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Park

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(54) **ORGANIC LIGHT-EMITTING DISPLAY APPARATUS AND METHOD OF PROVIDING POWER THEREIN**

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(30) **Foreign Application Priority Data**

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(51) **Int. Cl.**
G09G 3/32 (2006.01)

(52) **U.S. Cl.**
CPC ***G09G 3/3208*** (2013.01); *G09G 2330/028* (2013.01); *G09G 2330/04* (2013.01); *G09G 2330/12* (2013.01)

(58) **Field of Classification Search**
USPC 345/76–83, 204, 690; 315/169.3
See application file for complete search history.

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(57) **ABSTRACT**

An organic light-emitting display apparatus and method of providing power in the organic light-emitting display apparatus. The organic light-emitting display apparatus including an organic light-emitting panel, a power supplying unit for supplying a first power voltage and a second power voltage to the organic light-emitting panel, and a driver integrated circuit comprising a short protection unit, wherein the short protection unit detects a short based on at least one of the first power voltage and the second power voltage and outputs an enable off signal that blocks the first power voltage and the second power voltage from being supplied to the power supplying unit.

20 Claims, 8 Drawing Sheets

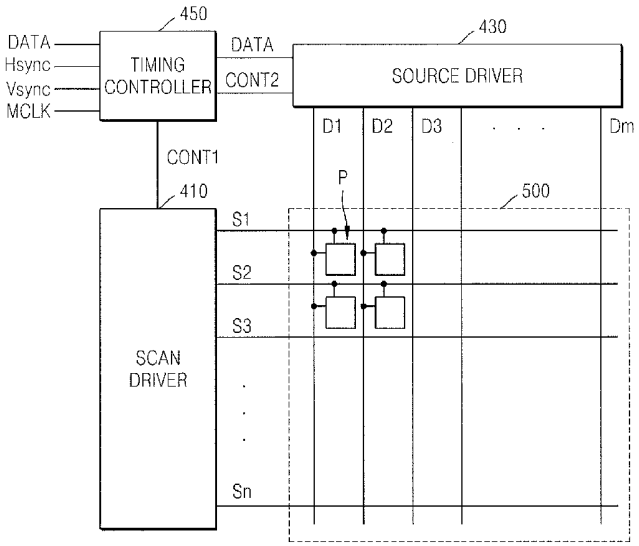

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FIG. 1

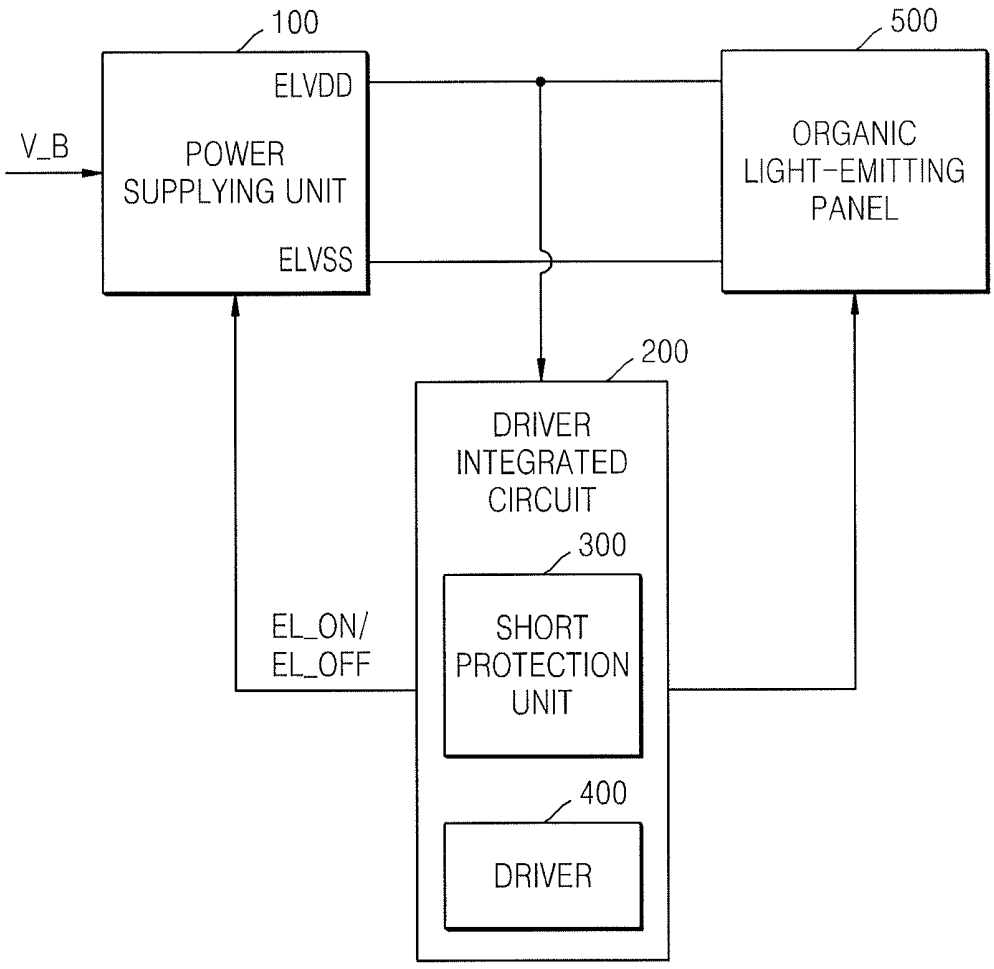

100
ELVDD
V_B
POWER SUPPLYING UNIT
ELVSS
500
ORGANIC LIGHT-EMITTING PANEL
200
DRIVER INTEGRATED CIRCUIT
300
SHORT PROTECTION UNIT
EL_ON/ EL_OFF
400
DRIVER

FIG. 2

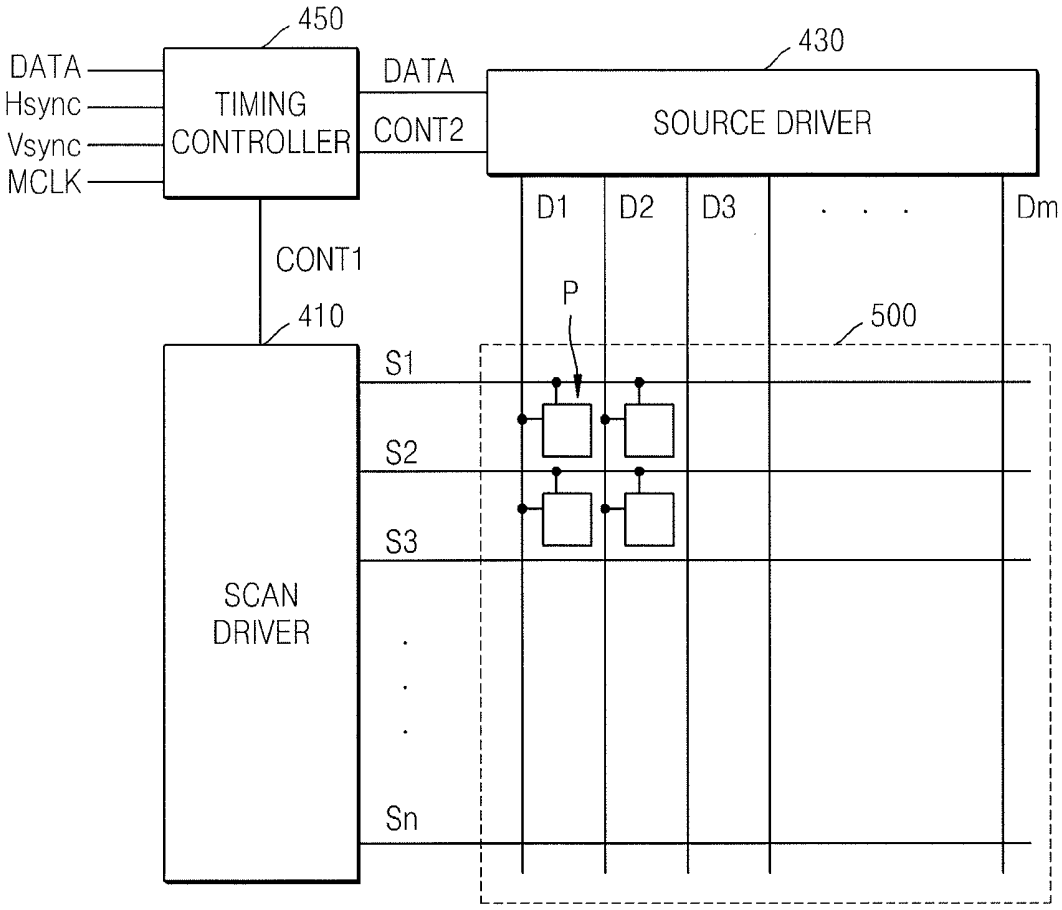

450
DATA
Hsync
Vsync
MCLK
TIMING CONTROLLER
DATA
CONT2
430
SOURCE DRIVER
D1
D2
D3
Dm
CONT1
410
P
500
S1
S2
S3
SCAN DRIVER
Sn

