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

(11) EP 1 473 689 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
15.10.2008 Bulletin 2008/42

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

(21) Application number: **03090266.2**

(22) Date of filing: **21.08.2003**

(54) **Pixel circuit, display panel, image display device and driving method thereof**

Pixelschaltung, Anzeigetafel, Anzeigevorrichtung und Steuerverfahren dafür

Circuit pixel, panneau d'affichage, dispositif d'affichage et procédé de commande pour ceux-ci

(84) Designated Contracting States:
DE FR GB

(30) Priority: **30.04.2003 KR 2003027604**

(43) Date of publication of application:
03.11.2004 Bulletin 2004/45

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EP-A- 1 220 191

EP 1 473 689 B1

Printed by Jouve, 75001 PARIS (FR)

Description

BACKGROUND OF THE INVENTION

(a) Field of the Invention

[0001] The present invention relates to an image display device, and a display panel and driving method thereof. More specifically, the present invention relates to an organic electroluminescent (hereinafter, referred to as "EL") display device.

(b) Description of the Related Art

[0002] The organic EL display device, which is a display device for electrically exciting a fluorescent organic compound to emit a light, has organic light-emitting cells that are voltage- or current-driven to display an image. These organic light-emitting cells have a structure composed of an anode (indium tin oxide (ITO)) layer, an organic thin film, and a cathode (metal) layer. For a good balance between electrons and holes to enhance luminescent efficiency, the organic thin film has a multi-layer structure that includes an emitting layer (EML), an electron transport layer (ETL), and a hole transport layer (HTL). The multi-layer structure of the organic thin film can also include an electron injecting layer (EIL), and a hole injecting layer (HIL).

[0003] There are two driving methods for these organic light-emitting cells: a passive matrix driving method, and an active matrix driving method using thin film transistors (TFTs). In the passive matrix driving method, anode and cathode stripes are arranged perpendicularly to each other to selectively drive the lines. On the other hand, in the active matrix driving method, a thin film transistor and a capacitor are coupled to ITO pixel electrodes so as to sustain a voltage by the capacity of the capacitor. According to the form of the signals applied to the capacitor to sustain the voltage, the active matrix driving method can be divided into a voltage programming method and a current programming method.

[0004] The voltage programming method is for displaying an image by applying a data voltage representing gradation to the pixel circuit, but may have a problem of non-uniformity due to a deviation of the threshold voltage of the driving transistor and the electron mobility. The current programming method is for displaying an image by applying a data current representing gradation to the pixel circuit, guaranteeing uniformity. But, this method is problematic in securing the time for charging the load of the data lines, since only a slight quantity of current is used in controlling the organic EL element.

[0005] EP 1 220 191 A2 discloses a pixel circuit for compensating for deviations of the thershold voltage of the driving transistor and a driving method thereof. The pixel circuit disclosed in EP 1 220 191 A2 includes, as shown in its Fig. 5, an OLED, two transistors M1 and M2, two switches S1 and S2, and a capacitor C1. The transistor M1 and the transistor M2 are configured in PMOS type TFTs or NMOS type TFTs.

[0006] The OLED emits light corresponding to the supplied current, and the current driving transistor M1 has a source coupled to a power voltage V_{DD} and a drain coupled to the OLED, and supplies the current corresponding to the data voltage which is provide to a gate of the transistor M1 via the data line, to the OLED. The transistor M2 has a gate coupled to the gate of the transistor M1, and a gate and a drain of the transistor M2 are couple to function as a diode. The transistor M2 compensates for deviations of the threshold voltage of the transistor M1 for supplyind the current,

[0007] The capacitor C1, coupled between the power voltage V_{DD} and the gate of the transistor M1, maintains the data voltage supplied to the gate of the transistor M1 during a predetermined frame period.

[0008] The switch S1 is switched responsive to a select signal supplied by the scan line, and transmits the data voltage supplied to the data line to the current driving transistor M1 via the transistor M2. The switch S2 initialized the gate voltage of the transistor M1 in response to a reset signal.

[0009] In other embrodiments of this invention, as shown in its Fig. 7, the first switch S1 is a third transistor M3 and the second switch is a fourth transistor M4, so the pixel circuit includes four transistors M1 to M4.

[0010] A pixel circuit for compensating for the threshold voltage of the driving transistor in the voltage programming method is disclosed in U.S. Patent No. 6,362,798 issued to Kimura et al.

[0011] The pixel circuit disclosed in U.S. Patent No. 6,362,798 includes, as shown in Fig. 1, four transistors M1 to M4, and an organic EL element (OLED). The driving transistor M1 transfers a current corresponding to a voltage between its gate and source to OLED, and has a capacitor Cst between the gate and source. The transistor M2 is configured to operate as a diode (i.e., its gate and drain are connected together) and has the gate connected to the gate of the transistor M1. A gate of the switching transistor M3 is connected to a first scanline Sn, and a gate of the transistor M4 is connected to a second scan line S_{n-1}.

[0012] When the threshold voltage of the transistor M1 is equal to that of the transistor M2, it can be compensated due to the transistor M2. But, when the gate voltage of the driving transistor M1 is higher than the data voltage applied through the transistor M3, the transistor M2 is diode-connected (i.e., configured to operate as a diode) in a reverse direction, as a result of which the data voltage cannot be transferred to the gate of the driving transistor M1. To prevent

this phenomenon in the prior art, the precharge voltage V_P is applied to the gate of the driving transistor M1 and sustained to be less than the lowest data voltage, while a selection signal is applied to the second scan line S_{n-1}. In this manner, the gate voltage of the driving transistor M1 reaches the precharge voltage V_P when the data voltage is applied, thereby coupling the transistor M2 in the forward direction.

[0013] A current flows through the driving transistor M1 due to a voltage corresponding to the difference between the precharge voltage V_P and the power voltage V_{DD}, when the precharge voltage V_P is transferred to the gate of the driving transistor M1. This current causes the OLED to emit a light, in which case normal black level cannot be displayed to represent black level gradation. Moreover, the current flows to the OLED while the data voltage is transferred to the gate of the driving transistor M1 and charged in the capacitor $C_{st,}$ thereby increasing power consumption.

SUMMARY OF THE INVENTION

[0014] In one exemplary embodiment of the present invention, there is provided a pixel circuit that compensates for the threshold voltage of the driving transistor and prevents an unnecessary current flowing to the light emitting element according to that defined in claim 1. In one exemplary embodiment, a transistor may be added between the driving transistor and the light emitting element.

[0015] In an exemplary embodiment of the present invention, there is provided a display panel for image display that includes a plurality of data lines for transferring a data voltage representing an image signal, a plurality of scan lines, each scan line for transferring a selection signal, and a plurality of pixel circuits, each pixel circuit being coupled to a corresponding data line among the plurality of said data lines and to a first and a second scan line among the plurality of said scan lines, the first and the second scan lines being adjacent in the display panel. The pixel circuit includes a light emitting element, first and second transistors, and first, second and third switching elements. The first transistor generates a current corresponding to a voltage between its main electrode and control electrode. A capacitor is coupled between the main electrode and the control electrode. The second transistor is configured to operate as a diode, and has a control electrode coupled to the control electrode of the first transistor. The first switching element is coupled to a main electrode of the second transistor, and transfers the data voltage from the data lines to the second transistor in response to the selection signal from one of the two adjacent scan lines. The second switching element transfers a precharge voltage to the control electrode of the first transistor in response to a first control signal before the data voltage is supplied. The third switching element is turned off in response to a second control signal for electrically isolating the first transistor from the light emitting element.

[0016] In another exemplary embodiment, the data voltage is applied to the data lines after transferring the precharge voltage in response to the first control signal and before applying the selection signal to the first scan line.

[0017] In another exemplary embodiment, the second control signal includes the first control signal. The selection signal from the second scan line is used as both the first and second control signals. The second switching element is a transistor of a first conductive type, and the third switching element is a transistor of a second conductive type, which is an opposite of the first conductive type.

[0018] In another exemplary amendment of the present invention, the second control signal is a selection signal from the first scan line. The second switching element is a transistor of a first conductive type, and the third switching element is a transistor of a second conductive type, which is an opposite of the first conductive type. The first control signal is a selection signal from a second scan line.

[0019] In yet another exemplary embodiment of the present invention, there is provided an image display device that includes the above-described display panel.

[0020] In still another exemplary embodiment of the present invention, there is provided a method for driving an image display device according to that defined in claim 25.

[0021] In a further exemplary embodiment, the first control signal is a selection signal from a second scan line. The first transistor is electrically isolated from the light emitting element in response to the first control signal during the first time period.

[0022] In a still further exemplary embodiment, the first transistor is electrically isolated from the light emitting element in response to the second control signal during the second time period. The second control signal is a selection signal from the first scan line.

[0023] In yet further exemplary embodiment, a time period of preventing the precharge voltage and the data voltage from being transferred to the control electrode of the first transistor is included between the first and second time periods.

[0024] In yet another exemplary embodiment of the present invention is provided a display device that includes a light emitting element, a first transistor, a first switching element and a capacitor. The light emitting element is for displaying a portion of an image in response to a current being applied. The first transistor has a main electrode and a control electrode, and is coupled between a voltage source and the light emitting element. The capacitor is coupled between the main electrode and the control electrode, wherein the first transistor is capable of generating the current in response to a charge in the capacitor. The first switching element is coupled between the first transistor and the light emitting

element to interrupt the current to the light emitting element while charging the capacitor using at least one of a precharge voltage and a data voltage representative of the image portion.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] The accompanying drawings, which together with the specification, illustrate exemplary embodiments of the present invention, and, together with the description, serve to explain the principles of the present invention:

Fig. 1 is an equivalent circuit diagram of a pixel circuit according to prior art;
Fig. 2 is a schematic diagram of an organic EL display device according to an embodiment of the present invention;
Figs. 3, 5, 7, 8 and 10 are equivalent circuit diagrams of pixel circuits according to exemplary embodiments of the present invention;
Figs. 4, 6 and 11 are driving waveform diagrams for driving the pixel circuits shown in Figs. 3, 5 and 10, respectively; and
Fig. 9 is a diagram showing graphs that depict a current flowing to the organic EL element in the pixel circuit.

DETAILED DESCRIPTION

[0026] In the following detailed description, exemplary embodiments of the present invention are shown and described, by way of illustration. As those skilled in the art would recognize, the described embodiments may be modified in various different ways, all without departing from the scope of the present invention as defined in the appended claims. Accordingly, the drawings and description are to be regarded as illustrative in nature, and not restrictive.

[0027] The parts not related to the description are omitted in the Figures for more definite description of the present invention. When a component is described as being coupled to another component it refers to cases where the two components are directly coupled to each other, and additionally to cases where the two components are coupled to each other with a third element between them.

[0028] Now, reference will be made to Fig. 2 in the description of an organic EL display device according to an exemplary embodiment of the present invention. Fig. 2 is a schematic diagram of the organic EL display device according to the exemplary embodiment of the present invention.

