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

(11) EP 1 465 143 B1

(12) EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent:
27.09.2006 Bulletin 2006/39

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

(21) Application number: **03090385.0**

(22) Date of filing: **13.11.2003**

(54) **Light emitting display, display panel, and driving method thereof**

Lichtemittierende Anzeige, Anzeigetafel und Verfahren zu ihrer Ansteuerung

Dispositif d'affichage émettent de la lumière, panneau d'affichage et méthode pour le commander

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LI LU MC NL PT RO SE SI SK TR

(30) Priority: **01.04.2003 KR 2003020432**

(43) Date of publication of application:
06.10.2004 Bulletin 2004/41

(73) Proprietor: **Samsung SDI Co., Ltd.**
Suwon-city,
Kyungki-do (KR)

(72) Inventor: **Kwon, Oh-Kyong**
Seoul (KR)

(74) Representative: **Hengelhaupt, Jürgen et al**
Anwaltskanzlei
Gulde Hengelhaupt Ziebig & Schneider
Wallstrasse 58/59
10179 Berlin (DE)

(56) References cited:
EP-A- 1 220 191
US-A1- 2001 026 251
US-A1- 2003 132 931
US-B1- 6 229 506
US-B1- 6 348 906

EP 1 465 143 B1

Description

BACKGROUND OF THE INVENTION

(a) Field of the Invention

[0001] The present invention relates to a light emitting display, a display panel, and a driving method thereof. More specifically, the present invention relates to an organic electroluminescent (EL) display.

(b) Description of the Related Art

[0002] In general, an organic EL display electrically excites a phosphorous organic compound to emit light, and it voltage- or current-drives N x M organic emitting cells to display images. As shown in FIG. 1, the organic emitting cell includes an anode of indium tin oxide (ITO), an organic thin film, and a cathode layer of metal. The organic thin film has a multi-layer structure including an emitting layer (EML), an electron transport layer (ETL), and a hole transport layer (HTL) for maintaining balance between electrons and holes and improving emitting efficiencies, and it further includes an electron injecting layer (EIL) and a hole injecting layer (HIL).

[0003] Methods for driving the organic emitting cells include the passive matrix method, and the active matrix method using thin film transistors (TFTs) or metal oxide semiconductor field effect transistors (MOSFETs). The passive matrix method forms cathodes and anodes to cross with each other, and selectively drives lines. The active matrix method connects a TFT and a capacitor with each ITO pixel electrode to thereby maintain a predetermined voltage according to capacitance. The active matrix method is classified as a voltage programming method or a current programming method according to signal forms supplied for maintaining a voltage at a capacitor.

[0004] Referring to FIGs. 2 and 3, conventional organic EL displays of the voltage programming and current programming methods will be described.

[0005] FIG. 2 shows a conventional voltage programming type pixel circuit for driving an organic EL element, representing one of NxM pixels. Referring to FIG. 2, transistor M1 is coupled to an organic EL element (referred to as an OLED hereinafter) to thus supply current for light emission. The current of transistor M1 is controlled by a data voltage applied through switching transistor M2. In this instance, capacitor C1 for maintaining the applied voltage for a predetermined period is coupled between a source and a gate of transistor M1. Scan line S_n is coupled to a gate of transistor M2, and data line Dm is coupled to a source thereof.

[0006] As to an operation of the above-configured pixel, when transistor M2 is turned on according to a select signal applied to the gate of switching transistor M2, a data voltage from data line Dm is applied to the gate of transistor M1. Accordingly, current I_{OLED} flows to transistor M2 in correspondence to a voltage V_{GS} charged between the gate and the source by capacitor C1, and the OLED emits light in correspondence to current I_{OLED}.

[0007] In this instance, the current that flows to the OLED is given in Equation 1.

Equation 1

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

where I_{OLED} is the current flowing to the OLED, V_{GS} is a voltage between the source and the gate of transistor M1, V_{TH} is a threshold voltage at transistor M1, and β is a constant.

[0008] As given in Equation 1, the current corresponding to the applied data voltage is supplied to the OLED, and the OLED gives light in correspondence to the supplied current, according to the pixel circuit of FIG. 2. In this instance, the applied data voltage has multi-stage values within a predetermined range so as to represent gray.

[0009] However, the conventional pixel circuit following the voltage programming method has a problem in that it is difficult to obtain high gray because of deviation of a threshold voltage V_{TH} of a TFT and deviations of electron mobility caused by non-uniformity of an assembly process. For example, in the case of driving a TFT of a pixel through. 3 volts (3V), voltages are to be supplied to the gate of the TFT for each interval of 12mV (=3V/256) so as to represent 8-bit (256) grays, and if the threshold voltage of the TFT caused by the non-uniformity of the assembly process deviates, it is difficult to represent high gray. Also, since the value β in Equation 1 changes because of the deviation of the mobility, it becomes even more difficult to represent the high gray.

[0010] On assuming that the current source for supplying the current to the pixel circuit is uniform over the whole panel, the pixel circuit of the current programming method can achieve uniform display features even though a driving transistor in each pixel has non-uniform voltage-current characteristics.

[0011] FIG. 3 shows a pixel circuit of a conventional current programming method for driving the OLED, representing one of NxM pixels. Referring to FIG. 3, transistor M1 is coupled to the OLED to supply the current for light emission, and the current of transistor M1 is controlled by the data current applied through transistor M2.

[0012] First, when transistors M2 and M3 are turned on because of the select signal from scan line S_n, transistor M1 becomes diode-connected, and the voltage matched with data current I_{DATA} from data line Dm is stored in capacitor C1. Next, the select signal from scan line S_n becomes high-level to turn on transistor M4. Then, the power is supplied from power supply voltage VDD, and the current matched with the voltage stored in capacitor C1 flows to the OLED to emit light. In this instance, the current flowing to the OLED is as follows.

Equation 2

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

where V_{GS} is a voltage between the source and the gate of transistor M1, V_{TH} is a threshold voltage at transistor M1, and β is a constant.

[0013] As given in Equation 2, since current I_{OLED} flowing to the OLED is the same as data current I_{DATA} in the conventional current pixel circuit, uniform characteristics can be obtained when the programming current source is set to be uniform over the whole panel. However, since current I_{OLED} flowing to the OLED is a fine current, control over the pixel circuit by fine current I_{DATA} problematically requires much time to charge the data line. For example, assuming that the load capacitance of the data line is 30pF, it requires several milliseconds of time to charge the load of the data line with the data current of several tens to hundreds of nA. This causes a problem that the charging time is not sufficient in consideration of the line time of several tens of microseconds.

[0014] Furthermore US 6,348,906 B1 discloses a light emitting element comprising a display panel on which are formed a plurality of data lines for transmitting data current that displays video signals, a plurality of scan lines for transmitting select signals and a plurality of pixel circuits formed at a plurality of pixels defined by the data lines and the scan lines, wherein at least one pixel circuit includes: a light emitting element for emitting light corresponding to an applied current, a first transistor having first and second main electrodes and a control electrode for supplying a driving current for the light emitting element; a first switch for diode-connecting the first transistor in response to a first control signal; a first storage unit for storing a first voltage corresponding to a treshhold voltage of the first transistor in response to a second control signal; a second switch for transmitting a data signal from a data line in response to the select signal from the scan line; a second storage unit for storing a second voltage corresponding to a data current from the first switch; and a third switch for transmitting the driving current from the first transistor to the light emitting element in response to a third control signal. Also the display disclosed US US 6,348,906 B1 cannot compensate the threshold voltage of transistors or electron mobility. Therefore a sufficient charging the data line is not assured.