FIG. 3

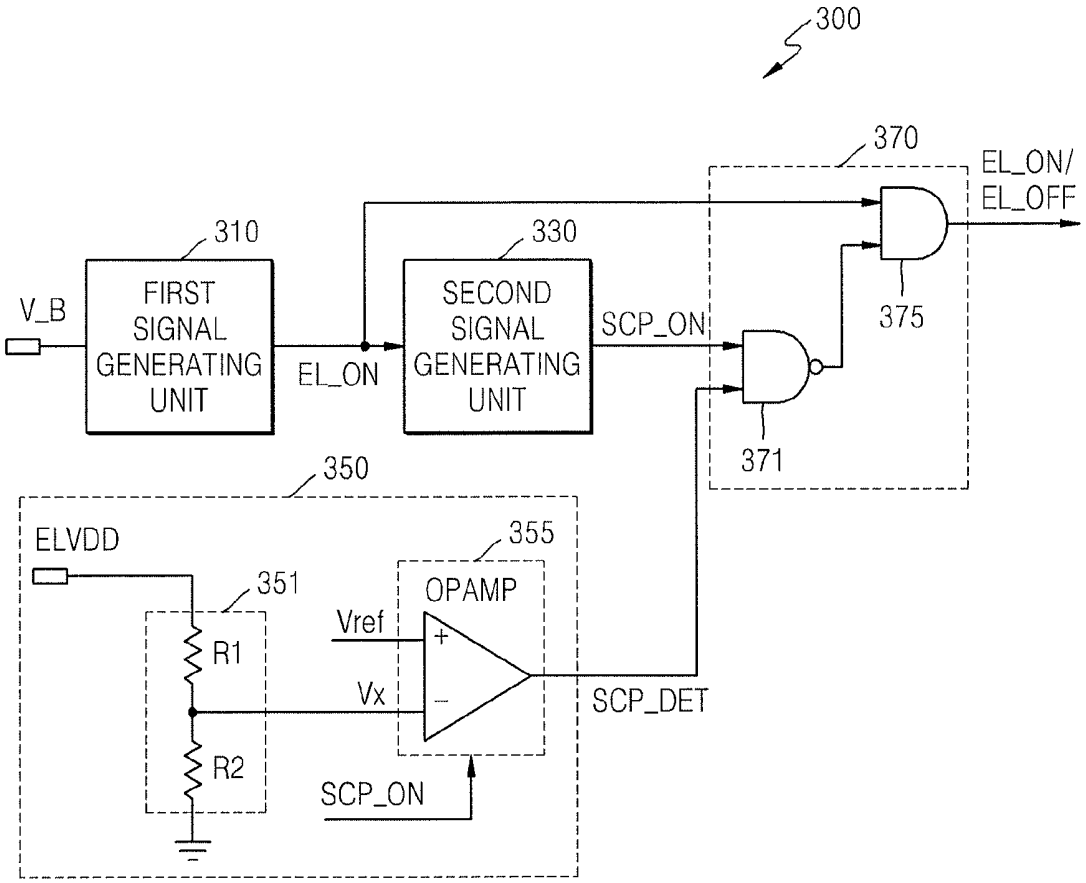

300
370
EL_ON/
EL_OFF
310
330
V_B
FIRST
SIGNAL
GENERATING
UNIT
EL_ON
SECOND
SIGNAL
GENERATING
UNIT
SCP_ON
375
371
350
ELVDD
355
OPAMP
351
Vref
R1
Vx
SCP_DET
R2
SCP_ON