[0029] The organic EL display device according to the described embodiment of the present invention includes, as shown in Fig. 2, an organic EL display panel 10, a scan driver 20, and a data driver 30.

[0030] The organic EL display panel 10 includes a plurality of data lines D_1 to D_M arranged in columns, a plurality of scan lines S_1 to S_N arranged in rows, and a plurality of pixel circuits 11. The data lines D_1 to D_M transfer a data voltage representing an image signal to the pixel circuits 11. The scan lines S_1 to S_N transfer a selection signals for selecting the pixel circuits 11. Each of the pixel circuits 11 is formed in a pixel area defined by two adjacent data lines and two adjacent scan lines.

[0031] The scan driver 20 sequentially applies the selection signal to the scan lines S_1 to S_N, and the data driver 30 applies the data voltage representing an image signal to the data lines D_1 to D_M.

[0032] The scan driver 20 and/or the data driver 30 can be coupled to the display panel 10, or mounted in the form of a chip on a tape carrier package (TCP) that is coupled to the display panel 10 by soldering. The scan driver 20 and/or the data driver 30 can also be mounted in the form of a chip on a flexible printed circuit (FPC) or a film coupled to the display panel by soldering. This method is called "CoF (Chip on Flexible board, or Chip on Film)". Further, the scan driver 20 and/or the data driver 30 can be mounted directly on the glass substrate of the display panel 10, or replaced for the driving circuit that includes the same layers as scan and data lines and thin film transistors on the glass substrate. This method is called "CoG (Chip on Glass)". In other embodiments, the scan driver 20 and/or the data driver 30 may be mounted on any other suitable location using any suitable mounting method.

[0033] Next, the pixel circuit 11 of the organic EL display panel 10 according to an exemplary embodiment of the present invention will be described in detail with reference to Figs. 3 and 4. Fig. 3 is an equivalent circuit diagram of the pixel circuit 11 according to the exemplary embodiment of the present invention, and Fig. 4 is a driving waveform diagram for driving the pixel circuit 11 shown in Fig. 3. For example, the pixel circuit 11 is coupled to the m-th data line D_m and the n-th scan line S_n in Fig. 3. The pixel circuit 11 may be coupled to any other data line/scan line combination illustrated in Fig. 2. The term "first scan line" as used herein refers to a scan line for transferring a current selection signal (a "current scan line"), and the term "second scan line" as used herein refers to a scan line for transferring a selection signal prior to the current selection signal (a "previous scan line").

[0034] The pixel circuit 11 according to the exemplary embodiment of the present invention includes, as shown in Fig. 3, an organic EL element (OLED), transistors M1 to M5, and a capacitor C_{st}. The transistors M1 to M4 are PMOS type transistors, and the transistor M5 is an NMOS type transistor. These transistors M1 to M5 should be thin film transistors, each of which has gate, drain and source electrodes formed on the glass substrate of the display panel 10 as a control

electrode and two main electrodes, respectively.

[0035] The driving transistor M1 has a source electrode coupled to a power voltage V_{DD}. A capacitor C_{st} is coupled between the source electrode and a gate electrode. The capacitor C_{st} sustains gate-source voltage V_{GS} of the transistor M1 for a period of time, which may be predefined. The compensating transistor M2 is configured to operate as a diode (i.e., its gate and drain are coupled together). The gate of the compensating transistor M2 is also coupled to the gate of the transistor M1. The switching transistor M3 transfers, to the transistor M2, a data voltage from the data line D_m in response to a selection signal from the first scan line S_n. The drain of the transistor M2 is coupled to the transistor M4. The transistor M4 transfers a precharge voltage V_P to the transistor M2 in response to the selection signal from the second scan line S_{n-1}.

[0036] The transistor M5 is coupled between the drain of the transistor M1 and the anode of the OLED, and electrically isolates the transistor M1 from the OLED in response to the selection signal from the second scan lineS_{n-1} . The OLED has a cathode coupled to a reference voltage V_{SS}, and emits a light corresponding to the current applied. The reference voltage V_{SS} is lower than the power voltage V_{DD} and may be a ground voltage.

[0037] Now, the operation of the pixel circuit 11 according to the exemplary embodiment of the present invention will be described in detail with reference to Fig. 4.

[0038] Referring to Fig. 4, during a precharge time period T1, the selection signal from the second scan line S_{n-1} becomes "low" to turn the transistor M4 on and the transistor M5 off. With the transistor M4 on, the precharge voltage V_P is transferred to the gate of the transistor M1. The precharge voltage V_P is slightly lower than any data voltage applied to the gate of the transistor M1 through the transistor M2 (taking into account the voltage drops in the transistors M2 and M4, respectively), i.e., the lowest data voltage applied through the data line D_m, for the sake of acquiring a maximum gradation level. In this manner, the data voltage is always higher than the gate voltage of the transistor M1 when it is applied through the data line D_m. Therefore, the transistor M1 is coupled in the forward direction so that the data voltage is charged in the capacitor C_{st}.

[0039] During the precharge time period T1, the gate-source voltage V_{GS} of the transistor M1 is increased due to the precharge voltage V_P, so that a high current would flow through the transistor M1 if a current path is available. If supplied to the OLED, this current would cause the OLED to emit a light, thereby preventing an accurate representation of a black level gradation. According to the exemplary embodiment of the present invention, the turned-off transistor M5 electrically isolates the transistor M1 from the organic OLED to prevent a current flow, which otherwise would have been caused by the precharge voltage V_P. This enables an accurate representation of black level gradation and prevents an unnecessary current flow, thereby also reducing power consumption.

[0040] During a blanking time period T2, the selection signal from the second scan line S_{n-1} becomes "high" while the selection signal from the first scan line S_n is sustained at a high level. In this time period T2, the voltage on the data line D_m is changed to a data voltage corresponding to the pixel circuit 11 coupled to the first scan line S_n. In other words, voltage on the data line D_m should be saturated to a desired data voltage during the blanking time period T2. Without the blanking time period T2, the previous data voltage applied to the data line D_m may be transferred to the transistor M1 via the transistor M3 when the selection signal from the first scan line S_n becomes "low" before the current data voltage is applied.

[0041] During a data charge period T3, the selection signal from the first scan line S_n becomes "low" to turn the transistor M3 on. Then the data voltage from the data line D_m is transferred to the transistor M2 through the transistor M3. The transistor M2 is configured to operate as a diode, so the voltage corresponding to the data voltage minus threshold voltage V_{TH2} of the transistor M2 is transferred to the gate of the transistor M1. This voltage is charged in the capacitor C_{st} and sustained for a period of time, which may be predefined. Further, the selection signal from the second scan line S_{n-1} becomes "high" to turn the transistor M5 on. In practice, as indicated on FIG. 4, the selection signal line S_{n-1} from the second scan line becomes "high" during the blanking time period T2, thereby turning on the transistor M5.

[0042] During a light-emitting time period T4, a current I_{OLED} corresponding to the gate-source voltage V_{GS} of the transistor M1 is supplied to the OLED, so the OLED emits a light. The current I_{OLED} can be defined as follows.

[Equation 1]

$$I_{OLED} = \frac{\beta}{2}\left(|V_{GS}| - |V_{TH1}|\right)^2 = \frac{\beta}{2}\left(V_{DD} - \left(V_{DATA} - |V_{TH2}|\right) - |V_{TH1}|\right)^2$$

where V_{TH1} is the threshold voltage of the transistor M1; V_{DATA} is the data voltage from the data line D_m; and β is a constant

[0043] When the threshold voltage V_{TH1} of the transistor M1 is equal to the threshold voltage V_{TH2} of the transistor M2, the equation 1 can be rewritten as:

[Equation 2]

$$I_{OLED} = \frac{\beta}{2}(V_{DD} - V_{DATA})^2$$

[0044] Accordingly, a current corresponding to the data voltage applied through the data line D_m flows to the OLED irrespective of the threshold voltage V_{TH1} of the transistor M1.

[0045] In this manner, the exemplary embodiment of the present invention compensates for a deviation of the threshold voltage of the driving transistor M1 and prevents the current from flowing to the OLED caused by the precharge voltage V_P.

[0046] The pixel circuit 11 according to the exemplary embodiment of the present invention uses the second scan line S_{n-1} so as to control the transistors M4 and M5. In other embodiments, a separate control line (not shown) may be used to transfer a control signal for turning the transistor M4 on and/or the transistor M5 off during the precharge time period T1.

[0047] In the exemplary embodiment of the present invention, the type of the transistor M5 is an opposite of that of the transistor M4 so as to turn the transistor M5 off during the precharge time period T1. The transistor M5 may have the same type as the transistor M4 in another embodiment of the present invention, which will be described, for example, in detail with reference to Figs. 5 and 6 as follows.

[0048] Fig. 5 is an equivalent circuit diagram of the pixel circuit 11 according to another exemplary embodiment of the present invention, and Fig. 6 is a driving waveform diagram for driving the pixel circuit 11 shown in Fig. 5.

[0049] The pixel circuit 11 according to this exemplary embodiment of the present invention has the same structure as the exemplary embodiment of Fig. 3 except for the type of the transistor M6 (which is different from the type of the transistor M5 of Fig. 3) and an addition of a control line C_n. More specifically, the transistor M6 is a PMOS type transistor, which is the same type as the transistors M1 to M4, and turns off in response to a "high" control signal from the control line C_n. The control signal applied to the control line C_n is an inversed form of the selection signal applied to the second scan line S_{n-1}, as shown in Fig. 6. Hence, the transistor M6 is turned off during the precharge time period T1 to interrupt the current flowing to the OLED, as in the exemplary embodiment of Fig. 3.

[0050] In this manner, this exemplary embodiment implements the pixel circuit 11 with the transistors of the same type, thereby simplifying the fabrication process relative to the exemplary embodiment of Fig. 3.

[0051] The above described exemplary embodiments additionally use the transistors M5 and M6, respectively, so as to interrupt the current flowing to the OLED during the precharge time period T1. In other exemplary embodiments, a transistor may be added in addition to (or instead of) the transistor M5 or M6, and the driving waveform may be selected so as to interrupt the current flowing to the OLED during the data charge time period T3. One such exemplary embodiment will be described in detail with reference to Fig. 7 as follows.

[0052] Fig. 7 is an equivalent circuit diagram of a pixel circuit 11 according to yet another exemplary embodiment of the present invention.

[0053] Referring to Fig. 7, the pixel circuit 11 according to this exemplary embodiment has a transistor M5 coupled between the transistor M1 and the OLED. The transistor M5 is an NMOS type transistor similar to the transistor M5 of Fig. 3. However, the transistor M5 has a gate coupled to the first scan line S_n. The pixel circuit 11 in this exemplary embodiment is driven by the driving waveform of Fig. 4.

[0054] In this manner, the transistor M5 is turned off in response to the selection signal from the first scan line S_n to electrically isolate the transistor M1 from the OLED while the data voltage from the data line D_m is charged in the capacitor C_{st} during the data charge time period T3. Thus, the current flowing to the OLED is interrupted while the data voltage is charged in the capacitor C_{st}.

