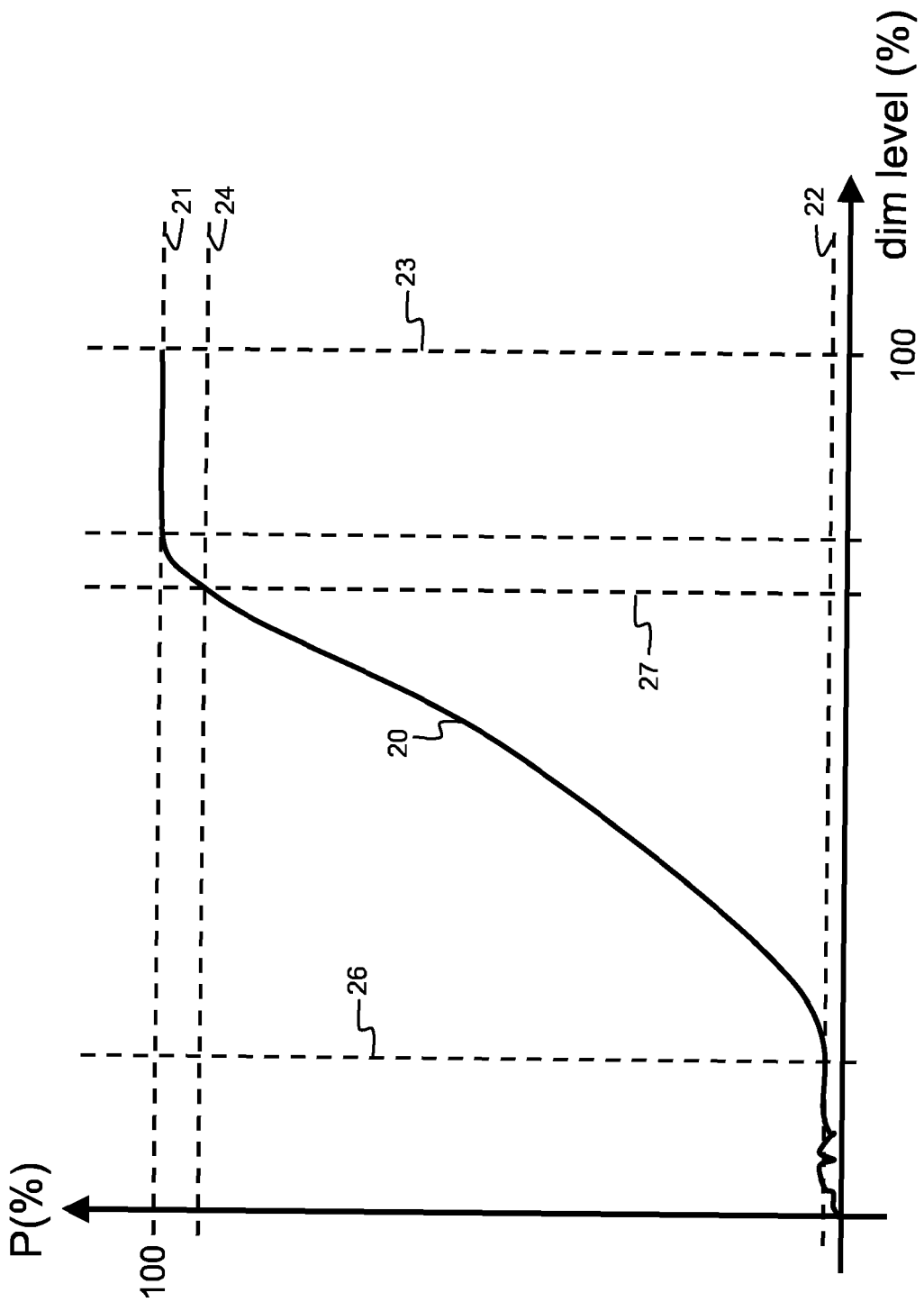

Fig. 3

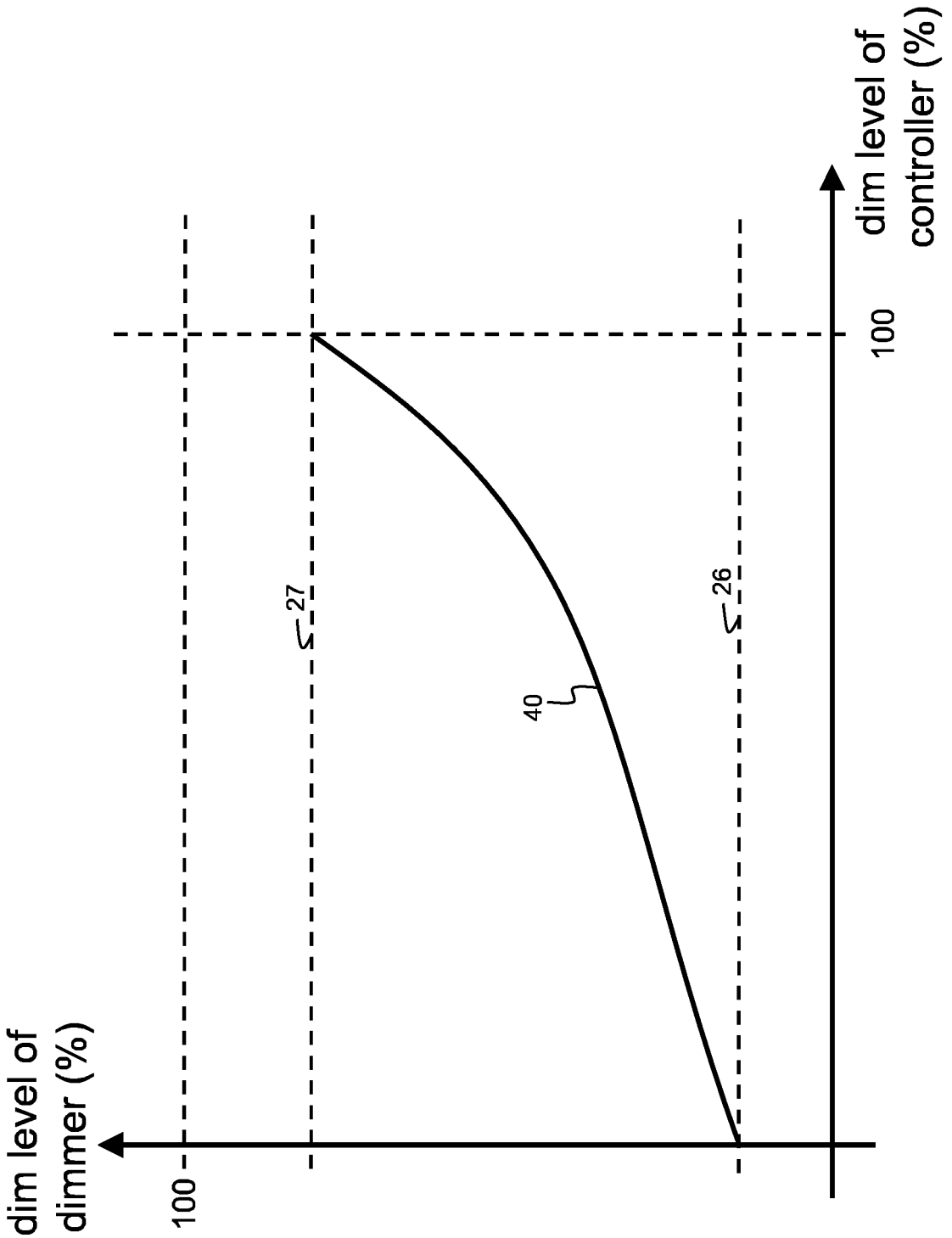

Fig. 4

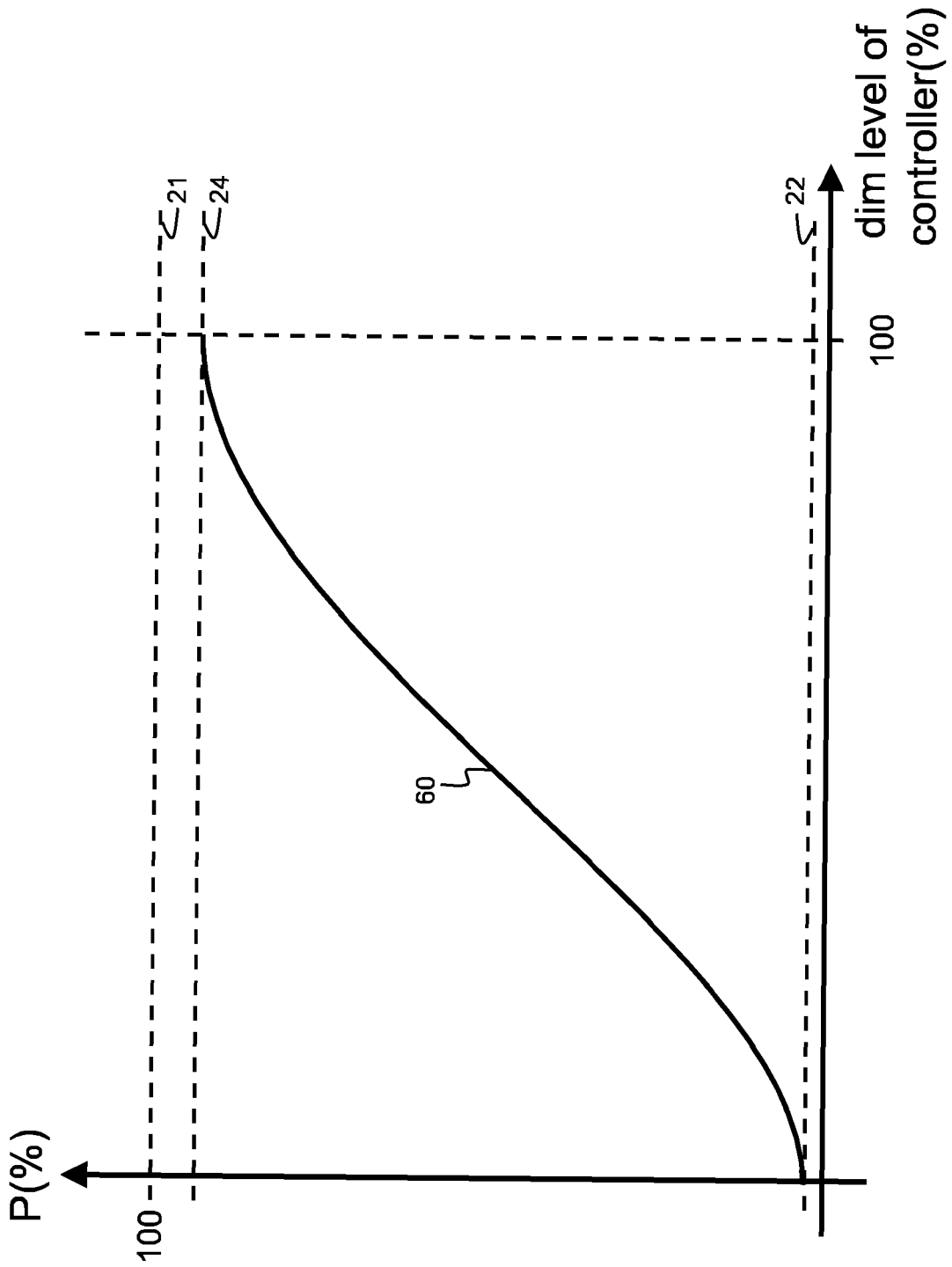

Fig. 5

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 2013010018 A1 **[0007]**
- US 7190126 B1 **[0008]**

Non-patent literature cited in the description

- ASSIST recommends... Dimming: A technology-neutral Definition. Alliance for Solid-State Illumination Systems and Technologies (ASSIST). Lighting Research Center, 2013, vol. 12 **[0006]**