

(19)



(11)

EP 2 889 867 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:
08.11.2017 Bulletin 2017/45

(51) Int Cl.:
G09G 3/3233 ^(2016.01) **G09G 3/3291** ^(2016.01)

(21) Application number: **14200422.5**

(22) Date of filing: **29.12.2014**

(54) Organic light emitting display device and method for driving the same

Organische lichtemittierende Anzeigevorrichtung und Verfahren zur Ansteuerung davon

Dispositif d'affichage électroluminescent organique et son procédé de commande

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

(30) Priority: **31.12.2013 KR 20130169476**

(43) Date of publication of application:
01.07.2015 Bulletin 2015/27

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(56) References cited:
**US-A1- 2005 078 065 US-A1- 2008 297 055
US-A1- 2010 090 932 US-A1- 2010 103 203
US-A1- 2010 141 626 US-A1- 2011 134 101
US-A1- 2013 050 292**

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Description

BACKGROUND OF THE INVENTION

Field of the Disclosure

[0001] Embodiments of the present invention relate to an organic light emitting display device, and more particularly, to an organic light emitting display device which is capable of reducing defects caused by a characteristic variation of a pixel and improving reliability of external compensation by reducing a sensing error, and to a method for driving the same.

Discussion of the Related Art

[0002] Recently, there is an increased interest for an organic light emitting display device owing to various advantages. In contrast to a liquid crystal display (LCD) device, the organic light emitting display device can achieve wider viewing angle, and better brightness and contrast ratio. In addition, the organic light emitting display device can emit light in itself, that is, the organic light emitting display device needs no additional backlight unit. Thus, the organic light emitting display device may be manufactured in a thin profile with a light weight, and the organic light emitting display device may have advantages of low power consumption and rapid response speed.

[0003] The pixel characteristics of the organic light emitting display device vary depending on driving time and temperature. According to a position of a compensation circuit so as to compensate for the change of the pixel characteristics, there may be an external or internal compensation method. In case of the internal compensation method, the compensation circuit is positioned inside the pixel. Meanwhile, in case of the external compensation method, the compensation circuit is positioned outside the pixel.

[0004] Due to the deviations in a process of manufacturing a thin film transistor (TFT) substrate, mobility (k) and threshold voltage of a driving TFT (DT) may vary between pixels. Accordingly, even though a data voltage (V_{data}) is identically applied to the driving TFT for each of the pixels in the organic light emitting display device according to the related art, it is difficult to realize uniform picture quality due to a deviation in the electric current flowing in organic light emitting diodes (OLEDs).

[0005] In order to overcome this problem, the change in mobility (k) and threshold voltage (V_{th}) of driving TFT for each pixel may be sensed, and then be compensated so that a driving voltage ($k \cdot V_{data} + V_{th}$), obtained by adding a compensation voltage (V_{th} , k) to the data voltage (V_{data}) in accordance with a video signal, may be supplied to a gate of the driving TFT.

[0006] FIGs. 1 and 2 illustrate a method for sensing the pixel characteristics for the external compensation in the organic light emitting display device according to the related art.

[0007] Referring to FIGs. 1 and 2, a method for measuring the characteristics of an OLED panel in the organic light emitting display device may be largely classified into an applied-voltage-based current measuring method and an applied-voltage-based voltage measuring method. The applied-voltage-based voltage measuring method is widely used owing to a shorter measuring time in comparison to that of the applied-voltage-based current measuring method. These methods are based on charging a source terminal of the driving TFT.

[0008] In case of the applied-voltage-based voltage measuring method as shown in <S1> of FIG. 1, a voltage is applied to the gate of a driving TFT (Tr3). A current flowing in a source terminal of the driving TFT is charged in a line cap. Thereafter, as shown in <S2> of FIG. 1, a voltage charged by turning off a switching transistor 'Tr1' is measured by an analog-to-digital converter (ADC) provided in the display device, thereby sensing the characteristics of the driving TFT.

[0009] On assumption that a current change according to a drain-source voltage (V_{ds}) of the driving TFT is identical in a saturation area, the method for sensing the pixel characteristics according to the related art is carried out by charging a source voltage of the driving TFT, and measuring the charged value. The source voltage of the driving TFT is a voltage at the source terminal of the driving TFT, and a drain voltage of the driving TFT is a voltage at the drain terminal of the driving TFT. The drain-source voltage (V_{ds}) of the driving TFT is a voltage across the source and drain terminals of the driving TFT.

[0010] However, in reality, a change in the amount of current flowing in the driving TFT varies depending on a variation of the drain-source voltage (V_{ds}) by a modulation effect of a channel, which might cause incorrectness in the amount of electric current measured by the applied-voltage-based voltage measuring method according to the related art.

[0011] Also, if the source voltage of driving TFT is increased, the drain-source voltage (V_{ds}) of the driving TFT is decreased in the related art due to the way that the drain voltage of the driving TFT is driven. As such, it is difficult to precisely sense the characteristics of the OLED panel due to the varying characteristics of the driving TFTs.

[0012] In case of the applied-voltage-based current measuring method according to the related art, it is assumed that the drain of the driving TFT is fixed to a high power line (V_{dd}), and the driving TFT is a constant current source. In this case, if the source terminal of the driving TFT is in high- z (high- z) state, a capacitor is fully charged by the current flowing in the driving TFT, whereby the source voltage of the driving TFT is increased.

[0013] As shown in FIG. 2 (see S2 area), by measuring the current at the source terminal of the driving TFT twice at times T_1 and T_2 (sampling times), it is possible to calculate the amount of current (i_{TFT}) flowing in the driving TFT by the following Math Formula 1:

[Math Formula 1]

$$i_{TFT} = C \cdot (V_2 - V_1) / \Delta t$$

where C is capacitance of storage capacitor, V₂ and V₁ are voltages at the source terminal of the driving TFT sensed respectively at T₁ and T₂, and Δt equals T₂ minus T₁.

[0014] FIG. 3 illustrates a change in the constant current (I_d) in accordance with the drain-source voltage (V_{ds}) of the driving TFT according to the related art.

[0015] Generally, if the source voltage of the driving TFT is increased, the drain-source voltage (V_{ds}) of the driving TFT is decreased proportionally, assuming that the driving TFT is a constant current source. However, in reality, as the drain-source voltage (V_{ds}) of the driving TFT is decreased, the current (I_d) of the driving TFT does not remain constant but is also decreased even in the saturation area as shown in FIG. 3. That is, the driving TFT is not driven as the constant current source.

[0016] That is, unlike the theory, the current (I_d) of the saturation area for the driving TFT as shown in FIG. 3 is changed in accordance with the small change of the drain-source voltage (V_{ds}), and the current (I_d) is more sensitive to the change in the drain-source voltage (V_{ds}) when the drain-source voltage (V_{ds}) is equal to or greater than 7V. According to the increase in the source voltage of the driving TFT, a level of the drain-source voltage (V_{ds}) of the driving TFT decreases when the fixed drain voltage is applied. In this case, the amount of current flowing for the driving TFT also varies so that it is difficult to correctly measure the amount of current flowing in the driving TFT.

[0017] US 2005/0078065 describes a display device which efficiently drives light emitting display pixels and which can restrain an excessive increment of an operational voltage outputted from a power supply circuit due to trouble of the circuit or the like. Treating light emitting elements in all the display pixels in a light emitting display panel as objects, a maximum value of the forward voltages is drawn by a multi-input comparator and a peak hold circuit. Based on the maximum value of the forward voltages, a voltage boost circuit switching operates a power FET to supply a boosted output by this operation to a constant current circuit as the operational voltage V_H. In the case where the maximum value of the forward voltages increases due to trouble or the like and based on this increment the operational voltage V_H excessively increases, the operation of the voltage boost circuit is stopped by a control output from an analog comparator which functions as a voltage limiter.