SUMMARY OF THE INVENTION

[0015] In accordance with the present invention a light emitting display is provided for compensating for the threshold voltage of transistors or for electron mobility, and sufficiently charging the data line.

[0016] According to the invention a light emitting display comprises
a display panel on which are formed a plurality of data lines for transmitting data current which corresponds to the video data that have to be displayed, a plurality of scan lines, and a plurality of pixel circuits formed at a plurality of pixels defined by the data lines and the scan lines, wherein at least one pixel circuit includes:

> a light emitting element for emitting light corresponding to an applied current, a first transistor having first and second main electrodes and a control electrode, a first switch, a second switch, a third switch, a first storage unit, and a second storage unit,

wherein the first transistor supplies a driving current for the light emitting element, a first switch diode-connects the first transistor in response to a first control signal, the first and second storage units store a first voltage corresponding to a threshold voltage of the first transistor in response to a second control signal, a second switch transmits a data signal from a data line in response to a select signal from the scan line; the first storage unit stores a second voltage corresponding to the gate voltage of the first transistor when the data current flows through the first transistor, and a third switch transmits the driving current from the first transistor to the light emitting element in response to a third control signal; wherein a third voltage determined by coupling of the first and second storage units is applied to the first transistor to supply the driving current to the light emitting element.

[0017] Preferably the light emitting display further comprising a scan driver for setting the second control signal to the enable level in a first interval, for setting the select signal the enable level in a second interval after the first interval, and for setting the third control signal to the enable level in a third interval after the second interval. Preferably the first switch, the second switch, the third switch and the first transistor are transistors of the same conductive type. Preferably at least one of the first switch, second switch and third switch has a conductive type opposite to that of the first transistor. Preferably the first storage unit is coupled between the first main electrode and the control electrode of the first transistor, the second storage unit has a first end coupled to the first main electrode of the first transistor, and the pixel circuit further comprises a fourth switch turned on in response to the second control signal, and coupled between a second end of the second storage unit and the control electrode of the first transistor. Preferably the second control signal is the select signal (SEn) from the scan line, and the fourth switch responds in the disable level of the select signal. Preferably the first control signal includes a select signal from a previous scan line and a select signal from a current scan line. Preferably the first switch includes a second transistor for diode-connecting the first transistor in response to the select signal from the previous scan line and a third transistor for diode-connecting the first transistor in response to the select signal from the current scan line. Preferably the second control signal includes a select signal from a previous scan line, and the third control signal. Preferably the pixel circuit further comprises a fifth switch coupled in parallel to the fourth switch; and the fourth and fifth switches are respectively turned on in response to the select signal from the previous scan line and the third control signal. Preferably the first control signal includes a select signal from a previous scan line and a select signal from the current scan line; and the second control signal includes a select signal from the previous scan line and the third control signal. Preferably the first and second storage units are coupled in series between the first main electrode and the control electrode of the first transistor, the pixel circuit further comprises a fourth switch coupled between the control electrode of the first transistor and the contact point of the first and second storage units, and responding to the second control signal. Preferably the light emitting display further comprises a first driving circuit for supplying the select signal; the first control signal, the second control signal and the third control signal; anda second driving circuit for supplying the data current; wherein the first driving circuit and the second driving circuit are coupled to the display panel, mounted as an integrated circuit chip type on the display panel, or directly formed in the same layers of the scan lines, the data lines, and the first switch on the substrate.

[0018] The method for driving a light emitting display having a pixel circuit including a switch for transmitting a data current from a data line in response to a select signal from a scan line, a transistor including a first main electrode, a second main electrode and a control electrode for outputting a driving current in response to the data current, and a light emitting element for emitting light corresponding to the driving current from the transistor, comprises the following steps:

storing a first voltage corresponding to a threshold voltage of the transistor in first and second storage units formed between the control electrode and the first main electrode of the transistor;
storing a second voltage corresponding to the gate voltage of the transistor when the data current flows through the transistor in the first storage unit formed between the control electrode and the first main electrode of the transistor;
coupling the first and second storage units to establish the voltage between the control electrode and the first main electrode of the transistor as a third voltage; and
transmitting the driving current from the transistor to the light emitting element;

wherein the driving current from the transistor is determined corresponding to the third voltage.

[0019] Preferably the storage of the first voltage in the first and second storage units comprises coupling the first and second storage units in parallel; and the storage of the second voltage in the first storage unit comprises coupling the first storage unit between the control electrode and the first main electrode of the transistor, and electrically intercepting one end of the second storage unit and the control electrode of the transistor, wherein the third voltage is determined by parallel coupling of the first and second storage units.

Preferably the storage of the first voltage in the first and second storage units comprises coupling the first and second storage units in series, and the storage the second voltage in the first storage unit comprises coupling the first storage unit between the control electrode and the first main electrode of the transistor, and electrically intercepting one end of the second storage unit and the control electrode of the transistor, wherein the third voltage is determined by serial coupling of the first and second storage units. Preferably the storage of the first voltage in the first and second storage units further comprises diode-connecting the transistor and electrically intercepting the transistor and the light emitting element. Preferably the storage of the second voltage in the first storage unit further comprises diode connecting the transistor and electrically intercepting the transistor and the light emitting element.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020]

FIG. 1 shows a concept diagram of an OLED.
FIG. 2 shows an equivalent circuit of a conventional pixel circuit following the voltage programming method.
FIG. 3 shows an equivalent circuit of a conventional pixel circuit following the current programming method.
FIG. 4 shows a brief plane diagram of an organic EL display according to an embodiment of the present invention,
FIGS. 5, 7, 9, 11, 13, 14, and 15 respectively show an equivalent circuit of a pixel circuit according to first through seventh embodiments of the present invention.
FIGS. 6, 8, 10, 12, and 16 respectively show a driving waveform for driving the pixel circuit of FIGS. 5, 7, 9, 11, and 15.

DETAILED DESCRIPTION

[0021] An organic EL display, a corresponding pixel circuit, and a driving method thereof will be described in detail with reference to drawings.

[0022] First, referring to FIG. 4, the organic EL display will be described. FIG. 4 shows a brief ground plan of the OLED.

[0023] As shown, the organic EL display includes organic EL display panel 10, scan driver 20, and data driver 30.

[0024] Organic EL display panel 10 includes a plurality of data lines D_1 through D_m in the row direction, a plurality of scan lines S_1 through S_n, E_1 through E_n, X_1 through X_n, and Y_1 through Y_n, and a plurality of pixel circuits 11. Data lines D_1 through D_m transmit data signals that represent video signals to pixel circuit 11, and scan lines S_1 through S_n transmit select signals to pixel circuit 11. Pixel circuit 11 is formed at a pixel region defined by two adjacent data lines D_1 through D_m and two adjacent scan lines S_1 through S_n. Also, scan lines E_1 through E_n transmit emit signals for controlling emission of pixel circuits 11, and scan lines X_1 through X_n and Y_1 through Y_n respectively transmit control signals. for controlling operation of pixel circuits 11.

