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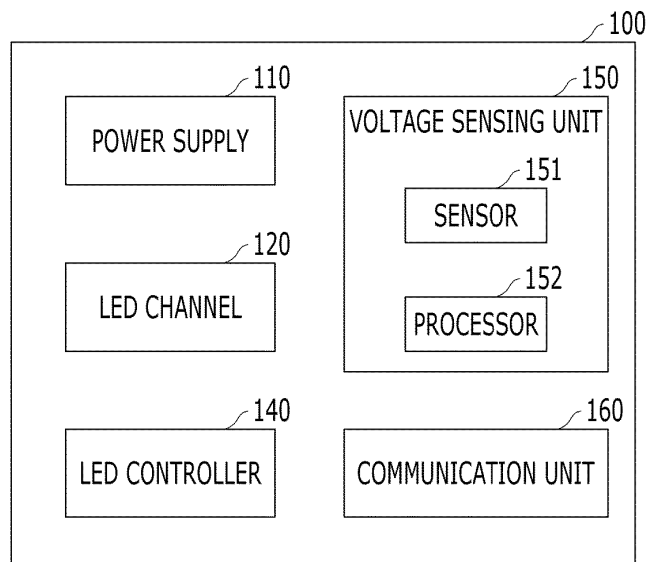
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(54) **ELECTRONIC DEVICE AND ELECTRONIC DEVICE CONTROL METHOD**

(57) According to embodiments, provided is an electronic device comprising: a sensor for sensing an input voltage supplied from a power supply; and a processor

for controlling so that the duty cycle of current being supplied to one or more LEDs is 100% when the sensed input voltage is at least a first voltage.

FIG. 3



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Description

[Technical Field]

[0001] Embodiments relate to an electronic device and a method for controlling the electronic device. For example, the embodiments are applied to an electronic device and a method for controlling the electronic device in which operation of the electronic device is controlled when an overvoltage is introduced.

[Background]

[0002] Recently, in a field of display technology, electronic devices having excellent characteristics such as thin, flexible, rollable, and stretchable characteristics have been developed. A light emitting diode (LED) is a semiconductor light emitting element well known for converting a current into light, and has been used as a light source for a display image of the electronic device including an information communication device, along with a GaP:N-based green LED, since a red LED using a GaAsP compound semiconductor was commercialized in 1962.

[0003] The LED emits light by itself, so that it is necessary to limit current supplied to the LED. For example, to control on/off of the LED or to control luminance of the LED to be high or constant in the LED in the on state, control of the current supplied to the LED is required. In addition, for example, when a current having a level equal to or higher than a predetermined level is supplied to the LED, a lifespan of the LED is shortened and/or the LED is damaged. Therefore, to control operation of such LED, the electronic device separately has a driver IC for controlling the operation of the LED.

[0004] In one example, when an overvoltage is supplied to the driver IC, the driver IC is damaged. For example, when an external power source connected to the electronic device is damaged and an excessive voltage is supplied into the electronic device, the driver IC is damaged.

[0005] To solve such problem, a method including a circuit for suppressing the overvoltage to protect the driver IC when the overvoltage is introduced into the driver IC is proposed. However, in this case, as the number of LEDs increases, the numbers of necessary circuits, elements, and printed circuit boards (PCBs) increase. In addition, the driver IC is rather damaged in the overvoltage suppression process.

[Summary]

[Technical Problem]

[0006] Embodiments are to provide an electronic device and a method for controlling the electronic device that solve the above-described problems.

[0007] Embodiments are to protect an LED and a

controller that controls an LED current when an overvoltage is introduced.

[0008] Embodiments are to, while protecting an LED and a controller that controls an LED current when an overvoltage is introduced, minimize a space occupied by a circuit and/or an element for such protection.

[0009] It will be appreciated by persons skilled in the art that the objects that could be achieved with the various embodiments of the present disclosure are not limited to what has been particularly described hereinabove and the above and other objects that the various embodiments of the present disclosure could achieve will be more clearly understood from the following detailed description.

[Technical Solutions]

[0010] According to embodiments, provided is an electronic device including a sensor that senses an input voltage supplied from a power supply, and a processor that controls a duty of a current supplied to one or more light emitting diodes (LEDs) to be 100% when the sensed input voltage is equal to or greater than a first voltage.

[0011] According to embodiments, the processor may control a magnitude of the current supplied to the one or more LEDs to be equal to or smaller than a predetermined magnitude when the sensed input voltage is equal to or greater than the first voltage.

[0012] According to embodiments, the processor may transmit a feedback voltage increase request to the power supply when the sensed input voltage is equal to or greater than a second voltage smaller than the first voltage.

[0013] According to embodiments, the processor may control the current supplied to the one or more LEDs and then re-sense the input voltage supplied via the power supply using the sensor, and allow the current supplied to the one or more LEDs to be operated based on a signal when the re-sensed input voltage is smaller than the second voltage.

[0014] According to embodiments, the sensor may be connected in parallel with each of the one or more LEDs.

[0015] According to embodiments, the sensor may sense a voltage divided by a first resistor and a second resistor connected to each other in series.

[0016] According to embodiments, the first voltage may be equal to or greater than 90% of a predetermined limit voltage for the one or more LEDs.

[0017] According to embodiments, provided is a method for controlling an electronic device including sensing an input voltage, and controlling a duty of a current supplied to one or more LEDs to be 100% when the sensed input voltage is equal to or greater than a first voltage.

[0018] According to embodiments, the sensing of the input voltage may include dividing the input voltage by a first resistor and a second resistor connected to each other in series, and sensing the divided voltage.

[0019] According to embodiments, the method may further include transmitting a feedback voltage increase request for the input voltage when the sensed input voltage is equal to or greater than a second voltage and smaller than the first voltage, wherein the second voltage is smaller than the first voltage.

[0020] According to embodiments, the method may further include allowing the current supplied to the one or more LEDs to be operated based on a signal when the sensed input voltage is smaller than the second voltage.

[0021] According to embodiments, the method may further include transmitting a feedback voltage increase request for the input voltage when the sensed input voltage is equal to or greater than the first voltage.

[Advantageous Effects]

[0022] The embodiments may protect the controller that controls the LED current from the overvoltage supply.

[0023] The embodiments may efficiently use the space even when the number of LEDs increases.

[0024] In the embodiments, even when the number of LEDs increases, the required numbers of elements and circuits, and/or the area size increase of the PCB are not great.

[0025] Effects obtainable from the present embodiments are not limited by the above mentioned effects, and other unmentioned effects can be clearly understood from the above description by those having ordinary skill in the technical field to which the present disclosure pertains.

[Brief Description of the Drawings]

[0026] The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this application, illustrate embodiment(s) of the invention and together with the description serve to explain the principle of the invention. In the drawings:

FIG. 1 schematically illustrates an operation circuit according to embodiments.

FIG. 2 illustrates a voltage-based operation aspect based on FIG. 1.

FIG. 3 is a block diagram schematically illustrating each component of an electronic device according to embodiments.

FIG. 4 schematically illustrates an operation circuit of an electronic device according to embodiments.

FIG. 5 is a flowchart illustrating a method for controlling an electronic device according to embodiments.

FIG. 6 is a flowchart illustrating an example of a control method for s102 in FIG. 5.

FIG. 7 illustrates a voltage-based operation aspect based on FIGS. 3 to 6.

[Best Mode]

[0027] Description will now be given in detail according to exemplary embodiments disclosed herein, with reference to the accompanying drawings. For the sake of brief description with reference to the drawings, the same or equivalent components may be provided with the same reference numbers, and description thereof will not be repeated. In general, a suffix such as "module" and "unit" may be used to refer to elements or components. Use of such a suffix herein is merely intended to facilitate description of the specification, and the suffix itself is not intended to give any special meaning or function.

[0028] In the present disclosure, that which is well-known to one of ordinary skill in the relevant art has generally been omitted for the sake of brevity. The accompanying drawings are used to help easily understand various technical features and it should be understood that the embodiments presented herein are not limited by the accompanying drawings. As such, the present disclosure should be construed to extend to any alterations, equivalents and substitutes in addition to those which are particularly set out in the accompanying drawings.

[0029] It will be understood that although the terms first, second, etc. may be used herein to describe various elements, these elements should not be limited by these terms. These terms are generally only used to distinguish one element from another. It will be understood that when an element is referred to as being "connected with" another element, the element can be directly connected with the other element or intervening elements may also be present.

[0030] In contrast, when an element is referred to as being "directly connected with" another element, there are no intervening elements. A singular representation may include a plural representation unless it represents a definitely different meaning from the context. Terms such as "include" or "has" are used herein and should be understood that they are intended to indicate an existence of several components, functions or steps, disclosed in the specification, and it is also understood that greater or fewer components, functions, or steps may likewise be utilized.

