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

(11) EP 1 939 848 A2

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
02.07.2008 Bulletin 2008/27

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

(21) Application number: **07254798.7**

(22) Date of filing: **12.12.2007**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC MT NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR MK RS

(30) Priority: **27.12.2006 KR 20060135093**

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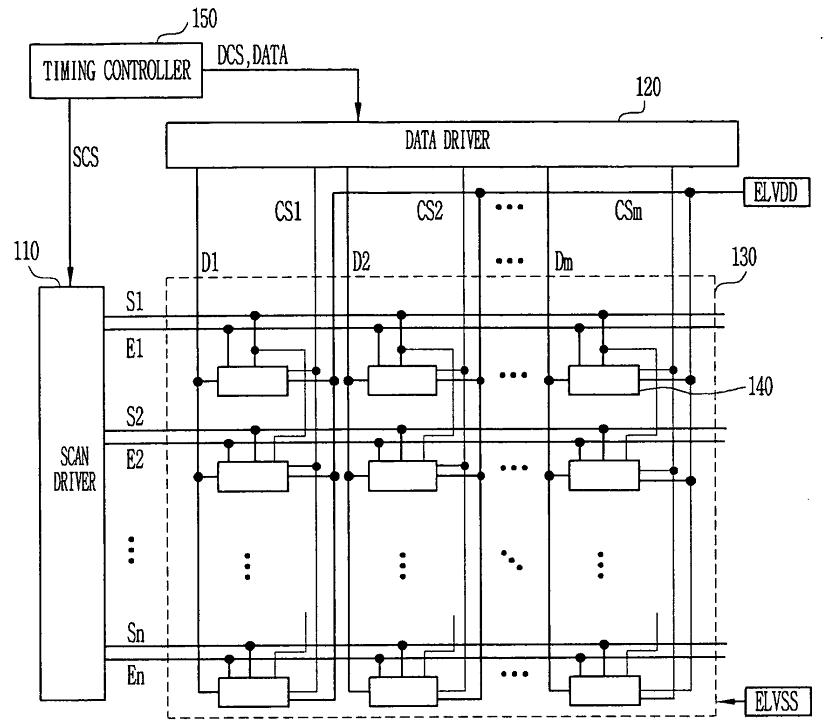
(54) Organic light emitting diode display device and method of driving the same

(57) An electroluminescent display device includes pixels (140) each adapted to receive respective first and second scan signals via respective first and second lines; a scan driver (110) adapted to supply a respective scan signal to each of the scan lines and to supply a respective light emitting control signal to each of the light emitting control lines; and a data driver (120) adapted to primarily charge the pixel by sinking a predetermined electric current through a respective electric current sink line when the first scan signal is supplied to the first scan line, and to secondarily charge the respective pixel by supplying a voltage data signal to a respective one of the data lines when the second scan signal is supplied to the second scan line associated with the pixel.

FIG. 1



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Description

BACKGROUND

1. Field of the Invention

[0001] The present invention relates to an electroluminescent display, e.g., an organic light emitting diode (OLED) display device, and a method of driving the same. More particularly, the invention relates to an OLED display device capable of displaying an image having a uniform luminance, and a method of driving the same.

2. Description of the Related Art

[0002] There have been many attempts to develop various flat panel displays capable of reducing the weight and volume characteristics typical of cathode ray tubes. Flat panel displays include, e.g., liquid crystal displays, field emission displays, plasma display panels, OLED display devices, etc.

[0003] OLED display devices produce an image by employing light emitting diode(s), which generate light by recombining electrons and holes. OLED display devices may have advantages such as rapid response time and/or relatively low power consumption. OLED display devices may employ a voltage driving mode employing a voltage as a data signal, or an electric current driving mode employing an electric current as a data signal.

[0004] The voltage driving mode may divide a predetermined voltage into a plurality of grey levels, and may display a predetermined image by supplying one of the divided voltages as a data signal to pixels. However, with the voltage driving mode, it may be difficult to display a uniform image due to variations in threshold voltage and electron mobility of a respective drive transistor included in each of the pixels of the display.

[0005] The electric current driving mode may display an image by supplying a respective predetermined electric current as a data signal to the pixels of the display. Such an electric current driving mode may display a uniform image regardless of the threshold voltage and the electron mobility of the respective drive transistor. However, the electric current driving mode may not charge a desired voltage to the respective pixels within a given time because the electric current driving mode employs a micro-electric current as a data signal. Therefore, it may be impossible to drive a large-area circuit using the electric current driving mode. More particularly, when the micro-electric current is used as the data signal, a large amount of time may be required for charging the pixels because of load capacitance in each data line. The electric current driving mode may be disadvantageous because it may be very difficult to design a data driver that uses the micro-electric current to display a large number of grey levels.

[0006] The above information disclosed in this Background section is only for enhancement of understanding of the background of the invention, and therefore it may contain information that does not form the prior art that is already known in this country to a person of ordinary skill in the art.

SUMMARY OF THE INVENTION

[0007] The invention is directed to a light emitting diode display device and a method of driving the same, which substantially overcome one or more of the problems due to the limitations and disadvantages of the related art.

[0008] It is therefore an object of the invention to provide a light emitting diode display device capable of displaying an image having a uniform luminance, and a method of driving the same.

[0009] Accordingly, a first aspect of the invention provides an organic light emitting diode display device, including data lines, scan lines, light emitting control lines, electric current sink lines, pixels in regions at least partially defined by respective portions of the data lines, the scan lines, the light emitting control lines and the electric current sink lines, each of the pixels being coupled with at least two of the scan lines, a scan driver adapted to supply a respective scan signal to each of the scan lines and to supply a respective light emitting control signal to each of the light emitting control lines, the respective scan signals including a first scan signal corresponding to a first of the at least two scan lines associated with a respective one of the pixels and a second scan signal corresponding to a second of the at least two scan lines associated with the respective pixel, and a data driver adapted to primarily charge the respective pixel by sinking a predetermined electric current through a respective one of the electric current sink lines when the first scan signal is supplied to the first of the at least two scan lines, and to secondarily charge the respective pixel by supplying a voltage data signal to a respective one of the data lines when the second scan signal is supplied to the second of the at least two scan lines associated with the respective pixel.