[0018] US 2011/0134101 describes a method of driving a display device, the display device having a display section including a display region in which a plurality of display pixels are arranged two-dimensionally, the display pixels having first light emitting elements, and a non-display region in which one or multiple adjustment pixels

are arranged, each adjustment pixel having a second light emitting element, the method including a step of applying a power-supply voltage, having a value corresponding to voltage variation in the second light emitting element when the second light emitting element emits light, to each display pixel.

[0019] US 2008/0297055 describes a cathode potential controller for controlling a common cathode potential applied to a self light emission type display panel in which an emission state of each of pixels is driven and controlled in accordance with an active matrix drive system, said cathode potential controller including a self light emitting element for voltage measurement disposed outside an effective display region, a constant current source for supplying a constant current to said self light emitting element for voltage measurement, an electrode-to-electrode voltage measuring portion measuring a potential developed at an anode electrode of said self light emitting element for voltage measurement, and measuring an electrode to electrode voltage of said self light emitting element for voltage measurement, a cathode potential determining portion determining a cathode potential value by using a difference value between a measured value of the electrode to electrode voltage of said self light emitting element for voltage measurement, and a reference voltage value as a correction value, and a cathode potential applying portion applying a cathode potential corresponding to the determined cathode potential value to a common cathode electrode of said self light emission type display panel.

[0020] US 2010/0103203 describes a method of driving an organic light emitting display having pixels to control current that flows from a first power source to a second power source, the method including storing a sum voltage of a voltage for driving transistors in a saturation region when the driving transistors included in the pixels supply current corresponding to the highest gray level and a voltage in consideration of a process deviation of the driving transistors in a memory as first data, supplying current corresponding to the maximum gray level to an organic light emitting diode (OLED) included in at least one specific pixel through a data line, comparing a third voltage that is a sum voltage of a first voltage extracted from the OLED in response to the current of the maximum gray level and a second voltage generated by changing the first data into an analog signal with the first power source, and controlling a voltage value of the second power source in response to the comparison result.

[0021] US 2010/0090932 describes an organic light emitting diode (OLED) display capable of preventing a defect of picture quality by instability of an output voltage of a power IC in a low temperature environment. The OLED display includes a display panel having an effective display area in which pixels displaying a gray scale are formed and a non-display area in which a pixel monitoring part monitoring a degree of deterioration of the pixels is formed, wherein each of the pixels includes an organic light emitting diode and a driving element, a pow-

er IC supplying a driving voltage to the display panel, and a voltage limiting part connected between the pixel monitoring part and the power IC to restrict voltage levels of feedback voltages supplied from the pixel monitoring part.

[0022] US 2013/050292 A1 describes an organic light display device including a plurality of pixels for generating images, wherein each of the plurality of pixels is connected to a gate line, a data line, and a reference line (RL), each of the plurality of pixels including at least a first switching thin film transistor connected between the data line and the gate of a driving TFT, and driven by the signal applied to the gate line, a second switching thin film transistor connected between the reference line and the source of the driving TFT and an organic light emitting diode (OLED) connected to the source of the driving TFT.

SUMMARY OF THE INVENTION

[0023] Accordingly, embodiments of the present invention are directed to an organic light emitting display device and a method for driving the same that substantially obviates one or more problems due to limitations and disadvantages of the related art.

[0024] An aspect of the embodiments of the present invention is to provide an organic light emitting display device which is capable of improving reliability of external compensation by reducing a sensing error, and to provide a method for driving the same.

[0025] Another aspect of the embodiments of the present invention is to provide an organic light emitting display device which is capable of reducing defects, caused by a characteristic variation of pixels, through a precise sensing process for the characteristics of pixels, and to provide a method for driving the same.

[0026] Additional advantages and features of embodiments of the invention will be set forth in part in the description which follows and in part will become apparent to those having ordinary skill in the art upon examination of the following or may be learned from practice of embodiments of the invention. The objectives and other advantages of embodiments of the invention may be realized and attained by the structure particularly pointed out in the written description and claims hereof as well as the appended drawings.

[0027] To achieve these and other advantages and in accordance with the purpose of embodiments of the invention, as embodied and broadly described herein, there is provided in one aspect a method for driving an organic light emitting display device that may include sensing the characteristics of a driving TFT by applying a voltage to a plurality of pixels of the organic light emitting display device, wherein a drain voltage of the driving TFT varies on the basis of a change in an anode voltage of an organic light emitting diode during the sensing of the characteristics of the driving TFT formed in the plurality of pixels.

[0028] At this time, a gate-source voltage (V_{gs}) of the

driving TFT may be sensed. Also, a driving voltage (V_{dd}) may vary on the basis of feedback of the anode voltage of the organic light emitting diode. Also, the anode voltage of the organic light emitting diode may be changed during the sensing of the drain voltage of the driving TFT. The drain voltage in the plurality of driving TFTs may be changed at the same time. As a variation, the drain voltage of the driving TFT may vary in a step-by-step method according to time.

[0029] In another example, the drain voltage of the driving TFT may be changed by the change in the anode voltage on the basis of the feedback of the anode voltage of the organic light emitting diode.

[0030] Various embodiments provide a method for controlling an organic light emitting display device according to claim 1 is provided. In one or more embodiments, applying a varied voltage to a drain or source of a specific driving TFT in one of the plurality of pixels comprises applying a varied drain voltage to the drain of the specific driving TFT in the one of the plurality of pixels. In one or more embodiments, the applying step applies the varied drain voltages to the driving TFTs in the plurality of pixels, simultaneously. In one or more embodiments, the method further comprises: prior to the applying step, sensing a variation in a source voltage of the specific driving TFT over a predetermined time duration; and varying the drain voltage according to the sensed variation in the source voltage of the specific driving TFT to generate the varied drain voltage. In one or more embodiments, in the applying step, the varied drain voltage is a drain voltage that is increased in steps over time. In one or more embodiments, the applying step includes: sensing, by a sensor, an anode voltage of the corresponding OLED, which has been fed back to the sensor; and generating the varied drain voltage by varying the drain voltage according to a change in the sensed anode voltage of the corresponding OLED. In one or more embodiments, the applying step applies the varied drain voltages to the driving TFTs in the plurality of pixels, simultaneously. In one or more embodiments, the organic light display device includes a high voltage line and the driving TFT is connected to the high voltage line, and the method further comprises: generating the varied voltage at the high voltage line. In one or more embodiments, the applying step applies the varied voltage from the high voltage line to the source of the specific driving TFT. In one or more embodiments, the applying step applies the varied voltages to the driving TFTs in the plurality of pixels, simultaneously. In one or more embodiments, the method further comprises: prior to the applying step, sensing a variation in a drain or source voltage of the specific driving TFT over a predetermined time duration; and varying the voltage at the high voltage line according to the sensed variation in the drain or source voltage of the specific driving TFT to generate the varied voltage. In one or more embodiments, in the applying step, the varied voltage is a drain or source voltage that is increased in steps over time. In one or more embodiments, the ap-

plying step applies the varied voltages to the driving TFTs in the plurality of pixels, simultaneously. In one or more embodiments, the applying step includes: sensing, by a sensor, an anode voltage of the corresponding OLED connected to the specific driving TFT, which has been fed back to the sensor, wherein the generating step generates the varied voltage by varying the voltage from the high voltage line according to a change in the sensed anode voltage of the corresponding OLED. In one or more embodiments, the applying step applies the varied voltages to the driving TFTs in the plurality of pixels, simultaneously.