[0055] As the selection signal from the first scan line S_n becomes "high", the transistor M5 is turned on to couple the transistor M1 to the OLED. Hence, a current I_{OLED} corresponding to the voltage charged in the capacitor C_{st} flows to the OLED, which then emits light in the light-emitting time period T4. Therefore, in this embodiment, the current flowing to the OLED is interrupted while the data voltage is charged, thereby reducing power consumption.

[0056] In yet another exemplary embodiment, the transistor M5 may be of the same transistor type as the switching transistor M3. In that exemplary embodiment, the transistor M5 may be driven by a signal of an inversed form of the selection signal applied to the scan line S_n to realize an equivalent pixel circuit as the pixel circuit 11 of Fig. 7.

[0057] In the exemplary embodiment of Fig. 7, the current does not flow (i.e., is interrupted) to the OLED during the data charge time period T3. The current flowing to the OLED may also be interrupted during the precharge time period T1 in other exemplary embodiments, one of which will be described in detail with reference to Figs. 8 and 9 as follows.

[0058] Fig. 8 is an equivalent circuit diagram of the pixel circuit 11 according to still another exemplary embodiment of the present invention, and Fig. 9 shows a current flowing to the OLED in the pixel circuits shown in Figs. 1, 3 and 8, respectively.

[0059] Referring to Fig. 8, the pixel circuit according to this exemplary embodiment has a transistor M7 added to the

pixel circuit 11 in the exemplary embodiment of Fig. 3. For example, the transistors M7 and M5 are coupled in series between the transistor M1 and the anode of the OLED, and formed with NMOS transistors. The gate of the transistor M5 is coupled to the second scan line S_{n-1}, and that of the transistor M7 is coupled to the first scan line $S_{n.}$ Here, the transistors M5 and M7 can be switched in position. The pixel circuit 11 of Fig. 8 is driven using the driving waveform of Fig. 4.

[0060] In this manner, the transistor M5 is turned off in response to the selection signal from the second scan line S_{n-1} during the precharge time period T1, so that no current flows to the OLED in response to the precharge voltage V_P. Further, the transistor M7 is turned off in response to the selection signal from the first scan line S_n during the data charge time period T3, so that no current flows to the OLED while the data voltage is charged. In the light-emitting time period T4, both the transistors M5 and M7 are turned on, and a current corresponding to the voltage charged in the capacitor C_{st} flows to the OLED.

[0061] In other embodiments, the transistor M5 may have the same transistor type as the transistor M4 and applied with a signal having an inversed form of the selection signal applied to the second scan line S_{n-1} to the gate of the transistor M5. Similarly, the transistor M7 may be formed to have the same transistor type as the transistor M3, and applied with a signal having an inversed form of the selection signal applied to the first scan line S_n. The operation of such pixel circuits would be equivalent to that of the pixel circuit 11 of FIG. 8.

[0062] Referring to Fig. 9, the pixel circuit of Fig. 1, as shown on graph 100, allows a current to flow to the OLED during both the precharge time period T1 and the data charge time period T3. On the other hand, the pixel circuit 11 of Fig. 3, as shown on graph 110, allows a current to flow to the OLED not in the precharge time period T1 but in the data charge time period T3. Unlike the pixel circuits of Figs 1 and 3, the pixel circuit of Fig. 8, as shown on graph 120 does not allow a current to flow to OLED during both the precharge time period T1 and the data charge time period T3.

[0063] Although the transistors M1 to M4 are formed with PMOS type transistors in the above described exemplary embodiments, they may also be formed with NMOS type transistors in other embodiments. One such exemplary embodiment will be described in detail with reference to Figs. 10 and 11. In still other embodiments, the transistors M1 to M4 may be any other suitable transistors.

[0064] Fig. 10 is an equivalent circuit diagram of the pixel circuit 11 according to a still further exemplary embodiment of the present invention, and Fig. 11 is a driving waveform diagram for the pixel circuit 11 shown in Fig. 10.

[0065] The pixel circuit 11 according to this embodiment, as shown in Fig. 10, has transistors M11 to M14 formed with NMOS type transistors, and transistors M15 and M16 formed with PMOS type transistors. The pixel circuit 11 of Fig. 10 also has a structure that is symmetrical to the pixel circuit 11 of Fig. 8. More specifically, the transistor M11 has a source electrode coupled to the reference voltage V_{SS}, and the OLED has an anode coupled to the power voltage V_{DD}. The transistors M15 and M16 are coupled in series between the cathode of the OLED and the drain of the transistor M11.

[0066] Referring to Fig. 11, the driving waveform for the pixel circuit 11 of Fig. 10 has an inverted form of the driving waveform (in Fig. 4) of the pixel circuit 11 of Fig. 8. The pixel circuit 11 of Fig. 10 performs an equivalent operation as the pixel circuit 11 of Fig. 8, and its operation will not be described in detail.

[0067] The transistors M11 to M14 formed with NMOS type transistors can be applied to all the embodiments of the present invention. Likewise, if the same functions of the above-stated transistors are enabled, the pixel circuit 11 can be implemented with a combination of PMOS and NMOS transistors or other switching elements.

[0068] As described above, the exemplary embodiments according to the present invention may compensate for a deviation of the threshold voltage of the transistors when the driving transistor has the same threshold voltage as the compensating transistor. In the pixel circuits 11 of the exemplary embodiment, a current may not be provided to the OLED while the precharge voltage is being charged in a capacitor, thereby allowing an accurate representation of black level gradation, which may enhance a contrast ratio. Further, a current may not be provided to the OLED while the data voltage is being charged, thereby reducing power consumption.

[0069] Although exemplary embodiments of the present invention have been described by way of an organic EL display device, the present invention is not specifically limited to the organic EL display device and may be applied to other light-emitting display devices that emit a light in response to the current applied.

[0070] While this invention has been described in connection with certain exemplary embodiments, it is to be understood that the invention is not limited to the disclosed exemplary embodiments, but, on the contrary, is intended to cover various modifications included within the scope of the appended claims.

Claims

1. A pixel circuit (11), which is adapted to respond to a precharge voltage from a first signal line (V_p), a selection signal from a first scan line (S_n) and a data voltage representing an image signal from a second signal line (D_m), the pixel circuit comprising:

    a first transistor (M1) having a main electrode and a control electrode;

a capacitor (C_{st}) coupled between the main electrode and the control electrode, wherein the first transistor (M1) is adapted to generate a current in response to a voltage charged in the capacitor (C_{st});
a second transistor (M2) having a control electrode coupled to the control electrode of the first transistor (M1), the second transistor (M2) being configured to operate as a diode;
a light emitting electroluminescent element (OLED), the emission of said light emitting element corresponding to a current generated by the first transistor (M1); and
switching means (M5, M6) coupled between the first transistor (M1) and the light emitting element (OLED), **characterised in that**
the precharge voltage (V_p) is applied to the control electrode of the first transistor (M1) in response to a first control signal in a first time period, and the data voltage is applied to the control electrode of the first transistor (M1) in response to a selection signal in a second time period, and the first transistor (M1) is electrically isolated from the light emitting element (OLED) by the switching means during at least one of said first time period and said second time period.

2. The pixel circuit as claimed in claim 1 wherein the first control signal is a selection signal from a second scan line (S_{n-1}) which is adjacent to said first scan line (S_n).

3. A display panel (10) for image display, said display panel (10) comprising a plurality of pixel circuits as defined in claim 1, a plurality of data lines (D_1-D_M) for transferring a data voltage representing an image signal, a plurality of scan lines (S_1-S_N) for transferring a selection signal, each pixel circuit (11) being coupled to a corresponding data line among the plurality of said data lines and to a first (S_n) and a second (S_{n-1}) scan line among the plurality of said scan lines, the first (S_n) and the second (S_{n-1}) scan lines being adjacent in the display panel (10), the panel (10) further comprising
a first switching element (M3) coupled to a main electrode of the second transistor (M2), wherein the first switching element (M3) is adapted to transfer the data voltage from the data lines (D_1-D_M) to the second transistor (M2) in response to the selection signal from one of the two adjacent scan lines;
a second switching element (M4) for transferring the precharge voltage (V_p) to the control electrode of the first transistor (M1) in response to said first control signal before the data voltage is supplied; and
a third switching element (M5) adapted to be turned off in response to a second control signal for electrically isolating the first transistor (M1) from the light emitting element (OLED).

4. The display panel as claimed in claim 3, wherein the first control signal is the selection signal from the second scan line (S_{n-1}).

5. The display panel as claimed in claim 4 further comprising means adapted to apply the data voltage to the data lines, said data voltage being applied after the transfer of the precharge voltage in response to the first control signal and before the application of the selection signal to the second scan line.

6. The display panel as claimed in claim 5, wherein the data voltage in the data lines (D_1-D_m) is changed to a desired voltage before the select signal is applied to the first scan line.

7. The display panel as claimed in claim 3, wherein the second control signal and the first control signal are the same signal.

8. The display panel as claimed in claim 7, wherein the selection signal from the second scan line is used as both the first and second control signals, and
the second switching element (M1) comprises a transistor of a first conductive type, the third switching element (M5) comprises a transistor of a second conductive type, the second conductive type being an opposite of the first conductive type.

9. The display panel as claimed in claim 3, wherein the selection signal from the first scan line (S_n) is used as the second control signal, and
the second switching element (M4) comprises a transistor of a first conductive type, the third switching element (M5) comprises a transistor of a second conductive type, the second conductive type being an opposite of the first conductive type.

10. The display panel as claimed in claim 9, wherein the selection signal from the second scan line (S_{n-1}) is used as the first control signal.

11. The display panel as claimed in claim 3, wherein the third switching element (M5) is turned off during a time period in which the precharge voltage is transferred using the first control signal and during another time period in which the data voltage is transferred using the selection signal from the first scan line (S_n).

12. The display panel as claimed in claim 11, wherein the third switching element comprises third and fourth transistors coupled in series,
the second control signal comprises a third control signal for turning the third transistor off during the time period of transferring the precharge voltage, and a fourth control signal for turning the fourth transistor off during said another time period of transferring the data voltage.

13. The display panel as claimed in claim 12, wherein the selection signal from the second scan line is used as both the first and third control signals,
the second switching element (M4) is a transistor of a first conductive type, the third switching element (M5) is a transistor of a second conductive type, and the second conductive type is an opposite of the first conductive type.

14. The display panel as claimed in claim 12, wherein the fourth control signal is a selection signal from the first scan line (S_n), and
the fourth transistor is a transistor of a type that is opposite of the type of the first transistor.

15. The display panel as claimed in claim 3, wherein the first (M3) and second (M4) switching elements are transistors of the same type as the first and second transistors (M1, M2).

16. The display panel as claimed in claim 3, wherein the precharge voltage is lower than a lowest data voltage from the data lines (D_1-D_m).

17. An image display device comprising:

the display panel according to one of claims 3-16;
a data driver mounted on the display panel or coupled to the display panel, said data driver being capable of applying the data voltage to the data lines; and
a scan driver mounted on the display panel or coupled to the display panel, said scan driver being capable of applying the selection signal to the scan lines.