[0010] The first scan signal may be supplied to the first scan line before the second scan signal is supplied to the second scan line such that the first of the at least two scan lines primarily charges some of the pixels during a previous time period before a subsequent time period during which the second one of the at least two scan lines secondarily charges other ones of the pixels. The predetermined electric current may be an electric current that charges a load capacitor of each of the electric current sink lines. The predetermined electric current may be set to a level substantially identical to or higher than an electric current resulting in a maximum luminance from an organic light emitting diode in each of the pixels.

[0011] The data driver may include electric current sources coupled to each of the electric current sink lines to sink the predetermined electric current. The data driver may include an electric current source commonly coupled to the electric current sink lines to sink the predetermined electric current. Each of the pixels may be adapted to convert the primarily charged voltage and the secondly charged voltage into one converted voltage, and to supply an electric current corresponding to the converted voltage to a light emitting element.

[0012] Each of the pixels may include a light emitting diode, a drive transistor adapted to supply an electric current to the light emitting diode, a first transistor adapted to supply a data signal to a first node when the respective second scan signal is supplied to the respective second scan line associated with the pixel, a first capacitor coupled between a gate electrode of the drive transistor and a first power source, a second capacitor coupled between the first node and the first power source, a second transistor adapted to electrically connect a second electrode of the drive transistor with a feedback line when the respective first scan signal is supplied to the respective first scan line associated with the pixel, a third transistor adapted to electrically connect the second electrode with the gate electrode of the drive transistor when the respective first scan signal is supplied to the respective first scan line associated with the pixel, and a fourth transistor coupled between the gate electrode of the drive transistor and the first node.

[0013] The display device may be adapted to charge the primarily charged voltage, which at least substantially compensates for a threshold voltage and an electron mobility of the drive transistor, in the first capacitor when the respective first scan signal is supplied to the respective first scan line, and to charge the secondarily charged voltage, corresponding to the data signal, in the second capacitor. The display device may be adapted to convert the voltages charged in the first capacitor and the second capacitor into one voltage when the fourth transistor is turned on, and the drive transistor supplies an electric current corresponding to the converted voltage to the organic light emitting diode.

[0014] The scan driver may be adapted to simultaneously output the respective light emitting control signal to a current (ith) one of the light emitting control lines, the respective first scan signal to the respective first (ith-1) scan line and the respective second scan signal to the respective second (ith) scan line, where i is an integer from 1 to n. Each of the pixels may further include a fifth transistor coupled between the drive transistor and the light emitting diode, and the fifth transistor is adapted to turn on when the respective one of the light emitting control signals is supplied to the respective one of the light emitting control lines.

[0015] At least one of the above an other features and advantages of the present embodiments may be realized by separately providing a pixel of a display including data lines, scan lines, light emitting control lines, and electric current sink lines, and the pixel including an organic light emitting diode, a drive transistor adapted to supply an electric current to the organic light emitting diode, a first transistor coupled to a respective one of the light emitting control lines, a first capacitor and a second capacitor coupled in parallel between a first power source and a gate electrode of the drive transistor, a second transistor coupled between a respective one of electric current sink lines and a second electrode of the drive transistor, the second transistor being adapted to turn on when a first scan signal is supplied to a first respective one of the scan lines associated with the pixel, a third transistor coupled between a gate electrode and the second electrode of the drive transistor, and a fourth transistor coupled between the gate electrode of the drive transistor and the second capacitor, wherein the first transistor is adapted to supply a data signal when a second scan signal is supplied to a second respective one of the scan lines associated with the pixel, the first scan signal being supplied before the second scan signal is supplied.

[0016] The first capacitor may be adapted to be charged by a predetermined electric current supplied to the respective electric current sink line when the first scan signal is supplied to the first scan line associated with the pixel, and the second capacitor may be adapted to be charged by the data signal when the second scan signal is supplied to the second scan line associated with the pixel. The fourth transistor may be adapted to be turned on to convert a voltage charged in the first capacitor and a voltage charged in the second capacitor into one voltage when the light emitting control signal is supplied to the respective light emitting control line, and the drive transistor is adapted to supply an electric current corresponding to the converted voltage to the organic light emitting diode.

[0017] The pixel may include a fifth transistor coupled between the drive transistor and the light emitting diode, and the fifth transistor is adapted to be turned on when the light emitting control signal is supplied to the respective light emitting control line.

[0018] At least one of the above an other features and advantages of the present embodiments may be realized by separately providing a method of driving a pixel of an organic light emitting diode display device, including charging a voltage in a first capacitor included in the pixel while sinking a predetermined electric current via a drive transistor of the pixel when a first scan signal is supplied to a first scan line associated with the pixel, after charging the voltage in the first capacitor, charging a voltage in a second capacitor included in the pixel by supplying a data signal to the pixel when a second scan signal is supplied to a second scan line associated with the pixel, converting the voltages charged in the first capacitor and the second capacitor into one voltage, and supplying an electric current corresponding to the converted voltage to an organic light emitting diode of the pixel.

[0019] The predetermined electric current may be set to an electric current that charges a load capacitor of an electric current sink line associated with the pixel. Converting the voltages may include electrically coupling the second capacitor with the first capacitor.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] The above and other features and advantages of the present invention will become more apparent to those of ordinary skill in the art from referring to the following detailed description of embodiments thereof taken in conjunction with the attached drawings, in which:

[0021] FIG. 1 is a diagram of an OLED display device according to an embodiment of the present invention;

[0022] FIG. 2 is a diagram of an embodiment of a pixel employable by the display device shown in FIG. 1;

[0023] FIG. 3 illustrates a data driver coupled to the pixel of FIG. 2; and

[0024] FIG. 4 is a waveform diagram of signals employable by a method of driving the pixel of FIG. 2 according to an embodiment of the present invention.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0025] The invention will now be described more fully hereinafter with reference to the accompanying drawings, in which embodiments of the invention are illustrated. Aspects of the invention may, however, be embodied in different forms and should not be construed as limited to the embodiments set forth herein.