[0031] Preferred embodiments are described in the dependent claims.

[0032] Various embodiments provide a method for controlling an organic light emitting display device, the organic light display device including a plurality of pixels for generating images, each of the plurality of pixels including at least one switching thin film transistor (TFT) connected to a gate line and a data line, a driving TFT connected to the at least one switching TFT, and an organic light emitting diode (OLED) connected to the driving TFT, the method comprising: applying a varied drain voltage to a drain of a specific driving TFT in one of the plurality of pixels; and compensating the specific driving TFT by the varied drain voltage, so as to maintain a constant drain-source voltage at the specific driving TFT. In one or more embodiments, the applying step applies the varied drain voltages to the driving TFTs in the plurality of pixels, simultaneously. In one or more embodiments, the method further comprises: prior to the applying step, sensing a variation in a source voltage of the specific driving TFT over a predetermined time duration; and varying the drain voltage according to the sensed variation in the source voltage of the specific driving TFT to generate the varied drain voltage. In one or more embodiments, in the applying step, the varied drain voltage is a drain voltage that is increased in steps over time. In one or more embodiments, the applying step applies the varied drain voltages to the driving TFTs in the plurality of pixels, simultaneously. In one or more embodiments, the applying step includes: sensing, by a sensor, an anode voltage of the corresponding OLED, which has been fed back to the sensor; and generating the varied drain voltage by varying the drain voltage according to a change in the sensed anode voltage of the corresponding OLED. In one or more embodiments, the applying step applies the varied drain voltages to the driving TFTs in the plurality of pixels, simultaneously.

[0033] Various embodiments provide a method for controlling an organic light emitting display device, the organic light display device including a high voltage line and a plurality of pixels for generating images, each of the plurality of pixels including at least one switching thin film transistor (TFT) connected to a gate line and a data line, a driving TFT connected to the high voltage line and the at least one switching TFT, and an organic light emitting diode (OLED) connected to the driving TFT, the

method comprising: generating a varied voltage at the high voltage line; applying the varied voltage to a drain or source of a specific driving TFT in one of the plurality of pixels; and compensating the specific driving TFT by the varied voltage, so as to maintain a constant drain-source voltage at the specific driving TFT. In one or more embodiments, the applying step applies the varied voltage from the high voltage line to the source of the specific driving TFT. In one or more embodiments, the applying step applies the varied voltages to the driving TFTs in the plurality of pixels, simultaneously. In one or more embodiments, the method further comprises: prior to the applying step, sensing a variation in a drain or source voltage of the specific driving TFT over a predetermined time duration; and varying the voltage at the high voltage line according to the sensed variation in the drain or source voltage of the specific driving TFT to generate the varied voltage. In one or more embodiments, in the applying step, the varied voltage is a drain or source voltage that is increased in steps over time. In one or more embodiments, the applying step applies the varied voltages to the driving TFTs in the plurality of pixels, simultaneously. In one or more embodiments, the applying step includes: sensing, by a sensor, an anode voltage of the corresponding OLED connected to the specific driving TFT, which has been fed back to the sensor, wherein the generating step generates the varied voltage by varying the voltage from the high voltage line according to a change in the sensed anode voltage of the corresponding OLED. In one or more embodiments, the applying step applies the varied voltages to the driving TFTs in the plurality of pixels, simultaneously.

[0034] It is to be understood that both the foregoing general description and the following detailed description of the present invention are exemplary and explanatory and are intended to provide further explanation of embodiments of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0035] The accompanying drawings, which are included to provide a further understanding of embodiments 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 embodiments of the invention. In the drawings:

FIGs. 1 and 2 illustrate a method for sensing the pixel characteristics for an external compensation in an organic light emitting display device according to the related art;

FIG. 3 illustrates a change of a constant current (I_d) in accordance with a drain-source voltage (V_{ds}) of a driving TFT according to a related art;

FIG. 4 illustrates a method for driving an organic light emitting display device according to an embodiment of the present invention, which shows a change in

the amount of electric current in accordance with a change of drain-source voltage (V_{ds}) of a driving TFT of the display device; and

FIGs. 5 and 6 illustrate a method for driving an organic light emitting display device according to an embodiment of the present invention, which respectively shows a time step compensation method and a feedback compensation method.

DETAILED DESCRIPTION OF THE INVENTION

[0036] Reference will now be made in detail to the exemplary embodiments of the present invention, examples of which are illustrated in the accompanying drawings. Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts.

[0037] On explanation about the embodiments of the present invention, the following details about the terms should be understood.

[0038] The term of a singular expression should be understood to include a multiple expression as well as the singular expression if there is no specific definition in the context. If using the term such as "the first" or "the second", it is to separate any one element from other elements. Thus, a scope of claims is not limited by these terms.

[0039] Also, it should be understood that the term such as "include" or "have" does not preclude existence or possibility of one or more features, numbers, steps, operations, elements, parts or their combinations.

[0040] It should be understood that the term "at least one" includes all combinations related with any one item. For example, "at least one among a first element, a second element and a third element" may include all combinations of the two or more elements selected from the first, second and third elements as well as each element of the first, second and third elements.

[0041] Hereinafter, an organic light emitting display device and a method for driving the same according to the embodiments of the present invention will be described with reference to the accompanying drawings.

[0042] FIG. 4 illustrates a method for driving an organic light emitting display device according to an embodiment of the present invention, which shows a change in the amount of electric current in accordance with a change of drain-source voltage (V_{ds}) of a driving TFT of the display device. The methods of FIGs. 4-6 can be applied to the circuitry/structure shown in FIG. 1 or to other suitable circuits/structures of a display device, and encompass the inventive features of the present invention. Further, these methods can be applied to various display devices or other electronic device having driving TFTs. The display device according to the present invention includes a plurality of pixels each having one or more driving TFTs, and the methods of the present invention are applied to one or more of such driving TFTs. The display devices of the present invention are operatively coupled and con-

figured.

[0043] On the characteristics of a driving TFT (D-TFT, e.g., Tr3 in FIGS. 1-6) of the organic light emitting display device, referring to FIG. 4, an amount of change in the current flowing in the driving TFT varies depending on a variation of the drain-source voltage (V_{ds}) of the driving TFT. Also, when a source voltage of the driving TFT is increased, a potential difference in the drain-source voltage (V_{ds}) is decreased due to the drain voltage of the driving TFT driven. That is, if the source voltage of the driving TFT is increased, the drain-source voltage (V_{ds}) of the driving TFT is decreased proportionally.

[0044] In the method for driving the organic light emitting display device according to an embodiment of the present invention, a drain voltage (V_{dd}) applied to the drain of the driving TFT is raised by a feedback of a charging value of a reference voltage (V_{ref}). The V_{dd} is considered a high voltage line, whereas a V_{ss} is considered a low voltage line. As a result, the drain-source voltage (V_{ds}) of the driving TFT (D-TFT) can be maintained constantly so that it is possible to improve correctness in measurement using the voltage.

[0045] Referring to FIG. 1, a pixel structure of the organic light emitting display device according to the embodiments of the present invention, and a method for sensing the characteristics of pixel in the organic light emitting display device according to the present invention will be described with reference to FIG. 1. That is, the inventive features and methods of the invention can be applied to the circuits/structures of FIG. 1.

[0046] On an organic light emitting diode (OLED) panel of the display device according to an embodiment of the present invention, there are a plurality of gate lines (GL), a plurality of sensing signal lines (SL), a plurality of data lines (DL) formed parallel to each other, a plurality of driving power lines (PL), and a plurality of reference lines (RL), wherein a plurality of pixels are defined by the plurality of gate lines (GL) and data lines (DL).