[0025] Scan driver 20 sequentially applies respective select signals and emit signals to scan lines S_1 through S_n and E_1 through E_n, and control signals to scan lines X_1 through X_n and Y_1 through Y_n. Data driver 30 applies the data current that represents video signals to data lines D_1 through D_m.

[0026] Scan driver 20 and/or data driver 30 can be coupled to display panel 10, or can be installed, in a chip format, in a tape carrier package (TCP) coupled to display panel 10. The same can be attached to display panel 10, and installed, in a chip format, on a flexible printed circuit (FPC) or a film coupled to display panel 10, which is referred to as a chip on flexible (CoF) board, or chip on film method. Differing from this, scan driver 20 and/or data driver 30 can be installed on the glass substrate of the display panel, and further, the same can be substituted for the driving circuit formed in the same layers of the scan lines, the data lines, and TFTs on the glass substrate, or directly installed on the glass substrate, which is referred to as a chip on glass (CoG) method.

[0027] Referring to FIGS. 5 and 6, pixel circuit 11 of the organic EL display according to the first embodiment of the present invention will now be described. FIG. 5 shows an equivalent circuit diagram of the pixel circuit according to the first embodiment, and FIG. 6 shows a driving waveform diagram for driving the pixel circuit of FIG. 5. In this instance, for ease of description, FIG. 5 shows a pixel circuit coupled to an m-th data line D_m and an n-th scan line S_n.

[0028] As shown in FIG. 5, pixel circuit 11 includes an OLED, PMOS transistors M1 through M5, and capacitors C1 and C2: The transistor is preferably a thin film transistor having a gate electrode, a drain electrode, and a source electrode formed on the glass substrate as a control electrode and two main electrodes.

[0029] Transistor M1 has a source coupled to power supply voltage VDD, and a gate coupled to transistor M5, and transistor M3 is coupled between the gate and a drain of transistor M1. Transistor M1 outputs current I_{OLED} corresponding to a voltage V_{GS} at the gate and the source thereof. Transistor M3 diode-connects transistor M1 in response to a control signal $CS1_n$ from scan line X_n. Capacitor C1 is coupled between power supply voltage VDD and the gate of transistor M1, and capacitor C2 is coupled between power supply voltage VDD and a first end of transistor M5. Capacitors C1 and C2 operate as storage elements for storing the voltage between the gate and the source of the transistor. A second end of transistor M5 is coupled to the gate of transistor M1, and transistor M5 couples capacitors C1 and C2 in response to a control signal $CS2_n$ from scan line Y_n.

[0030] Transistor M2 transmits data current I_{DATA} from data line D_m to transistor M1 in response to a select signal SE_n from scan line S_n. Transistor M4 coupled between the drain of transistor M1 and the OLED, transmits current I_{OLED} of transistor M1 to the OLED in response to an emit signal EM_n of scan line E_n. The OLED is coupled between transistor M4 and the reference voltage, and emits light corresponding to applied current I_{OLED}.

[0031] Referring to FIG. 6, an operation of the pixel circuit according to the first embodiment of the present invention will now be described in detail.

[0032] As shown, in interval T1, transistor M5 is turned on because of low-level control signal $CS2_n$, and capacitors C1 and C2 are coupled in parallel between the gate and the source of transistor M1. Transistor M3 is turned on because of low-level control signal $CS1_n$, transistor M1 is diode-connected, and the threshold voltage V_{TH} of transistor M1 is stored in capacitors C1 and C2 coupled in parallel because of diode-connected transistor M1. Transistor M4 is turned off because of high-level emit signal EM_n, and the current to the OLED is intercepted. That is, in interval T1, the threshold voltage V_{TH} of transistor M1 is sampled to capacitors C1 and C2.

[0033] In interval T2, control signal $CS2_n$ becomes high level to turn off transistor M5, and select signal SE_n becomes low level to turn on transistor M2. Capacitor C2 is floated while charged with voltage, because of turned-off transistor M5. Data current I_{DATA} from data line D_m flows to transistor M1 because of turned-on transistor M2. Accordingly, the gate-source voltage V_{GS} (T2) at transistor M1 is determined corresponding to data current I_{DATA}, and the gate-source voltage V_{GS}(T2) is stored in capacitor C1. Since data current I_{DATA} flows to transistor M1, data current I_{DATA} can be expressed as Equation 3, and the gate-source voltage V_{GS} (T2) in interval T2 is given as Equation 4 derived from Equation 3. That is, the gate-source voltage corresponding to data current I_{DATA} is programmed to capacitor C1 of the pixel circuit in interval T2.

Equation 3

$$I_{DATA} = \frac{\beta}{2}(|V_{GS}(T2)| - |V_{TH}|)^2$$

Equation 4

$$|V_{GS}(T2)| = \sqrt{\frac{2I_{DATA}}{\beta}} + |V_{TH}|$$

where β is a constant.

[0034] Next, in interval T3, transistors M3 and M2 are turned off in response to high-level control signal $CS1_n$ and select signal SE_n, and transistors M5 and M4 are turned on because of low-level control signal $CS2_n$ and emit signal EM_n. When transistor M5 is turned on, the gate-source voltage V_{GS} (T3) at transistor M1 in interval T3 becomes Equation 5 because of coupling of capacitors C1 and C2.

Equation 5

$$|V_{GS}(T3)| = |V_{TH}| + \frac{C_1}{C_1 + C_2}(|V_{GS}(T2)| - |V_{TH}|)$$

where C1 and C2 are respectively the capacitance of capacitors C1 and C2.

[0035] Therefore, current I_{OLED} flowing to transistor M1 becomes as Equation 6, and current I_{OLED} is supplied to the OLED because of turned-on transistor M4, to thereby emit light. That is, in interval T3, the voltage is provided and the OLED emits light because of coupling of capacitors C1 and C2.

Equation 6

$$I_{OLED} = \frac{\beta}{2}\left\{\frac{C_1}{C_1 + C_2}(|V_{GS}(T2)| - |V_{TH}|)\right\}^2 = \left(\frac{C_1}{C_1 + C_2}\right)^2 I_{DATA}$$

[0036] As expressed in Equation 6, since current I_{OLED} supplied to the OLED is determined with no relation to the threshold voltage V_{TH} of transistor M1 or the mobility, the deviation of the threshold voltage or the deviation of the mobility can be corrected. Also, current I_{OLED} supplied to the OLED is C1/(C1+C2) squared times smaller than the data current I_{DATA}. For example, if C2 is M times greater than C1 (C2=MxC1), the fine current flowing to the OLED can be controlled by data current I_{DATA} which is $(M+1)^2$ times greater than current I_{OLED}, thereby enabling representation of high gray. Further, since the large data current I_{DATA} is supplied to data lines D_1 through D_m, charging time for the data lines can be sufficiently obtained.

[0037] In the first embodiment, PMOS transistors are used for transistors M1 through M5. However, NMOS transistors can also be implemented, which will now be described referring to FIGs. 7 and 8.

[0038] FIG. 7 shows an equivalent circuit diagram of the pixel circuit according to a second embodiment of the present invention, and FIG. 8 shows a driving waveform diagram for driving the pixel circuit of FIG. 7.