[0026] In the following description one element is coupled to another element, one element may be not only directly coupled to another element but also indirectly coupled to another element via another element(s). Terms such as "primary" and "secondary" are used to distinguish different elements, and are not meant to express temporal or spatial correspondence. Irrelevant elements are omitted for clarity.

[0027] In some embodiments of the present invention, a predetermined electric current may flow, e.g., be supplied to a current sink, e.g., supplied from a current source to a respective one of electric current sink lines, to substantially and/or completely compensate for a threshold voltage and electron mobility of a drive transistor during a period when a driving scan signal is supplied to a prior scan line, and a data signal (voltage) may be supplied to charge a voltage corresponding to the respective data signal during a period when a current scan signal is supplied to the scan line currently being driven. In embodiments of the invention, the voltage for compensating for the threshold voltage and electron mobility of the drive transistor and the voltage corresponding to the data signal may be converted into one voltage, and the converted voltage may be used to drive the drive transistor. Therefore, it may be possible to display an image having uniform luminance.

[0028] In OLED display device(s) and method(s) of driving the same employing one or more aspects of the present invention, a predetermined electric current may flow, e.g., be supplied, e.g., from a current source to a respective one of the electric current sink lines, to primarily charge a voltage that may substantially and/or completely compensate for the threshold voltage and electron mobility of a drive transistor and to secondarily charge a voltage corresponding to the data signal. The primarily charged voltage and the secondarily charged voltage may be converted into one voltage, and an electric current corresponding to the converted voltage may be supplied to the respective OLED. Accordingly, embodiments of the present invention may display an image having uniform luminance regardless of the threshold voltage and electron mobility of the respective drive transistor(s). Embodiments of the present invention may stably and substantially and/or completely compensate for the threshold voltage and electron mobility of the respective drive transistor(s) because a predetermined, e.g., fixed, electric current source may be used to sink an electric current. That is, because a voltage corresponding to the threshold voltage and the electron mobility of the drive transistor may be stored in the pixel as a result of the predetermined electric current flowing to a current sink, e.g., flowing from the respective electric current source to the respective electric current sink line, load capacitance of the electric current sink line may be sufficiently charged.

[0029] FIG. 1 illustrates a diagram of an OLED display device according to an embodiment of the present invention.

[0030] Referring to FIG. 1, the OLED display device includes a pixel unit 130. The pixel unit 130 includes multiple pixels 140 coupled to scan lines S1, S2...Sn, light emitting control lines E1, E2...En, data lines D1, D2...Dm, electric current sink lines CS1, CS2...CSm, a scan driver 110, a data driver 120 and a timing controller 150. The scan driver 110 serves to drive the scan lines S1, 52...Sn and the light emitting control lines E1, E2...En. The data driver 120 serves to drive the data lines D1, D2...Dm and the electric current sink lines CS1, CS2...CSm. The timing controller 150 serves to control the scan driver 110 and the data driver 120.

[0031] The pixel unit 130 includes the pixels 140 in regions at least partially defined by the scan lines S1, S2...Sn, the light emitting control lines E1, E2...En, the data lines D1, D2...Dm, and the electric current sink lines CS1, Cs2...CSm. The pixels 140 are coupled to a first external power source ELVDD and a second external power source ELVSS. Each of the pixels 140 is primarily charged with a voltage to at least substantially and/or completely compensate for electron mobility and a threshold voltage of a respective drive transistor MD (see FIG. 2) included in each of the pixels 140, when an electric current flows to a current sink, e.g., flows from a current source to the electric current sink lines CS1, CS2...CSm. Each of the pixels 140 is secondarily charged with a voltage corresponding to a data signal when a data signal voltage is supplied to the data lines D1, D2...Dm. The pixels 140 supply a predetermined electric current from the first power source ELVDD to the second power source ELVSS via an OLED (see Fig. 2), where the predetermined electric current corresponds to the primarily and secondarily charged voltages. The pixels 140 will be described in greater detail below.

[0032] In some embodiments of the invention, a zeroth scan line S0 (not shown) is provided. The zeroth scan line S0 may be provided, e.g., adjacent to the first scan line S1, and the zeroth scan line S0 may be coupled with the respective pixels 140 arranged, e.g., on a first horizontal line. The respective pixels 140 arranged on the first horizontal line may also be driven stably.

[0033] The timing controller 150 generates the data drive control signal DCS and the scan drive control signal SCS corresponding to externally supplied synchronizing signals. The timing controller 150 supplies externally provided data DATA to the data driver 120. The data drive control signal DCS generated in the timing controller 150 are supplied to the data driver 120, and the scan drive control signal SCS is supplied to the scan driver 110.

[0034] The scan driver 110 receives the scan drive control signal SCS. The scan driver 110, receiving the scan drive control signal SCS, sequentially supplies scan signals to the scan lines S1, S2...Sn. The scan driver 110 receiving the scan drive control signal SCS sequentially supplies light emitting control signals to the light emitting control lines E1, E2...En. For each of the pixels 140, the respective light emitting control signal is supplied so that it overlaps with at least two scan signals. For example, the light emitting control signal supplied to an ith, where i is an integer from 1 to n, light emitting control line Ei overlaps with a prior scan signal supplied to a prior scan line, e.g., an ith-1 scan line Si-1, and a current scan signal supplied to an ith scan line Si. More particularly, e.g., the prior scan signal drives respective ones of the pixels 140 arranged in an ith-1 row to emit or not emit light and the current scan signal drives respective ones of the pixels 140 arranged in the ith row to emit or not emit light.