18. The display device according to claim 17, wherein, when the first selection signal is activated, the second switching element allows the precharge voltage to be applied to the capacitor for charging and the first switching element is turned off to prevent the current from flowing to the light emitting element.

19. The display device according to claim 17, wherein, when the second selection signal is activated, the third switching element allows the data voltage to be applied to the capacitor for charging and the first switching element is turned off to prevent the current from flowing to the light emitting element.

20. The display device of claim 18, wherein, when the second selection signal is activated, the third switching element allows the data voltage to be applied to the capacitor for charging and the first switching element is turned off to prevent the current from flowing to the light emitting element.

21. The display device of claim 20, wherein there is a time period between when the first selection signal is un-activated and when the second selection signal is activated.

22. The display device of claim 19, wherein the first switching element is turned on to allow the current to flow to the light emitting element when the second selection signal is un-activated after the capacitor has been charged using the data voltage.

23. The display device of claim 18, wherein said control electrodes of said second transistor is coupled to the precharge voltage via said second switching element.

24. The display device of claim 19, wherein the control electrode of the second transistor is coupled to the control electrode of the first transistor, the main electrode of the second transistor is coupled to the data voltage via the third switching element.

25. A method for driving an image display device comprising two adjacent scan lines, a first transistor (M1) having a main electrode and a control electrode; a capacitor (C_{st}) coupled between the main electrode and the control electrode of the first transistor (M1), the first transistor being capable of generating a current corresponding to a voltage charged in the capacitor (C_{st}), a second transistor (M2) having a control electrode coupled to the control electrode of the first transistor and being configured to operate as a diode, and a light emitting electroluminescent element (OLED), the emission of said light emitting element corresponding to a quantity of applied current generated by the first transistor (M1), **characterised by** the step of
transferring a precharge voltage (V_p) to the control electrode of the first transistor (M1) in response to a first control signal during a first time period;
transferring a data voltage to the control electrode of the first transistor (M1) through the second transistor (M2) in response to a selection signal from one of the two adjacent scan lines during a second time period; and
interrupting the transfer of the data voltage,
wherein the first transistor is electrically isolated from the light emitting element during at least one of the first time period and the second time period.

26. The method as claimed in claim 25, wherein the first transistor is electrically isolated from the light emitting element in response to the first control signal during the first time period.

27. The method as claimed in claim 25, wherein the two adjacent scan lines comprise a first scan line and a second scan line.

28. The method as claimed in claim 27, wherein the first control signal is a selection signal from the second scan line.

29. The method as claimed in claim 26, wherein the first transistor is electrically isolated from the light emitting element in response to the selection signal from said one of the two adjacent scan lines during the second time period.

30. The method as claimed in claim 27, wherein the first transistor is electrically isolated from the light emitting element in response to a second control signal during the second time period.

31. The method as claimed in claim 30, wherein the second control signal is the selection signal from the first scan line.

32. The method as claimed in claim 27, further comprising:

preventing the precharge voltage and the data voltage from being transferred to the control electrode of the first transistor between the first and second time periods.

33. The method as claimed in claim 32, wherein the first control signal is a selection signal from the second scan line, the first transistor is electrically isolated from the light emitting element in response to the selection signal from the second scan line during the first time period, and
the first transistor is electrically isolated from the light emitting element in response to the selection signal from the first von line (S_n) during the second time period.

Patentansprüche

1. Ein Pixelschaltkreis (11), der dazu ausgelegt ist, auf eine Vorladespannung von einer ersten Signalleitung (V_p), ein Auswahlsignal von einer ersten Abtastleitung (S_n) sowie eine ein Bildsignal repräsentierende Datenspannung von einer zweiten Signalleitung (D_m) anzusprechen, wobei der Pixelschaltkreis umfasst:

einen ersten Transistor (M1) mit einer Hauptelektrode und einer Steuerelektrode;
einen zwischen der Hauptelektrode und der Steuerelektrode geschalteten Kondensator (C_{st}), wobei der erste Transistor (M1) dazu ausgelegt ist, einen Strom als Antwort auf eine in dem Kondensator (C_{st}) geladene Spannung zu erzeugen;
einen zweiten Transistor (M2) mit einer mit der Steuerelektrode des ersten Transistors (M1) verbundenen Steuerelektrode, wobei der zweite Transistor (M2) derart konfiguriert ist, dass er als Diode arbeitet;
ein lichtemittierendes elektrolumineszentes Element (OLED), wobei die Emission besagten lichtemittierenden Elements einem von dem ersten Transistor (M1) erzeugten Strom entspricht; und
zwischen dem ersten Transistor (M1) und dem lichtemittierenden Element (OLED) geschaltete Schaltmittel

(M5, M6),
dadurch gekennzeichnet, dass
die Vorladespannung (V_p) als Antwort auf ein erstes Steuersignal in einer ersten Zeitspanne an die Steuerelektrode des ersten Transistors (M1) angelegt wird und die Datenspannung als Antwort auf ein Auswahlsignal in einer zweiten Zeitspanne an die Steuerelektrode des ersten Transistors (M1) angelegt wird und der erste Transistor (M1) durch die Schaltmittel während mindestens einer von besagter erster Zeitspanne und besagter zweiter Zeitspanne elektrisch von dem lichtemittierenden Element (OLED) isoliert wird.

2. Der Pixelschaltkreis nach Anspruch 1, wobei das erste Steuersignal ein Auswahlsignal von einer zweiten Abtastleitung (S_{n-1}) ist, die zu besagter erster Abtastleitung (S_n) benachbart ist.

3. Eine Anzeigetafel (10) zur Bildanzeige, wobei besagte Anzeigetafel (10) eine Vielzahl von Pixelschaltkreisen, wie sie in Anspruch 1 definiert sind, eine Vielzahl von Datenleitungen (D_1-D_M) zum Übertragen einer ein Bildsignal repräsentierenden Datenspannung, eine Vielzahl von Abtastleitungen (S_1-S_N) zum Übertragen eines Auswahlsignals umfasst, wobei jeder Pixelschaltkreis (11) mit einer entsprechenden Datenleitung aus der Vielzahl von besagten Datenleitungen sowie mit einer ersten (S_n) und einer zweiten (S_{n-1}) Abtastleitung aus der Vielzahl von besagten Abtastleitungen verbunden ist, wobei die ersten (S_n) und die zweiten (S_{n-1}) Abtastleitungen in der Anzeigetafel (10) benachbart sind, wobei die Tafel (10) ferner umfasst:

ein mit einer Hauptelektrode des zweiten Transistors (M2) verbundenes erstes Schaltelement (M3), wobei das erste Schaltelement (M3) dazu ausgelegt ist, als Antwort auf das Auswahlsignal von einer der zwei benachbarten Abtastleitungen die Datenspannung von den Datenleitungen (D_1-D_M) zu dem zweiten Transistor (M2) zu übertragen;
ein zweites Schaltelement (M4) zum Übertragen der Vorladespannung (V_p) zu der Steuerelektrode des ersten Transistors (M1) als Antwort auf besagtes erstes Steuersignal, bevor die Datenspannung geliefert wird; und
ein drittes Schaltelement (M5), das dazu ausgelegt ist, als Antwort auf ein zweites Steuersignal zum elektrischen Isolieren des ersten Transistors (M1) von dem lichtemittierenden Element (OLED) ausgeschaltet zu werden.

4. Die Anzeigetafel nach Anspruch 3, wobei das erste Steuersignal das Auswahlsignal von der zweiten Abtastleitung (S_{n-1}) ist.

5. Die Anzeigetafel nach Anspruch 4, ferner zum Anlegen der Datenspannung an die Datenleitungen ausgelegte Mittel umfassend, wobei besagte Datenspannung nach der Übertragung der Vorladespannung als Antwort auf das erste Steuersignal und vor dem Anlegen des Auswahlsignals an die zweite Abtastleitung angelegt wird.

6. Die Anzeigetafel nach Anspruch 5, wobei die Datenspannung in den Datenleitungen (D_1-D_m) auf eine gewünschte Spannung geändert wird, bevor das Auswahlsignal an die erste Abtastleitung angelegt wird.

7. Die Anzeigetafel nach Anspruch 3, wobei das zweite Steuersignal und das erste Steuersignal dasselbe Signal sind.

8. Die Anzeigetafel nach Anspruch 7, wobei das Auswahlsignal von der zweiten Abtastleitung als sowohl das erste als auch das zweite Steuersignal verwendet wird und
das zweite Schaltelement (M4) einen Transistor eines ersten Leitungstyps umfasst, das dritte Schaltelement (M5) einen Transistor eines zweiten Leitungstyps umfasst, wobei der zweite Leitungstyp ein dem ersten Leitungstyp entgegengesetzter ist.

9. Die Anzeigetafel nach Anspruch 3, wobei das Auswahlsignal von der ersten Abtastleitung (S_n) als das zweite Steuersignal verwendet wird und
das zweite Schaltelement (M4) einen Transistor eines ersten Leitungstyps umfasst, das dritte Schaltelement (M5) einen Transistor eines zweiten Leitungstyps umfasst, wobei der zweite Leitungstyp ein dem ersten Leitungstyp entgegengesetzter ist.

10. Die Anzeigetafel nach Anspruch 9, wobei das Auswahlsignal von der zweiten Abtastleitung (S_{n-1}) als das erste Steuersignal verwendet wird.

11. Die Anzeigetafel nach Anspruch 3, wobei das dritte Schaltelement (M5) während einer Zeitspanne, in der die Vorladespannung unter Verwendung des ersten Steuersignals übertragen wird, und während einer weiteren Zeitspanne, in der die Datenspannung unter Verwendung des Auswahlsignals von der ersten Abtastleitung (S_n) über-

tragen wird, ausgeschaltet ist.

12. Die Anzeigetafel nach Anspruch 11, wobei das dritte Schaltelement dritte und vierte in Reihe geschaltete Transistoren umfasst,
das zweite Steuersignal ein drittes Steuersignal zum Ausschalten des dritten Transistors während der Zeitspanne des Übertragens der Vorladespannung sowie ein viertes Steuersignal zum Ausschalten des vierten Transistors während besagter weiterer Zeitspanne des Übertragens der Datenspannung umfasst.

13. Die Anzeigetafel nach Anspruch 12, wobei das Auswahlsignal von der zweiten Abtastleitung als sowohl das erste als auch das dritte Steuersignal verwendet wird,
das zweite Schaltelement (M4) ein Transistor eines ersten Leitungstyps ist, das dritte Schaltelement (M5) ein Transistor eines zweiten Leitungstyps ist und der zweite Leitungstyp ein dem ersten Leitungstyp entgegengesetzter ist.

14. Die Anzeigetafel nach Anspruch 12, wobei das vierte Steuersignal ein Auswahlsignal von der ersten Abtastleitung (S_n) ist und
der vierte Transistor ein Transistor eines Typs ist, der dem Typ des ersten Transistors entgegengesetzt ist.