[0039] The pixel circuit of FIG. 7 includes NMOS transistors M1 through M5, and their coupling structure is symmetric with the pixel circuit of FIG. 5. In detail, transistor M1 has a source coupled to the reference voltage, a gate coupled to transistor M5, and transistor M3 is coupled between the gate and a drain of transistor M1. Capacitor C1 is coupled between the reference voltage and the gate of transistor M1, and capacitor C2 is coupled between the reference voltage and a first end of transistor M5. A second end of transistor M5 is coupled to the gate of transistor M1, and control signals $CS1_n$ and $CS2_n$ from scan lines X_n and Y_n are respectively applied to the gates of transistors M3 and M5. Transistor M2 transmits data current I_{DATA} from data line D_m to transistor M1 in response to select signal SE_n from scan line S_n. Transistor M4 is coupled between the drain of transistor M1 and the OLED, and emit signal EM_n from scan line E_n is applied to the gate of transistor M4. The OLED is coupled between transistor M4 and power supply voltage VDD.

[0040] Since the pixel circuit of FIG. 7 includes NMOS transistors, the driving waveform for driving the pixel circuit of FIG. 7 has an inverse form of the driving waveform of FIG. 6, as shown in FIG. 8. Since the detailed operation of the pixel circuit according to the second embodiment of the present invention can be easily obtained from the description of the first embodiment and FIGs. 7 and 8, no further detailed description will be provided.

[0041] According to the first and second embodiments, since transistors M1 through M5 are the same type transistors, a process for forming TFTs on the glass substrate of display panel 10 can be easily executed.

[0042] Transistors M1 through M5 are PMOS or NMOS types in the first and second embodiments, but without being restricted to this, they can be realized using combination of PMOS and NMOS transistors, or other switches having similar functions.

[0043] Two control signals $CS1_n$ and $CS2_n$ are used to control the pixel circuit in the first and second embodiments, and in addition, the pixel circuit can be controlled using a single control signal, which will now be described with reference to FIGS. 9 through 12.

[0044] FIG. 9 shows an equivalent circuit diagram of the pixel circuit according to a third embodiment of the present invention, and FIG. 10 shows a driving waveform diagram for driving the pixel circuit of FIG. 9.

[0045] As shown in FIG. 9, the pixel circuit has the same configuration as the first embodiment except for transistors M2 and M5. Transistor M2 includes an NMOS transistor, and gates of transistors M2 and M5 are coupled in common to scan line S_n. That is, transistor M5 is driven by select signal SE_n from scan line S_n.

[0046] Referring to FIG. 10, in interval T1, transistors M3 and M5 are turned on because of low-level control signal $CS1_n$ and select signal SE_n. Transistor M1 is diode-connected because of turned-on transistor M3, and the threshold voltage V_{TH} at transistor M1 is stored in capacitors C1 and C2. Also, transistor M4 is turned off because of high-level emit signal EM_n, and the current flow to the OLED is intercepted.

[0047] In interval T2, select signal SE_n becomes high level to turn transistor M2 on and transistor M5 off. Then, the voltage V_{GS} (T2) expressed in Equation 4 is charged in capacitor C1. In this instance, since the voltage charged in capacitor C2 can be changed when transistor M2 is turned on because of select signal SE_n, in order to prevent this, transistor M3 is turned off before transistor M2 is turned on, and again, transistor M3 is turned on after transistor M2 is turned on. That, is control signal $CS1_n$ is inverted to high level for a short time before select signal SE_n becomes high level.

[0048] Since other operations in the third embodiment of the present invention are matched with those of the first embodiment, no further corresponding description will be provided. According to the third embodiment, scan lines Y_1 through Y_n for supplying control signal $CS2_n$ can be removed, thereby increasing the aperture ratio of the pixels.

[0049] In the third embodiment, transistors M1 and M3 through M5 are realized with PMOS transistors, and transistor M2 with an NMOS transistor, and further, the opposite realization of the transistors are possible, which will be described with reference to FIGS. 11 and 12.

[0050] FIG. 11 shows an equivalent circuit diagram of the pixel circuit according to a fourth embodiment of the present invention, and FIG. 12 shows a driving waveform diagram for driving the pixel circuit of FIG. 11.

[0051] As shown in FIG. 11, the pixel circuit realizes transistor M2 with a PMOS transistor, and transistors M1 and M3 through M5 with NMOS transistors, and their coupling structure is symmetric with that of the pixel circuit of FIG. 9. Also, as shown in FIG. 12, the driving waveform for driving the pixel circuit of FIG. 11 has an inverse form of that of FIG. 10. Since the coupling structure and the operation of the pixel circuit according to the fourth embodiment can be easily obtained from the description of the third embodiment, no detailed description will be provided.

[0052] In the first through fourth embodiments, capacitors C1 and C2 are coupled in parallel to power supply voltage

VDD, and differing from this, capacitors C1 and C2 can be coupled in series to power supply voltage VDD, which will now be described referring to FIGs. 13 and 14.

[0053] FIG. 13 shows an equivalent circuit diagram of the pixel circuit according to a fifth embodiment of the present invention.

[0054] As shown, the pixel circuit has the same structure as that of the first embodiment except for the coupling states of capacitors C1 and C2, and transistor M5. In detail, capacitors C1 and C2 are coupled in series between power supply voltage VDD and transistor M3, and transistor M5 is coupled between the common node of capacitors C1 and C2 and the gate of transistor M1.

[0055] The pixel circuit according to the fifth embodiment is driven with the same driving waveform as that of the first embodiment, which will now be described referring to FIGs. 6 and 13.

[0056] In interval T1, transistor M3 is turned on because of low-level control signal $CS1_n$ to diode-connect transistor M1. The threshold voltage V_{TH} of transistor M1 is stored in capacitor C1 because of diode-connected transistor M1, and the voltage; at capacitor C2 becomes 0V. Also, transistor M4 is turned off because of high-level emit signal EM_n to intercept the current flow to the OLED.

[0057] In interval T2, control signal $CS2_n$ becomes high level to turn off transistor M5, and select SE_n becomes low level to turn on transistor M2. Data current I_{DATA} from data line D_m flows to transistor M1 because of turned-on transistor M2, and the gate-source voltage $V_{GS}(T2)$ at transistor M1 becomes as shown in Equation 4. Hence, the voltage V_{C1} at capacitor C1 charging the threshold voltage V_{TH} becomes as shown in Equation 7 because of coupling of capacitors C1 and C2.

Equation 7

$$V_{C1} = |V_{TH}| + \frac{C_2}{C_1 + C_2}(|V_{GS}(T2)| - |V_{TH}|)$$

[0058] Next, in interval T3, transistors M3 and M2 are turned off in response to high-level control signal $CS1_n$ and select signal SE_n, and transistors M5 and M4 are turned on because of low-level control signal $CS2_n$ and emit signal EM_n. When transistor M3 is turned off, and transistor M5 is turned on, the voltage V_{C1} at capacitor C1 becomes the gate-source voltage V_{GS} (T3) of transistor M1. Therefore, current I_{OLED} flowing to transistor M1 becomes as shown in Equation 8, and current I_{OLED} is supplied to the OLED according to transistor M4 thereby emitting light.