FIG. 4A

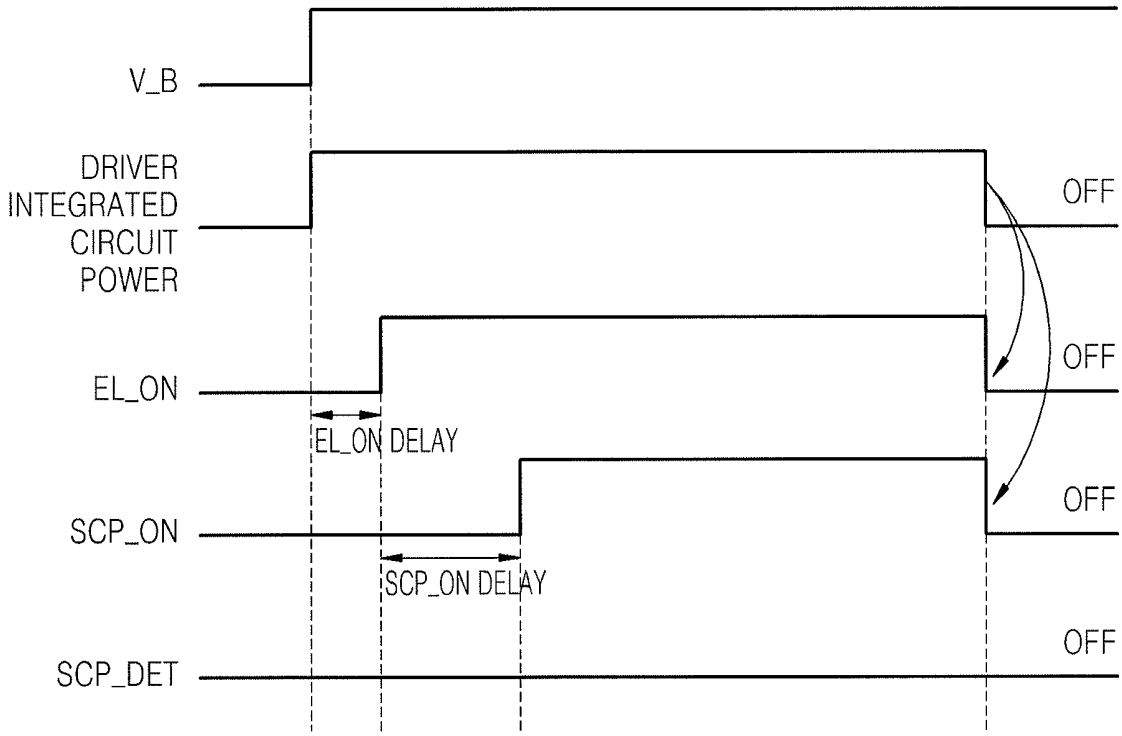

V_B
DRIVER INTEGRATED CIRCUIT POWER
OFF
EL_ON
OFF
EL_ON DELAY
SCP_ON
OFF
SCP_ON DELAY
SCP_DET
OFF

FIG. 4B

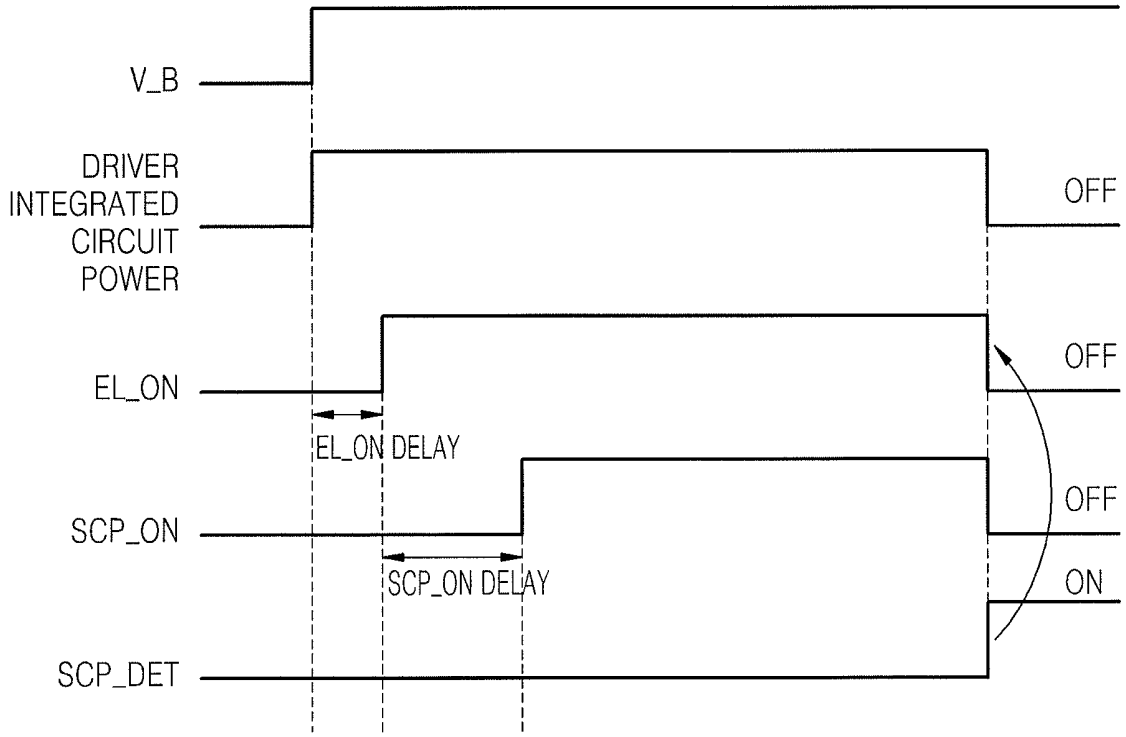

V_B
DRIVER INTEGRATED CIRCUIT POWER
OFF
EL_ON
OFF
EL_ON DELAY
SCP_ON
OFF
SCP_ON DELAY
ON
SCP_DET

FIG. 4C

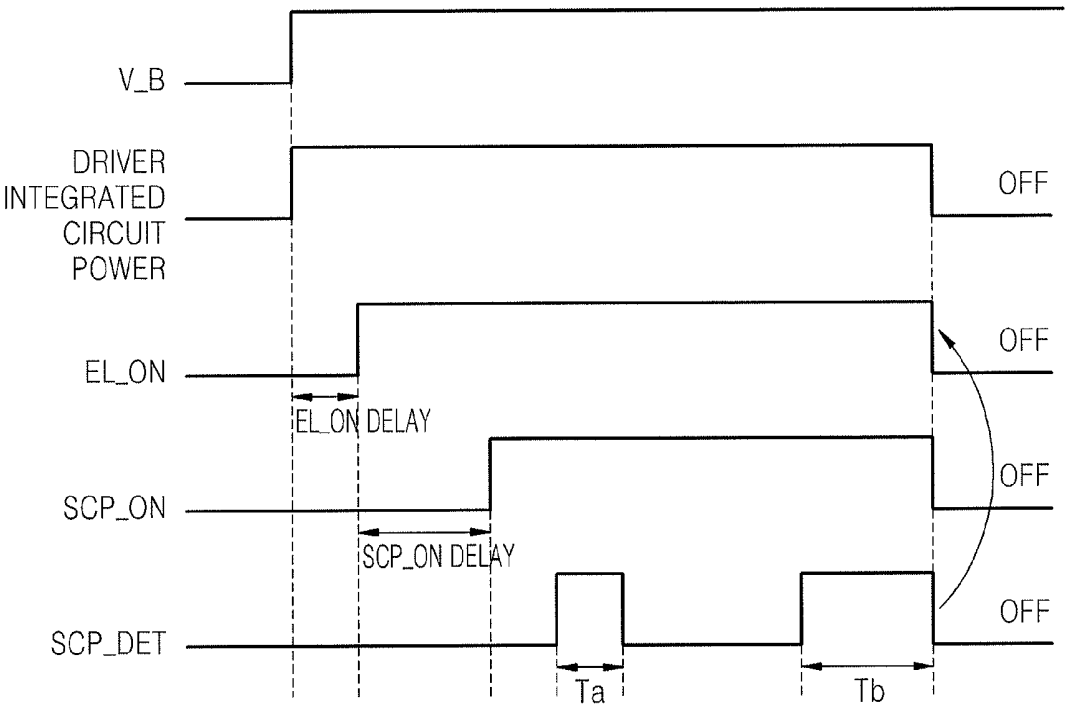

V_B
DRIVER INTEGRATED CIRCUIT POWER
OFF
EL_ON
OFF
EL_ON DELAY
SCP_ON
OFF
SCP_ON DELAY
SCP_DET
OFF
Ta
Tb

FIG. 5

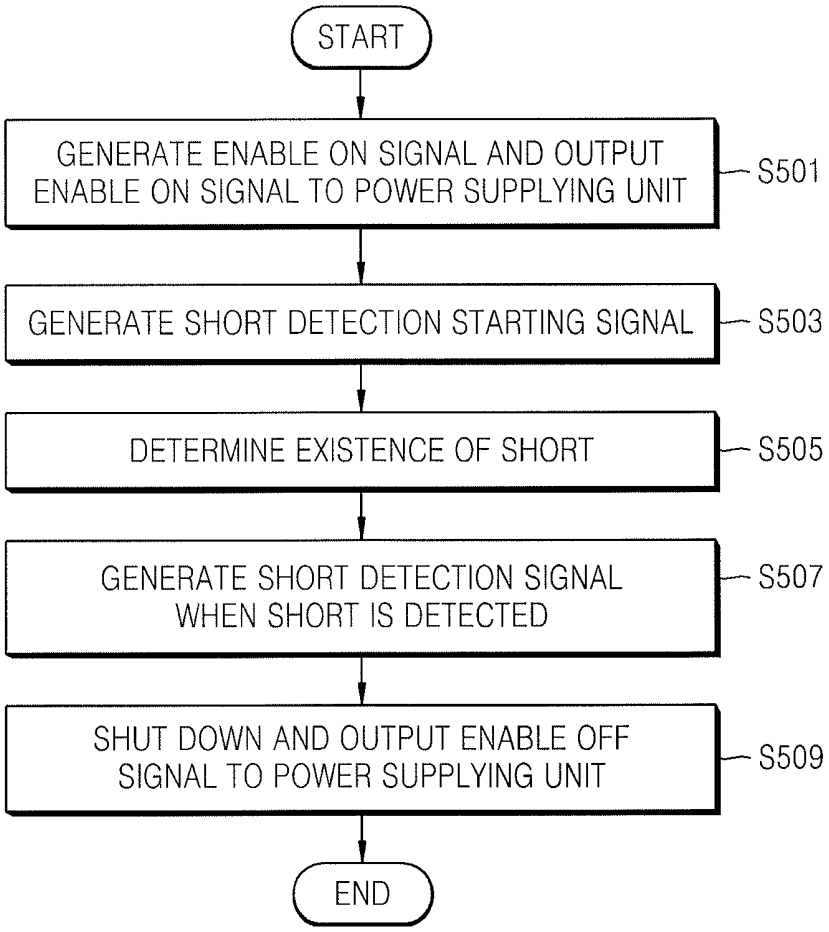

START
GENERATE ENABLE ON SIGNAL AND OUTPUT ENABLE ON SIGNAL TO POWER SUPPLYING UNIT
S501
GENERATE SHORT DETECTION STARTING SIGNAL
S503
DETERMINE EXISTENCE OF SHORT
S505
GENERATE SHORT DETECTION SIGNAL WHEN SHORT IS DETECTED
S507
SHUT DOWN AND OUTPUT ENABLE OFF SIGNAL TO POWER SUPPLYING UNIT
S509
END