[0031] An electronic device 100 described in the present disclosure includes all devices operated as electrical energy is supplied. For example, the electronic device 100 includes a display device. In this regard, the display device is a concept including all display devices that display information as a unit pixel or a set of the unit pixels. Therefore, it may be applied to components without being limited to a finished product. For example, a panel corresponding to a component of a digital TV also independently corresponds to the display device in the present disclosure. The finished product may include a mobile phone, a smart phone, a laptop computer, a digital broadcasting terminal, a personal digital assistant (PDA), a portable multimedia player (PMP), a navigation system, a slate PC, a tablet PC, an Ultra Book, the digital TV, a

desktop computer, and the like.

[0032] However, it will be easily understood by those skilled in the art that a configuration according to an embodiment described herein may also be applied to a display-capable device even in a new product form to be developed later.

[0033] In the present disclosure, for convenience of description, an example of controlling a current supplied to a light emitting diode (LED) will be described. However, the electronic device and a method for controlling the electronic device described herein include not only the LED but also all objects controlled and operated based on an abnormal state of an input voltage.

[0034] In the present disclosure, for convenience of description, the LED is exemplified as a light emitting means. However, any light emitting means for converting a current into light may also be applied to the electronic device according to the embodiments.

[0035] FIG. 1 schematically illustrates an operation circuit of an electronic device according to embodiments.

[0036] The electronic device 100 according to embodiments includes at least one LED channel 120. The at least one LED channel 120 includes at least one LED element (e.g., L1, L2, and L3). The electronic device 100 includes a power supply 110, an overvoltage inflow prevention circuit 130, and an LED controller 140 to operate the LED channel 120. The circuit diagram in FIG. 1 is merely an example, and the present disclosure is not limited to the circuit diagram in FIG. 1 and the components included in the circuit diagram.

[0037] The power supply 110 supplies power to the electronic device 100 from the outside. The power supply 110 is, for example, connected to the outside to supply a DC voltage.

[0038] The LED channel 120 receives an input voltage from the power supply 110. The LED channel 120 emits light via the received voltage. The LED channel 120 emits light via the at least one LED element (e.g., L1, L2, and L3) included therein. In this regard, the number of LED elements included in the LED channel 120 is not limited to three, and may be equal to or greater than one. In addition, FIG. 1 shows only one LED channel 120 for convenience of description, but the number of LED channels 120 may be equal to or greater than one. When the number of LED channels 120 is equal to or greater than one, the respective LED channels 120 are connected to each other in parallel, for example.

[0039] The LED controller 140 controls operation of the LED channel 120. The LED controller 140 controls the operation of the LED channel 120 by adjusting an amount of current flowing into the LED channel 120. For example, the LED controller 140 controls the one or more LED elements (e.g., L1, L2, and L3) included in the LED channel 120 to be turned on/off.

[0040] In one example, the LED controller 140 controls the operation of the one LED channel 120. For example, when the electronic device 100 includes two or more LED channels 120, the electronic device 100 may include two

or more LED controllers 140. For example, one LED controller 140 corresponds to one LED channel 120.

[0041] The overvoltage inflow prevention circuit 130 prevents an overvoltage from being introduced into the LED controller 140. In this regard, the overvoltage is a voltage with a magnitude equal to or greater than a predetermined value, and the predetermined value is different depending on the number of LED elements included in the LED channel 120 and a temperature. The predetermined value is a value pre-stored in a memory (not shown) included in the electronic device 100. Alternatively, the predetermined value is a value received from the outside via a communication unit 160 (see FIG. 3).

[0042] In this regard, the overvoltage inflow prevention circuit 130 corresponds to a pair of LED controllers 140 and the LED channel 120. For example, when the electronic device 100 includes the two LED channels 120 and the two LED controllers 140 respectively corresponding to the two LED channels 120, the electronic device 100 includes two overvoltage inflow prevention circuits 130, each corresponding to one of the two pairs of LED channels and LED controllers. Each overvoltage inflow prevention circuit 130 prevents the overvoltage from flowing into the LED channel 120 and/or the LED controller 140 corresponding thereto.

[0043] All or a portion of the voltage introduced via the power supply 110 is consumed by the LED channel 120. When a portion of the introduced voltage is consumed by the LED channel 120, the remaining voltage is introduced into the LED controller 140. In this regard, when the remaining voltage flowing into the LED controller 140 is the overvoltage, the LED controller 140 may be damaged. To prevent such problem, embodiments include the overvoltage inflow prevention circuit 130.

[0044] The overvoltage inflow prevention circuit 130 includes, for example, a switch Q1. The overvoltage inflow prevention circuit 130 controls whether the introduced voltage is supplied to the LED controller 140 via the switch Q1. That is, the overvoltage inflow prevention circuit 130 controls whether the voltage is supplied to the LED controller 140 via on/off of the switch Q1. The switch Q1 is, for example, a transistor, and is, for example, an NPN transistor. In one example, the overvoltage inflow prevention circuit 130 further includes a first ground power source X1. A base of the switch Q1 is connected to the first ground power source X1. Accordingly, the overvoltage inflow prevention circuit 130 allows the remaining voltage to flow from the LED channel 120 toward the LED controller 140.

[0045] In one example, the overvoltage inflow prevention circuit 130 may further include at least one of a first resistor R1 and a second resistor R2. At least one of the first resistor R1 and the second resistor R2 is connected to the base of the switch Q1. Accordingly, the overvoltage inflow prevention circuit 130 prevents the voltage with the magnitude equal to or greater than the predetermined value from flowing into the LED controller 140.

[0046] Accordingly, the electronic device 100 according to embodiments protects the LED channel 120 and/or the LED controller 140 via the overvoltage inflow prevention circuit 130 even when the overvoltage is introduced into the electronic device 100. In FIG. 2, the state in which the overvoltage is introduced in the case in which the embodiments described in FIG. 1 are applied will be described.

[0047] FIG. 2 illustrates a voltage-based operation aspect based on FIG. 1.

[0048] FIG. 2 illustrates a magnitude of a voltage over time in the electronic device 100 described in FIG. 1.

[0049] In FIG. 2, reference numeral 10 denotes a voltage input to the LED channel 120 described in FIG. 1, and denotes the input voltage. That is, the input voltage 10 represents a voltage of a first terminal J1 (see FIG. 1). In this regard, the first terminal J1 electrically connects, for example, the external power source with the power supply 110, and is, for example, an electric wire or an element.

[0050] In addition, reference numeral 11 in FIG. 2 denotes a voltage measured by the LED controller 140 described in FIG. 1, and denotes an inflow voltage introduced into the LED controller 140. The inflow voltage 11 is, for example, a voltage measured at a second terminal J2 (see FIG. 2) included in the LED controller 140. In this regard, the second terminal J2 electrically connects, for example, the LED channel 120 with the LED controller 140, and is an electric wire or an element.

[0051] In FIG. 2, S represents operation in a normal state. In addition, in FIG. 2, U represents operation in an abnormal state. The normal state S is a state in which power having a magnitude within a predetermined range is constantly supplied from the external power source toward the power supply 110. For example, in the normal state S, the electronic device 100 is operated by the supplied power without damage to an element and/or a circuit inside the electronic device 100. The abnormal state U is, for example, a case in which the voltage having the magnitude equal to or greater than the predetermined value is introduced. The abnormal state U is, for example, a case in which a problem occurs in the first terminal J1 connecting the external power source with the power supply 110. The abnormal state U includes, for example, a case in which the first terminal J1 or an external wire connected to the first terminal J1 is peeled off and the inside of the terminal or the external wire touches the ground or the like.

[0052] In the normal state S shown in FIG. 2, the input voltage 10 is constantly supplied to the LED channel 120. For example, the input voltage 10 is supplied to the LED channel 120 with a magnitude equal to or smaller than the predetermined value. Accordingly, the inflow voltage 11 is introduced into the LED controller 140 within the predetermined range.

[0053] In the abnormal state U shown in FIG. 2, the input voltage 10 is not uniformly supplied to the LED channel 120. For example, the input voltage 10 is sup-

plied to the LED channel 120 with a magnitude equal to or greater than the predetermined value. Accordingly, the inflow voltage 11 is introduced into the LED controller 140 within the predetermined range.

[0054] In this regard, as shown in FIG. 2, in the case of the abnormal state U, the overvoltage inflow prevention circuit 130 prevents current from flowing through the LED channel 120 in a section in which the overvoltage is applied to the LED controller 140 (a current-off section). Accordingly, even when the input voltage 10 is in the abnormal state U, the embodiments may prevent the LED controller 140 from being destroyed because of inflow of excessive voltage with the magnitude equal to or greater than the predetermined value.