[0035] The data driver 120 receives a data drive control signal DCS from the timing controller 150. During a prior scan period, e.g., when the prior scan signal is being supplied to, e.g., the ith-1 row, the data driver 120 receiving the data drive control signal DCS sinks a predetermined electric current via the electric current sink lines CS1, CS2...CSm to respective ones of the pixels 140, e.g., pixels arranged in the ith row, to be driven during a subsequent, e.g., next or current, scan period to display or not display light. More particularly, e.g., the ith-1 scan line Si-1 corresponds to the prior scan line if the pixels currently being driven are coupled with the ith-1 scan line Si-1 and the ith scan line Si.

[0036] The predetermined electric current is set to an electric current value sufficient to charge a load capacitance of each of the electric current sink lines CS1, CS2...CSm during a prior period when the prior scan signal is supplied to the prior scan line, e.g, Si-1. The predetermined electric current is be set to a level substantially identical to or higher than an electric current flowing in the OLEDs when each of the pixels 140 emits the light with maximum luminance. The predetermined electric current may be experimentally determined in consideration of a size of a panel, a width of the electric current sink lines CS1, CS2...CSm, resolution, etc.

During respective scan periods, e.g., the prior scan period, the current scan period, etc., the data driver 120 supplies the respective data signals via the data lines D1, D2...Dm to the respective ones of the pixels 140 to be selected by the respective scan signal. The respective data signal is set to a voltage corresponding to grey levels. The ith scan line Si is set to the current scan line if the pixels are coupled with the prior scan line, e.g., the ith-1 scan line Si-1, and the ith scan line Si.

[0037] FIG. 2 illustrates an embodiment of the pixel of FIG. 1. For convenience, the exemplary pixel 140 is illustrated to be coupled with a jth data line Dj, where j is an integer of 1 to m, and the ith scan line Si. However, embodiments of the invention are not limited thereto and other configurations may be employed.

[0038] Referring to FIG. 2, the pixel 140 includes an OLED, and a pixel circuit 142 adapted to supply an electric current to the OLED.

[0039] The OLED generates light having a predetermined color corresponding to the electric current supplied from the pixel circuit 142. The OLED generates light having one of red, green and blue colors to correspond to the electric current supplied to the OLED.

[0040] The pixel circuit 142 primarily charges the voltage that may at least substantially and/or completely compensate for a threshold voltage and electron mobility of the drive transistor MD when the prior scan signal is supplied to the prior scan line, e.g., the ith-1 scan line Si-1, and secondarily charges a voltage corresponding to the data signal when the current scan signal is supplied to the current scan line, e.g., the ith scan line Si. The pixel circuit 142 converts the primarily charged voltage and the secondarily charged voltage into one voltage, and the pixel circuit 142 supplies a predetermined driving or controlling electric current to the respective OLED coupled to the respective pixel circuit 142. The pixel circuit 142 includes the drive transistor MD, first to fifth transistors M1 to M5, a first capacitor C1 and a second capacitor C2.

[0041] A first electrode of the first transistor M1 is coupled to the data line Dj, and a second electrode is coupled to a first node N1. A gate electrode of the first transistor M1 is coupled to the ith scan line Si. The first transistor M1 turns on when the respective scan signal is supplied to the ith scan line Si, thereby electrically coupling the first node N1 with the data line Dj.

[0042] A first electrode of the second transistor M2 is coupled to the electric current sink line CSj, and a second electrode of the second transistor M2 is coupled to a second electrode of the drive transistor MD. A gate electrode of the second transistor M2 is coupled to the ith-1 scan line Si-1. The second transistor M2 turns on when the respective scan signal is supplied to the ith-1 scan line Si-1, thereby electrically coupling the second electrode of the drive transistor MD with the electric current sink line CSj.

[0043] A first electrode of the third transistor M3 is coupled to a gate electrode of the drive transistor MD, and a second electrode of the third transistor M3 is coupled to the second electrode of the drive transistor MD. A gate electrode of the third transistor M3 is coupled to the ith-1 scan line Si-1. The third transistor M3 turns on when the scan signal is supplied to the ith-1 scan line Si-1, and may causes the drive transistor MD to be diode-coupled.

[0044] A first electrode of the fourth transistor M4 is coupled to the first node N1, and a second electrode of the fourth transistor M4 is coupled to a second node N2. A gate electrode of the fourth transistor M4 is coupled to the light emitting control line Ei. The fourth transistor M4 turns on when the light emitting control signal is supplied, and the fourth transistor M4 turns off when a light emitting control signal is not supplied.

[0045] A first electrode of the fifth transistor M5 is coupled to the second electrode of the drive transistor MD, and a second electrode of the fifth transistor M5 is coupled to an anode electrode of the OLED. A gate electrode of the fifth transistor M5 is coupled to the light emitting control line Ei. The fifth transistor M5 turns on when the light emitting control signal is supplied, and turns off when the light emitting control signal is not supplied.

[0046] A first electrode of the drive transistor MD is coupled to the first power source ELVDD, and the second electrode of the drive transistor MD is coupled to the first electrode of the fifth transistor M5. A gate electrode of the drive transistor MD is coupled to the second node N2. The drive transistor MD supplies an electric current, corresponding to a voltage applied to the second node N2, flowing from the first power source ELVDD to the second power source ELVSS via the fifth transistor M5 and the OLED.

[0047] The first capacitor C1 is coupled between the second node N2 and the first power source ELVDD. The first capacitor C1 charges a predetermined voltage when an electric current flows into, e.g., sinks into, the electric current sink line CSj.

[0048] The second capacitor C2 is coupled between the first node N1 and the first power source ELVDD. The second capacitor C2 charges a voltage corresponding to the data signal supplied to the data line Dj.

[0049] FIG. 3 illustrates a data driver coupled to the pixel circuit 142 of the pixel illustrated in FIG. 2. Referring to FIG. 3, the data driver 120 includes an electric current source 121 and a data signal generation unit 122.