[0047] Each of the pixels may include an organic light emitting diode (OLED), and a pixel circuit (PC) for making the organic light emitting diode (OLED) emit light.

[0048] The plurality of gate lines (GL) and sensing signal lines (SL) may be formed parallel to each other in a first direction (for example, a horizontal direction) of the OLED panel. In this case, a scan signal (scan/gate driving signal, e.g., SCAN1, SCAN 2 in FIGS. 1-6) is applied from a gate driver to the gate line (GL), and a sensing signal (sense) is applied from the gate driver to the sensing signal line (SL).

[0049] The plurality of data lines (DL) are formed in a second direction (for example, a vertical direction) of the OLED panel. The plurality of data lines (DL) may be disposed perpendicular to the plurality of gate lines (GL) and sensing signal lines (SL).

[0050] A driving voltage (V_{DD}) is supplied from a data driver to the data line (DL). In this case, the driving voltage (V_{DD}) may be obtained by adding a compensation voltage (V_{th} , k) for compensating for a characteristic varia-

tion of the driving TFT to a data voltage (Vdata) in accordance with a video signal.

[0051] The compensation for the characteristics of the driving TFT (threshold voltage (V_{th}), mobility (k)) by the use of compensation data may be performed at a power-on time point of the organic light emitting display device, or a driving period for displaying images. Also, the compensation for the characteristics of driving TFT (threshold voltage (V_{th}), mobility (k)) may be performed at a power-off time point of the organic light emitting display device.

[0052] The plurality of reference lines (RL) may be provided in parallel to the plurality of data lines (DL). A display reference voltage (V_{ref}) may be selectively supplied from the data driver to the reference line (RL). In this case, the display reference voltage (V_{ref}) may be supplied to each reference line (RL) for a data charging period of each pixel (P).

[0053] The pixel circuit (PC) may include a first switching TFT (ST1, e.g., Tr1 in FIG. 1), a second switching TFT (ST2, e.g., Tr2 in FIG. 1), a driving TFT (DT, e.g., Tr3 in FIGS. 1-6), and a capacitor (Cst). In this case, the TFTs (ST1, ST2, DT) may be P-type TFT, for example, a-Si TFT, poly-Si TFT, Oxide TFT, Organic TFT, and etc., however, the TFTs are not limited to the P-type. The above TFTs (ST1, ST2, DT) may be N-type TFTs. That is, according to the present invention, the TFTs including the driving TFTs can be N-types, P-types, or other types, e.g., in the examples of FIGS. 5-6. For instance, although the N-type driving TFTs are shown in FIGS. 5-6, if the P-type driving TFTs are used instead, Vdd from the Vdd voltage line would be applied to the source terminal of the driving TFT (e.g., Tr3) directly, and the OLED would be connected directly between the drain terminal of the driving TFT (Tr3) and the Vss voltage line.

[0054] For the display period, a digital-to-analog converter (DAC) converts digital video data into an analog data voltage (Vdata), and then supplies the analog data voltage (Vdata) to each pixel.

[0055] For the sensing period, an analog-to-digital converter (ADC) converts an analog sensing value sensed in each pixel into digital sensing data, and then supplies the digital sensing data to a timing controller of the display device.

[0056] The digital-to-analog converter (DAC) of the data driver supplies the driving voltage (VDD), which is obtained by adding the compensation voltage (V_{th} , k) to the data voltage (Vdata) in accordance with the video signal, to the data line of each pixel. In this case, a voltage level of the driving voltage (VDD) may be obtained by adding the compensation voltage corresponding to the characteristic change of the driving TFT (DT) of the corresponding pixel (P) to the data voltage (Vdata).

[0057] Before shipping a product manufactured with the organic light emitting display device or at any desired time, according to the present invention, it may be necessary to compensate for mura (non-uniformity in luminance) of the OLED panel of the present invention by sensing the characteristics in all the pixels by using the

methods of FIGS. 5 and 6 according to the present invention.

[0058] More specifically, FIGS. 5 and 6 illustrate a method for driving the organic light emitting display device according to an embodiment of the present invention, which show respectively a time step compensation method and a feedback compensation method. In these methods, by varying the drain voltage Vdd of the driving TFT, the drain-source voltage Vds of the driving TFT is maintained at a constant or substantially constant level, which allows the measurement of the current flowing through the driving TFT to be more precise. In one embodiment, to generate the varied drain voltage to be applied to the drain of the driving TFT, a variation in the source voltage of the driving TFT may be measured over predetermined time duration, and then the drain voltage may be varied in accordance with the sensed variation in the source voltage of the driving TFT.

[0059] In case of an external compensation, the characteristics of pixels may be individually measured so as to compensate for all the pixels. In this respect, it is important to realize a correct electric current measurement. If an incorrect electric current measurement is obtained, the compensation for the pixel becomes imprecise, which might cause degradation in the picture quality and which may result in a defective OLED panel.

[0060] According to the embodiments of the present invention, the characteristics of the driving TFT in the pixel may be sensed by applying the voltage to the pixel of the organic light emitting display device and measuring the voltage of the pixel.

[0061] According to the embodiments of the present invention, when sensing the characteristics of the driving TFT formed in the plurality of pixels, the drain voltage applied to the drain of the driving TFT may be varied so as to sense the characteristics of the driving TFT (D-TFT, e.g., Tr3 in FIGS. 5-6). For example, the drain voltage (e.g., Vdd) of the driving TFT (D-TFT) may be varied on the basis of a change in an anode voltage of the organic light emitting diode (OLED) connected to the driving TFT.

[0062] In the time step compensation method of FIG. 5, the drain voltage of the driving TFT (D-TFT or Tr3) is varied in a step-by-step method according to time so as to sense the characteristics of the driving TFT (D-TFT). For instance, the drain voltage Vdd applied to the driving TFT is increased in steps over time as shown on the right side of FIG. 5. In this case, a gate-source voltage (V_{gs}) of the driving TFT (D-TFT) is sensed according to the variation in the drain voltage of the driving TFT (D-TFT) over time. Having the drain voltage of the driving TFT being in a step-increased format, a more accurate sensing of the V_{gs} occurs, which allows a more precise detection of the variation of the driving TFT.

[0063] Meanwhile, if sensing the drain voltage of driving TFT (D-TFT, e.g., Tr3), it is possible to change the anode voltage of the organic light emitting diode (OLED).

[0064] In one embodiment of the invention, to sense the characteristics of the driving TFT (D-TFT) formed in

each of all pixels, the gate-source voltage (V_{gs}) of the driving TFT (D-TFT) for each of the pixels is sensed by individually changing the drain voltage of the driving TFT (D-TFT) for each of the pixels.

[0065] However, it is not limited to the above method. In another embodiment of the present invention, for instance, to sense the characteristics of the driving TFT (D-TFT) formed in all the pixels, it is possible to simultaneously change all the drain voltages in the plurality of driving TFTs (D-TFT) at the same time.

[0066] According to another example, in the feedback compensation method as shown in FIG. 6, the anode voltage of the organic light emitting diode (OLED) may be fed back by the use of a sensor 10. Thereafter, a power IC 20 receives the feedback of the anode voltage, and changes the drain voltage (V_{dd}) for the driving TFT (Tr3) in accordance with the change in the anode voltage.