[0055] However, the destruction prevention of the LED controller 140 as such may be temporary. For example, the input voltage may be continuously introduced into the LED channel 120 even after the current-off section occurs. In this regard, although the input voltage is continuously introduced, the voltage is not consumed in the LED channel 120 in the current-off section of the LED channel 120. That is, the voltage introduced into the LED controller 140 becomes a maximum voltage. Accordingly, the LED controller 140 may be rather destroyed.

[0056] In addition, to prevent the overvoltage from being introduced into the pair of the LED channel 120 and the LED controller 140 controlling the operation of the LED channel 120, one overvoltage introduction prevention circuit 130 is required corresponding to the pair of the LED channel 120 and the LED controller 140. For example, the electronic device 100 may include a mini LED or a micro LED as a light emitting means. In this case, the electronic device 100 includes more LED channels as the number of LEDs increases. The electronic device 100 should include more overvoltage inflow prevention circuits. That is, as the number of LED channels 120 increases, the electronic device 100 is required to increase the number of required elements and/or increase an area size of a printed circuit board (PCB) on which the LED channels 120 are mounted.

[0057] Therefore, hereinafter, an electronic device in which the required number of elements and/or the increase in the PCB area size is not great while preventing the overvoltage from being introduced into the LED controller 140 will be described in detail.

[0058] FIG. 3 is a block diagram schematically illustrating each component of an electronic device according to embodiments.

[0059] The electronic device 100 according to embodiments outputs an image via, for example, the received electrical energy. The electronic device 100 includes a display (not shown) that outputs the image. In this regard, the image includes all types of visual information that may be output, such as a dot, a line, a 2D-shaped still image, a 2D-shaped moving image, a 3D-shaped still image, and a 3D-shaped moving image.

[0060] The electronic device 100 includes the power supply 110, the LED channel 120, the LED controller 140,

a voltage sensing unit 150, and a communication unit 160. However, this may be an example, and the electronic device 100 may further include other components in addition to the components illustrated in FIG. 3, or may omit the components illustrated in FIG. 3.

[0061] The power supply 110 receives the power from the outside and supplies the voltage to each component included in the electronic device 100. To this end, for example, the power supply 110 includes a terminal (e.g., J1 in FIG. 1 and J3 in FIG. 4) that is electrically connectable to the external power source. Alternatively, the power supply 110 includes a battery (not shown) embedded in the electronic device 100 or detachable from the electronic device 100. For example, the power supply 110 transmits the voltage supplied via the terminal J3 to the LED channel 120 and/or the voltage sensing unit 150.

[0062] The LED channel 120 is embedded in the display, so that the display outputs the image. For example, the LED channel 120 is mounted on the printed circuit board (PCB). The LED channel 120 is electrically connected to the components included in the electronic device 100 via a circuit printed on the PCB. For example, the LED channel 120 receives the input voltage from the power supply 110 via the circuit.

[0063] The LED includes, for example, one or more LEDs for the channel 120 to emit light. The LED channel 120 causes the display to output the image via the one or more LEDs that emit red (R), green (G), and/or blue (B) light.

[0064] In this regard, each of the one or more LEDs is, for example, a unit pixel of the image output by the electronic device 100. The unit pixel is, for example, a minimum unit for rendering one color. The LED is a type of semiconductor light emitting element that converts the current into light, and is a light emitting diode. In one example, the LED channel 120 may include any type of light emitting element instead of the LED.

[0065] In one example, the LED channel 120 adjusts luminance of the display via an on/off state of the one or more LEDs. For example, the LED channel 120 shortens a cycle of the on state to increase the luminance of the display. Alternatively, for example, the LED channel 120 lengthens the cycle of the on state, so that the luminance of the display is reduced.

[0066] The electronic device 100 may include, for example, a plurality of LED channels 120. The plurality of LED channels 120 are connected to each other in parallel, for example. Accordingly, the LED channels 120 receive the input voltage in the same or similar range from the power supply 110.

[0067] The LED controller 140 controls the operation of the LED channel 120. The LED controller 140 controls the operation of the LED channel 120 by adjusting an amount of current flowing into the LED channel 120. For example, the LED controller 140 controls a duty of the LED channel 120 based on a processor 152. Accordingly, the LED controller 140 allows the LED channel 120 to emit light of appropriate brightness and color.

[0068] The voltage sensing unit 150 senses the input voltage and determines whether the input voltage is the overvoltage. When the overvoltage is sensed, the voltage sensing unit 150 causes the LED controller 140 to operate with a microcurrent. Accordingly, the voltage sensing unit 150 prevents the overvoltage from being introduced into the LED channel 120 and/or the LED controller 140.

[0069] Specifically, the voltage sensing unit 150 includes a sensor 151 and the processor 152.

[0070] The sensor 151 senses the input voltage supplied from the power supply 110. That is, the sensor 151 senses the input voltage input to the LED channel 120. The sensor 151 is connected in parallel with, for example, the LED channel 120. When the electronic device 100 includes the plurality of LED channels 120, the sensor 151 is disposed to be connected in parallel to each of the plurality of LED channels 120. Accordingly, the electronic device 100 may sense the input voltages supplied to the respective plurality of LED channels 120 at once even via the one sensor 151.

[0071] The processor 152 determines whether the sensed input voltage is equal to or greater than a predetermined voltage.

[0072] For example, the processor 152 determines whether a value of the input voltage is equal to or greater than a predetermined value. For example, when the voltage with the value equal to or greater than the predetermined value is introduced, the processor 152 determines that the overvoltage is introduced.

[0073] As such, the overvoltage is the voltage with the value equal to or greater than the predetermined value. The predetermined value is different depending on the number of LED elements included in the LED channel 120 and the temperature. The predetermined value is a value pre-stored in the memory (not shown) included in the electronic device 100. Alternatively, the predetermined value is a value received from the outside via the communication unit 160 (see FIG. 3).

[0074] The processor 152 controls the current supplied to the LED channel 120 based on the sensed input voltage. The processor 152 controls a duty of the current supplied to the LED channel 120 based on the input voltage to control the current supplied to the LED channel 120. In this regard, the duty represents an on/off ratio of the LED. For example, when the duty is 0%, all of the one or more LEDs included in the LED channel 120 are completely turned off. For example, when the duty is 100%, all of the one or more LEDs included in the LED channel 120 are continuously in the on state.

[0075] For example, when it is determined that the value of the input voltage is equal to or greater than the predetermined value, the processor 152 transmits the input voltage to the LED controller 140. That is, when it is determined that the overvoltage has been introduced, the processor 152 controls the LED controller 140 to protect the LED channel 120 and/or the LED controller 140 from the overvoltage. For example, when the value of

the input voltage is equal to or greater than the predetermined value, the processor 152 controls the duty of the current supplied to the LED channel 120 to be 100%.

[0076] The communication unit 160 enables data transmission/reception between the components included in the electronic device 100. For example, when the processor 152 determines whether the overvoltage has been introduced, the communication unit 160 transmits such determination result to the LED controller 140. For example, the communication unit 160 transmits a duty to be output based on the determination result of the processor 152 to the LED controller 140. Alternatively, for example, the communication unit 160 transmits an input voltage to be input based on the determination result of the processor 152 to the power supply 110.

[0077] Alternatively, the communication unit 160 transmits and receives data to and from an external server of the electronic device 100. For example, the communication unit 160 receives data on the image to be output via the display from the external server. Alternatively, for example, when the processor 152 determines whether the overvoltage has been introduced, the communication unit 160 transmits information indicating that the overvoltage has been introduced to the external server.

[0078] Hereinafter, such components of the electronic device will be described via a circuit diagram.

[0079] FIG. 4 schematically illustrates an operation circuit of an electronic device according to embodiments.

[0080] As described with reference to FIG. 3, the electronic device 100 according to embodiments includes the power supply 110, the one or more LED channels 120, the LED controller 140 corresponding to the LED channels 120, and the voltage sensing unit 150.

[0081] The electronic device 100 supplies the voltage to the LED channel 120 via the third terminal J3 (e.g., corresponding to J1 described with reference to FIGS. 1 and 2) included in the power supply 110. In this regard, the third terminal J3 electrically connects, for example, the external power source with the power supply 110, and is, for example, an electric wire or an element.

[0082] Although omitted in FIG. 4, the electronic device 100 according to embodiments may further include a capacitor. The capacitor is, for example, a constant voltage output capacitor. The capacitor maintains the constant voltage input via the power supply 110.

[0083] The LED channel 120 emits light via the voltage supplied from the power supply 110. The LED channel 120 includes one or more LED elements (e.g., L4, L5, and L6). When a plurality of LED elements are included in one LED channel 120, the plurality of LED elements (e.g., L4, L5, and L6) are connected in series to each other. The LED channel 120 emits light via the one or more LED elements (e.g., L4, L5, and L6). In this regard, the number of LED elements included in the LED channel 120 is not limited to three, and may be equal to or greater than one.