Equation 8

$$I_{OLED} = \frac{\beta}{2}\left\{\frac{C_2}{C_1 + C_2}(|V_{GS}(T2)| - |V_{TH}|)\right\}^2 = \left(\frac{C_2}{C_1 + C_2}\right)^2 I_{DATA}$$

[0059] In the like manner of the first embodiment, current I_{OLED} supplied to the OLED is determined with no relation to the threshold voltage V_{TH} of transistor M1 or the mobility. Also, since the fine current flowing to the OLED using data current I_{DATA} that is (C1+C2)/C2 squared times current I_{OLED} can be controlled, high gray can be represented. By supplying large data current I_{DATA} to data lines D_1 through D_M, sufficient charging time of the data lines can be obtained.

[0060] Transistors M1 through M5 are realized with PMOS transistors in the fifth embodiment, and they can also be realized with NMOS transistors, which will now be described with reference to FIG. 14.

[0061] FIG. 14 shows an equivalent circuit diagram of the pixel circuit according to a sixth embodiment of the present invention.

[0062] As shown, the pixel circuit realizes transistors M1 through M5 with NMOS transistors, and their coupling structure is symmetric with that of the pixel circuit of FIG. 13. The driving waveform for driving the pixel circuit of FIG. 14 has an inverse driving waveform of the pixel circuit of FIG. 14, and it is the same driving waveform as that of FIG. 8. Since the coupling structure and the operation of the pixel circuit according to the sixth embodiment can be easily derived from the description of the fifth embodiment, no further detailed description will be provided.

[0063] Two or one control signal is used to control the pixel circuit in the first through sixth embodiments, and differing from this, the pixel circuit can be controlled by using a select signal of a previous scan line without using the control signal, which will now be described in detail with reference to FIGs. 15 and 16.

[0064] FIG. 15 shows an equivalent circuit diagram of the pixel circuit according to a seventh embodiment of the present invention, and FIG. 16 shows a driving waveform diagram for driving the pixel circuit of FIG. 15.

[0065] As shown in FIG. 15, the pixel circuit has the same structure as that of the first embodiment except for transistors M3, M5, M6, and M7. In detail, transistor M3 diode-connects transistor M1 in response to select signal SE_{n-1} from previous scan line S_{n-1}, and transistor M7 diode-connects transistor M1 in response to select signal SE_n from current scan line S_n. Transistor M7 is coupled between data line D_m and the gate of transistor M1 in FIG. 15, and it can also be coupled between the gate and the drain of transistor M1. Transistors M5 and M6 are coupled in parallel between capacitor C2 and the gate of transistor M1. Transistor M5 responds to select signal SE_{n-1} from previous scan line S_{n-1}, and transistor M6 responds to emit signal EM_n from scan line E_n.

[0066] Next, the operation of the pixel circuit of FIG. 15 will be described referring to FIG. 16.

[0067] As shown, in interval T1, transistors M3 and M5 are turned on because of low-level select signal SE_{n-1}. Capacitors C1 and C2 are coupled in parallel between the gate and the source of transistor M1 because of turned-on transistor M5. Transistor M1 is diode-connected because of turned-on transistor M3 to store the threshold voltage V_{TH} of transistor M1 in capacitors C1 and C2 coupled in parallel. Transistors M2, M7, M4, and M6 are turned off because of high-level select signal SE_n and emit signal EM_n.

[0068] In interval T2, select signal SE_{n-1} becomes high level to turn off transistor M3, and transistor M7 is turned on because of low-level select signal SE_n to diode-connect transistor M1 and maintain the diode-connected state of transistor M1. Transistor M5 is turned off because of select signal SE_{n-1} to have capacitor C2 be floated while storing the voltage. Transistor M2 is turned on because of select signal SE_n to make data current I_{DATA} from data line D_m flow to transistor M1. The gate-source voltage V_{GS} (T2) of transistor M1 is determined corresponding to data current I_{DATA}, and the gate-source voltage V_{GS} (T2) is given as Equation 4 in the same manner of the first embodiment.

[0069] Next, in interval T3, select signal SE_n becomes high level to turn off transistors M2 and M7, and transistors M4 and M6 are turned off because of low-level emit signal EM_n. When transistor M6 is turned on, the gate-source voltage V_{GS} (T3) of transistor M1 is given as Equation 5 because of coupling of capacitors C1 and C2 in the like manner of the first embodiment. Therefore, current I_{OLED} shown in Equation 6 is supplied to the OLED because of turned-on transistor M4 to emit light.

[0070] The two control signals $CS1_n$ and $CS2_n$ are removed in the seventh embodiment, and differing from this, one of control signals $CS1_n$ and $CS2_n$ can be removed. In detail, in the case of additionally using control signal $CS1_n$ in the seventh embodiment, transistor M7 is removed from the pixel circuit of FIG. 15, and transistor M3 is driven by not select signal SE_{n-1} but by control signal $CS1_n$. In the case of additionally using control signal $CS2_n$ in the seventh embodiment, transistor M6 is removed from the pixel circuit of FIG. 15, and transistor M5 is not driven by the select signal SE_{n-1} and emit signal EM_n but by control signal $CS2_n$. Accordingly, the number of wires increases compared to FIG. 15, but the number of transistors can be reduced.

[0071] In the above, PMOS and/or NMOS transistors are used to realize a pixel circuit in the first through seventh embodiments, and without being restricted to this, the pixel circuit can be realized by PMOS transistors, NMOS transistors, or a combination of PMOS and NMOS transistors, and by other switches having similar functions.

[0072] Accordingly, since the current flowing to the OLED can be controlled using the large data current, the data line can be sufficiently charged during a single line time frame. Also, the deviation of the threshold voltage of the transistor or the deviation of the mobility is corrected, and a light emission display with high resolution and a wide screen can be realized.

Claims

1. A light emitting display comprising:

a display panel (10) on which are formed a plurality of data lines (D1-Dm) for transmitting data current which corresponds to the video data that have to be displayed, a plurality of scan lines (S1-Sn), and a plurality of pixel circuits (11) formed at a plurality of pixels defined by the data lines (D1-Dm) and the scan lines (S1-Sn), wherein at least one pixel circuit (11) includes:

a light emitting element (OLED) for emitting light corresponding to an applied current (I_{OLED}), a first transistor (M1) having first and second main electrodes and a control electrode, a first switch (M3), a second switch (M2), a third switch (M4), a first storage unit (C1), and a second storage unit (C2),

wherein the first transistor (M1) supplies a driving current for the light emitting element (OLED) the first switch (M3) diode-connects the first transistor in response to a first control signal (CS1n, SEn-1), the first and second storage units (C1, C2) store a first voltage corresponding to a threshold voltage of the first transistor in response to a second control signal (CS2n, Sen, SEn-1), the second switch (M2) transmits a data signal from a data line in response to a select signal (SEn) from the scan line; the first storage unit (C1) stores a second voltage corresponding to the gate voltage of the first transistor (M1) when the data current flows through the first transistor (M1), and the third switch (M4) transmits the driving current from the first transistor (M1) to the light emitting element (OLED) in response to a third control signal (EMn);

characterized in that
a third voltage determined by coupling of the first and second storage units (C1, C2) is applied to the first transistor to supply the driving current to the light emitting element (OLED).