15. Die Anzeigetafel nach Anspruch 3, wobei die ersten (M3) und zweiten (M4) Schaltelemente Transistoren desselben Typs wie die ersten und zweiten Transistoren (M1, M2) sind.

16. Die Anzeigetafel nach Anspruch 3, wobei die Vorladespannung niedriger ist als eine niedrigste Datenspannung von den Datenleitungen (D_1-D_m).

17. Eine Bildanzeigevorrichtung, umfassend:

die Anzeigetafel gemäß einem der Ansprüche 3-16;
einen auf der Anzeigetafel montierten oder mit der Anzeigetafel verbundenen Datentreiber, wobei besagter Datentreiber in der Lage ist, die Datenspannung an die Datenleitungen anzulegen; und
einen auf der Anzeigetafel montierten oder mit der Anzeigetafel verbundenen Abtasttreiber, wobei besagter Abtasttreiber in der Lage ist, das Auswahlsignal an die Abtastleitungen anzulegen.

18. Die Anzeigevorrichtung gemäß Anspruch 17, wobei, wenn das erste Auswahlsignal aktiviert wird, das zweite Schaltelement zulässt, dass die Vorladespannung zum Laden an den Kondensator angelegt wird, und das erste Schaltelement ausgeschaltet wird, um zu verhindern, dass der Strom zu dem lichtemittierenden Element fließt.

19. Die Anzeigevorrichtung gemäß Anspruch 17, wobei, wenn das zweite Auswahlsignal aktiviert wird, das dritte Schaltelement zulässt, dass die Datenspannung zum Laden an den Kondensator angelegt wird, und das erste Schaltelement ausgeschaltet wird, um zu verhindern, dass der Strom zu dem lichtemittierenden Element fließt.

20. Die Anzeigevorrichtung von Anspruch 18, wobei, wenn das zweite Auswahlsignal aktiviert wird, das dritte Schaltelement zulässt, dass die Datenspannung zum Laden an den Kondensator angelegt wird, und das erste Schaltelement ausgeschaltet wird, um zu verhindern, dass der Strom zu dem lichtemittierenden Element fließt.

21. Die Anzeigevorrichtung von Anspruch 20, wobei zwischen der Deaktivierung des ersten Auswahlsignals und der Aktivierung des zweiten Auswahlsignals eine Zeitspanne existiert.

22. Die Anzeigevorrichtung von Anspruch 19, wobei das erste Schaltelement angeschaltet wird, damit der Strom zu dem lichtemittierenden Element fließen kann, wenn das zweite Auswahlsignal deaktiviert wird, nachdem der Kondensator unter Verwendung der Datenspannung geladen wurde.

23. Die Anzeigevorrichtung von Anspruch 18, wobei besagte Steuerelektrode besagten zweiten Transistors über besagtes zweites Schaltelement mit der Vorladespannung verbunden ist.

24. Die Anzeigevorrichtung von Anspruch 19, wobei die Steuerelektrode des zweiten Transistors mit der Steuerelektrode des ersten Transistors verbunden ist, wobei die Hauptelektrode des zweiten Transistors über das dritte Schaltelement mit der Datenspannung verbunden ist.

25. Ein Verfahren zum Ansteuern einer Bildanzeigevorrichtung, umfassend zwei benachbarte Abtastleitungen, einen

ersten Transistor (M1) mit einer Hauptelektrode und einer Steuerelektrode; einen zwischen der Hauptelektrode und der Steuerelektrode des ersten Transistors (M1) geschalteten Kondensator (C_{st}), wobei der erste Transistor in der Lage ist, einen einer in dem Kondensator (C_{st}) geladenen Spannung entsprechenden Strom zu erzeugen, einen zweiten Transistor (M2) mit einer mit der Steuerelektrode des ersten Transistors verbundenen Steuerelektrode, der derart konfiguriert ist, dass er als Diode arbeitet, sowie ein lichtemittierendes elektrolumineszentes Element (OLED), wobei die Emission besagten lichtemittierenden Elements einer Stärke angelegten Stroms, die von dem ersten Transistor (M1) erzeugt wird, entspricht,
gekennzeichnet durch den Schritt des
Übertragens einer Vorladespannung (V_p) an die Steuerelektrode des ersten Transistors (M1) als Antwort auf ein erstes Steuersignal während einer ersten Zeitspanne;
Übertragens einer Datenspannung an die Steuerelektrode des ersten Transistors (M1) **durch** den zweiten Transistor (M2) als Antwort auf ein Auswahlsignal von einer der zwei benachbarten Abtastleitungen während einer zweiten Zeitspanne; und
Unterbrechens der Übertragung der Datenspannung,
wobei der erste Transistor während mindestens einer der ersten Zeitspanne und der zweiten Zeitspanne elektrisch von dem lichtemittierenden Element isoliert wird.

26. Das Verfahren nach Anspruch 25, wobei der erste Transistor als Antwort auf das erste Steuersignal während der ersten Zeitspanne elektrisch von dem lichtemittierenden Element isoliert wird.

27. Das Verfahren nach Anspruch 25, wobei die zwei benachbarten Abtastleitungen eine erste Abtastleitung und eine zweite Abtastleitung umfassen.

28. Das Verfahren nach Anspruch 27, wobei das erste Steuersignal ein Auswahlsignal von der zweiten Abtastleitung ist.

29. Das Verfahren nach Anspruch 26, wobei der erste Transistor als Antwort auf das Auswahlsignal von besagter einer der zwei benachbarten Abtastleitungen während der zweiten Zeitspanne elektrisch von dem lichtemittierenden Element isoliert wird.

30. Das Verfahren nach Anspruch 27, wobei der erste Transistor als Antwort auf ein zweites Steuersignal während der zweiten Zeitspanne elektrisch von dem lichtemittierenden Element isoliert wird.

31. Das Verfahren nach Anspruch 30, wobei das zweite Steuersignal das Auswahlsignal von der ersten Abtastleitung ist.

32. Das Verfahren nach Anspruch 27, ferner umfassend:

Verhindern, dass die Vorladespannung und die Datenspannung zwischen den ersten und zweiten Zeitspannen an die Steuerelektrode, des ersten Transistors übertragen werden.

33. Das Verfahren nach Anspruch 32, wobei das erste Steuersignal ein Auswahlsignal von der zweiten Abtastleitung ist, der erste Transistor als Antwort auf das Auswahlsignal von der zweiten Abtastleitung während der ersten Zeitspanne elektrisch von dem lichtemittierenden Element isoliert wird und
der erste Transistor als Antwort auf das Auswahlsignal von der ersten Abtastleitung (S_n) während der zweiten Zeitspanne elektrisch von dem lichtemittierenden Element isoliert wird.

Revendications

1. Circuit de pixel (11), qui est adapté pour répondre à une tension de précharge venant d'une première ligne de signal (V_p), à un signal de sélection venant d'une première ligne de balayage (S_n), et à une tension de données représentant un signal d'image venant d'une deuxième ligne de signal (D_m), le circuit de pixel comprenant :

un premier transistor (M1) comportant une électrode principale et une électrode de commande ;
un condensateur (C_{st}) couplé entre l'électrode principale et l'électrode de commande, le premier transistor (M1) étant adapté pour générer un courant en réponse à une tension chargée dans le condensateur (C_{st}) ;
un deuxième transistor (M2) comportant une électrode de commande couplée à l'électrode de commande du premier transistor (M1), le deuxième transistor (M2) étant configuré de façon à fonctionner en diode ;
un élément électroluminescent émetteur de lumière (OLED), l'émission dudit élément émetteur de lumière

correspondant à un courant généré par le premier transistor (M1) ; et
des moyens de commutation (M5, M6) couplés entre le premier transistor (M1) et l'élément émetteur de lumière (OLED),
caractérisé en ce que :

la tension de précharge (V_p) est appliquée à l'électrode de commande du premier transistor (M1) en réponse à un premier signal de commande dans une première période de temps, et la tension de données est appliquée à l'électrode de commande du premier transistor (M1) en réponse à un signal de sélection dans une deuxième période de temps, et le premier transistor (M1) est électriquement isolé de l'élément émetteur de lumière (OLED) par les moyens de commutation durant au moins l'une de ladite première période de temps et de ladite deuxième période de temps.

2. Circuit de pixel selon la revendication 1, dans lequel le premier signal de commande est un signal de sélection venant d'une deuxième ligne de balayage (S_{n-1}) qui est adjacente à ladite première ligne de balayage (S_n).

3. Panneau d'affichage (10) pour l'affichage d'images, ledit panneau d'affichage (10) comprenant une pluralité de circuits de pixel selon la revendication 1, une pluralité de lignes de données (D_1 à D_m) pour transférer une tension de données représentant un signal d'image, une pluralité de lignes de balayage (S_1 à S_N) pour transférer un signal de sélection, chaque circuit de pixel (11) étant couplé à une ligne de données correspondante parmi la pluralité desdites lignes de données et à une première (S_n) et une deuxième (S_{n-1}) lignes de balayage parmi la pluralité desdites lignes de balayage, la première (S_n) et la deuxième (S_{n-1}) lignes de balayage étant adjacentes dans le panneau d'affichage (10), le panneau (10) comprenant de plus :

un premier élément de commutation (M3) couplé à une électrode principale du deuxième transistor (M2), le premier élément de commutation (M3) étant adapté pour transférer la tension de données venant des lignes de données (D_1 à D_M) au deuxième transistor (M2) en réponse au signal de sélection venant de l'une des deux lignes de balayage adjacentes ;
un deuxième élément de commutation (M4) pour transférer la tension de précharge (V_p) à l'électrode de commande du premier transistor (M1) en réponse audit premier signal de commande avant que la tension de données ne soit délivrée ; et
un troisième élément de commutation (M5) adapté pour être mis hors service en réponse à un deuxième signal de commande pour insoler électriquement le premier transistor (M1) de l'élément émetteur de lumière (OLED).

4. Panneau d'affichage selon la revendication 3, dans lequel le premier signal de commande est le signal de sélection venant de la deuxième ligne de balayage (S_{n-1}).

5. Panneau d'affichage selon la revendication 4, comprenant de plus des moyens adaptés pour appliquer la tension de données aux lignes de données, ladite tension de données étant appliquée après le transfert de la tension de précharge en réponse au premier signal de commande et avant l'application du signal de sélection à la deuxième ligne de balayage.

6. Panneau d'affichage selon la revendication 5, dans lequel la tension de données dans les lignes de données (D_1 à D_m) est changée en une tension désirée avant que le signal de sélection ne soit appliqué à la première ligne de balayage.

7. Panneau d'affichage selon la revendication 3, dans lequel le deuxième signal de commande et le premier signal de commande sont le même signal.

8. Panneau d'affichage selon la revendication 7, dans lequel le signal de sélection venant de la deuxième ligne de balayage est utilisé tout à la fois pour les premier et deuxième signaux, et
le deuxième élément de commutation (M4) comprend un transistor d'un premier type de conductivité, le troisième élément de commutation (M5) comprend un transistor d'un deuxième type de conductivité, le deuxième type de conductivité étant l'opposé du premier type de conductivité.