[0067] As the drain voltage (V_{dd}) is changed on the basis of the feedback of the anode voltage of the OLED, the drain voltage (V_{dd}) applied to the drain of the driving TFT (D-TFT) is varied accordingly. That is, the feedback of the anode voltage of the OLED allows the drain voltage V_{dd} to be varied in more accordance with the actual anode voltage of the OLED. In both methods of FIGS. 5 and 6, by varying the drain voltage V_{dd} of the driving TFT, the V_{ds} (drain-source voltage) of the driving TFT can be maintained at a constant level. Thus, the characteristics of the driving TFT may be sensed more accurately by changing the drain voltage (V_{dd}) of the driving TFT (D-TFT).

[0068] The above methods for driving the organic light emitting display device according to the embodiments of the present invention reduce errors in the current measurement, and furthermore improve preciseness in sensing the characteristics of the driving TFTs.

[0069] Accordingly, it is possible to realize high reliability in the compensation parameters/methods, and to improve the yield of OLED panel by precisely compensating for screen mura which might be considered defects.

[0070] Also, the current flowing to the driving TFT (D-TFT) becomes insensitive to the change in the drain-source voltage (V_{ds}) of the driving TFT. Thus, it is possible to obtain the correct measurement value for the current regardless of sensing time, to thereby improve the process margin and yield.

[0071] According to the embodiments of the present invention, it is possible to improve reliability of external compensation by reducing the sensing error in the organic light emitting display device or other types of display devices.

[0072] According to the embodiments of the present invention, it is possible to reduce defects, caused by the characteristic variation of pixels, through the precise sensing process for the characteristics of pixel in the organic light emitting display devices.

[0073] It will be apparent to those skilled in the art that various modifications and variations can be made in the

present invention without departing from the scope of the inventions. Thus, it is intended that the present invention covers the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

Claims

1. A method for controlling an organic light emitting display device, the organic light display device including a plurality of pixels for generating images, each of the plurality of pixels is connected to a gate line (GL), a data line (DL), and a reference line (RL), each of the plurality of pixels including at least:

- a first switching thin film transistor (Tr1) connected between the data line (DL) and the gate of a driving TFT (Tr3), and driven by the signal applied to the gate line (GL),
- a second switching thin film transistor (Tr2) connected between the reference line (RL) and the source of the driving TFT (Tr3), and
- an organic light emitting diode (OLED) connected to the source of the driving TFT (Tr3),

the method comprising:

- applying (S1) a predetermined voltage between gate and source of the driving thin film transistor (Tr3), through the first and second switching thin film transistors (Tr1 and Tr2), then
- sensing the characteristics of the driving thin film transistor by means of sensing (S2) a variation in the source voltage of the driving thin film transistor (Tr3) over a predetermined time duration through the second switching thin film transistor (Tr2) and the reference line, for an external compensation, to get a compensation voltage,

the method being further **characterized by**:

- during the sensing (S2) of the variation in the source voltage of the driving thin film transistor (Tr3), varying the voltage applied to the drain of the driving thin film transistor, so as to maintain the drain-source voltage of the driving thin film transistor (Tr3) constant, and then
- adding the compensation voltage to the data voltage (V_{data}) in accordance with the video signal, and supplying the data voltage to the data line of each pixel.

2. The method of claim 1, wherein varying the voltage applied to the drain of the driving thin film transistor comprises applying a varied drain voltage (V_{dd}) to the drain of the driving TFT (Tr3).

3. The method of claim 2, wherein the applying step applies varied drain voltages (Vdd) to the driving TFTs (Tr3) in the plurality of pixels, simultaneously.

4. The method of claim 2, wherein in the applying step, the varied drain voltage (Vdd) is a drain voltage that is increased in steps over time.

5. The method of claim 2, wherein the applying step includes:

sensing, by a sensor (10), an anode voltage of the corresponding OLED, which has been fed back to the sensor (10); and
generating the varied drain voltage (Vdd) by varying the drain voltage (Vdd) according to a change in the sensed anode voltage of the corresponding OLED.

6. The method of claim 4 or 5, wherein the applying step applies the varied drain voltage (Vdd) to the driving TFTs (Tr3) in the plurality of pixels, simultaneously.

7. The method of claim 1, wherein the organic light display device includes a high voltage line and the driving TFT (Tr3) is connected to the high voltage line, the method further comprising:

generating the voltage applied to the drain of the driving TFT at the high voltage line.

8. The method of claim 7, wherein the applying step applies the voltage from the high voltage line to the driving TFT (Tr3).

9. The method of claim 7 or 8, wherein the applying step applies the voltage to the driving TFTs (Tr3) in the plurality of pixels, simultaneously.

10. The method of claim 7 or 8, wherein in the applying step, the voltage is a voltage that is increased in steps over time.

11. The method of claim 10, wherein the applying step applies the voltage to the driving TFTs (Tr3) in the plurality of pixels, simultaneously.

12. The method of claim 7 or 8, wherein the applying step includes:

sensing, by a sensor (10), an anode voltage of the corresponding OLED connected to the driving TFT (Tr3), which has been fed back to the sensor (10),
wherein the generating step generates the voltage by varying the voltage from the high voltage line according to a change in the sensed anode

voltage of the corresponding OLED.

13. The method of claim 12, wherein the applying step applies the varied voltages to the driving TFTs (Tr3) in the plurality of pixels, simultaneously.

Patentansprüche

1. Ein Verfahren zum Steuern einer organischen lichtemittierenden Anzeigevorrichtung, wobei die organische Licht-Anzeigevorrichtung eine Mehrzahl von Pixeln zum Erzeugen von Bildern aufweist, wobei jedes der Mehrzahl von Pixeln mit einer Gate-Leitung (GL) einer Datenleitung (DL) und einer Referenzleitung (RL) verbunden ist, wobei jedes der Mehrzahl von Pixeln zumindest aufweist:

- einen ersten Schalt-Dünnschichttransistor (Tri), der zwischen die Datenleitung (DL) und das Gate eines Treiber-TFT (Tr3) geschaltet ist und von dem an die Gate-Leitung (GL) angelegten Signal betrieben wird,
- einen zweiten Schalt-Dünnschichttransistor (Tr2), der zwischen die Referenzleitung (RL) und die Source des Treiber-TFT (Tr3) geschaltet ist, und
- eine organische lichtemittierende Diode (OLED), die mit der Source des Treiber-TFT (Tr3) verbunden ist,

wobei das Verfahren aufweist:

- Anlegen (S1) einer vorbestimmten Spannung zwischen Gate und Source des Treiber-Dünnschichttransistors (Tr3) durch den ersten und den zweiten Schalt-Dünnschichttransistor (Tri und Tr2), danach
- Erfassen der Eigenschaften des Treiber-Dünnschichttransistors mittels Erfassens (S2) einer Variation in der Source-Spannung des Treiber-Dünnschichttransistors (Tr3) über eine vorbestimmte Zeitdauer durch den zweiten Schalt-Dünnschichttransistor (Tr2) und die Referenzleitung, für einen externen Ausgleich, um eine Ausgleichsspannung zu erhalten, wobei das Verfahren ferner **gekennzeichnet ist durch:**

- während des Erfassens (S2) der Variation in der Source-Spannung des Treiber-Dünnschichttransistors (Tr3), ein Variieren der an den Drain des Treiber-Dünnschichttransistors angelegten Spannung, um die Drain-Source-Spannung des Treiber-Dünnschichttransistors (Tr3) konstant zu halten, und danach
- Hinzufügen der Ausgleichsspannung zu der Datenspannung (Vdata) in Übereinstimmung mit dem Videosignal, und Bereit-