2. The light emitting display of claim 1, further comprising a scan driver (20) for setting the second control signal to the enable level in a first interval, for setting the select signal the enable level in a second interval after the first interval, and for setting the third control signal to the enable level in a third interval after the second interval.

3. The light emitting display of claim 1, wherein the first switch, the second switch, the third switch and the first transistor are transistors of the same conductive type.

4. The light emitting display of claim 1, wherein at least one of the first switch, second switch and third switch has a conductive type opposite to that of the first transistor.

5. The light emitting display of claim 1, wherein
the first storage unit (C1) is coupled between the first main electrode and the control electrode of the first transistor (M1),
the second storage unit (C2) has a first end coupled to the first main electrode of the first transistor (M1), and
the pixel circuit further comprises a fourth switch (M5) turned on in response to the second control signal, and coupled between a second end of the second storage unit (C2) and the control electrode of the first transistor (M1).

6. The light emitting display of claim 5, wherein
the second control signal is the select signal (SEn) from the scan line, and
the fourth switch (M5) responds in the disable level of the select signal.

7. The light emitting display of claim 5, wherein the first control signal includes a select signal (SEn-1) from a previous scan line and a select signal (SEn) from a current scan line.

8. The light emitting display of claim 7, wherein the first switch includes a second transistor (M3) for diode-connecting the first transistor in response to the select signal (SEn-1) from the previous scan line and a third transistor (M7) for diode-connecting the first transistor in response to the select signal (SEn) from the current scan line.

9. The light emitting display of claim 5, wherein the second control signal includes a select signal (SEn-1) from a previous scan line, and the third control signal (EMn).

10. The light emitting display of claim 9, wherein
the pixel circuit further comprises a fifth switch (M6) coupled in parallel to the fourth switch (M5); and
the fourth and fifth switches (M5, M6) are respectively turned on in response to the select signal (SEn-1) from the previous scan line and the third control signal (EMn).

11. The light emitting display of claim 5, wherein the first control signal includes a select signal (SEn-1) from a previous scan line and a select signal (SEn) from the current scan line; and
the second control signal includes a select signal (SEn-1) from the previous scan line and the third control signal (EMn).

12. The light emitting display of claim 1, wherein
the first and second storage units (C1, C2) are coupled in series between the first main electrode and the control electrode of the first transistor (M1),
the pixel circuit further comprises a fourth switch (M5) coupled between the control electrode of the first transistor and the contact point of the first and second storage units (C1, C2), and responding to the second control signal.

13. The light emitting display of claim 1, further comprising
a first driving circuit (20) for supplying the select signal; the first control signal, the second control signal and the third control signal; and
a second driving circuit (30) for supplying the data current;
wherein the first driving circuit and the second driving circuit are coupled to the display panel, mounted as an integrated circuit chip type on the display panel, or directly formed in the same layers of the scan lines, the data lines, and the first switch on the substrate.

14. A method for driving a light emitting display having a pixel circuit (11) including a switch (M2) for transmitting a data current (I_{DATA}) from a data line (Dm) in response to a select signal from a scan line (Sn), a transistor (M1) including a first main electrode, a second main electrode and a control electrode for outputting a driving current (I_{OLED}) in response to the data current (I_{DATA}), and a light emitting element (OLED) for emitting light corresponding to the driving current (I_{OLED}) from the transistor (M1), the method comprising:

storing a first voltage corresponding to a threshold voltage, of the transistor (M1) in first and second storage units (C1, C2) formed between the control electrode and the first main electrode of the transistor (M1);
storing a second voltage corresponding to the gate voltage of the transistor (M1) when the data current flows through the transistor (M1) in the first storage unit (C1) formed between the control electrode and the first main electrode of the transistor (M1);
coupling the first and second storage units (C1, C2) to establish the voltage between the control electrode and the first main electrode of the transistor (M1) as a third voltage; and
transmitting the driving current (I_{OLED}) from the transistor (M1) to the light emitting element (OLED);

wherein the driving current (I_{OLED}) from the transistor (M1) is determined corresponding to the third voltage.

15. The method of claim 14, wherein
storing the first voltage in the first and second storage units (C1, C2) comprises coupling the first and second storage units (C1, C2) in parallel; and
storing the second voltage in the first storage unit (C1) comprises coupling the first storage unit (C1) between the control electrode and the first main electrode of the transistor (M1), and electrically intercepting one end of the second storage unit (C2) and the control electrode of the transistor (M1),
wherein the third voltage is determined by parallel coupling of the first and second storage units (C1, C2).

16. The method of claim 14, wherein
storing the first voltage in the first and second storage units (C1, C2) comprises coupling the first and second storage units (C1, C2) in series; and
storing the second voltage in the first storage unit (C1) comprises coupling the first storage unit (C1) between the control electrode and the first main electrode of the transistor (M1), and electrically intercepting one end of the second storage unit (C2) and the control electrode of the transistor (M1),
wherein the third voltage is determined by serial coupling of the first and second storage units (C1, C2).

17. The method of any one of claims 14-16, wherein
storing the first voltage in the first and second storage units (C1, C2) further comprises diode-connecting the transistor (M1) and electrically intercepting the transistor and the light emitting element (OLED).

18. The method of claim 17, wherein
storing the second voltage in the first storage unit (C1) further comprises diode-connecting the transistor (M1) and electrically intercepting the transistor and the light emitting element (OLED).

Patentansprüche

1. Eine lichtemittierende Anzeige, welche folgendes umfasst:

eine Anzeigetafel (10), auf der eine Mehrzahl von Datenleitungen (D1 -Dm) ausgebildet ist, um Datenstrom zu übertragen, der den Videodaten entspricht, die angezeigt werden sollen, ei ne Mehrzahl von Abtastleitungen (S1 -Sn) und
eine Mehrzahl von Bildpunktschaltkreisen (11), welche bei einer Mehrzahl von Bildpunkten ausgebildet sind,

welche von den Datenleitungen (D1 -Dm) und den Abtastleitungen (S1 -Sn) bestimmt werden, wobei mindestens e in Bildpunktschaltkreis (11) folgendes enthält:

ein lichtemittierendes Element (OLED), um Licht entsprechend einem angelegten Strom (I_{OLED}) zu emittieren, einen ersten Transistor (M1) mit ersten und zweiten Hauptelektroden und einer Steuerungselektrode, ei nen ersten Schalter (M3), einen zweiten Schalter (M2), einen dritten Schalter (M4), eine erste Speichereinheit (C1) und eine zweite Speichereinheit (C2),

wobei der erste Transistor (M1) einen Ansteuerungsstrom für das lichtemittierende Element (OLED) lief ert, der erste Schalter (M3) den ersten Transistor als Antwort auf ein erstes Steuersignal (CS1n, SEn -1) als Diode schaltet, die ersten und zweiten Speichereinheiten (C1, C2) eine erste Spannung entsprechend einer Schwellenspannung des ersten Transistors a ls Antwort auf ein zweites Steuersignal (CS2n, Sen, SEn -1) speichern, der zweite Schalter (M2) als Antwort auf ein Auswahlsignal (SEn) von der Abtastleitung ein Datensignal von einer Datenleitung überträgt; die erste Speichereinheit (C1) eine zweite Spannung speichert, die der Gatterspannung des ersten Transistors (M1) entspricht, wenn der Datenstrom durch den ersten Transistor (M1) fließt, und der dritte Schalter (M4) als Antwort auf ein drittes Steuersignal (EMn) den Ansteuerungsstrom von dem ersten Transistor (M1) zu dem lichtemittierenden Element (OLED) überträgt;

dadurch gekennzeichnet, dass
zum Liefern des Ansteuerungsstroms an das lichtemittierende Element (OLED) eine dritte Spannung, bestimmt durch Verschalten der ersten und zweiten Speichereinheiten (C1, C2), an den ersten Transistor angelegt wird.