[0084] In addition, FIG. 4 shows only one LED channel 120 for convenience of description, but the number of LED channels 120 may be equal to or greater than one.

When there are the plurality of LED channels 120, the LED channels 120 are connected in parallel to each other, for example. When there are the plurality of LED channels 120, each of the plurality of LED channels corresponds to the LED controller 140. Accordingly, the electronic device 100 includes the LED controllers 140 as much as the number corresponding to the number of LED channels 120.

[0085] The LED controller 140 controls the operation of the LED channel 120. The LED controller 140 controls the operation of the LED channel 120 by adjusting the amount of current flowing into the LED channel 120. For example, the LED controller 140 controls the one or more LED elements (e.g., L4, L5, and L6) included in the LED channel 120 to be turned on/off.

[0086] The voltage sensing unit 150 senses the voltage supplied from the power supply 110 to the LED channel 120. To this end, the voltage sensing unit 150 is connected in parallel with the LED channel 120. When the electronic device 100 includes the plurality of LED channels 120, the voltage sensing unit 150 is connected in parallel with each of the plurality of LED channels 120. Accordingly, the voltage sensing unit 150 senses the voltage supplied to each LED channel 120.

[0087] The voltage sensing unit 150 includes a fifth terminal J5 to sense the voltage supplied to the LED channel 120. The fifth terminal J5 is connected in parallel to each of the one or more LED channels 120 to sense the input voltage.

[0088] The voltage sensing unit 150 includes a third resistor R3 and a fourth resistor R4 to sense the input voltage via the fifth terminal J5. In this regard, for example, the third resistor R3 has a smaller resistance value than the fourth resistor R4. As shown in FIG. 4, the third resistor R3 and the fourth resistor R4 are connected in parallel to each other. The third resistor R3 and the fourth resistor R4 are connected in parallel with the LED channel 120. The voltage sensing unit 150 further includes a second ground power source X2 connected in series with the third resistor R3 and the fourth resistor R4.

[0089] The fifth terminal J5 is positioned between the third resistor R3 and the fourth resistor R4. The fifth terminal J5 measures an output pressure, which is a pressure output to the fifth terminal J5, via such terminal.

[0090] The voltage sensing unit 150 senses a change in the output pressure. In this regard, the change in the output pressure may occur resulted from the inflow of the overvoltage. Accordingly, the voltage sensing unit 150 determines that it is not the normal state anymore when the output pressure is out of a predetermined range. That is, the voltage sensing unit 150 determines that it is the abnormal state when the output pressure is out of the predetermined range.

[0091] For example, the inflow voltage introduced via the third terminal J3 is 10V. In the normal state, each of the LED elements L4, L5, and L6 included in the LED channel 120 consumes a voltage of 3V. In this case, 9V of the inflow voltage is consumed in the LED channel 120,

and the remaining 1V of the inflow voltage is introduced into the LED controller 140 via a fourth terminal J4 included in the LED controller 140.

[0092] In this regard, the electronic device 100 according to embodiments senses the inflow voltage via the fifth terminal J5 included in the voltage sensing unit 150. For example, the third resistor R3 and the fourth resistor R4 have resistance values of 10kΩ and 100kΩ, respectively. In the third resistor R3 and the fourth resistor R4 connected in series with each other, the fifth terminal J5 measures a voltage applied to the third resistor R3 that varies based on the inflow voltage.

[0093] For example, the inflow voltage introduced via the third terminal J3 is 10 V. The fifth terminal J5 measures about 0.91V as a 1/11 value of 10V. 0.91V is, for example, a value smaller than the predetermined value described in FIG. 3. In this case, the processor 152 determines that the inflow voltage is in the normal state. That is, the processor 152 determines that the voltage of 1V flowing into the fourth terminal J4 is in the normal state.

[0094] Alternatively, for example, the inflow voltage introduced via the third terminal J3 is equal to or greater than 15V. The fifth terminal J5 measures a value equal to or greater than about 1.36V as a 1/11 value of a value equal to or greater than 15V. 1.36V is, for example, a value equal to or greater than the predetermined value described in FIG. 3. In this case, the processor 152 determines that the inflow voltage is in the abnormal state. That is, the processor 152 determines that a voltage of 6V flowing into the fourth terminal J4 is in the abnormal state, which is the overvoltage state.

[0095] When determining that the voltage flowing into the LED controller 140 is equal to or greater than the predetermined value, the processor 152 controls a magnitude of the current supplied to the LED channel 120 to be equal to or smaller than a predetermined magnitude. The electronic device 100 according to embodiments prevents damage to the LED element by causing the LED channel 120 to be operated with a low current.

[0096] As described above, the processor 152 controls the LED channel 120 not to be turned off and to be continuously operated in the overvoltage state. As the LED channel 120 is continuously operated in the on state, at least a portion of the voltage introduced via the third terminal J3 is consumed.

[0097] For example, the inflow voltage introduced via the third terminal J3 is equal to or greater than 15V. When the LED channel 120 is in the off state, an overvoltage equal to or greater than 15V is introduced into the LED controller 140 via the fourth terminal J4. In this case, the LED controller 140 may be damaged by the overvoltage.

[0098] However, when the LED channel 120 is continuously in the on state, each of the LED elements L4, L5, and L6 included in the LED channel 120 consumes a voltage of 3V. In this case, 9V of the inflow voltage is consumed in the LED channel 120, and the remaining voltage of 6V or more is introduced into the LED controller

140 via the fourth terminal J4 included in the LED controller 140. That is, as the LED channel 120 is operated at a duty rate of 100% and is continuously in the on state, embodiments may reduce the magnitude of the voltage flowing into the LED controller 140.

[0099] As described above, as the LED channel 120 is continuously operated in the on state rather than in the off state in the overvoltage inflow state, the electronic device 100 according to embodiments prevents the LED channel 120 and/or the LED controller 140 from being damaged by the overvoltage.

[0100] In addition, embodiments may sense the abnormal states of all of the one or more LED channels 120 via the one voltage sensing unit 150. Accordingly, the electronic device 100 according to embodiments does not require a separate overvoltage inflow prevention circuit and a PCB space in which such a circuit is mounted even when the number of LED channels 120 increases. Accordingly, in embodiments, even when the number of LED channels 120 is great, the operation circuit may be effectively disposed.

[0101] Hereinafter, a method for controlling the electronic device according to the above-described embodiments will be described in detail.

[0102] FIG. 5 is a flowchart illustrating a method for controlling an electronic device according to embodiments.

[0103] The method for controlling the electronic device 100 according to embodiments includes sensing the input voltage (s101).

[0104] The voltage sensing unit 150 senses the input voltage via the sensor 151. As described above with reference to FIGS. 3 to 4, the sensor 151 senses the input voltage via the two resistors (e.g., the third resistor and the fourth resistor described above with reference to FIG. 4) connected in series to each other. For example, the two resistors connected in series to each other divide the input voltage. The sensor 151 senses the divided voltage. The processor 152 sets a threshold value based on a magnitude of the divided voltage. The threshold value includes, for example, the predetermined value described in FIGS. 1 to 4. The processor 152 may calculate the input voltage introduced into the electronic device 100 via the sensed input voltage. In the present document, for convenience of description, setting of the threshold value, the predetermined value, and the like based on the calculated input voltage will be described as an example.

[0105] The method for controlling the electronic device 100 according to embodiments includes determining whether the input voltage is in the abnormal state (s102).

[0106] The processor 152 determines whether the sensed input voltage is in the abnormal state based on whether the sensed input voltage is equal to or greater than the threshold value. For example, the processor 152 determines that the input voltage is in the abnormal state when the sensed input voltage is equal to or greater than the threshold value. The abnormal state includes the

above-described overvoltage state. For example, when the sensed input voltage is smaller than the threshold value, the processor 152 determines that the input voltage is not in the abnormal state.

[0107] The method for controlling the electronic device 100 according to embodiments includes controlling the LED channel 120 to be operated in response to a signal when it is determined that the input voltage is not in the abnormal state (s103).

[0108] In the normal state, the processor 152 controls the LED controller 140 to output the duty of the LED channel 120 in response to the signal. In this case, the LED channel 120 is operated in the duty range of 0% to 100%. For example, the LED controller 140 controls the duty of the LED channel 120 based on a signal included in the input to be output.

[0109] The method for controlling the electronic device 100 according to embodiments includes operating a section of the LED channel 120 in which the abnormal state is sensed to have a duty of 100% when it is determined that the input voltage is in the abnormal state (s104).