[0050] The electric current source 121 is coupled to the electric current sink line CSj in order to sink the predetermined electric current. In some embodiments of the invention, each of the electric current sink lines CS1, CS2...CSm (see FIG. 1) is coupled to respective electric current sources 121 to sink the electric current from the electric current sink lines CS1, CS2...CSm. In other embodiments, electric current sink lines CS1, CS2...CSm is commonly coupled to a single electric current source 121. In embodiments employing a plurality of the electric current sources 121, each of the electric current sources 121 supplies the same or substantially the same amount of current.

[0051] In FIGS. 2 and 4, the transistors M1 to M5 have been exemplified as p-type transistors, e.g., PMOS, but are not limited thereto. Also, at least for the scan signals and the light emitting control signals, "supplying" a signal may correspond to a "low level" state of the signal and "not supplying" a signal may correspond to a "high level" state of the signal, but is not limited thereto.

[0052] The data signal generation unit 122 generates the data signal to correspond to data DATA supplied by the timing controller 150. The data signal generation unit 122 includes a shift register, latches, a digital/analog converter, a buffer, etc.

[0053] FIG. 4 illustrates a waveform diagram of signals employable by a method of driving the pixel 140 illustrated in FIGS. 3 and 4.

[0054] The light emitting control signal is supplied, e.g., a portion of the light emitting control signal having a low level is supplied, to the ith light emitting control line Ei. The fourth transistor M4 and the fifth transistor M5 is turned on when the light emitting control signal is supplied, e.g., logic low level, to the ith light emitting control line Ei. The fourth transistor M4 and the fifth transistor M5 are turned off when the light emitting control signal is not supplied, e.g., logic high level, to the ith light emitting control line Ei.

[0055] The scan signal is then supplied to the ith-1 scan line Si-1. The second transistor M2 and the third transistor M3 is turned on when the scan signal is supplied to the ith-1 scan line Si-1. The second electrode of the drive transistor MD is electrically coupled with the electric current sink line CSj when the second transistor M2 is turned on. The drive transistor MD is diode-coupled when the third transistor M3 is turned on. The predetermined electric current sinks, e.g., flows from the electric current source 121 via the drive transistor MD and the third transistor M3, when the second and third transistors M2 and M3 are turned on.

[0056] A voltage corresponding to the predetermined electric current flowing in the drive transistor MD is applied to the second node N2, and the first capacitor C1 is charged with a voltage corresponding to a voltage applied to the second node N2. The voltage applied to the second node N2 is determined by an electric current flowing in the drive transistor MD. The voltage applied to the second node N2 corresponds to a voltage sufficient to substantially and/or completely compensate for the threshold voltage and electron mobility of the drive transistor MD. The voltage applied to the second node N2 is set to the voltage that substantially and/or completely compensates for the threshold voltage and electron mobility the respective drive transistor MD in each of the pixels 142, since the electric current flowing in the drive transistor MD is set to the same level in each of the pixels 142.

[0057] The first transistor M1 is maintained in an off state during a period when the scan signal is not supplied, e.g., is at a logic high level, to the ith-1 scan line Si-1. Accordingly, during that time, the data signal supplied to the data line Dj is supplied to pixels coupled to the ith scan line Si.

[0058] Then, the supply of the scan signal to the ith-1 scan line Si-1 is stopped, e.g., changed to logic high, and the current scan signal is supplied to the ith scan line Si. The second transistor M2 and the third transistor M3 are turned off when the supply of the current scan signal to the ith-1 scan line Si-1 is stopped. The first transistor M1 is turned on when the current scan signal is supplied to the ith scan line Si. When the first transistor M1 is turned on, the data signal DS supplied to the data line Dm is supplied to the first node N1. The second capacitor C2 charges a voltage corresponding to the data signal.

[0059] The first transistor M1 is turned off when supply of the current scan signal to the ith scan line Si is stopped, i.e., changed to a logic high level, after the voltage corresponding to the data signal is charged in the second capacitor C2. The light emitting control signal is then supplied, e.g., changed to a logic low level, to the ith light emitting control line Ei.

[0060] The fourth transistor M4 and the fifth transistor M5 are turned on when the light emitting control signal is supplied to the ith light emitting control line Ei. The second node N2 is electrically coupled with the first node N1 when the fourth transistor M4 is turned on. When the second node N2 is electrically coupled with the first node N1, the voltage charged in the first capacitor C1 and the voltage charged in the second capacitor C2 are divided and converted into one voltage, and the converted voltage is applied to the second node N2. The voltage applied to the second node N2 is determined by the voltage of the data signal and stored in the first capacitor C1, which substantially and/or completely compensates for the threshold voltage and electron mobility of the drive transistor MD.

[0061] The voltage applied to the second node N2 is varied according to the capacitances of the first capacitor C1 and the second capacitor C2. For this purpose, the capacitances of the first capacitor C1 and the second capacitor C2 are experimentally determined to apply a desired voltage to the second node N2.

[0062] The drive transistor MD supplies a driving or controlling electric current from the first power source ELVDD to the OLED via the fifth transistor M5 corresponding to the voltage applied to the second node N2. Light having a predetermined luminance may then be emitted by the OLED.

[0063] Embodiments of the present invention 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 scope of the present invention as set forth in the following claims.

Claims

1. An organic light emitting diode display device, comprising:

   data lines;
   scan lines;
   light emitting control lines;
   electric current sink lines;
   pixels in regions at least partially defined by respective portions of the data lines, the scan lines, the light emitting control lines and the electric current sink lines, each of the pixels being coupled with at least two of the scan lines;
   a scan driver adapted to supply a respective scan signal to each of the scan lines and to supply a respective light emitting control signal to each of the light emitting control lines, the respective scan signals including a first scan signal corresponding to a first of the at least two scan lines associated with a respective one of the pixels and a second scan signal corresponding to a second of the at least two scan lines associated with the respective pixel; and
   a data driver adapted to primarily charge the respective pixel by sinking a predetermined electric current through a respective one of the electric current sink lines when the first scan signal is supplied to the first of the at least two scan lines, and to secondarily charge the respective pixel by supplying a voltage data signal to a respective one of the data lines when the second scan signal is supplied to the second of the at least two scan lines associated with the respective pixel.