2. Lichtemittierende Anzeige nach Anspruch 1, welche weiterhin einen Abtasttreiber (20), um das zweite Steuersignal in einem ersten Intervall auf das Auslösungsniveau einzustellen, um das Auswahlsignal in ei nem zweiten Intervall nach dem ersten Intervall auf das Auslösungsniveau einzustellen, und um das dritte Steuersignal in einem dritten Intervall nach dem zweiten Intervall auf das Auslösungsniveau einzustellen, umfasst.

3. Lichtemittierende Anzeige nach Anspruch 1,
dadurch gekennzeichnet, dass
der erste Schalter, der zweite Schalter, der dritte Schalter und der erste Transistor Transistoren vom gleichen Leitungstyp sind.

4. Lichtemittierende Anzeige nach Anspruch 1,
dadurch gekennzeichnet, dass
von dem erste n Schalter, dem zweiten Schalter und dem dritten Schalter mindestens ein Schalter einen dem Leitungstyp des ersten Transistors entgegengesetzten Leitungstyp hat.

5. Lichtemittierende Anzeige nach Anspruch 1,
dadurch gekennzeichnet, dass

- die erste Speichereinheit (C1) zwischen die erste Hauptelektrode und die Steuerungselektrode des ersten Transistors (M1) geschaltet ist,
- die zweite Speichereinheit (C2) ein erstes Ende hat, welches mit der ersten Hauptelektrode des ersten Transistors (M1) verschaltet ist, und
- der Bildpunktschaltkreis weiterhin einen vierten Schalter (M5) umfasst, welcher als Antwort auf das zweite Steuersignal eingeschaltet wird und zwischen einem zweiten Ende der zweiten Speichereinheit (C2) und der Steuerungselektrode des ersten Transistors (M1) verschaltet ist.

6. Lichtemittierende Anzeige nach Anspruch 5,
dadurch gekennzeichnet, dass

- das zweite Steuersignal das Auswahlsignal (SEn) von der Abtastleitung ist, und
- der vierte Schalter (M5) im Nichtauslösungsniveau des Auswahlsignals anspricht.

7. Lichtemittierende Anzeige nach Anspruch 5,
dadurch gekennzeichnet, dass
das erste Steuersignal ein Auswahlsignal (SEn -1) von einer vorherigen Abtastleitung und ein Auswahlsignal (SEn) von einer aktuellen Abtastleitung enthält.

8. Lichtemittierende Anzeige nach Anspruch 7,
dadurch gekennzeichnet, dass
der erste Schalter einen zweiten Transistor (M3), um den ersten Transistor als Antwort auf das Auswahlsignal (SEn -1) von der vorherigen Abtastleitung als Diode zu schalten, und einen dritten Transistor (M7), u m den ersten Transistor als Antwort auf das Auswahlsignal (SEn) von der aktuellen Abtastleitung als Diode zu schalten, enthält.

9. Lichtemittierende Anzeige nach Anspruch 5,
dadurch gekennzeichnet, dass
das zweite Steuersignal ein Auswahlsignal (SEn -1) von einer vorherigen Abtastleitung und das dritte Steuersignal (EMn) enthält.

10. Lichtemittierende Anzeige nach Anspruch 9,
dadurch gekennzeichnet, dass

- der Bildpunktschaltkreis weiterhin einen fünften Schalter (M6) umfasst, welcher parallel zu dem vierten Scha lter (M5) geschaltet ist; und
- die vierten und fünften Schalter (M5, M6) als Antwort auf das Auswahlsignal (SEn-1) von der vorherigen Abtastleitung beziehungsweise auf das dritte Steuersignal (EMn) eingeschaltet werden.

11. Lichtemittierende Anzeige nach Anspruch 5,
dadurch gekennzeichnet, dass

- das erste Steuersignal ein Auswahlsignal (SEn -1) von einer vorherigen Abtastleitung und ein Auswahlsignal (SEn) von der aktuellen Abtastleitung enthält; und
- das zweite Steuersignal ein Auswahlsignal (SEn -1) von der vorherigen Abtastleitung und das dritte Steuersignal (EMn) enthält.

12. Lichtemittierende Anzeige nach Anspruch 1,
dadurch gekennzeichnet, dass

- die ersten und zweiten Speichereinheiten (C1, C2) zwischen der ersten Hauptelektrode und der Steuerelektrode des erste n Transistors (M1) in Reihe geschaltet sind,
- der Bildpunktschaltkreis weiterhin einen vierten Schalter (M5) umfasst, welcher zwischen der Steuerungselektrode des ersten Transistors und dem Kontaktpunkt der ersten und zweiten Speichereinheiten (C1, C2) geschaltet ist und auf das zweite Steuersignal anspricht.

13. Lichtemittierende Anzeige nach Anspruch 1, die weiterhin folgendes umfasst:

- einen ersten Ansteuerungsschaltkreis (20) um das Auswahlsignal, das erste Steuersignal, das zweite Steuersignal und das dritt e Steuersignal zu liefern; und
- einen zweiten Ansteuerungsschaltkreis (30), um den Datenstrom zu liefern;

dadurch gekennzeichnet, dass
der erste Ansteuerungsschaltkreis und der zweite Ansteuerungsschaltkreis mit der Anzeigetafel verschaltet sind, auf der An zeigetafel als Chip nach Art eines integrierten Schaltkreises angebracht sind, oder direkt in den selben Schichten der Abtastleitungen, der Datenleitungen und des ersten Schalters auf dem Substrat ausgebildet sind.

14. Verfahren zum Ansteuern einer lichtemittierenden Anzeige mit einem Bildpunktschaltkreis (11), welcher einen Schalter (M2) zum Übertragen eines Datenstroms (I DATA) von einer Datenleitung (Dm) als Antwort auf ein Auswahlsignal von einer Abtastleitung (Sn) enthält, einem Transistor (M1), welcher eine erste Hauptelektrode, eine zweite Hauptelektrode und eine Steuerelektrode zum Ausbringen eines Ansteuerungsstroms (I_{OLED}) als Antwort auf den Datenstrom (I DATA) enthält, und einem lichtemittierenden Element (OLED) zum Emittieren von Licht entsprechend dem Ansteuerungsstrom (I_{OLED}) von dem Transistor (M1), wobei das Verfahren folgendes umfasst:

- Speichern einer ersten Spannung entsprechend einer Schwellenspannung des Transistors (M1) in ersten und zweiten Speichereinheiten (C1, C2), welche zwischen der Steuerelektrode und der ersten Hauptelektrode des Transistors (M1) ausgebildet sind;
- Speichern einer zweiten Spannung entsprechend der Gatterspannung des Transistors (M1), wenn der Da-

tenstrom durch den Transistor (M1) fließt, in der ersten Speichereinheit (C1), welche zwischen der Steuerelektrode und der ersten Hauptelektrode des Transistors (M1) ausgebildet ist;
• Verschalten der ersten und zweiten Speichereinheiten (C1, C2), um die Spannung zwischen der Steuerelektrode und der ersten Hauptelektrode des Transistors (M1) als dritte Spannung zu bilden; und
• Übertragen des Ansteuerungsstroms (I_{OLED}) von dem Transistor (M1) zu dem lichtemittierenden Element (OLED);

dadurch gekennzeichnet, dass
der Ansteuerungsstrom (I_{OLED}) von dem Transistor (M1) entsprechend der dritten Spannung bestimmt wird.