FIG. 6

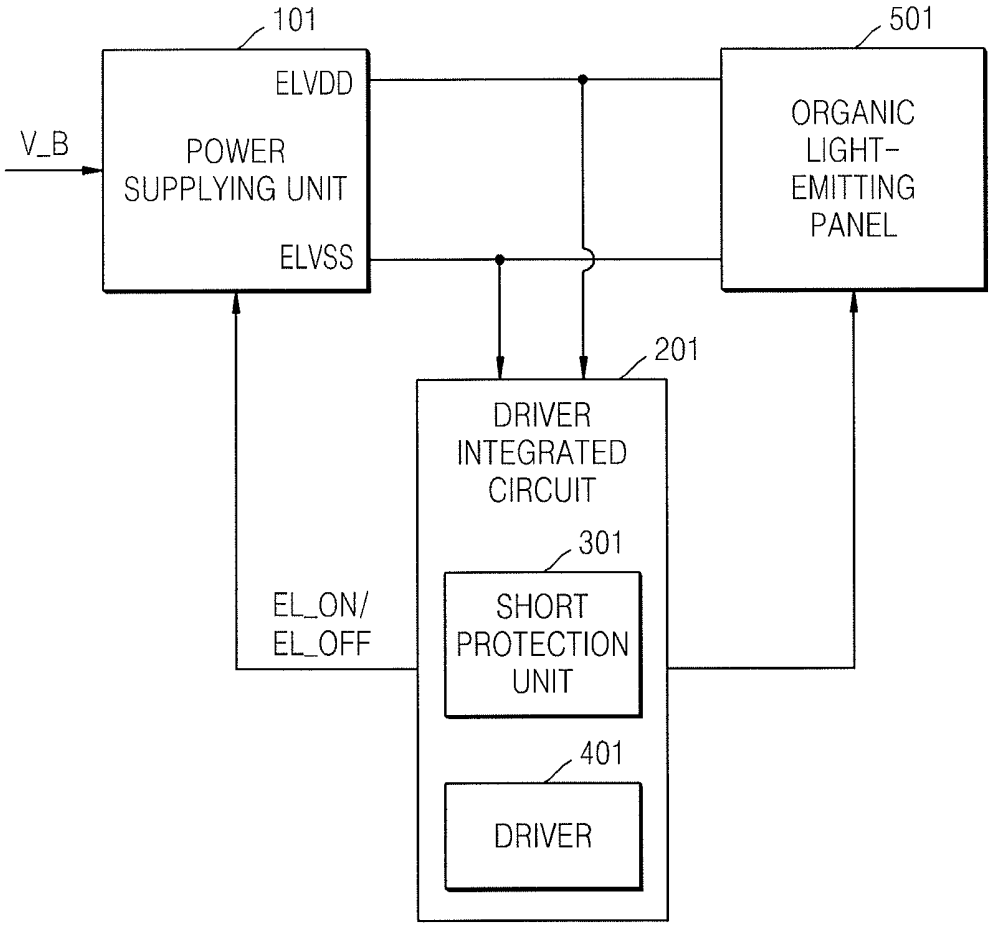
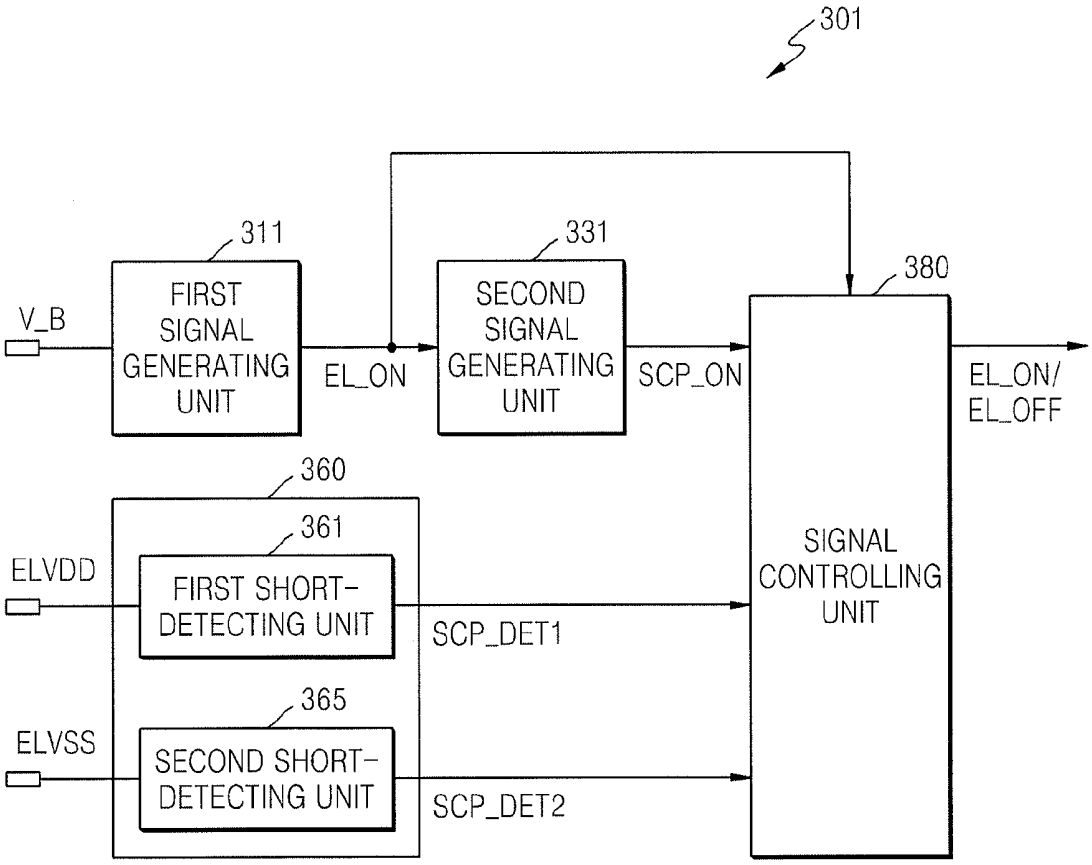

101
ELVDD
V_B
POWER SUPPLYING UNIT
ELVSS
501
ORGANIC LIGHT-EMITTING PANEL
201
DRIVER INTEGRATED CIRCUIT
301
SHORT PROTECTION UNIT
401
DRIVER
EL_ON/ EL_OFF

FIG. 7


301
311
FIRST SIGNAL GENERATING UNIT
V_B
EL_ON
331
SECOND SIGNAL GENERATING UNIT
SCP_ON
380
SIGNAL CONTROLLING UNIT
EL_ON/ EL_OFF
360
361
FIRST SHORT-DETECTING UNIT
ELVDD
SCP_DET1
365
SECOND SHORT-DETECTING UNIT
ELVSS
SCP_DET2

ORGANIC LIGHT-EMITTING DISPLAY APPARATUS AND METHOD OF PROVIDING POWER THEREIN

BACKGROUND

1. Field

Embodiments relate to an organic light-emitting display apparatus, and more particularly, to an organic light-emitting display apparatus including a short protective circuit for power voltage and a method of providing power in the organic light-emitting display apparatus.

2. Description of the Related Art

Organic light-emitting display apparatuses are used as display apparatuses such as portable information terminals including personal computers, mobile phones, PDAs, various information devices, etc. Also, various light emitting display apparatuses having lower weight and volume than those of cathode ray tubes have been developed. In particular, organic light-emitting display apparatuses having excellent light emission efficiency, brightness, and viewing angles and rapid response speeds have been highlighted.

An organic light-emitting display apparatus includes an organic light-emitting panel, a scan driver, and a source driver. The organic light-emitting panel includes pixels electrically connected to each other between scan lines and data lines that cross the scan lines. The scan driver drives the scan lines, and the source driver drives the data lines. The scan driver sequentially applies scan signals to the organic light-emitting panel through the scan lines and the source driver sequentially applies data signals to the organic light-emitting panel through the data lines. The organic light-emitting panel is electrically connected to the data lines and the scan lines, and thereby receives the data signals and the scan signals so that light is emitted.

SUMMARY

One or more embodiments may provide an organic light-emitting display apparatus which may reduce a possibility of a fire starting due to a short between power voltages in an organic light-emitting panel.

One or more embodiments may provide an organic light-emitting display apparatus including an organic light-emitting panel, a power supplying unit for supplying a first power voltage and a second power voltage to the organic light-emitting panel, and a driver integrated circuit including a short protection unit, wherein the short protection unit detects a short based on at least one of the first power voltage and the second power voltage and outputs an enable off signal that blocks the first power voltage and the second power voltage from being supplied to the power supplying unit.

The short protection unit may include a signal generating unit for generating a short detection starting signal that starts short detection based on the enable on signal that allows the power supplying unit to supply the first power voltage and the second power voltage to the organic light-emitting panel, a short-detecting unit for detecting the short and generating a short detection signal, and a signal controlling unit for outputting the enable off signal based on the enable on signal, the short detection starting signal, and the short detection signal.

The short detection starting signal may be generated after a predetermined time delay from the enable on signal.

The short-detecting unit may include a voltage distribution unit for distributing the first power voltage and outputting a detected voltage, and a comparing unit for comparing the detected voltage with a reference voltage and detecting a short.

The comparing unit may determine that there is a short when the detected voltage is less than the reference voltage and outputs the short detection signal.

The comparing unit may include an operational amplifier in which the reference voltage is input to a non-inverting input terminal thereof and the detected voltage is input to an inverting input terminal thereof.

The comparing unit may be activated based on the short detection starting signal.

The voltage distribution unit may include a first resistor connected between the first power voltage and the detected voltage, and a second resistor connected between the detected voltage and ground voltage.

The signal controlling unit may include a logic gate that logically operates the enable on signal, the short detection starting signal, and the short detection signal.