2. An organic light emitting diode display device as claimed in claim 1,wherein the scan driver is adapted to supply the first scan signal to the first scan line before the second scan signal is supplied to the second scan line such that the first of the at least two scan lines primarily charges some of the pixels during a previous time period before a subsequent time period during which the second one of the at least two scan lines secondarily charges other ones of the pixels.

3. An organic light emitting diode display device as claimed in claim 1 or claim 2, wherein the predetermined electric current is an electric current that is adapted to charge a load capacitor of each of the electric current sink lines.

4. An organic light emitting diode display device as claimed in claim 3, wherein the predetermined electric current is set to a level substantially identical to or higher than an electric current resulting in a maximum luminance from a light emitting diode in each

of the pixels.

5. An organic light emitting diode display device as claimed in any preceding claim, wherein the data driver includes electric current sources coupled to each of the electric current sink lines to sink the predetermined electric current.

6. An organic light emitting diode display device as claimed in one of claims 1 to 4, wherein the data driver includes an electric current source commonly coupled to the electric current sink lines to sink the predetermined electric current.

7. An organic light emitting diode display device as claimed in any preceding claim, wherein each of the pixels is adapted to convert the primarily charged voltage and the secondly charged voltage into one converted voltage, and to supply an electric current corresponding to the converted voltage to a light emitting element.

8. An organic light emitting diode display device as claimed in claim 7, wherein each of the pixels comprises:

an organic light emitting diode;
a drive transistor adapted to supply an electric current to the light emitting diode;
a first transistor adapted to supply a data signal to a first node when the respective second scan signal is supplied to the respective second scan line associated with the pixel;
a first capacitor coupled between a gate electrode of the drive transistor and a first power source;
a second capacitor coupled between the first node and the first power source;
a second transistor adapted to electrically connect a second electrode of the drive transistor with a feedback line when the respective first scan signal is supplied to the respective first scan line associated with the pixel;
a third transistor adapted to electrically connect the second electrode with the gate electrode of the drive transistor when the respective first scan signal is supplied to the respective first scan line associated with the pixel; and
a fourth transistor coupled between the gate electrode of the drive transistor and the first node.

9. An organic light emitting diode display device as claimed in claim 8, wherein the display device is adapted to charge the primarily charged voltage, which at least substantially compensates for a threshold voltage and an electron mobility of the drive transistor, in the first capacitor when the respective first scan signal is supplied to the respective first scan line, and to charge the secondarily charged voltage, corresponding to the data signal, in the second capacitor.

10. An organic light emitting diode display device as claimed in claim 9, wherein the display device is adapted to convert the voltages charged in the first capacitor and the second capacitor into one voltage when the fourth transistor is turned on, and the drive transistor supplies an electric current corresponding to the converted voltage to the light emitting diode.

11. An organic light emitting diode display device as claimed in any one of claims 8 to 10, wherein the scan driver is adapted to simultaneously output the respective light emitting control signal to a current (ith) one of the light emitting control lines, the respective first scan signal to the respective first (ith-1) scan line and the respective second scan signal to the respective second (ith) scan line, where i is an integer from 1 to n.

12. An organic light emitting diode display device as claimed in any one of claims 8 to 11, wherein each of the pixels further includes a fifth transistor coupled between the drive transistor and the light emitting diode, and the fifth transistor is adapted to turn on when the respective one of the light emitting control signals is supplied to the respective one of the light emitting control lines.

13. A pixel of a display including data lines, scan lines, light emitting control lines, and electric current sink lines, the pixel comprising:

an organic light emitting diode;
a drive transistor adapted to supply an electric current to the organic light emitting diode;
a first transistor coupled to a respective one of the light emitting control lines;
a first capacitor and a second capacitor coupled in parallel between a first power source and a gate electrode of the drive transistor;
a second transistor coupled between a respective one of electric current sink lines and a second electrode of the drive transistor, the second transistor being adapted to turn on when a first scan signal is supplied to a first respective one of the scan lines associated with the pixel;
a third transistor coupled between a gate electrode and the second electrode of the drive transistor; and
a fourth transistor coupled between the gate electrode of the drive transistor and the second capacitor,
wherein the first transistor is adapted to supply a data signal when a second scan signal is sup-

plied to a second respective one of the scan lines associated with the pixel, the first scan signal being supplied before the second scan signal is supplied.

14. A pixel as claimed in claim 13, wherein the first capacitor is adapted to be charged by a predetermined electric current supplied to the respective electric current sink line when the first scan signal is supplied to the first scan line associated with the pixel, and the second capacitor is adapted to be charged by the data signal when the second scan signal is supplied to the second scan line associated with the pixel.

15. A pixel as claimed in claim 14, wherein the fourth transistor is adapted to be turned on to convert a voltage charged in the first capacitor and a voltage charged in the second capacitor into one voltage when the light emitting control signal is supplied to the respective light emitting control line, and the drive transistor is adapted to supply an electric current corresponding to the converted voltage to the organic light emitting diode.

16. A pixel as claimed in any one of claims 13 to 15, further comprising a fifth transistor coupled between the drive transistor and the organic light emitting diode, and the fifth transistor is adapted to be turned on when the light emitting control signal is supplied to the respective light emitting control line.

17. A method of driving a pixel of an organic light emitting diode display device, comprising:

charging a voltage in a first capacitor included in the pixel while sinking a predetermined electric current via a drive transistor of the pixel when a first scan signal is supplied to a first scan line associated with the pixel;
after charging the voltage in the first capacitor, charging a voltage in a second capacitor included in the pixel by supplying a data signal to the pixel when a second scan signal is supplied to a second scan line associated with the pixel;
converting the voltages charged in the first capacitor and the second capacitor into one voltage; and
supplying an electric current corresponding to the converted voltage to a light emitting diode of the pixel.