- stellen der Datenspannung an die Datenleitung jedes Pixels.
2. Das Verfahren gemäß Anspruch 1, wobei das Variieren der an den Drain des Treiber-Dünnschichttransistors angelegten Spannung das Anlegen einer varierten Drain-Spannung (Vdd) an den Drain des Treiber-TFT (Tr3) aufweist. 5
 3. Das Verfahren gemäß Anspruch 2, wobei bei dem Anlegen-Schritt variierte Drain-Spannungen (Vdd) gleichzeitig an die Treiber-TFTs (Tr3) in der Mehrzahl von Pixeln angelegt werden. 10
 4. Das Verfahren gemäß Anspruch 2, wobei bei dem Anlegen-Schritt die variierte Drain-Spannung (Vdd) eine Drain-Spannung ist, die von Zeit zu Zeit stufenweise erhöht wird. 15
 5. Das Verfahren gemäß Anspruch 2, wobei der Anlegen-Schritt aufweist: 20

Erfassen, durch einen Sensor (10), einer an den Sensor (10) zurückgeführten Anodenspannung der korrespondierenden OLED; und

Erzeugen der variierten Drain-Spannung (Vdd) durch Variieren der Drain-Spannung (Vdd) gemäß einer Änderung in der erfassten Anodenspannung der korrespondierenden OLED. 25
 6. Das Verfahren gemäß Anspruch 4 oder 5, wobei bei dem Anlegen-Schritt die variierte Drain-Spannung (Vdd) gleichzeitig an die Treiber-TFTs (Tr3) in der Mehrzahl von Pixeln angelegt wird. 30
 7. Das Verfahren gemäß Anspruch 1, wobei die organische Licht-Anzeigevorrichtung eine Hohe-Spannung-Leitung aufweist und der Treiber-TFT (Tr3) mit der Hohe-Spannung-Leitung verbunden ist, wobei das Verfahren ferner aufweist: 35

Erzeugen der an den Drain des Treiber-TFT angelegten Spannung an der Hohe-Spannung-Leitung. 40
 8. Das Verfahren gemäß Anspruch 7, wobei in dem Anlegen-Schritt die Spannung von der Hohe-Spannung-Leitung an den Treiber-TFT (Tr3) angelegt wird. 45
 9. Das Verfahren gemäß Anspruch 7 oder 8, wobei in dem Anlegen-Schritt die Spannung gleichzeitig an die Treiber-TFTs (Tr3) in der Mehrzahl von Pixeln angelegt wird. 50
 10. Das Verfahren gemäß Anspruch 7 oder 8, wobei bei dem Anlegen-Schritt die Spannung eine Spannung ist, die von Zeit zu Zeit stufenweise erhöht wird. 55

11. Das Verfahren gemäß Anspruch 10, wobei in dem Anlegen-Schritt die Spannung gleichzeitig an die Treiber-TFTs (Tr3) in der Mehrzahl von Pixeln angelegt wird.

12. Das Verfahren gemäß Anspruch 7 oder 8, wobei der Anlegen-Schritt aufweist:

Erfassen, durch einen Sensor (10), einer an den Sensor (10) zurückgeführten Anodenspannung der korrespondierenden OLED, die mit dem Treiber-TFT (Tr3) verbunden ist, wobei bei dem Erzeugen-Schritt die Spannung durch ein Variieren der Spannung von der Hohe-Spannung-Leitung erzeugt wird gemäß einer Änderung in der erfassten Anodenspannung der korrespondierenden OLED.

13. Das Verfahren gemäß Anspruch 12, wobei in dem Anlegen-Schritt die variierten Spannungen gleichzeitig an die Treiber-TFTs (Tr3) in der Mehrzahl von Pixeln angelegt werden.

Revendications

1. Procédé destiné à commander un dispositif d'affichage électroluminescent organique, le dispositif d'affichage électroluminescent organique comprenant une pluralité de pixels destinés à générer des images, chacun de la pluralité de pixels étant connecté à une ligne de grille (GL), à une ligne de données (DL), et à une ligne de référence (RL), chacun de la pluralité de pixels comprenant au moins :

- un premier transistor à couches minces de commutation (Tr1) connecté entre la ligne de données (DL) et la grille d'un TFT de commande (Tr3), et commandé par le signal appliqué à la ligne de grille (GL) ;
- un second transistor à couches minces de commutation (Tr2) connecté entre la ligne de référence (RL) et la source du TFT de commande (Tr3) ; et
- une diode électroluminescente organique (OLED) connectée à la source du TFT de commande (Tr3) ;

le procédé comprenant les étapes consistant à :

- appliquer (S1) une tension prédéterminée entre la grille et la source du transistor à couches minces de commande (Tr3), par l'intermédiaire des premier et second transistors à couches minces de commutation (Tr1 et Tr2) ; puis
- détecter les caractéristiques du transistor à couches minces de commande au moyen d'une étape consistant à détecter (S2) une variation

de la tension de source du transistor à couches minces de commande (Tr3) au cours d'une durée de temps prédéterminée par l'intermédiaire du second transistor à couches minces de commutation (Tr2) et de la ligne de référence, pour une compensation extérieure, de façon à obtenir une tension de compensation ;

le procédé étant **caractérisée en outre par** les étapes consistant à :

- faire varier, au cours de l'étape consistant à détecter (S2) une variation de la tension de source du transistor à couches minces de commande (Tr3), la tension appliquée au drain du transistor à couches minces de commande, de façon à maintenir constante la tension drain - source du transistor à couches minces de commande (Tr3) ; et ensuite
- ajouter la tension de compensation à la tension de données (Vdata) selon le signal vidéo, et appliquer la tension de données à la ligne de données de chaque pixel.

2. Procédé selon la revendication 1, dans lequel l'étape consistant à faire varier la tension appliquée au drain du transistor à couches minces de commande, comprend une étape consistant à appliquer une tension de drain qui a varié (Vdd) au drain du TFT de commande (Tr3).

3. Procédé selon la revendication 2, dans lequel l'étape d'application applique simultanément des tensions de drain qui ont varié (Vdd) aux TFT de commande (Tr3) dans la pluralité de pixels.

4. Procédé selon la revendication 2, dans lequel, dans l'étape d'application, la tension de drain qui a varié (Vdd) est une tension de drain qui augmente par paliers au cours du temps.

5. Procédé selon la revendication 2, dans lequel l'étape d'application comprend les étapes consistant à :

- détecter, à l'aide d'un détecteur (10), une tension d'anode de l'OLED correspondant, qui a été renvoyée vers le détecteur (10) ; et
- générer la tension de drain qui a varié (Vdd) en faisant varier la tension de drain (Vdd) selon une modification de la tension d'anode détectée de l'OLED correspondant.

6. Procédé selon la revendication 4 ou la revendication 5, dans lequel l'étape d'application applique simultanément les tensions de drain qui ont varié (Vdd) aux TFT de commande (Tr3) dans la pluralité de pixels.

7. Procédé selon la revendication 1, dans lequel le dispositif d'affichage électroluminescent organique comprend une ligne à haute tension, et le TFT de commande (Tr3) est connecté à la ligne à haute tension ; le procédé comprenant en outre une étape consistant à :

générer la tension appliquée au drain du TFT de commande au niveau de la ligne à haute tension.

8. Procédé selon la revendication 7, dans lequel l'étape d'application applique au TFT de commande (Tr3) la tension en provenance de la ligne à haute tension.

9. Procédé selon la revendication 7 ou la revendication 8, dans lequel l'étape d'application applique simultanément la tension aux TFT de commande (Tr3) dans la pluralité de pixels.

10. Procédé selon la revendication 7 ou la revendication 8, dans lequel, dans l'étape d'application, la tension est une tension qui augmente par paliers au cours du temps.