The short-detecting unit may include: a first short-detecting unit for detecting a short based on the first power voltage; and a second short-detecting unit for detecting a short based on the second power voltage.

The driver integrated circuit may output the enable off signal when the short occurs over a reference time.

The driver integrated circuit may be shut down at the same time as the output of the enable off signal or after a predetermined time delay.

One or more embodiments may provide a method of providing power in an organic light-emitting display apparatus including detecting a short in a driver integrated circuit based on at least one of a first power voltage and a second power voltage supplied from a power supplying unit to an organic light-emitting panel, and outputting an enable off signal to the power supplying unit when a short is detected, wherein the enable off signal blocks the first power voltage and the second power voltage being supplied from the driver integrated circuit.

Detecting the short may include generating a short detection starting signal that starts short detection based on the enable on signal that allows the power supplying unit to supply the first power voltage and the second power voltage to the organic light-emitting panel, and detecting the short and generating a short detection signal.

The short detection starting signal may be generated after a predetermined time delay from the enable on signal.

Generating of the short detection signal may include distributing the first power voltage and generating a detected voltage, comparing the detected voltage with a reference voltage after receiving the short detection starting signal, and generating the short detection signal when the reference voltage is less than the reference voltage.

Outputting of the enable off signal may include outputting the enable off signal when the short occurs over a reference time.

Outputting of the enable off signal may include outputting the enable off signal by logically operating the enable on signal, the short detection starting signal, and the short detection signal.

When a short is detected, the driver integrated circuit may be shut down at the same time as the output of the enable off signal or after a predetermined time delay.

Outputting the short detection signal may include outputting a first short detection signal when the first power voltage is less than first reference voltage, and outputting a second short detection signal when the second power voltage is greater than second reference voltage.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other features and advantages will become more apparent to those of ordinary skill in the art by describing in detail exemplary embodiments with reference to the attached drawings, in which:

FIG. **1** illustrates a block diagram of an organic light-emitting display apparatus according to an exemplary embodiment;

FIG. **2** illustrates a schematic diagram of an organic light-emitting panel of FIG. **1**, according to an exemplary embodiment;

FIG. **3** illustrates a block diagram of a short protection unit of FIG. **1**, according to an exemplary embodiment;

FIGS. **4**A through **4**C illustrate timing diagrams of an operation of a driver integrated circuit (IC), according to exemplary embodiments;

FIG. **5** illustrates a flowchart of a method of providing power in an organic light-emitting display apparatus, according to an exemplary embodiment;

FIG. **6** illustrates a block diagram of an organic light-emitting display apparatus, according to another exemplary embodiment; and

FIG. **7** illustrates a block diagram of a short protection unit of FIG. **6**.

DETAILED DESCRIPTION

Korean Patent Application No. 10-2010-0075991, filed on Aug. 6, 2010, in the Korean Intellectual Property Office, and entitled: "Organic Light-Emitting Display Apparatus and Method of Providing Power Therein," is incorporated by reference herein in its entirety.

Exemplary embodiments will now be described more fully hereinafter with reference to the accompanying drawings; however, they may be embodied in different forms and should not be construed as limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. In the drawings, like reference numerals denote like elements. In the description, the detailed descriptions of well-known technologies and structures may be omitted so as not to hinder understanding.

FIG. **1** illustrates a block diagram of an organic light-emitting display apparatus according to an exemplary embodiment. Referring to FIG. **1**, the organic light-emitting display apparatus includes a power supplying unit **100**, a driver integrated circuit (IC) **200**, and an organic light-emitting panel **500**.

The power supplying unit **100** may receive an input voltage V_B from an external power unit such as a battery and may convert the input voltage V_B so as to generate a first power voltage ELVDD and a second power voltage ELVSS for a light-emitting device of the organic light-emitting panel **500** to emit light. The first power voltage ELVDD and the second power voltage ELVSS may be input to the organic light-emitting panel **500**. The power supplying unit **100** may be a direct current-direct current (DC-DC) converter. The power supplying unit **100** may receive an enable on signal EL_ON from the driver IC **200** in a normal mode and may apply the first power voltage ELVDD and the second power voltage ELVSS to the organic light-emitting panel **500**. When there is a short in the organic light-emitting panel **500**, the power supplying unit **100** may receive an enable off signal EL_OFF from the driver IC **200** and may stop supplying the first power voltage ELVDD and the second power voltage ELVSS.

The driver **1**C **200** may include a short protection unit **300** and a driver **400**. The driver **400** may supply driving power to the organic light-emitting panel **500**. The short protection unit **300** may sense at least one of the first power voltage ELVDD and the second power voltage ELVSS and may detect the existence of a short in the organic light-emitting panel **500**. In FIG. **1**, the first power voltage ELVDD may be sensed to detect the existence of a short. When power is turned on, the driver IC **200** may output the enable on signal EL_ON to the power supplying unit **100**. Then, when a short is detected, the driver IC **200** may output the enable off signal EL_OFF to the power supplying unit **100**.

If the organic light-emitting panel **500** is damaged, e.g., as a result of being dropped or an electric shock, a short may occur in a first power voltage ELVDD line and a second power voltage ELVSS line of the organic light-emitting panel **500**. When a short occurs and the power supplying unit **100** continuously applies the first power voltage ELVDD and the second power voltage ELVSS to the organic light-emitting panel **500**, excessive current may flow and/or fire may start when a short occurs.

Accordingly, in embodiments, when a short occurs, the driver IC **200** may shut down the power supplying unit **100** and may block supply of the first power voltage ELVDD and the second power voltage ELVSS to the organic light-emitting panel **500**. The driver IC **200** may sense that the first power voltage ELVDD is reduced below a reference voltage. More particularly, e.g., the driver IC **200** may detect a short when it determines that the first power voltage ELVDD is below a reference voltage. When a short is detected, the driver IC **200** may output the enable off signal EL_OFF to the power supplying unit **100**. Accordingly, the power supplying unit **100** may be shut down. When a short is detected, supply of the first power voltage ELVDD and the second power voltage ELVSS to the organic light-emitting panel **500** may be stopped.

The driver IC **200** may output the enable off signal EL_OFF and may shut down at that same time or after a predetermined time has passed. For example, the power supplying unit **100** may shut down after a corresponding frame is completed so that the driver IC **200** is in a sleep mode. Under such circumstances, as a driving voltage is not applied to the organic light-emitting panel **500**, an abnormal screen may be prevented from being displayed. The time when the driver IC **200** enters to the sleep mode may be determined in consideration of stability of a display device.

The driver IC **200** that is shut down may normally operate again by being reset. When the driver IC **200** that is shut down normally operates after a reset, the driver IC **200** may perform a short detecting operation again.

The organic light-emitting panel **500** may receive the first power voltage ELVDD and the second power voltage ELVSS from the power supplying unit **100** and may supply the received first power voltage ELVDD and second power voltage ELVSS to each pixel. In each pixel, a driving current may flow from to the first power voltage ELVDD to the second power voltage ELVSS through a light-emitting device. The light-emitting device may emit light in correspondence to a data signal applied to the pixel.

FIG. **2** schematically illustrates the organic light-emitting panel **500** of FIG. **1**, according to an exemplary embodiment.

Referring to FIG. **2**, the organic light-emitting panel **500** may include a plurality of scan lines S**1**-Sn, a plurality of data lines D**1**-Dm, and a plurality of pixels P. The plurality of scan lines S**1**-Sn may be spaced apart from each other by a predetermined interval, may be arranged in rows, and may each transmit a scan signal. The plurality of data lines D**1**-Dm may

be spaced apart from each other by a predetermined interval, may be arranged in columns, and may each transmit a data signal. The plurality of scan lines S1-Sn and the plurality of data lines D1-Dm may be arranged in the form of matrix and one pixel P is formed at a cross point thereof.

In order to display a color, each pixel P may display its own color from among primary colors or may alternately display primary colors according to time so that a desired color may be recognized by spatial or temporal integration of the primary colors. Examples of the primary colors may include red R, green G, and blue B. When a color is displayed by a temporal integration, red R, green G, and blue B are alternately and temporarily displayed in one pixel so that only one color is displayed. When a color is displayed by a spatial integration, one color is displayed by a R pixel, a G pixel, and a B pixel. Thus, each of the R pixel, the G pixel, and the B pixel is referred to as a sub-pixel and three sub-pixels are referred to as one pixel. Also, when a color is displayed by a spatial integration, the R pixel, the G pixel, and the B pixel may be alternately arranged in a row direction or a column direction or the three pixels may be arranged to correspond to three apexes of a triangle.