[0110] In the abnormal state, the processor 152 controls the LED controller 140 to output the duty of the LED channel 120 at 100%. That is, the processor 152 keeps the LED channel 120 in the on state in the abnormal state. In addition, the processor 152 allows the LED channel 120 to be operated with the low current having a magnitude equal to or smaller than a predetermined magnitude via the LED controller 140. In this regard, the processor 152 sets a reference of the low current based on internal/external temperature of the electronic device 100. Alternatively, the reference for the low current is a value pre-stored in the memory (not shown). Alternatively, the reference for the low current is received via the communication unit 160. Accordingly, the electronic device 100 according to embodiments prevents the LED channel 120 and/or the LED controller 140 from being damaged by the abnormal state.

[0111] Hereinafter, a method for controlling such an abnormal state will be described in more detail.

[0112] FIG. 6 is a flowchart illustrating an example of a control method for the s102 in FIG. 5.

[0113] The method for controlling the electronic device 100 according to embodiments includes sensing the input voltage (s101). S101 is the same as or similar to that described in FIG. 5.

[0114] The method for controlling the electronic device 100 according to embodiments includes determining whether the input voltage is equal to or greater than a first voltage (s201).

[0115] The processor 152 determines whether the input voltage is equal to or greater than the first voltage. In this regard, the first voltage is set based on a limit voltage. For example, the first voltage is 80% of the limit voltage. The first voltage is not limited thereto, and may be a value smaller than a second voltage to be described later. The predetermined value described in FIGS. 3 to 5 includes

the first voltage.

[0116] In one example, the processor 152 sets the limit voltage based on the number of LED elements included in each of the LED channels 120. Alternatively, the processor 152 sets the limit voltage via a value pre-stored in the memory. Alternatively, the processor 152 receives the limit voltage via the communication unit 160. In this regard, the limit voltage is a maximum value of the input voltage that may be protected by the low current operation state described with reference to FIGS. 3 to 5.

[0117] The method for controlling the electronic device 100 according to embodiments includes controlling the LED channel 120 to be operated in response to the signal when it is determined that the input voltage is smaller than the first voltage (s103). S103 is the same as or similar to that described in FIG. 5.

[0118] The method for controlling the electronic device 100 according to embodiments includes performing feedback control when it is determined that the input voltage is equal to or greater than the first voltage (s202).

[0119] The processor 152 makes a request for the feedback control to the power supply 110 when the input voltage is equal to or greater than the first voltage. The feedback control is, for example, a voltage control request requesting the power supply 110 to adjust the voltage to return the abnormal state to the normal state. For example, when the input voltage is equal to or greater than the first voltage, the processor 152 transmits a feedback voltage increase request to the power supply 110.

[0120] Accordingly, the electronic device 100 according to embodiments prevents the input voltage from rising to an overvoltage section.

[0121] The method for controlling the electronic device 100 according to embodiments includes determining whether the input voltage is equal to or greater than a second voltage (s203).

[0122] After the feedback control, the processor 152 re-senses, using the sensor, the input voltage supplied via the power supply 110. The processor 152 determines whether the re-sensed input voltage is equal to or greater than the second voltage. In this regard, the second voltage is set based on the limit voltage. For example, the second voltage is 90% of the limit voltage. The value of the second voltage is not limited thereto, and may be a value smaller than 100% of the limit voltage. The predetermined value described in FIGS. 3 to 5 includes the second voltage. The second voltage is a value greater than the first voltage. The second voltage is a voltage when the input voltage does not decrease below the first voltage even by the feedback control s202. The processor 152 determines that the LED channel 120 corresponds to the overvoltage section when the input voltage is equal to or greater than the second voltage.

[0123] The method for controlling the electronic device 100 according to embodiments includes operating the section of the LED channel 120 in which the abnormal voltage is sensed to have a duty of 100% when it is

determined that the input voltage is equal to or greater than the second voltage (s104). S104 is the same as or similar to that described in FIG. 5.

[0124] When it is determined that the input voltage is equal to or greater than the second voltage, the processor 152 continues to perform step s202 together while performing step s104. That is, the processor 152 makes the request for the feedback control to the power supply 110 while controlling the LED channel 120 to be continuously operated at the low current in the on state. Accordingly, the electronic device 100 according to embodiments more effectively protects the LED channel 120 and the LED controller 140.

[0125] On the other hand, when it is determined that the input voltage re-sensed via the sensor 151 is smaller than the second voltage, the processor 152 determines again whether the re-sensed input voltage is equal to or greater than the first voltage (s201). In this regard, when the re-sensed input voltage is smaller than the first voltage, the processor 152 controls the LED controller 140 to output a duty of the LED channel 120 in response to the signal (S103). When the re-sensed input voltage is equal to or greater than the first voltage, the processor 152 performs the feedback control (s202).

[0126] As described above, the electronic device 100 according to embodiments performs the low current operation in the on state to prevent the overvoltage as described above, before the input voltage reaches 100% of the limit voltage. Accordingly, embodiments prevent the display from being suddenly turned off because of the overvoltage inflow. In addition, the electronic device 100 according to embodiments provides an element and/or an operation circuit that is efficiently disposed. In addition, embodiments aim to reduce production costs by reducing the required number of elements and the area size of the PCB. In addition, embodiments prevent the overvoltage from being introduced into each LED channel. In addition, in the abnormal state, embodiments simultaneously realize the overvoltage inflow prevention and protection of the device and a user by performing different operation for each introduced voltage.

[0127] FIG. 7 illustrates a voltage-based operation aspect based on FIGS. 3 to 6.

[0128] FIG. 7 illustrates a magnitude of a voltage over time in the electronic device 100 described with reference to FIGS. 3 to 6.

[0129] In FIG. 7, reference numeral 10 denotes the voltage input to the LED channel 120 described with reference to FIGS. 3 to 6, and denotes the input voltage. That is, the input voltage 10 represents the voltage of the third terminal J3. In this regard, the third terminal J3 electrically connects, for example, the external power source with the power supply 110, and is, for example, the electric wire or the element.

[0130] In addition, in FIG. 7, reference numeral 11 is the voltage measured by the LED controller 140 described with reference to FIGS. 3 to 6, and represent the inflow voltage introduced into the LED controller 140.

The inflow voltage 11 is, for example, the voltage measured at the fourth terminal J4 included in the LED controller 140. In this regard, the fourth terminal J4 electrically connects the LED channel 120 with the LED controller 140 and is, for example, the electric wire or the element.

[0131] In FIG. 7, S represents operation in the normal state. In addition, in FIG. 7, U represents operation in the abnormal state. The normal state S is the state in which the power having the magnitude within the predetermined range is constantly supplied from the external power source toward the power supply 110. For example, in the normal state S, the electronic device 100 is operated by the supplied power without damage to the element and/or the circuit inside the electronic device 100. The abnormal state U is, for example, the case in which the voltage having the magnitude equal to or greater than the predetermined value is introduced. The abnormal state U is, for example, a case in which a problem occurs in the third terminal J3 (see FIG. 1) connecting the external power source with the power supply 110. The abnormal state U includes, for example, a case in which the third terminal J3 or an external wire connected to the third terminal J3 is peeled off and the inside of the terminal or the external wire touches the ground or the like.

[0132] In the normal state S shown in FIG. 7, the input voltage 10 is constantly supplied to the LED channel 120. For example, the input voltage 10 is supplied to the LED channel 120 with the magnitude equal to or smaller than the predetermined value. Accordingly, the inflow voltage 11 is introduced into the LED controller 140 within the predetermined range.

[0133] In the abnormal state U shown in FIG. 7, the input voltage 10 is not uniformly supplied to the LED channel 120. For example, the input voltage 10 is supplied to the LED channel 120 with the magnitude equal to or greater than the predetermined value.

[0134] When determining that the input voltage is in the abnormal state U, the processor 152 controls the LED channel 120 to be operated at the duty rate of 100%. That is, as shown in FIG. 7, in the abnormal state U, the LED channel 120 continuously maintains the on state without being in the off state (11). In addition, the LED channel 120 is operated with the low current in the abnormal state U.

[0135] Accordingly, a maximum value V2 of the inflow voltage shown in FIG. 7 is smaller than a maximum value V1 of the inflow voltage shown in FIG. 2. Accordingly, it may be seen that the electronic device 100 according to embodiments reduces the magnitude of the maximum voltage flowing into the LED controller 140. That is, the electronic device 100 according to embodiments reduces the overvoltage introduced into the LED controller 140 via the continuous low current operation, thereby more effectively protecting the LED controller 140 from the overvoltage.

[0136] In addition, the electronic device 100 according to embodiments prevents the LED controller 140 from

being damaged in such an abnormal state, thereby more effectively protecting the user who is using the electronic device 100.

[0137] Although the electronic device and the method for controlling the electronic device according to embodiments of the present disclosure have been described as the specific embodiments, this is merely an example, and the present disclosure is not limited thereto, and should be interpreted to have the broadest range according to the basic idea disclosed herein.