11. Procédé selon la revendication 10, dans lequel l'étape d'application applique simultanément la tension aux TFT de commande (Tr3) dans la pluralité de pixels.

12. Procédé selon la revendication 7 ou la revendication 8, dans lequel l'étape d'application comprend une étape consistant à :

- détecter, à l'aide d'un détecteur (10), une tension d'anode de l'OLED correspondant connectée au TFT de commande (Tr3), qui a été renvoyée vers le détecteur (10) ;
- dans lequel l'étape de génération génère la tension en faisant varier la tension en provenance de la ligne à haute tension selon une variation de la tension d'anode détectée de l'OLED correspondant.

13. Procédé selon la revendication 12, dans lequel l'étape d'application applique simultanément les tensions qui ont varié aux TFT de commande (Tr3) dans la pluralité de pixels.

FIG. 2

Related Art

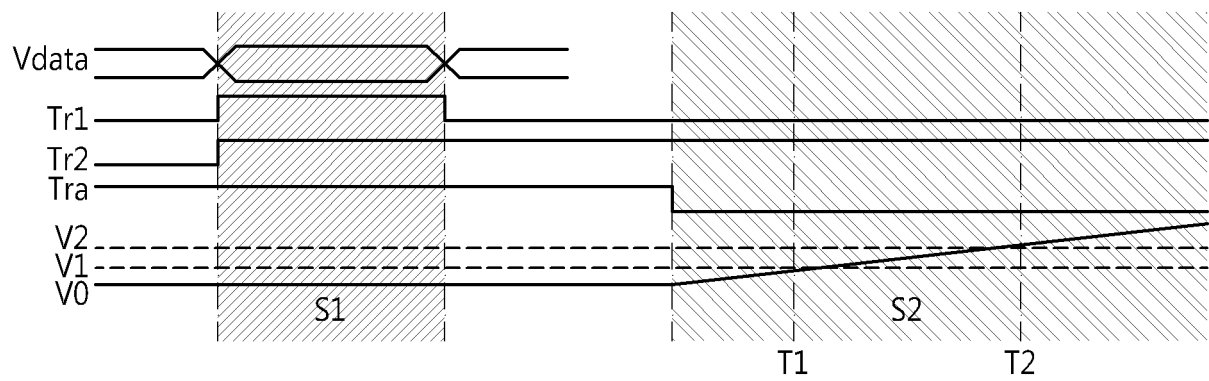


FIG. 3

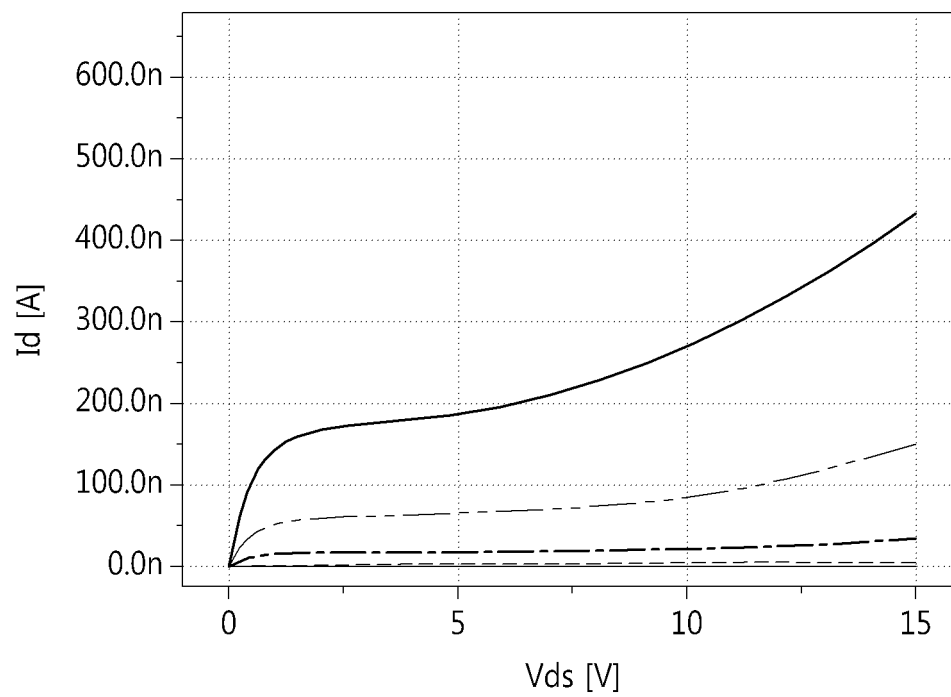


FIG. 4

< Amount of current change in accordance
with variation of drain-source voltage (V_{ds}) >