18. A method of driving a pixel of an organic light emitting diode display device as claimed in claim 17, wherein the predetermined electric current is set to an electric current that charges a load capacitor of an electric current sink line associated with the pixel.

19. A method of driving a pixel of an organic light emitting diode display device as claimed in claim 17 or claim 18, wherein converting the voltages includes electrically coupling the second capacitor with the first capacitor.

FIG. 1

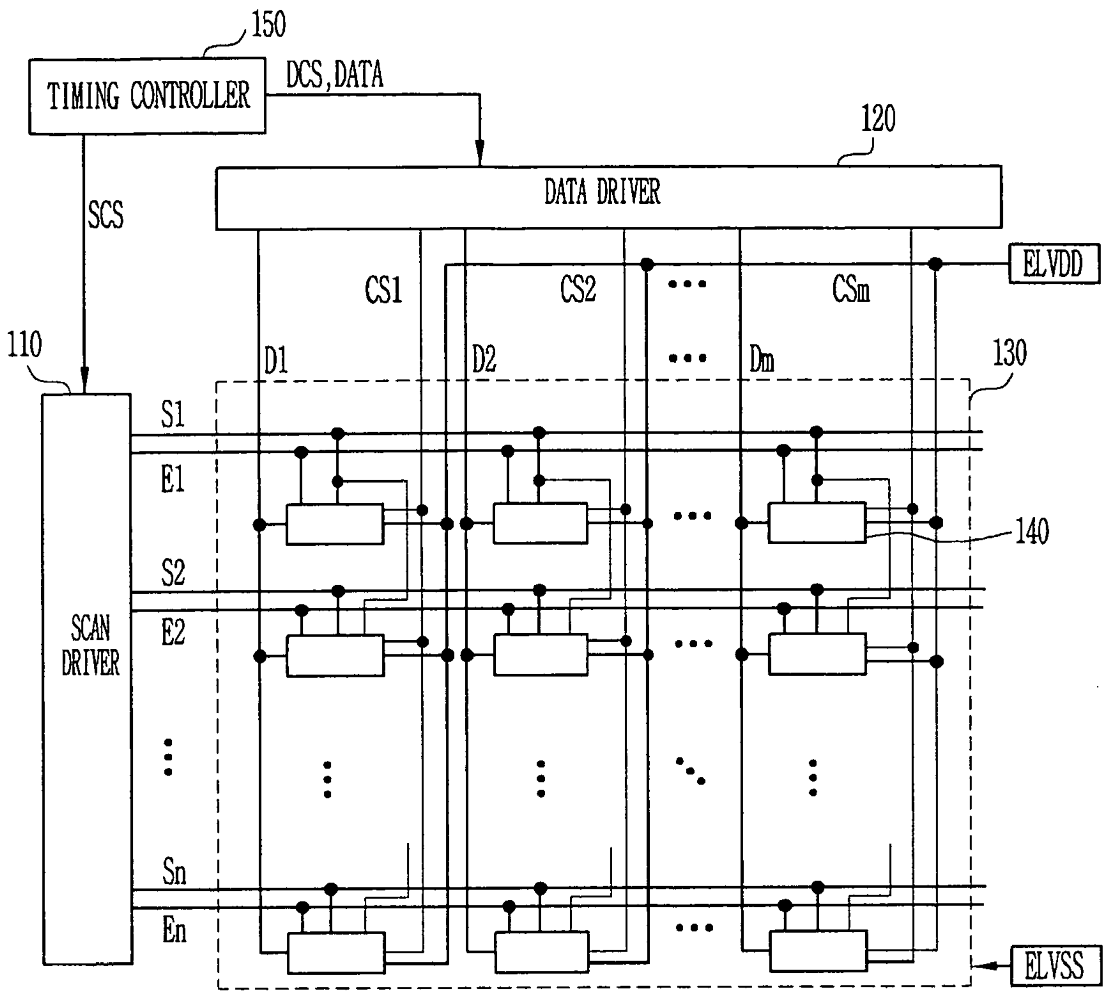
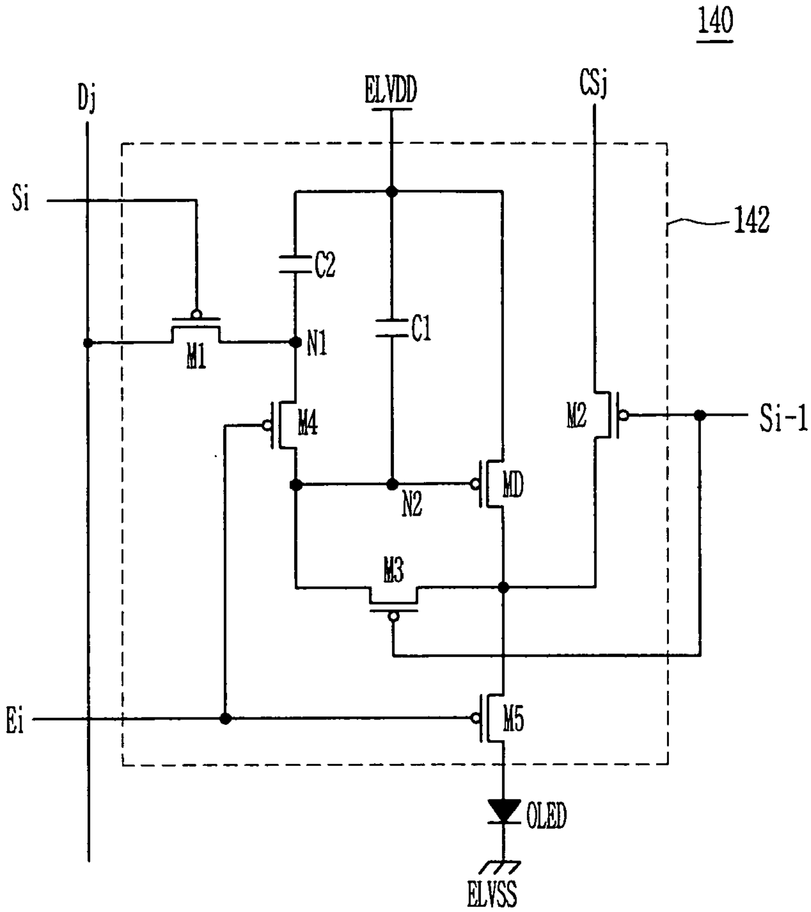