The organic light-emitting panel **500** may be connected to a scan driver **410**, a source driver **430**, and a timing controller **450**. The scan driver **410**, the source driver **430**, and the timing controller **450** may each be directly installed on the organic light-emitting panel **500** in the form of at least one integrated circuit chip or may be integrated on the organic light-emitting panel **500** along with the signal lines S1 through Sn, the data lines D1 through Dm, and a thin film transistor. Also, the scan driver **410**, the source driver **430**, and the timing controller **450** may each be integrated on the organic light-emitting panel **500** in a single chip.

The scan driver **410** may be connected to the scan lines S1 through Sn of the organic light-emitting panel **500** and may apply scan signals including a combination of a gate-on voltage and a gate-off voltage to the scan lines S1 through Sn. Here, the scan driver **410** may sequentially apply the scan signals to the plurality of scan lines S1 through Sn. When the scan signals include the gate-on voltage, a switching transistor connected to the corresponding scan line is turned on.

The source driver **430** may be connected to the data lines D1 through Dm of the organic light-emitting panel **500** and may apply data signals indicating gray scale to the data lines D1 through Dm. The source driver **430** may convert input image data DATA having gray scale input from the timing controller **450** into data signals in the form of voltage or current.

The timing controller **450** may receive the input image data DATA from an external graphic controller (not illustrated) and input control signals for controlling displaying of the input image data DATA. Examples of the input control signals may include a horizontal synchronization signal Hsync, a vertical synchronization signal Vsync, and a main clock signal MCLK. The timing controller **450** may transmit the input image data DATA to the source driver **430**, may generate a scan control signal CONT1 and a data control signal CONT2, and may transmit the generated scan control signal CONT1 and data control signal CONT2 to the scan driver **410** and the source driver **430**, respectively. The scan control signal CONT1 may include a scan starting signal SSP for indicating a scan start, and a plurality of clock signals SCLK. The data control signal CONT2 may include a horizontal synchronization starting signal STH indicating transmission of input image data for a pixel P in one row, and a clock signal.

FIG. **3** illustrates a block diagram of the short protection unit **300** of FIG. **1**, according to an exemplary embodiment.

Referring to FIG. **3**, the short protection unit **300** may include a first signal generating unit **310**, a second signal generating unit **330**, a short-detecting unit **350**, and a signal controlling unit **370**.

The first signal generating unit **310** may generate the enable on signal EL_ON. The power supplying unit **100** supplies the first power voltage ELVDD and the second power voltage ELVSS to the organic light-emitting panel **500** due to the enable on signal EL_ON. When the first signal generating unit **310** receives the input voltage V_B from a battery, the first signal generating unit **310** generates the enable on signal EL_ON. The enable on signal EL_ON may be generated after a predetermined time from when the input voltage V_B is applied. The enable on signal EL_ON may be applied to the second signal generating unit **330** and the signal controlling unit **370**.

According to the current exemplary embodiment, the first signal generating unit **310** is included in the short protection unit **300**. However, the first signal generating unit **310** may be separate from the short protection unit **300** and/or may be included in the driver IC **200**.

The second signal generating unit **330** may generate a short detection starting signal SCP_ON that starts short detection. The second signal generating unit **330** may generate the short detection starting signal SCP_ON after a predetermined time from when the enable on signal EL_ON is applied. In this regard, the power supplying unit **100** may stably output the first power voltage ELVDD and the second power voltage ELVSS by the enable on signal EL_ON and then a short may be detected. The short detection starting signal SCP_ON may be applied to the short-detecting unit **350** and the signal controlling unit **370**.

When the short-detecting unit **350** receives the short detection starting signal SCP_ON, the short-detecting unit **350** may determine the existence of a short. The short-detecting unit **350** may sense the first power voltage ELVDD and may determine the existence of a short according to whether the first power voltage ELVDD is reduced below a predetermined voltage. When a short is detected, the short-detecting unit **350** may generate a short detection signal SCP_DET.

The short-detecting unit **350** may include a voltage distribution unit **351** and a comparing unit **355**. The voltage distribution unit **351** may include a first resistor R1 and a second resistor R2. The first resistor R1 may be connected between the first power voltage ELVDD and a detected voltage Vx, and the second resistor R2 may be connected between the detected voltage V and a ground voltage. The comparing unit **355** may include an operational amplifier OPAMP. A reference voltage Vref may be input to a non-inverting input terminal of the operational amplifier OPAMP, and the detected voltage V may be input to an inverting input terminal of the operational amplifier OPAMP. The operational amplifier OPAMP may compare the reference voltage Vref with the detected voltage Vx. When the detected voltage Vx is less than the reference voltage Vref, the operational amplifier OPAMP may determine a short has occurred and generates the short detection signal SCP_DET.

The signal controlling unit **370** may receive the enable on signal EL_ON from the first signal generating unit **310**. The signal controlling unit **370** may receive the short detection starting signal SCP_ON from the second signal generating unit **330**. The signal controlling unit **370** may receive the short detection signal SCP_DET from the short-detecting unit **350**. The signal controlling unit **370** may be formed of a 3in-1out logic gate by combining at least one from the group consisting of an AND gate, a NAND gate, an OR gate, a NOR gate, and XNOR gate. In FIG. **3**, the signal controlling unit **370**

includes a NAND gate **371** and an AND gate **375**. The NAND gate **371** may receive the short detection starting signal SCP_ON and the short detection signal SCP_DET, may perform a NAND operation on the signals, and may output the result to the AND gate **375**. The AND gate **375** performs an AND operation on the enable on signal EL_ON and the signal supplied from the NAND gate **371**. As the result of operation, the enable on signal EL_ON or the enable off signal EL_OFF may be output. As an example, when the received signals are on signals, that is, in a high-level state, the AND gate **375** may output the enable off signal EL_OFF.

FIG. **4**A illustrates a timing diagram illustrating an operation of the driver IC **200** in a normal mode without a short, according to an exemplary embodiment.

Referring to FIGS. **3** and **4**A, the driver IC **200** may receive the input voltage V_B from a battery, and a mode of the driver IC **200** may converted from a sleep mode to a driving mode when power is turned on.

The short protection unit **300** may generate the enable on signal EL_ON after a predetermined time delay EL_ON_DELAY from when the input voltage V_B is applied. The enable on signal EL_ON may be output to the power supplying unit **100** according to the result of a logic operation of the signal controlling unit **370**. Before the short detection starting signal SCP_ON is generated, only the enable on signal EL_ON may be generated, and the short detection starting signal SCP_ON and the short detection signal SCP_DET may be in an off-state. The signal controlling unit **370** may output the enable on signal EL_ON according to the result of a logic operation of the enable on signal EL_ON, the short detection starting signal SCP_ON being in an off-state, and the short detection signal SCP_DET. The power supplying unit **100** may receive the enable on signal EL_ON, may generate the first power voltage ELVDD and the second power voltage ELVSS based on the input voltage V_B, and may output the generated first power voltage ELVDD and second power voltage ELVSS to the organic light-emitting panel **500**.

The short protection unit **300** may generate the enable on signal EL_ON and generates the short detection starting signal SCP_ON after a predetermined time delay SCP_ON_DELAY. For example, the short detection starting signal SCP_ON may be generated after the time delay SCP_ON_DELAY required to receive the enable on signal EL_ON by the power supplying unit **100** and may generate the first power voltage ELVDD and the second power voltage ELVSS.

The short protection unit **300** may start short detection via the short detection starting signal SCP_ON. When a short is not detected, the short detection signal SCP_DET may be in an off-state. Accordingly, the enable on signal EL_ON may be maintained in a high state according to the result of a logic operation of the enable on signal EL_ON in the signal controlling unit **370**, the short detection starting signal SCP_ON, and the short detection signal SCP_DET in an off-state.

In addition, when power of the driver IC **200** is turned off, a mode thereof may be converted to a sleep mode, and the enable on signal EL_ON and the short detection starting signal SCP_ON may change to an off-state.

FIG. **4**B illustrates a timing diagram of an exemplary operation of the driver IC **200** in a short mode, according to an exemplary embodiment.

Referring to FIGS. **3** and **4**B, the driver IC **200** may receive the input voltage V_B from a battery and a mode of the driver IC **200** may be converted from a sleep mode to a driving mode when power is turned on.