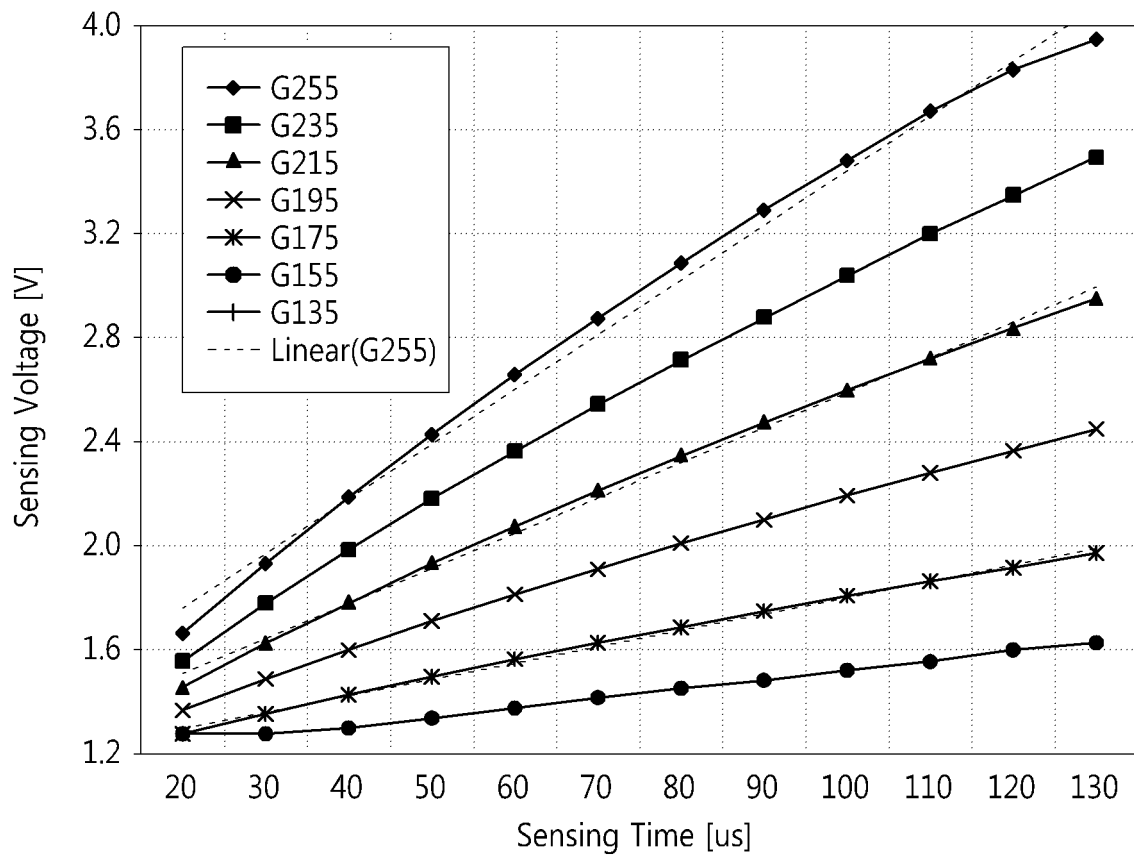


FIG. 5

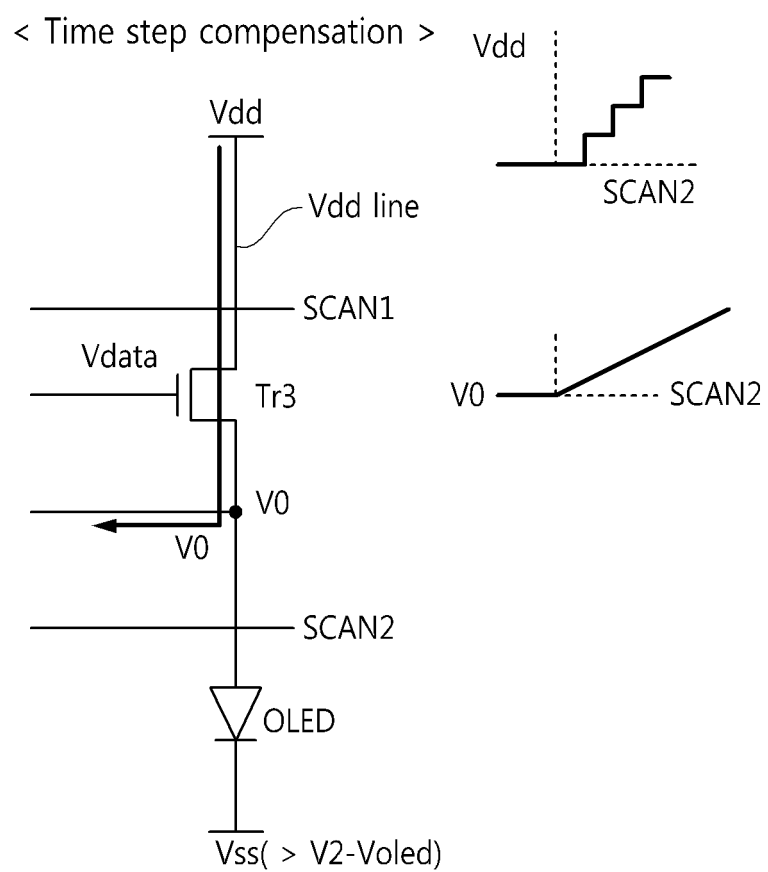
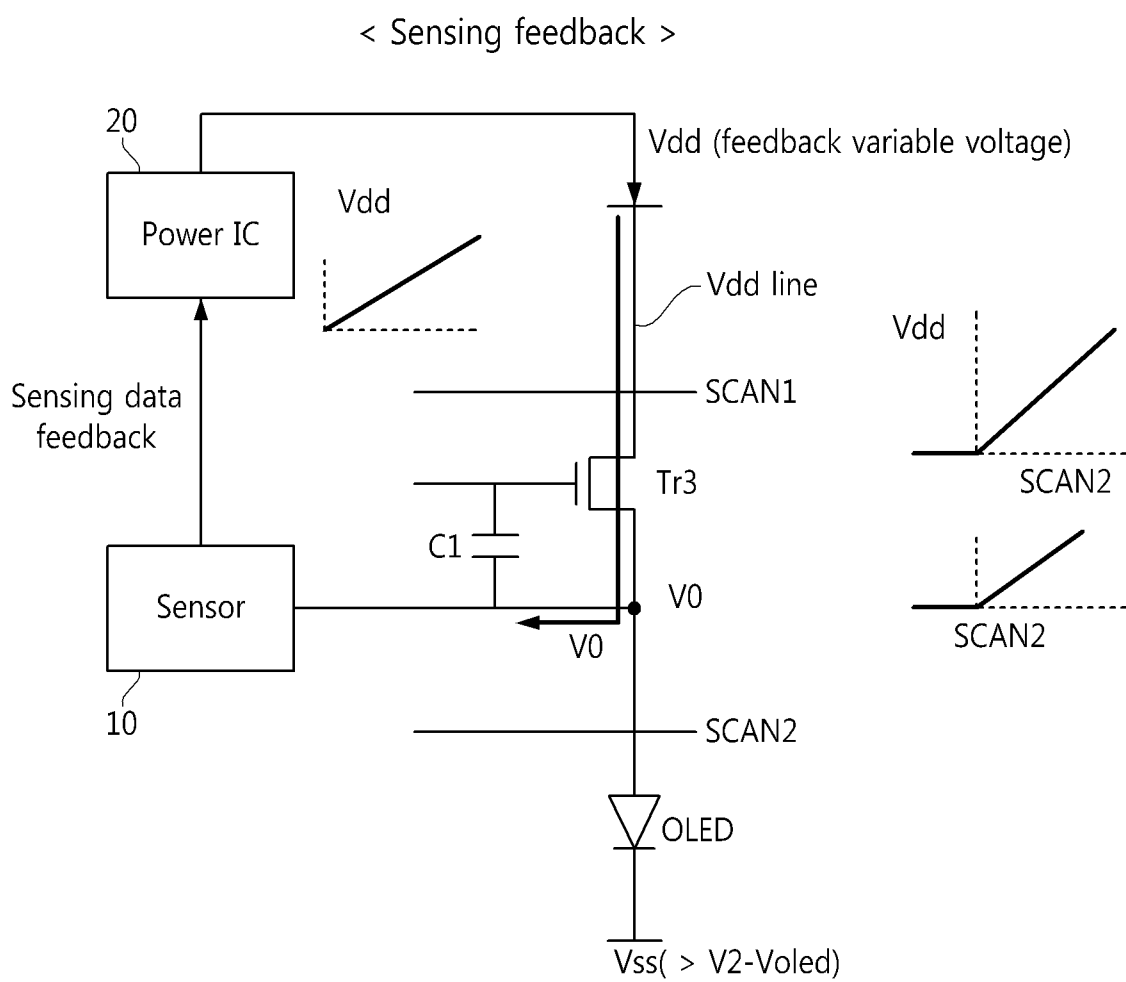


FIG. 6



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 20050078065 A [0017]
- US 20110134101 A [0018]
- US 20080297055 A [0019]
- US 20100103203 A [0020]
- US 20100090932 A [0021]
- US 2013050292 A1 [0022]

专利名称(译)	有机发光显示装置及其驱动方法		
公开(公告)号	EP2889867B1	公开(公告)日	2017-11-08
申请号	EP2014200422	申请日	2014-12-29
[标]申请(专利权)人(译)	乐金显示有限公司		
申请(专利权)人(译)	LG DISPLAY CO. , LTD.		
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IPC分类号	G09G3/3233 G09G3/3291		
CPC分类号	G09G3/3258 G09G3/3233 G09G3/3291 G09G2300/0819 G09G2310/0289 G09G2320/0233 G09G2320/029 G09G2320/043 G09G2330/021		
优先权	1020130169476 2013-12-31 KR		
其他公开文献	EP2889867A1		
外部链接	Espacenet		

摘要(译)

讨论了一种补偿有机发光显示装置中的驱动TFT的方法。根据一个实施例，该方法包括将变化的漏极电压施加到多个像素之一中的特定驱动TFT的漏极;并且通过改变的漏极电压补偿特定的驱动TFT，以便在特定的驱动TFT处保持恒定的漏源电压。

[Math Formula 1]

$$i_{TFT} = C \cdot (V_2 - V_1) / \Delta t$$