150
TIMING CONTROLLER
DCS,DATA
120
DATA DRIVER
SCS
ELVDD
CS1
CS2
CSm
110
D1
D2
Dm
130
S1
E1
140
S2
E2
SCAN DRIVER
Sn
En
ELVSS

FIG. 2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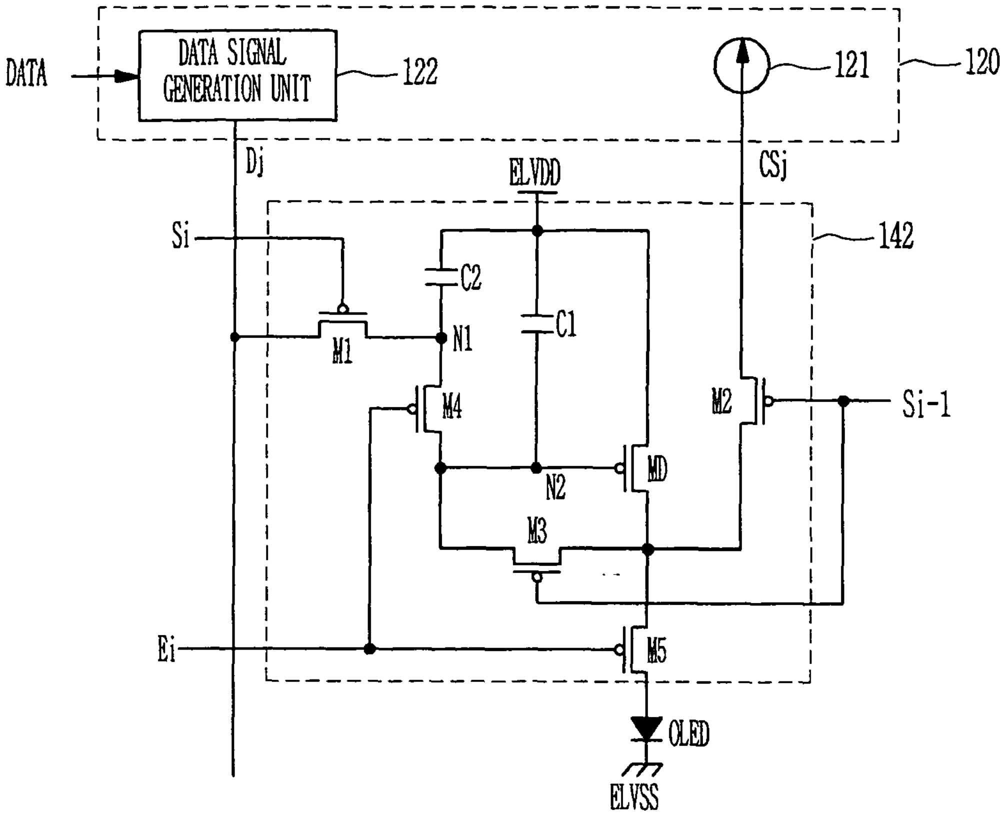
Dj
ELVDD
CSj
Si
142
C2
C1
M1
N1
M2
Si-1
M4
MD
N2
M3
Ei
M5
OLED
ELVSS

FIG. 3


DATA
DATA SIGNAL GENERATION UNIT
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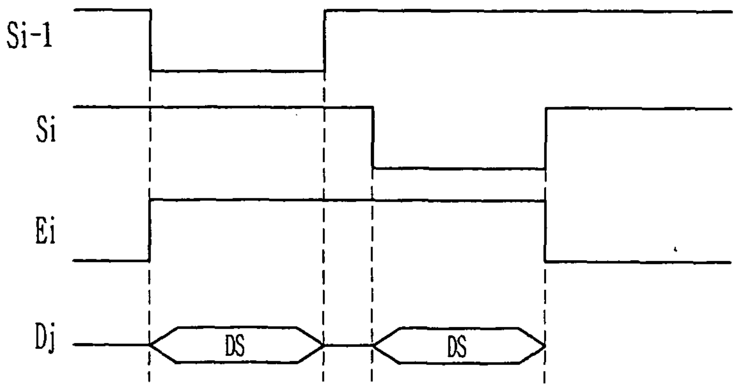
121
120
Dj
CSj
ELVDD
142
Si
C2
C1
N1
M1
M4
M2
Si-1
N2
MD
M3
Ei
M5
OLED
ELVSS

FIG. 4


Si-1
Si
Ei
Dj
DS
DS

专利名称(译)	有机发光二极管显示装置及其驱动方法		
公开(公告)号	[EP1939848A2]	公开(公告)日	2008-07-02
申请号	EP2007254798	申请日	2007-12-12
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IPC分类号	G09G3/32		
CPC分类号	G09G3/3233 G09G3/3291 G09G2300/043 G09G2300/0819 G09G2300/0852 G09G2300/0861 G09G2310/0251 G09G2310/0262 G09G2320/0233		
优先权	1020060135093 2006-12-27 KR		
其他公开文献	EP1939848B1 EP1939848A3		
外部链接	[Espacenet]		

摘要(译)

一种电致发光显示装置，包括像素（140），每个像素适于通过相应的第一和第二线接收相应的第一和第二扫描信号。扫描驱动器（110），适于向各扫描线提供相应的扫描信号，并向各发光控制提供相应的发光控制信号;数据驱动器（120），适于在第一扫描信号提供给第一扫描线时通过相应的电流吸收线吸收预定电流来对像素充电，并通过提供电压对相应像素进行二次充电当第二扫描信号被提供给与像素相关联的第二扫描线时，数据信号到相应的一条数据线。

FIG. 1