9. Panneau d'affichage selon la revendication 3, dans lequel le signal de sélection venant de la première ligne de balayage (S_n) est utilisé comme deuxième signal de commande, et
le deuxième élément de commutation (M4) comprend un transistor d'un premier type de conductivité, le troisième élément de commutation (M5) comprend un transistor d'un deuxième type de conductivité, le deuxième type de

conductivité étant l'opposé du premier type de conductivité.

10. Panneau d'affichage selon la revendication 9, dans lequel le signal de sélection venant de la deuxième ligne de balayage (S_{n-1}) est utilisé comme premier signal de commande.

11. Panneau d'affichage selon la revendication 3, dans lequel le troisième élément de commutation (M5) est mis hors service pendant une période de temps dans laquelle la tension de précharge est transférée à l'aide du premier signal de commande et pendant une autre période de temps dans laquelle la tension de données est transférée à l'aide du signal de sélection venant de la première ligne de balayage (S_n).

12. Panneau d'affichage selon la revendication 11, dans lequel le troisième élément de commutation comprend des troisième et quatrième transistors couplés en série,
le deuxième signal de commande comprend un troisième signal de commande pour bloquer le troisième transistor pendant la période de temps de transfert de la tension de précharge, et un quatrième signal de commande pour bloquer le quatrième transistor pendant ladite autre période de temps de transfert de la tension de données.

13. Panneau d'affichage selon la revendication 12, dans lequel le signal de sélection venant de la deuxième ligne de balayage est utilisé tout à la fois pour les premier et troisième signaux de commande,
le deuxième élément de commutation (M4) est un transistor d'un premier type de conductivité, le troisième élément de commutation (M5) est un transistor d'un deuxième type de conductivité, et le deuxième type de conductivité est l'opposé du premier type de conductivité.

14. Panneau d'affichage selon la revendication 12, dans lequel le quatrième signal est un signal de sélection venant de la première ligne de balayage (S_n), et
le quatrième transistor est un transistor d'un type qui est opposé au type du premier transistor.

15. Panneau d'affichage selon la revendication 3, dans lequel les premier (M3) et deuxième (M4) éléments de commutation sont des transistors du même type que les premier et deuxième transistors (M1, M2).

16. Panneau d'affichage selon la revendication 3, dans lequel la tension de précharge est inférieure à une tension de données la plus basse des lignes de données (D_1 à D_m) -

17. Dispositif d'affichage d'image, comprenant :

le panneau d'affichage selon l'une des revendications 3 à 16 ;
un dispositif d'attaque de données monté sur le panneau d'affichage ou couplé au panneau d'affichage, ledit dispositif d'attaque de données étant susceptible d'appliquer la tension de données aux lignes de données ; et
un dispositif d'attaque de balayage monté sur le panneau d'affichage ou couplé au panneau d'affichage, ledit dispositif d'attaque de balayage étant susceptible d'appliquer le signal de sélection aux lignes de balayage.

18. Dispositif d'affichage selon la revendication 17, dans lequel, lorsque le premier signal de sélection est activé, le deuxième élément de commutation permet à la tension de précharge d'être appliquée au condensateur pour la charge et le premier élément de commutation est mis hors service pour empêcher le courant de circuler vers l'élément émetteur de lumière.

19. Dispositif d'affichage selon la revendication 17, dans lequel, lorsque le deuxième signal de sélection est activé, le troisième élément de commutation permet à la tension de données d'être appliquée au condensateur pour la charge et le premier élément de commutation est mis hors service afin d'empêcher le courant de circuler vers l'élément émetteur de lumière.

20. Dispositif d'affichage selon la revendication 18, dans lequel, lorsque le deuxième signal de sélection est activé, le troisième élément de commutation permet à la tension de données d'être appliquée au condensateur pour la charge et le premier élément de commutation est mis hors service afin d'empêcher le courant de circuler vers l'élément émetteur de lumière.

21. Dispositif d'affichage selon la revendication 20, dans lequel il y a une période de temps entre le moment où le premier signal de sélection est désactivé et le moment où le deuxième signal de sélection est activé.

22. Dispositif d'affichage selon la revendication 19, dans lequel le premier élément de commutation est mis en service pour permettre au courant de circuler vers l'élément émetteur de lumière lorsque le deuxième signal de sélection est désactivé après que le condensateur ait été chargé à l'aide de la tension de données.

23. Dispositif d"affichage selon la revendication 18, dans lequel lesdites électrodes de commande dudit deuxième transistor sont couplées à la tension de décharge par l'intermédiaire dudit deuxième élément de commutation.

24. Dispositif d'affichage selon la revendication 19, dans lequel l'électrode de commande du deuxième transistor est couplée à l'électrode de commande du premier transistor, l'électrode principale du deuxième transistor étant couplée à la tension de données par l'intermédiaire du troisième élément de commutation.

25. Procédé pour attaquer un dispositif d'affichage d'image comprenant deux lignes de balayage adjacentes, un premier transistor (M1) comportant une électrode principale et une électrode de commande ; un condensateur (C_{st}) couplé entre l'électrode principale et l'électrode de commande du premier transistor (M1), le premier transistor étant susceptible de générer un courant correspondant à une tension chargée dans le condensateur (C_{st}), un deuxième transistor (M2) comportant une électrode de commande couplée à l'électrode de commande du premier transistor et configuré de façon à fonctionner en diode, et un élément électroluminescent émetteur de lumière (OLED), l'émission dudit élément émetteur de lumière correspondant à une quantité de courant appliqué générée par le premier transistor (M1), **caractérisé par** les étapes consistant à :

transférer une tension de précharge (V_p) à l'électrode de commande du premier transistor (M1) en réponse à un premier signal de commande pendant une première période de temps ;
transférer une tension de données à l'électrode de commande du premier transistor (M1) par l'intermédiaire du deuxième transistor (M2) en réponse à un signal de sélection venant de l'une des deux lignes de balayage adjacentes pendant une deuxième période de temps ; et
interrompre le transfert de la tension de données,
dans lequel le premier transistor est électriquement isolé de l'élément émetteur de lumière pendant au moins l'une de la première période de temps et de la deuxième période de temps.

26. Procédé selon la revendication 25, dans lequel le premier transistor est électriquement isolé de l'élément émetteur de lumière en réponse au premier signal de commande pendant la première période de temps.

27. Procédé selon la revendication 25, dans lequel les deux lignes de balayage adjacentes comprennent une première ligne de balayage et une deuxième ligne de balayage.

28. Procédé selon la revendication 27, dans lequel le premier signal de commande est un signal de sélection venant de la deuxième ligne de balayage.

29. Procédé selon la revendication 26, dans lequel le premier transistor est électriquement isolé de l'élément émetteur de lumière en réponse au signal de sélection venant de ladite première des deux lignes de balayage adjacentes pendant la deuxième période de temps.

30. Procédé selon la revendication 27, dans lequel le premier transistor est électriquement isolé de l'élément émetteur de lumière en réponse à un deuxième signal de commande pendant la deuxième période de temps.

31. Procédé selon la revendication 30, dans lequel le deuxième signal de commande est le signal de sélection venant de la première ligne de balayage.

32. Procédé selon la revendication 27, comprenant de plus :

le fait d'empêcher la tension de précharge et la tension de données d'être transférées à l'électrode de commande du premier transistor entre les première et deuxième périodes de temps.

33. Procédé selon la revendication 32, dans lequel le premier signal de commande est un signal de sélection venant de la deuxième ligne de balayage,
le premier transistor est électriquement isolé de l'élément émetteur de lumière en réponse au signal de sélection venant de la deuxième ligne de balayage pendant la première période de temps, et
le premier transistor est électriquement isolé de l'élément émetteur de lumière en réponse au signal de sélection

venant de la première ligne de balayage (S_n) pendant la deuxième période de temps.