[0138] A person skilled in the art may practice unspecified embodiments by combining or substituting the disclosed embodiments, without departing from the scope of the present disclosure. It will be apparent to those skilled in the art that various modifications and variations can be made in the present disclosure without departing from the spirit or scope of the invention. Thus, it is intended that the present disclosure cover the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

[Industrial Availability]

[0139] The electronic device and the method for controlling the electronic device according to the embodiments have industrial applicability.

Claims

1. An electronic device (100) comprising:

a sensor (151) configured to sense an input voltage supplied from a power supply (110); and a processor (152) configured to control a duty of a current supplied to one or more light emitting diodes (LEDs) to be 100% when the sensed input voltage is equal to or greater than a first voltage.

2. The electronic device (100) of claim 1, wherein the processor (152) is configured to control a magnitude of the current supplied to the one or more LEDs to be equal to or smaller than a predetermined magnitude when the sensed input voltage is equal to or greater than the first voltage.

3. The electronic device (100) of claim 1, wherein the processor (152) is configured to transmit a feedback voltage increase request to the power supply (110) when the sensed input voltage is equal to or greater than a second voltage smaller than the first voltage.

4. The electronic device (100) of claim 3, wherein the processor (152) is configured to:

control the current supplied to the one or more

LEDs and then re-sense the input voltage supplied via the power supply (110) using the sensor (151); and

allow the current supplied to the one or more LEDs to be operated based on a signal when the re-sensed input voltage is smaller than the second voltage.

5. The electronic device (100) of claim 1, wherein the sensor (151) is connected in parallel with each of the one or more LEDs.

6. The electronic device (100) of claim 1, wherein the sensor (151) is configured to sense a voltage divided by a first resistor and a second resistor connected to each other in series.

7. The electronic device (100) of claim 1, wherein the first voltage is equal to or greater than 90% of a predetermined limit voltage for the one or more LEDs.

8. A method for controlling an electronic device (100), the method comprising:

sensing an input voltage; and controlling a duty of a current supplied to one or more LEDs to be 100% when the sensed input voltage is equal to or greater than a first voltage.

9. The method of claim 8, wherein the sensing of the input voltage includes:

dividing the input voltage by a first resistor and a second resistor connected to each other in series; and sensing the divided voltage.

10. The method of claim 8, further comprising: transmitting a feedback voltage increase request for the input voltage when the sensed input voltage is equal to or greater than a second voltage and smaller than the first voltage, wherein the second voltage is smaller than the first voltage.

11. The method of claim 10, further comprising: allowing the current supplied to the one or more LEDs to be operated based on a signal when the sensed input voltage is smaller than the second voltage.

12. The method of claim 8, further comprising: transmitting a feedback voltage increase request for the input voltage when the sensed input voltage is equal to or greater than the first voltage.