The short protection unit **300** may generate the enable on signal EL_ON after a predetermined time delay EL_ON_DELAY from when the input voltage V_B is applied. The enable on signal EL_ON may be output to the power supplying unit **100** according to the result of a logic operation of the signal controlling unit **370**. Before the short detection starting signal SCP_ON is generated, only the enable on signal EL_ON is generated, and the short detection starting signal SCP_ON and the short detection signal SCP_DET are in an off-state. The signal controlling unit **370** may output the enable on signal EL_ON according to the result of a logic operation of the enable on signal EL_ON, the short detection starting signal SCP_ON being in an off-state, and the short detection signal SCP_DET. The power supplying unit **100** may receive the enable on signal EL_ON, may generate the first power voltage ELVDD and the second power voltage ELVSS based on the input voltage V_B, and may output the generated first power voltage ELVDD and second power voltage ELVSS to the organic light-emitting panel **500**.

The short protection unit **300** may generate the enable on signal EL_ON and generates the short detection starting signal SCP_ON after a predetermined time delay SCP_ON_DELAY. For example, the short detection starting signal SCP_ON may be generated after the time delay SCP_ON_DELAY required to receive the enable on signal EL_ON by the power supplying unit **100** and may generate the first power voltage ELVDD and the second power voltage ELVSS.

The short protection unit **300** may start short detection by the short detection starting signal SCP_ON. When a short is detected, the short detection signal SCP_DET may be generated. The signal controlling unit **370** may output the enable off signal EL_OFF to the power supplying unit **100** according to the result of a logic operation of the enable on signal EL_ON, the short detection starting signal SCP_ON, and the short detection signal SCP_DET, each of which are in an on-state.

The driver IC **200** may be shut down after the enable off signal EL_OFF is output so that power is turned off and a mode thereof may be converted to a sleep mode. Accordingly, the short detection starting signal SCP_ON may be in an off-state. Conversion to the sleep mode may be accomplished at the same time as the output of the enable off signal EL_OFF or after the predetermined time delay, for example, at the time of completing a corresponding frame.

In addition, the power supplying unit **100** may receive the enable off signal EL_OFF and may stop output of the first power voltage ELVDD and the second power voltage ELVSS.

FIG. **4**C illustrates a timing diagram of an exemplary operation of the driver IC **200** in a short mode, according to an exemplary embodiment.

Referring to FIG. **4**C, the driver IC **200** may receive the input voltage V_B from a battery and a mode of the driver IC **200** may be converted from a sleep mode to a driving mode when power is turned on.

The short protection unit **300** generates the enable on signal EL_ON after a predetermined time delay EL_ON_DELAY from when the input voltage V_B is applied. The enable on signal EL_ON is output to the power supplying unit **100** according to the result of a logic operation of the signal controlling unit **370**. Before the short detection starting signal SCP_ON is generated, only the enable on signal EL_ON is generated, and the short detection starting signal SCP_ON and the short detection signal SCP_DET are in an off-state. The signal controlling unit **370** outputs the enable on signal EL_ON according to the result of a logic operation of the enable on signal EL_ON, the short detection starting signal SCP_ON in an off-state, and the short detection signal SCP_DET. The power supplying unit **100** receives the enable on signal EL_ON, generates the first power voltage ELVDD and the second power voltage ELVSS based on the input voltage

V_B, and outputs the generated first power voltage ELVDD and second power voltage ELVSS to the organic light emitting panel **500**.

The short protection unit **300** generates the enable on signal EL_ON and generates the short detection starting signal SCP_ON after predetermined time delay SCP_ON_DELAY. For example, the short detection starting signal SCP_ON is generated after the time delay SCP_ON_DELAY required to receive the enable on signal EL_ON by the power supplying unit **100** and generate the first power voltage ELVDD and the second power voltage ELVSS.

The short protection unit **300** starts short detection by the short detection starting signal SCP_ON. When a short is not detected, the short detection signal SCP_DET is generated. The short protection unit **300** controls output of the enable off signal EL_OFF according to the duration of the short detection signal SCP_DET. For example, when the duration Ta of the short detection signal SCP_DET is less than a reference time, the short protection unit **300** maintains the enable on signal EL_ON in an on-state and when the duration Tb of the short detection signal SCP_DET is greater than the reference time, the short protection unit **300** outputs the enable off signal EL_OFF.

The driver IC **200** is shut down after the enable off signal EL_OFF is output so that power is turned off and a mode thereof is converted to a sleep mode. Accordingly, the short detection starting signal SCP_ON is in an off-state. Conversion to the sleep mode may be accomplished at the same time as the output of the enable off signal EL_OFF or after the predetermined time delay. In addition, the power supplying unit **100** receives the enable off signal EL_OFF and stops output of the first power voltage ELVDD and the second power voltage ELVSS.

FIG. **5** is a flowchart illustrating a method of providing power in an organic light-emitting display apparatus, according to an exemplary embodiment.

Referring to FIG. **5**, a driver integrated circuit, which receives an input voltage from a battery, generates an enable on signal and outputs the generated enable on signal to a power supplying unit, in operation **S501**. The enable on signal allows the power supplying unit to apply a first power voltage and a second power voltage to an organic light-emitting panel. Here, in an initial stage of driving, a short detection starting signal and a short detection signal are in on off-state so that the enable on signal is output to the power supplying unit according to the result of a logic operation of the enable on signal, the short detection starting signal in an off-state, and the short detection signal in an off-state. The power supplying unit receives the enable on signal, generates the first power voltage and the second power voltage, and outputs the generated first power voltage and second power voltage.

A driver IC generates a short detection starting signal that starts short detection based on the enable on signal, in operation **S503**. The short detection starting signal is generated after predetermined time from the enable on signal, that is, time delay that is requested to receive the enable on signal by the power supplying unit and to complete boosting to the first power voltage and the second power voltage based on the input voltage.

The driver IC determines the existence of a short, in operation **S505**. The driver integrated circuit distributes the first power voltage to compare a detected voltage with a reference voltage. When the reference voltage is less than the reference voltage, it is determined that a short has occurred. The existence of a short is determined by the short detection starting signal.

When a short is detected, the driver IC generates the short detection signal, in operation **S507**, and outputs the enable off signal to the power supplying unit, in operation **S509**. The first power voltage and the second power voltage may be prevented from being supplied from the power supplying unit to the organic light-emitting panel by the enable off signal. Here, since the enable signal, the short detection starting signal, and the short detection signal are in on-state, the enable off signal is generated and output according to the result of a logic operation of the signals. The driver IC is shut down at the same time as the output of the enable off signal or after a predetermined time delay.

When power supply to the organic light-emitting panel is blocked by the enable off signal, an excessive current is blocked and the possibility of a fire occurrence is reduced when a short occurs in the organic light-emitting panel.

The driver IC that is shut down operates again by being reset and repeatedly performs short detection.

FIG. **6** illustrates a block diagram of an organic light-emitting display apparatus, according to an exemplary embodiment and FIG. **7** illustrates a block diagram of a short protection unit **301** of FIG. **6**.

Referring to FIG. **6**, the organic light-emitting display apparatus according to the current exemplary embodiment includes a power supplying unit **101**, a driver IC **201**, and an organic light-emitting panel **501**. The driver IC **201** includes a short protection unit **301** and a driver **401**.

The driver IC **201** of FIGS. **6** and **7** is different from the driver IC **200** of FIG. **1** in that the driver IC **201** senses both the first power voltage ELVDD and the second power voltage ELVSS and detects the existence of a short of the organic light-emitting panel **501**. Hereinafter, detailed descriptions that are the same as those with respect to FIG. **1** will not be repeated. Timing diagrams illustrating an operation of the driver IC **201** may be also illustrated in FIGS. **4**A through **4**C.

When a short occurs in a first power voltage ELVDD line and a second power voltage ELVSS line of the organic light-emitting panel **501**, the first power voltage ELVDD supplied to the first power voltage ELVDD line is reduced and the second power voltage ELVSS supplied to the second power voltage ELVSS line is increased. Accordingly, the short protection unit **301** senses that the first power voltage ELVDD is reduced below a first reference voltage and the second power voltage ELVSS is increased above a second reference voltage, thereby detecting a short.

Referring to FIG. **7**, the short protection unit **301** may include a first signal generating unit **311**, a second signal generating unit **331**, a short-detecting unit **360**, and a signal controlling unit **380**. The short-detecting unit **360** may include a first short-detecting unit **361** and a second short-detecting unit **365**. The first signal generating unit **311**, which receives the input voltage V_B from a battery, generates the enable on signal EL_ON. The enable on signal EL_ON may be generated after a predetermined time delay from when the input voltage V_B is applied. The enable on signal EL_ON may be supplied to the second signal generating unit **331** and the signal controlling unit **380**. As a result of a logic operation of the signal controlling unit **380**, the enable on signal EL_ON may be output to the power supplying unit **101**. The power supplying unit **101** may receive the enable on signal EL_ON, may generate the first power voltage ELVDD and the second power voltage ELVSS, and may output the generated first power voltage ELVDD and second power voltage ELVSS to the organic light-emitting panel **501**.