FIG.1

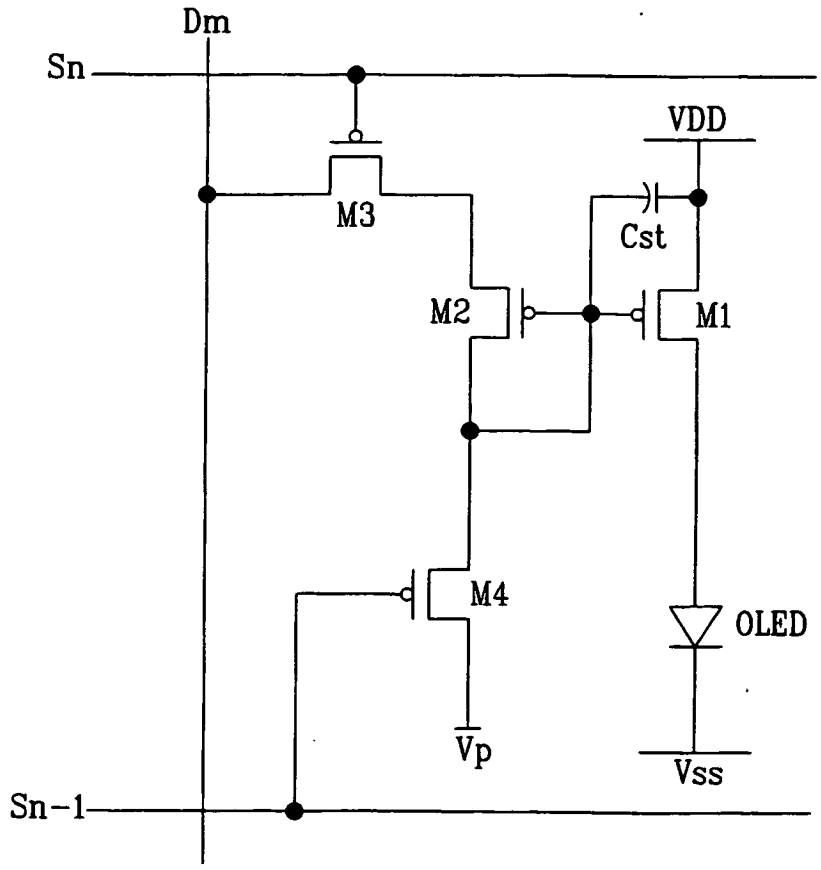


FIG.2

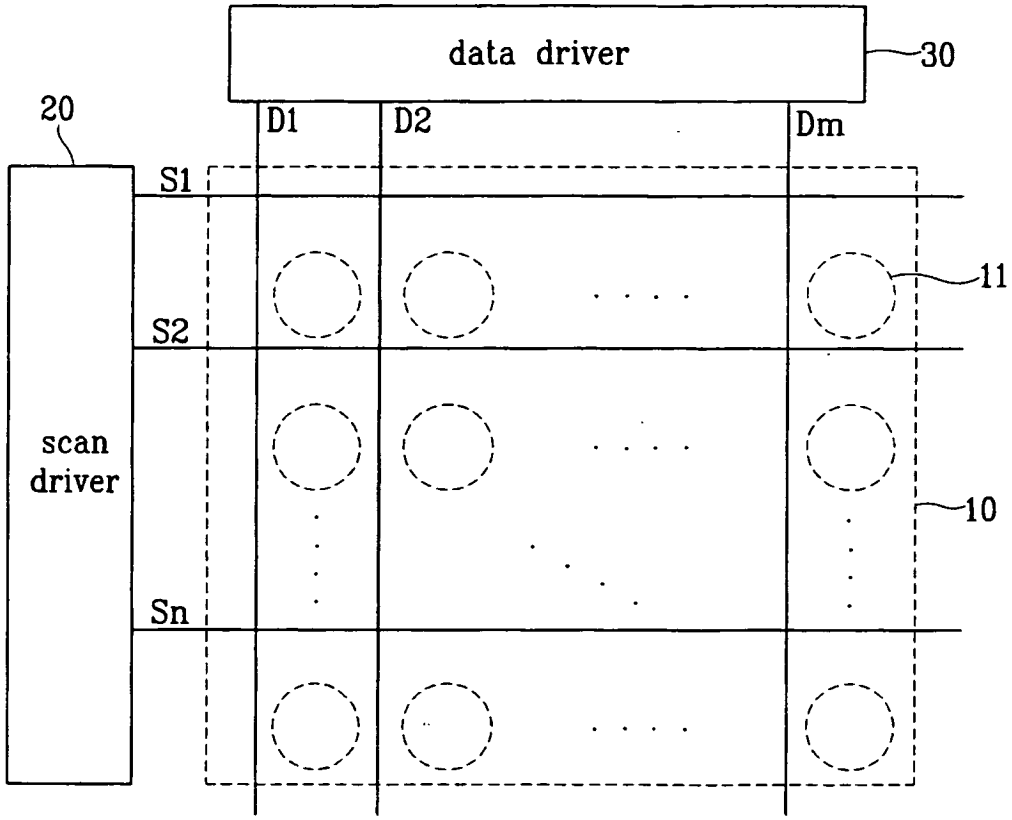


FIG.3

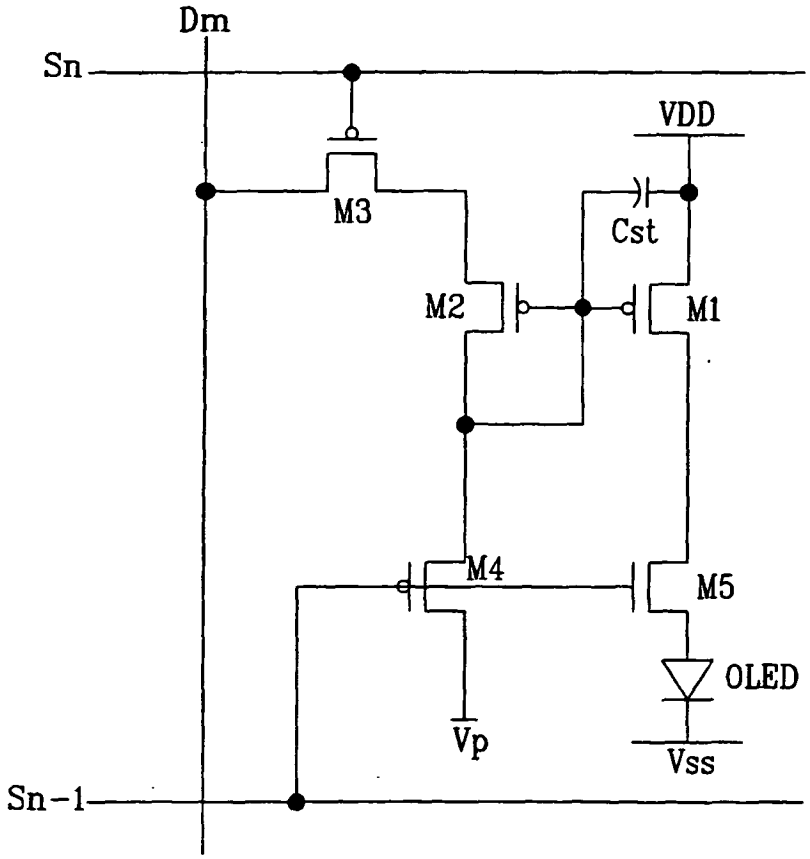


FIG.4

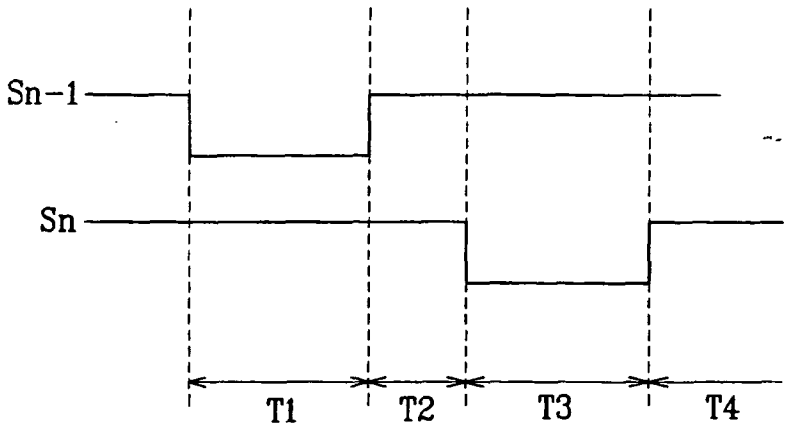


FIG.5

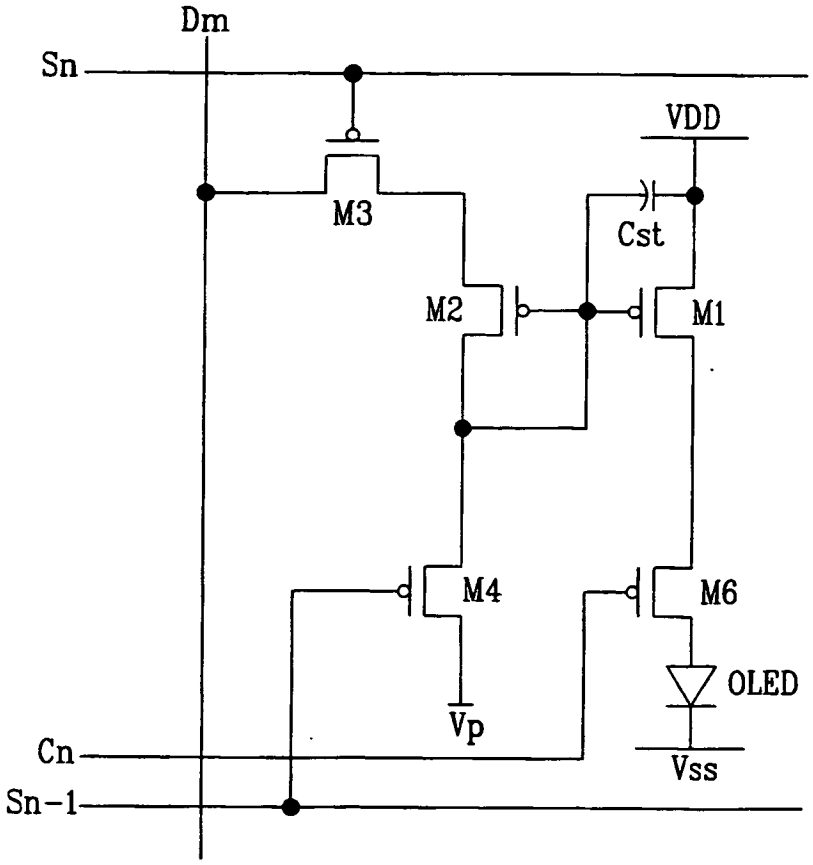


FIG.6

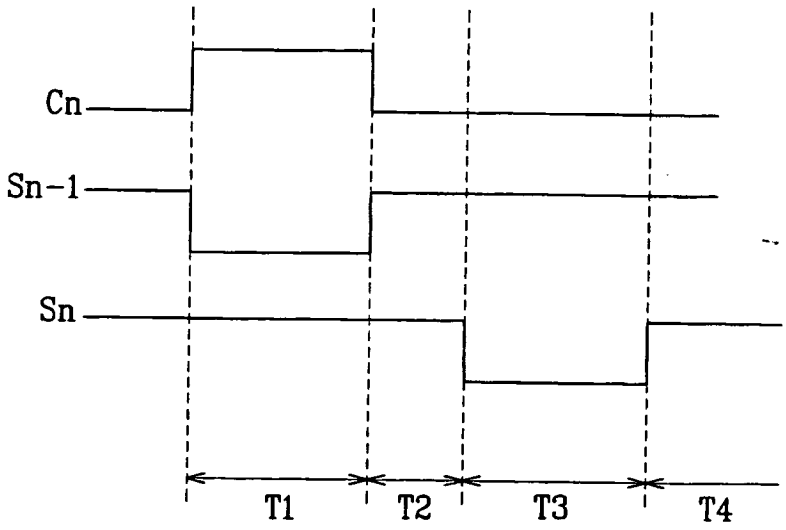


FIG.7

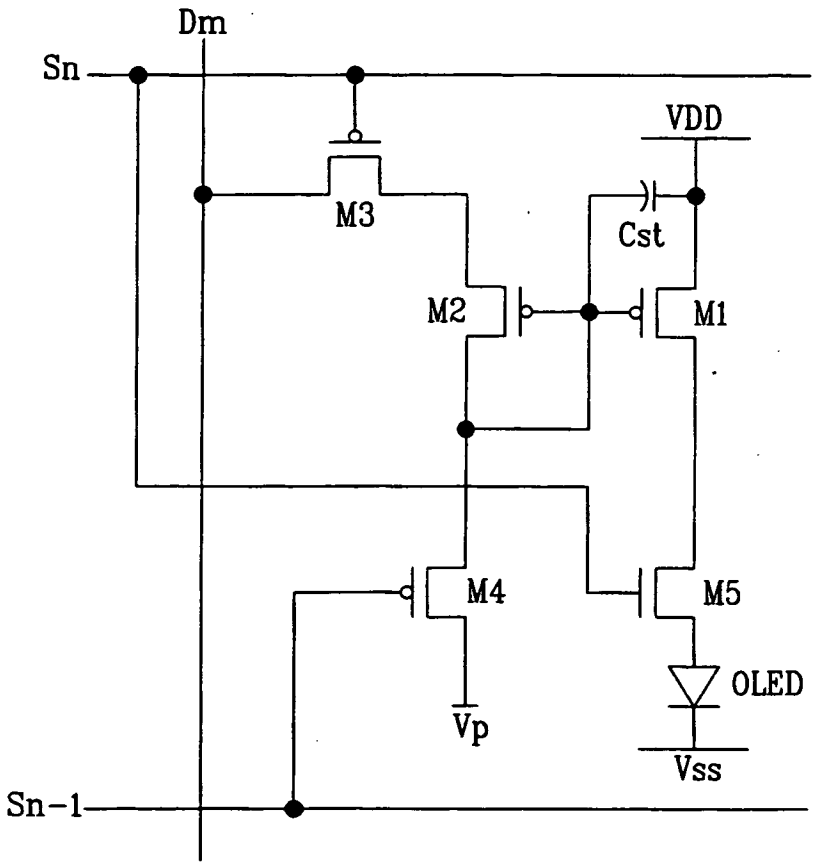


FIG.8

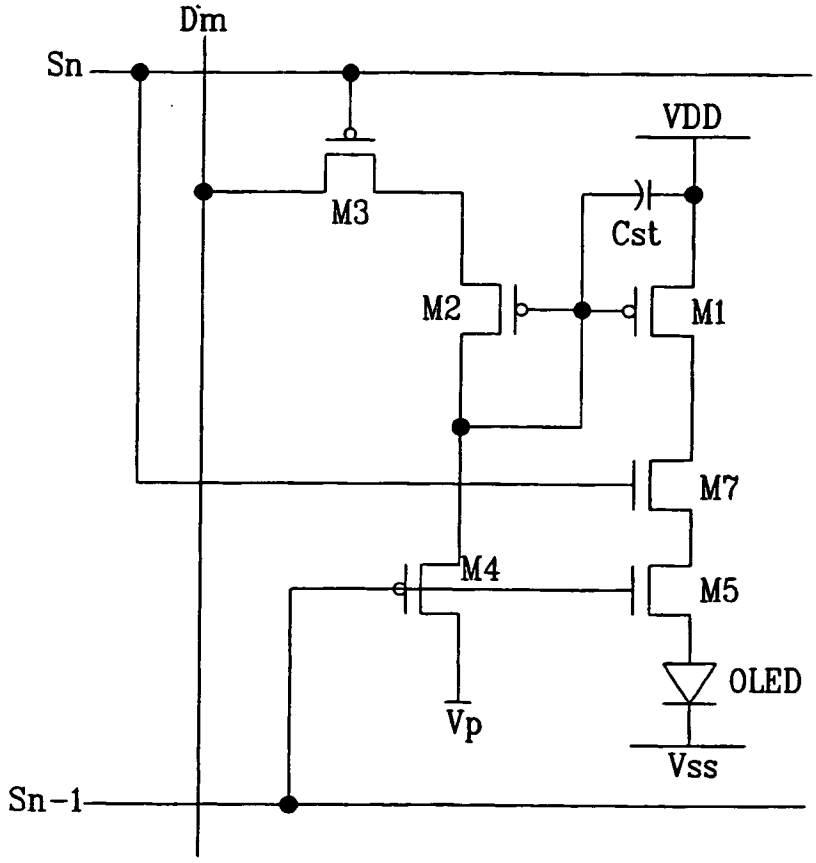


FIG.9

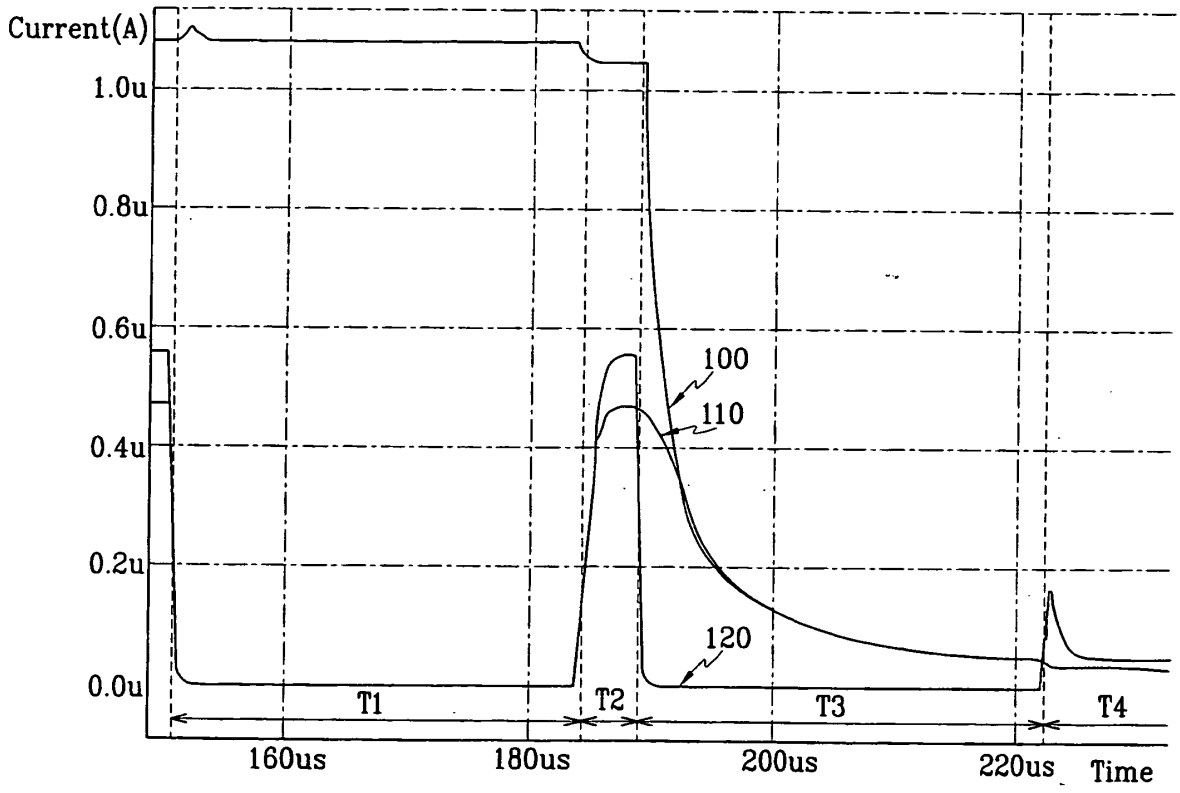

Current(A)
1.0u
0.8u
0.6u
0.4u
0.2u
0.0u
100
110
120
T1
T2
T3
T4
160us
180us
200us
220us
Time

FIG.10

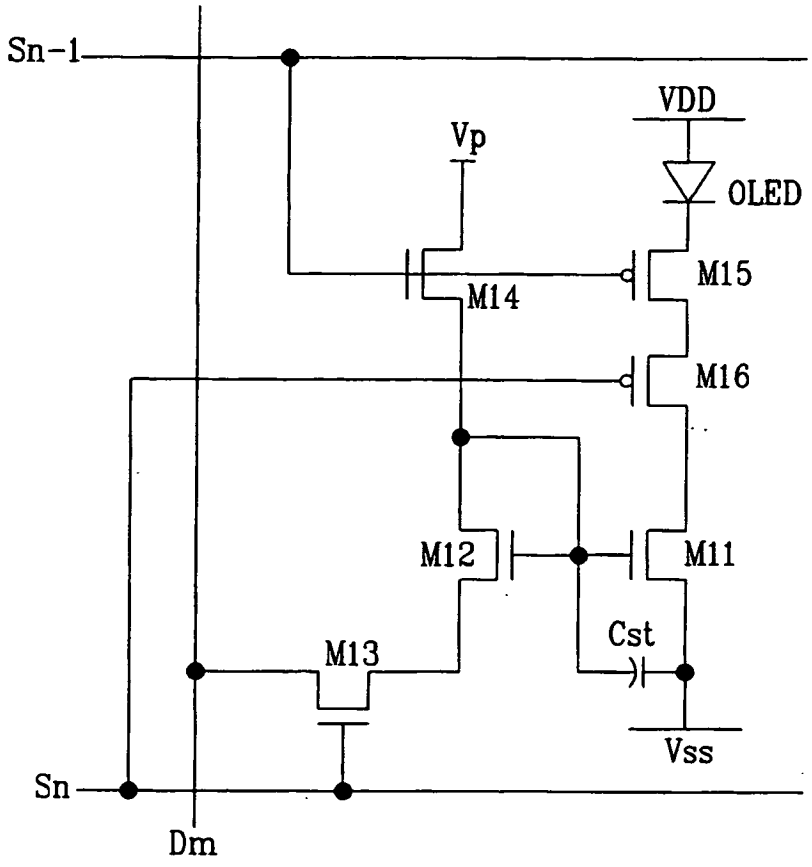
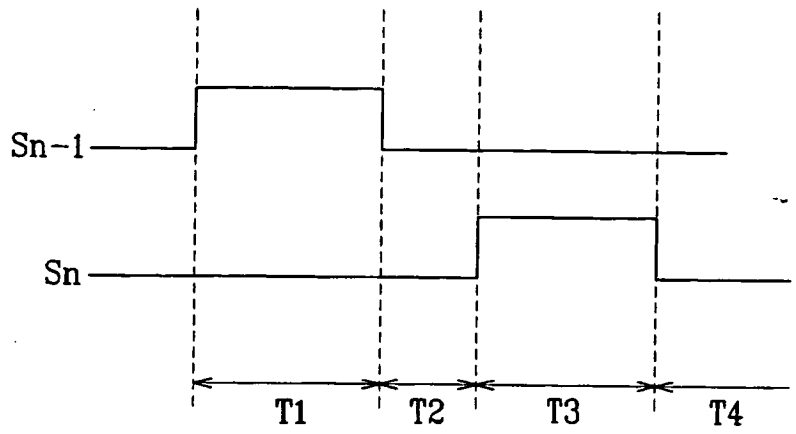


FIG.11



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 1220191 A2 **[0005] [0005]**
- US 6362798 B, Kimura **[0010] [0011]**