FIG. 1

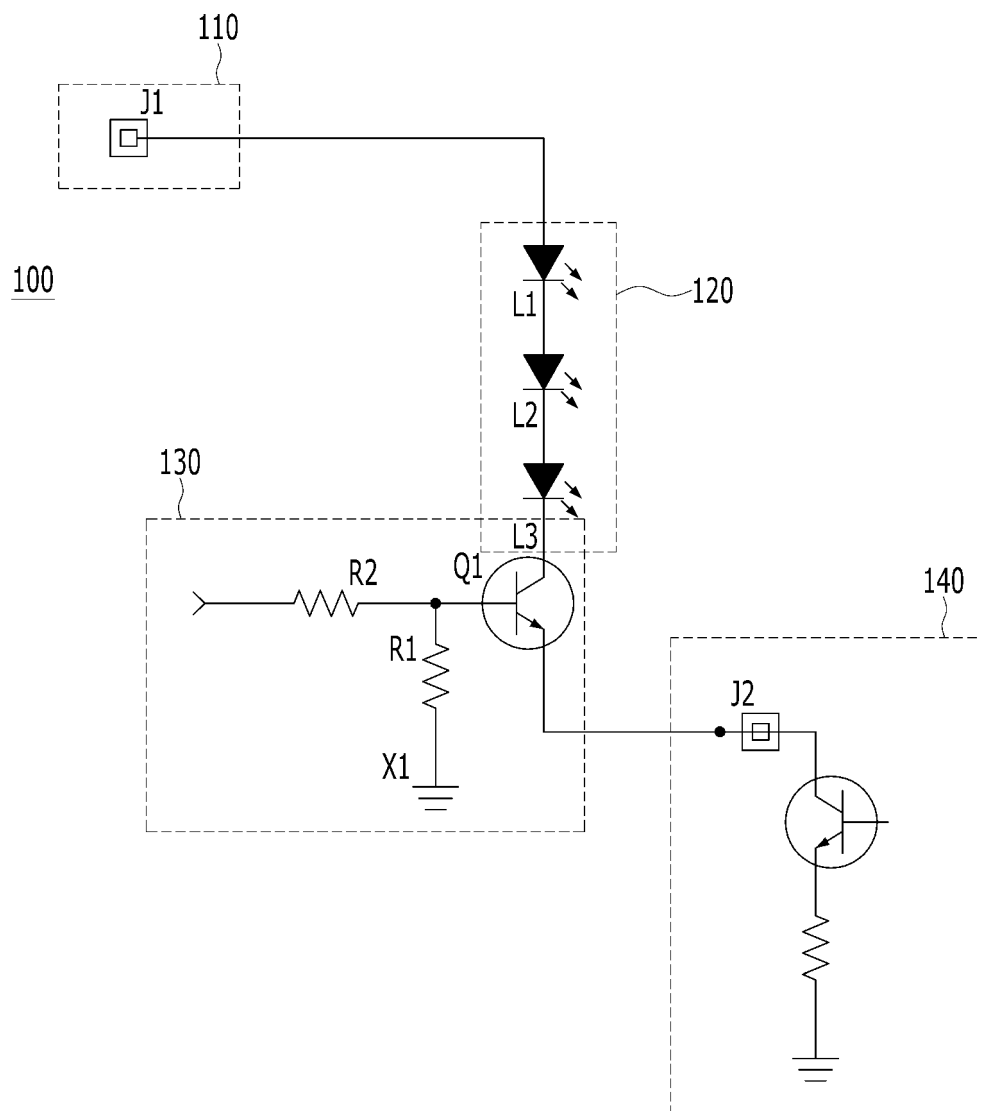


FIG. 2

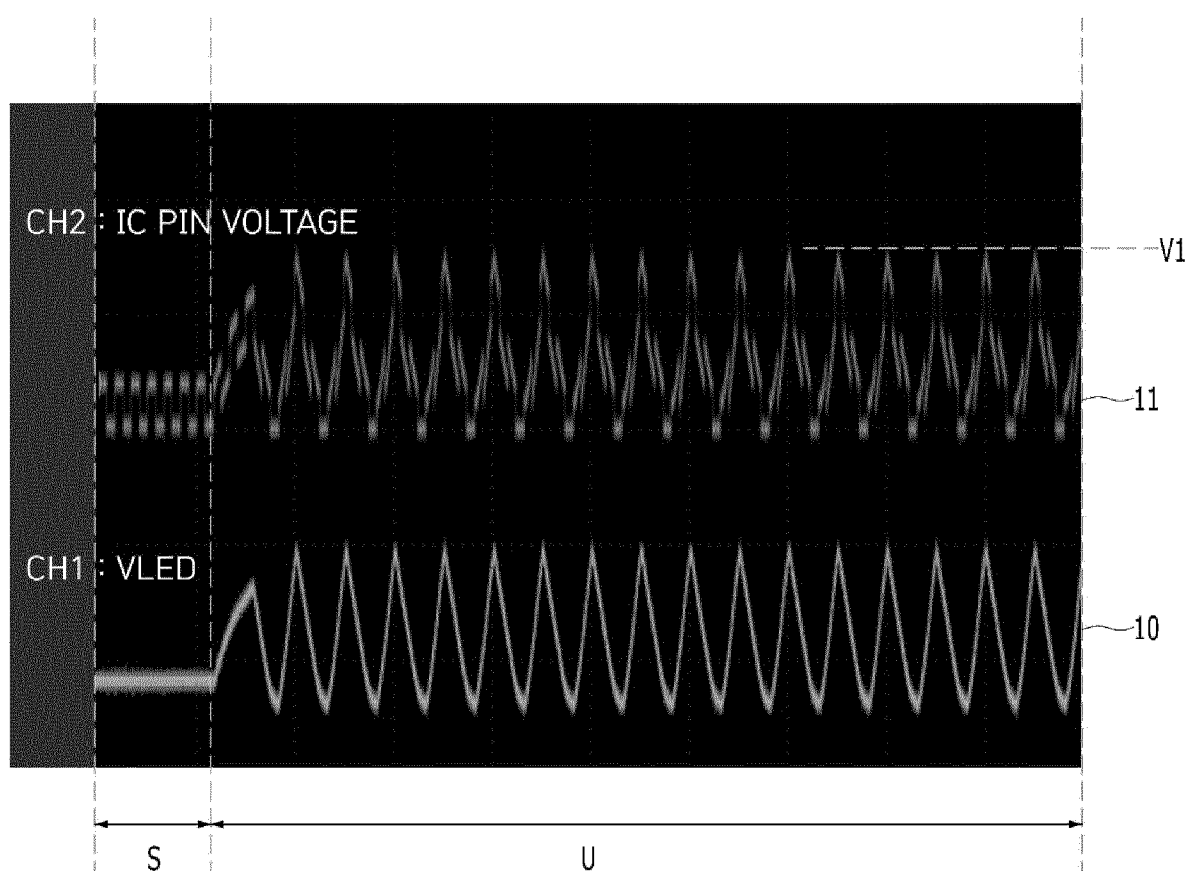


FIG. 3

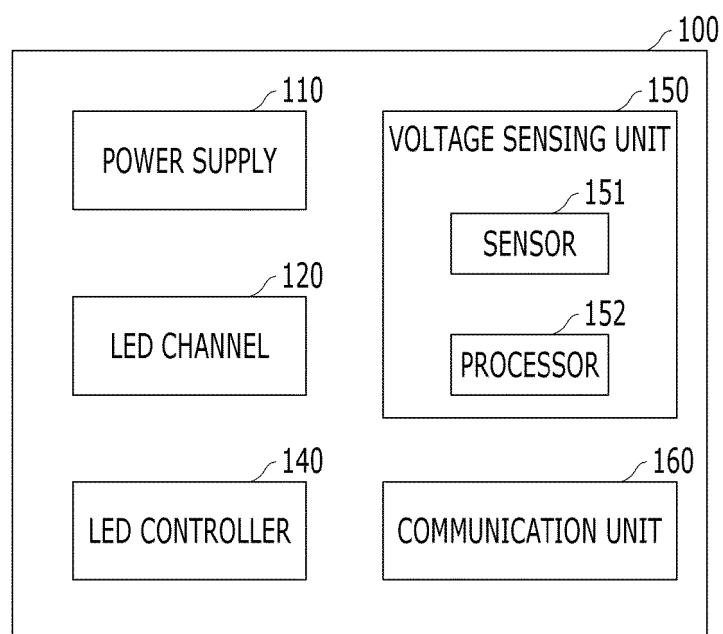


FIG. 4

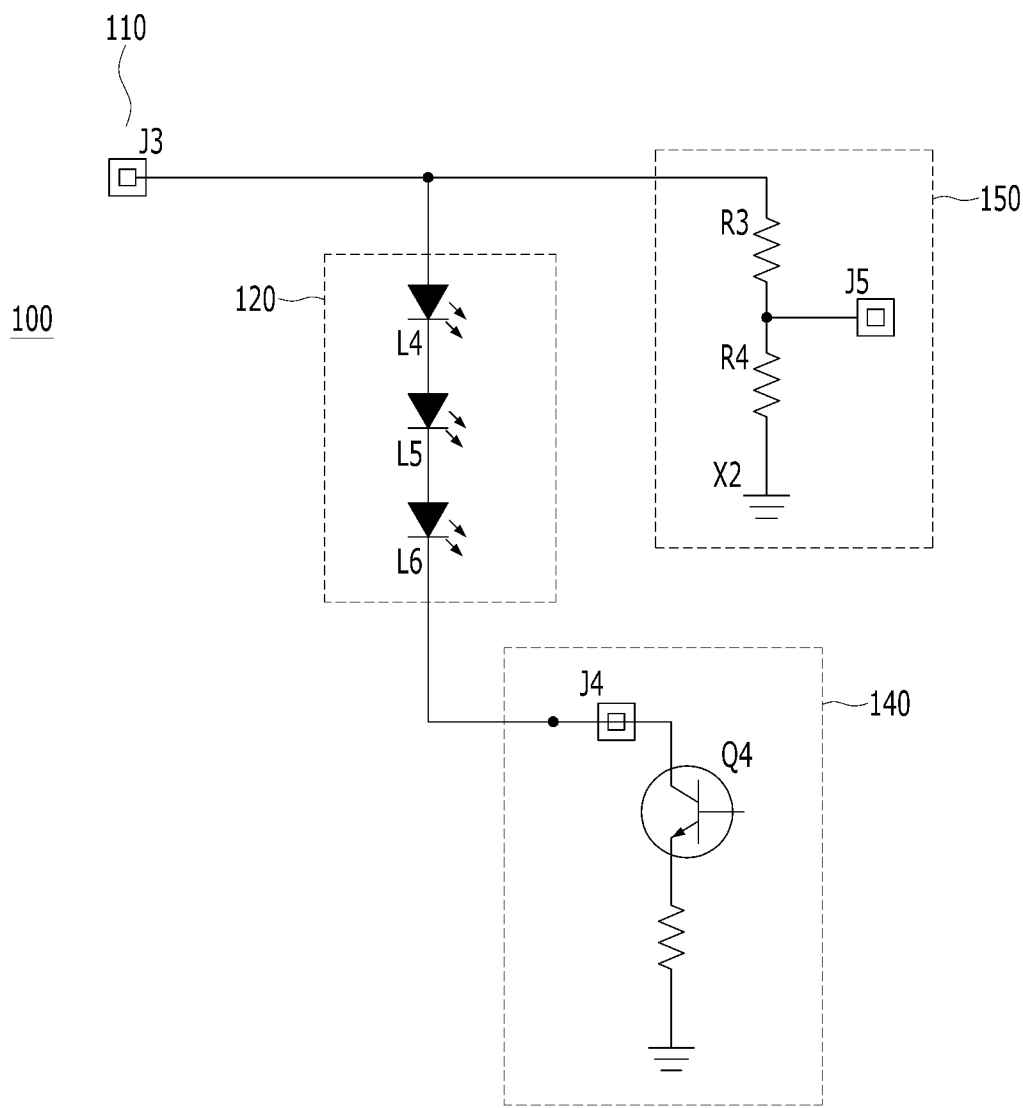


FIG. 5

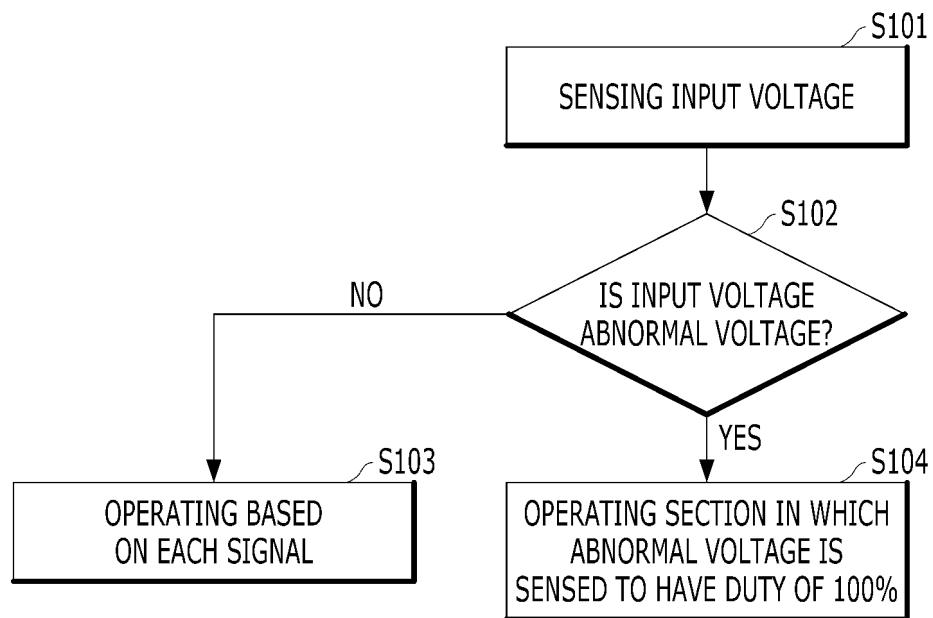


FIG. 6

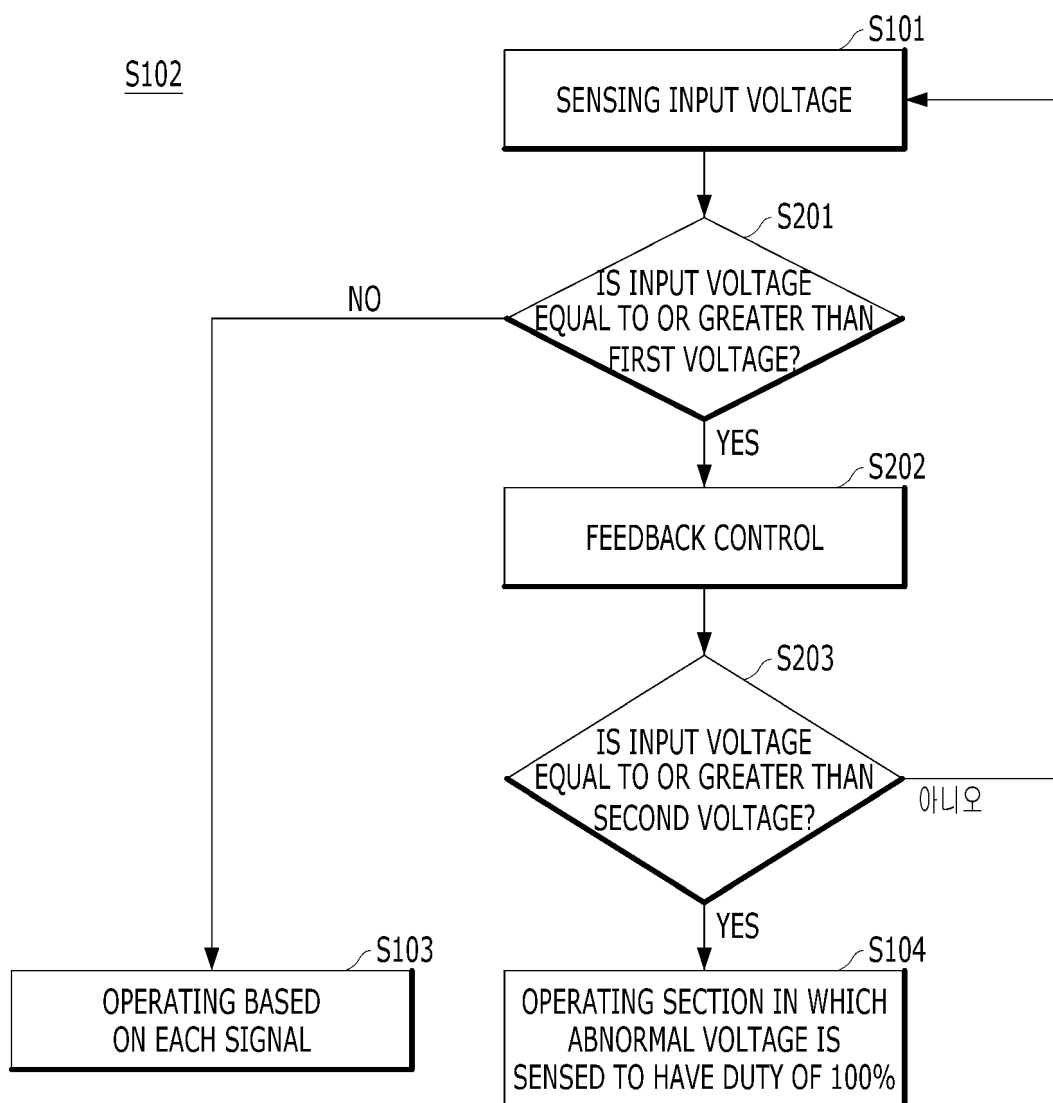
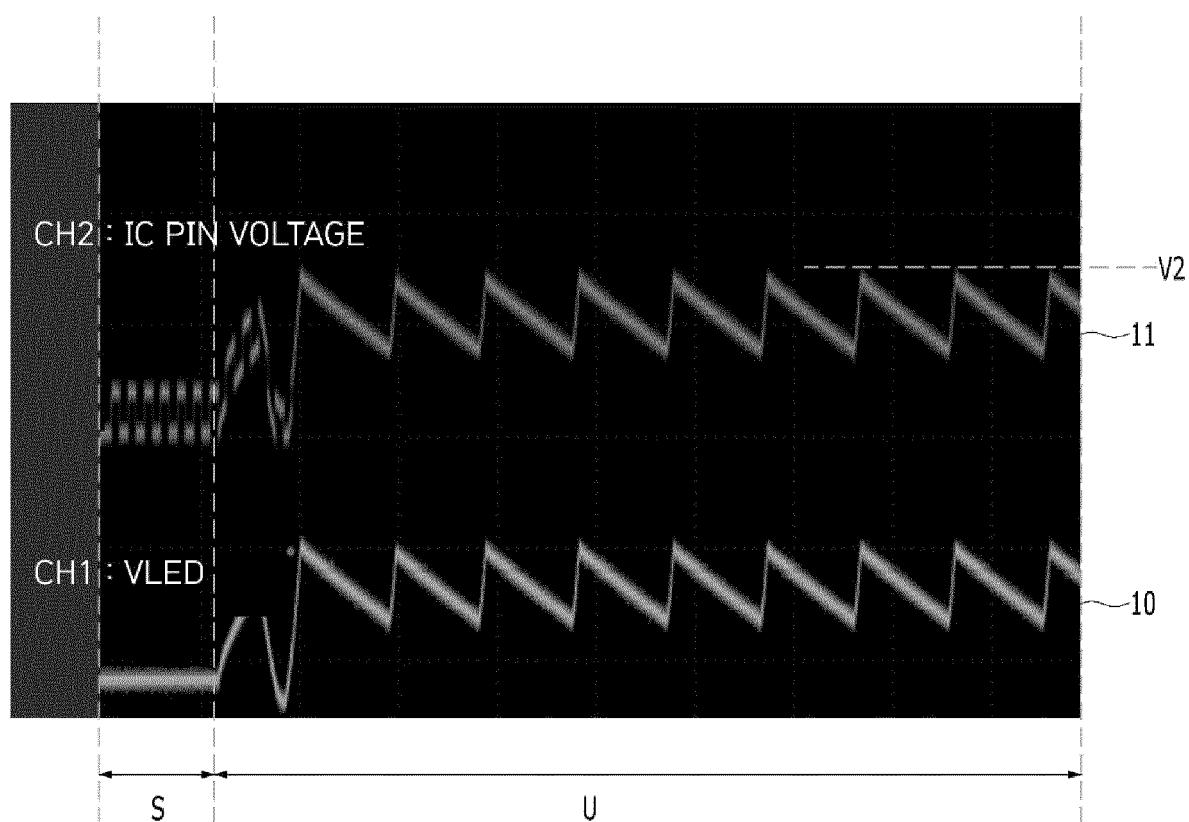


FIG. 7



INTERNATIONAL SEARCH REPORT

International application No.

PCT/KR2022/012350

A. CLASSIFICATION OF SUBJECT MATTER

G09G 3/32(2006.01)i; G09G 3/00(2006.01)i

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)

G09G 3/32(2006.01); G02F 1/133(2006.01); G09G 3/14(2006.01); G09G 3/34(2006.01); H02M 3/155(2006.01); H05B 37/02(2006.01); H05B 41/36(2006.01)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models: IPC as above

Japanese utility models and applications for utility models: IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS (KIPO internal) & keywords: 발광 다이오드(Light Emitting Diode, LED), 듀티(duty), 입력 전압(input voltage), 센싱(sensing), 피드백(feedback), 드라이버(driver), 과전압(overvoltage)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	KR 10-2015-0001067 A (SILICON WORKS CO., LTD.) 06 January 2015 (2015-01-06) See paragraphs [0042], [0052], [0061]-[0067] and [0072]-[0076]; claim 1; and figure 4.	1-12
Y	KR 10-2010-0058904 A (SAMSUNG ELECTRONICS CO., LTD.) 04 June 2010 (2010-06-04) See paragraph [0026]; claims 1-2; and figures 1-2 and 4.	1-12
A	JP 2014-108004 A (ALPINE ELECTRONICS INC.) 09 June 2014 (2014-06-09) See paragraphs [0037]-[0093]; and figures 1-9.	1-12
A	KR 10-1517207 B1 (FAIRCHILD KOREA SEMICONDUCTOR LTD.) 04 May 2015 (2015-05-04) See paragraphs [0010]-[0027]; and figures 1-2.	1-12
A	US 2008-0074348 A1 (KAO, Chin-Fa) 27 March 2008 (2008-03-27) See paragraphs [0020]-[0026]; and figure 2.	1-12

☐ Further documents are listed in the continuation of Box C.
 ☒ See patent family annex.

* Special categories of cited documents:

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“P” document published prior to the international filing date but later than the priority date claimed

“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

“X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

“&” document member of the same patent family

Date of the actual completion of the international search

09 May 2023

Date of mailing of the international search report

10 May 2023

Name and mailing address of the ISA/KR

Korean Intellectual Property Office
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Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/KR2022/012350

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