The second signal generating unit **331** may generate the short detection starting signal SCP_ON that starts short detection after a predetermined time delay from the enable on

signal EL_ON. The short detection starting signal SCP_ON may be supplied to the short-detecting unit **360** and the signal controlling unit **380**. When the short-detecting unit **360** receives the short detection starting signal SCP_ON, the short-detecting unit **360** may determine the existence of a short. The first short-detecting unit **361** may sense the first power voltage ELVDD and may determine there is a short when the power voltage ELVDD is less than the first reference voltage. When it is determined there is a short, the first short-detecting unit **361** may generate a first short detection signal SCP_DET**1**. The second short-detecting unit **365** may sense the second power voltage ELVSS and may determine there is a short when the second power voltage ELVSS is greater than the second reference voltage. When it is determined there is a short, the second short-detecting unit **365** may generate a second short detection signal SCP_DET**2**.

The signal controlling unit **380** may receive the enable on signal EL_ON from the first signal generating unit **311**, may receive the short detection starting signal SCP_ON from the second signal generating unit **331**, and may receive the first and second short detection signals SCP_DET**1** and SCP_DET**2** from the short-detecting unit **360**. The signal controlling unit **380** may perform an AND operation on the received signals. Since the signals received in the signal controlling unit **380** are in on-state (high-level state), the enable off signal EL_OFF may output as a result of the operation.

The driver IC **201** may be shut down after the enable off signal EL_OFF is output so that power is turned off and a mode thereof is converted to a sleep mode. Conversion to the sleep mode may be accomplished at the same time as the output of the enable off signal EL_OFF or after the predetermined time delay. The power supplying unit **101** may receive the enable off signal EL_OFF and may be shut down so that output of the first power voltage ELVDD and the second power voltage ELVSS is blocked.

The driver IC **201** that is shut down may operate again by being reset and repeatedly performs short detection.

In one or more embodiments, the organic light-emitting display apparatus may include a short detection function in the driver IC and may shut down the driver integrated circuit and the power supplying unit when a short occurs. Accordingly, one or more embodiments may reduce and/or prevent a fire due to a short.

Exemplary embodiments have been disclosed herein, and although specific terms are employed, they are used and are to be interpreted in a generic and descriptive sense only and not for purpose of limitation. Accordingly, it will be understood by those of ordinary skill in the art that various changes in form and details may be made without departing from the spirit and scope of the present invention as set forth in the following claims.

What is claimed is:

1. An organic light-emitting display apparatus, comprising:

an organic light-emitting panel;

a power supply to generate and supply a first power voltage and a second power voltage to the organic light-emitting panel; and

a driver integrated circuit including a short protection circuit, wherein the short protection circuit is to detect a short of the organic light-emitting panel based on at least one of the first power voltage or the second power voltage and to output an enable off signal, and wherein the power supply is to shut down in response to the enable off signal, the enable off signal to be generated by logically operating an enable on signal, a short detection starting signal, and a short detection signal, the enable off signal to be output to the power supply according to the logic operation of the enable on signal, the short detection starting signal, and the short detection signal, each of the enable on signal, the short detection starting signal, and the short detection signal being an on-state signal, and to block the first power voltage and the second power voltage from being supplied from the power supply to the organic light-emitting panel.

2. The apparatus as claimed in claim **1**, wherein the short protection circuit comprises:

a signal generator to generate the enable on signal and the short detection starting signal, the enable on signal allowing the power supply to supply the first and second power voltages to the organic light-emitting panel, and the short detection starting signal starting short detection based on the enable on signal;

a short detector to detect the short and generate a short detection signal; and

a signal controller to receive the enable on signal and the short detection starting signal from the signal generator and the short detection signal from the short detector, and to output the enable off signal, instead of the enable on signal, based on the enable on signal, the short detection starting signal, and the short detection signal, when the short is detected.

3. The apparatus as claimed in claim **2**, wherein the short detection starting signal is generated after a predetermined time delay from the enable on signal.

4. The apparatus as claimed in claim **2**, wherein an output of the short detector is independent of an output of the signal generator, the short detector comprises:

a voltage distributor to distribute the first power voltage and output a detected voltage; and

a comparator to compare the detected voltage with a reference voltage and detect a short.

5. The apparatus as claimed in claim **4**, wherein the comparator is to determine that there is a short when the detected voltage is less than the reference voltage and output the short detection signal.

6. The apparatus as claimed in claim **4**, wherein the comparator comprises an operational amplifier in which the reference voltage is input to a non-inverting input terminal thereof and the detected voltage is input to an inverting input terminal thereof.

7. The apparatus as claimed in claim **4**, wherein the comparator is activated based on the short detection starting signal.

8. The apparatus as claimed in claim **4**, wherein the voltage distributor comprises:

a first resistor connected between the first power voltage and the detected voltage; and

a second resistor connected between the detected voltage and ground voltage.

9. The apparatus as claimed in claim **2**, wherein the signal controller comprises:

three inputs, the enable on signal and the short detection starting signal output from the signal generator and the short detection signal output from the short detector being connected to the three inputs; and

a logic gate receiving signals from the three inputs, the logic gate to logically operate the enable on signal, the short detection starting signal, and the short detection signal.

10. The apparatus as claimed in claim **2**, wherein the short detector comprises:

a first short detector to detect a short based on the first power voltage; and

a second short detector to detect a short based on the second power voltage.

11. The apparatus as claimed in claim **1**, wherein the driver integrated circuit is to output an enable on signal during operation of the organic light-emitting panel, and to output the enable off signal only when the short occurs over a reference time.

12. The apparatus as claimed in claim **1**, wherein the driver integrated circuit is shut down at a same time as the output of the enable off signal or after a predetermined time delay.

13. A method of providing power in an organic light-emitting display apparatus, the method comprising:

detecting a short of the organic light-emitting panel in a driver integrated circuit based on at least one of a first power voltage or a second power voltage generated by a power supply and supplied from the power supply to an organic light-emitting panel; and

outputting an enable off signal to the power supply when a short is detected, wherein the enable off signal blocks the first power voltage and the second power voltage being supplied from the driver integrated circuit to the organic light-emitting panel, and wherein the enable off signal shuts down the power supply, the enable off signal being generated by logically operating an enable on signal, a short detection starting signal, and a short detection signal, the enable off signal is to be output to the power supply according to the logic operation of the enable on signal, the short detection starting signal, and the short detection signal, each of the enable on signal, the short detection starting signal, and the short detection signal being an on-state signal.

14. The method as claimed in claim **13**, wherein detecting the short comprises:

generating the short detection starting signal that starts short detection based on the enable on signal that allows the power supply to supply the first power voltage and the second power voltage to the organic light-emitting panel; and

detecting the short and generating the short detection signal.

15. The method as claimed in claim **14**, wherein the short detection starting signal is generated after a predetermined time delay from the enable on signal.

16. The method as claimed in claim **14**, wherein generating the short detection signal comprises:

distributing the first power voltage and generating a detected voltage;

comparing the detected voltage with a reference voltage after receiving the short detection starting signal; and

generating the short detection signal when the reference voltage is less than the reference voltage.

17. The method as claimed in claim **14**, wherein outputting the enable off signal comprises:

outputting the enable off signal by logically operating the enable on signal, the short detection starting signal, and the short detection signal.

18. The method as claimed in claim **13**, wherein outputting the enable off signal includes outputting the enable off signal when the short occurs over a reference time.

19. The method as claimed in claim **13**, wherein when a short is detected, the driver integrated circuit is shut down at a same time as the output of the enable off signal or after a predetermined time delay.

20. The method as claimed in claim **14**, wherein outputting the short detection signal comprises:

outputting a first short detection signal when the first power voltage is less than first reference voltage; and

outputting a second short detection signal when the second power voltage is greater than second reference voltage.

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摘要(译)

一种有机发光显示装置和在有机发光显示装置中提供电力的方法。一种有机发光显示装置，包括有机发光面板，用于向有机发光面板提供第一电源电压和第二电源电压的供电单元，以及包括短路保护单元的驱动器集成电路，其中短路保护单元基于第一电源电压和第二电源电压中的至少一个来检测短路，并输出阻止第一电源电压和第二电源电压被提供给供电单元的使能断开信号。