专利名称(译)	像素电路，显示面板，图像显示装置及其驱动方法		
公开(公告)号	EP1473689B1	公开(公告)日	2008-10-15
申请号	EP2003090266	申请日	2003-08-21
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IPC分类号	G09G3/32 H01L51/50 G09G3/20 G09G3/30		
CPC分类号	G09G3/3233 G09G2300/0819 G09G2300/0842 G09G2300/0861 G09G2310/0251 G09G2310/0262 G09G2320/0238 G09G2320/043 G09G2330/021		
代理机构(译)	hengelhaupt，Jürgen		
优先权	1020030027604 2003-04-30 KR		
其他公开文献	EP1473689A3 EP1473689A2		
外部链接	Espacenet		

摘要(译)

在有机EL显示装置的像素电路中，驱动晶体管的栅极耦合到补偿晶体管的栅极，补偿晶体管被配置为用作二极管。将预充电电压施加到驱动晶体管的栅极，同时将选择信号施加到前一扫描线，使得补偿晶体管沿正向偏置，以在驱动晶体管的栅极上施加数据电压。在预充电的同时，可以与有机EL元件（OLED）电隔离，以防止OLED使用预充电电压发光。另外，在对数据电压进行充电时，驱动晶体管可以与OLED电隔离，以防止OLED发光。

[Equation 1]

$$I_{OLED} = \frac{\beta}{2}(|V_{GS}| - |V_{TH1}|)^2 = \frac{\beta}{2}(V_{DD} - (V_{DATA} - |V_{TH2}|) - |V_{TH1}|)^2$$