15. Verfahren nach Anspruch 14, wobei

• Speichern der ersten Spannung in den ersten und zweiten Speichereinheiten (C1, C2) paralleles Verschalten der ersten und zweiten Speichereinheiten (C1, C2) umfasst; und
• Speichern der zweiten Spannung in der ersten Speichereinheit (C1) Verschalten der ersten Speichereinheit (C1) zwischen der Steuerelektrode und der ersten Hauptelektrode des Transistors (M1) und elektrisches Abgreifen eines Endes der zweiten Speichereinheit (C2) und der Steuerelektrode des Transistors (M1) umfasst,

dadurch gekennzeichnet, dass
die dritte Spannung durch paralleles Verschalten der ersten und zweiten Speichereinheiten (C1, C2) bestimmt wird.

16. Verfahren nach Anspruch 14, wobei

• Speichern der ersten Spannung in den ersten und zweiten Speichereinheiten (C1, C2) Verschalten der ersten und zweiten Speichereinheiten (C1, C2) in Reihe umfasst; und
• Speichern der zweiten Spannung in der ersten Speichereinheit (C1) Verschalten der ersten Speichereinheit (C1) zwischen der Steuerelektrode und der ersten Hauptelektrode des Transistors (M1) und elektrisches Abgreifen eines Endes der zweiten Speichereinheit (C2) und der Steuerelektrode des Transistors (M1) umfasst,

dadurch gekennzeichnet, dass
die dritte Spannung durch Schalten der ersten und zweiten Speichereinheiten (C1, C2) in Reihe bestimmt wird.

17. Verfahren nach einem der Ansprüche 14 -16,
dadurch gekennzeichnet, dass
Speichern der ersten Spannung in den ersten und zweiten Speichereinheiten (C1, C2) weiterhin Verschalten des Transistors (M1) als Diode und elektrisches Abgreifen des Transistors und des lichtemittierenden Elements (OLED) umfasst.

18. Verfahren nach Anspruch 17,
dadurch gekennzeichnet, dass
Speichern der ersten Spannung in der ersten Speichereinheit (C1) weiterhin Verschalten des Transistors (M1) als Diode und elektrisches Abgreifen des Transistors und des lichtemittierenden Elements (OLED) umfasst.

Revendications

1. Dispositif d'affichage émettant de la lumière, comportant :

un panneau d'affichage (10) sur lequel sont formées une pluralité de lignes de données (D1-Dm) pour la transmission d'un courant de données qui correspond aux données vidéo devant être affichées, une pluralité de lignes de balayage (S1-Sn) et une pluralité de circuits de pixels (11) formée en une pluralité de pixels définis par les lignes de données (D1-Dm) et les lignes de balayage (S1-Sn), dans lequel au moins un circuit de pixel (11) comprend :

un élément émetteur de lumière (OLED) destiné à émettre une lumière correspondant à un courant appliqué (I_{OLED}), un premier transistor (M1) ayant des première et seconde électrodes principales et une électrode de commande, un premier commutateur (M3), un deuxième commutateur (M2), un troisième commutateur (M4), une première unité de stockage (C1) et une seconde unité de stockage (C2), dans lequel le premier transistor (M1) fournit un courant d'attaque pour l'élément émetteur de lumière (OLED), le premier commutateur (M3) connecte en diode le premier transistor en réponse à un premier signal de commande (CS1n, SEn-1), les première et seconde unités de stockage (C1, C2) stockent une première tension correspondant à une tension de seuil du premier transistor en réponse à un deuxième signal de commande (CS2n, Sen, SEn-1), le deuxième commutateur (M2) transmet un signal de donnée depuis une ligne de données en réponse à un signal de sélection (SEn) provenant de la ligne de balayage ; la première unité de stockage (C1) stocke une seconde tension correspondant à la tension de grille du premier transistor (M1) lorsque le courant de données circule dans le premier transistor (M1), et le troisième commutateur (M4) transmet le courant d'attaque du premier transistor (M1) à l'élément émetteur de lumière (OLED) en réponse à un troisième signal de commande (EMn) ;

caractérisé en ce que
une troisième tension déterminée en couplant les première et seconde unités (C1, C2) de stockage est appliquée au premier transistor pour fournir le courant d'attaque à l'élément émetteur de lumière (OLED).

2. Dispositif d'affichage émettant de la lumière selon la revendication 1, comportant en outre un élément d'attaque de balayage (20) destiné à établir le deuxième signal de commande au niveau de validation dans un premier intervalle, à établir le signal de sélection au niveau de validation dans un deuxième intervalle après le premier intervalle, et à établir le troisième signal de commande au niveau de validation dans un troisième intervalle après le deuxième intervalle.

3. Dispositif d'affichage émettant de la lumière selon la revendication 1, dans lequel le premier commutateur, le deuxième commutateur, le troisième commutateur et le premier transistor sont des transistors du même type de conductivité.

4. Dispositif d'affichage émettant de la lumière selon la revendication 1, dans lequel au moins l'un du premier commutateur, du deuxième commutateur et du troisième commutateur a un type de conductivité opposé à celui du premier transistor.

5. Dispositif d'affichage émettant de la lumière selon la revendication 1, dans lequel
la première unité de stockage (C1) est couplée entre la première électrode principale et l'électrode de commande du premier transistor (M1),
la seconde unité de stockage (C2) a une première extrémité couplée à la première électrode principale du premier transistor (M1), et
le circuit de pixel comporte en outre un quatrième commutateur (M5) fermé en réponse au deuxième signal de commande, et couplé entre une seconde extrémité de la seconde unité de stockage (C2) et l'électrode de commande du premier transistor (M1).

6. Dispositif d'affichage émettant de la lumière selon la revendication 5, dans lequel
le deuxième signal de commande est le signal de sélection (SEn) provenant de la ligne de balayage, et
le quatrième commutateur (M5) réagit dans le niveau d'invalidation du signal de sélection.

7. Dispositif d'affichage émettant de la lumière selon la revendication 5, dans lequel le premier signal de commande comprend un signal de sélection (SEn-1) provenant d'une ligne de balayage précédente et un signal de sélection (SEn) provenant d'une ligne de balayage en cours.

8. Dispositif d'affichage émettant de la lumière selon la revendication 7, dans lequel le premier commutateur comprend un deuxième transistor (M3) pour une connexion en diode du premier transistor en réponse au signal de sélection (SEn-1) provenant de la ligne de balayage précédente et un troisième transistor (M7) pour la connexion en diode du premier transistor en réponse au signal de sélection (SEn) provenant de la ligne de balayage en cours.

9. Dispositif d'affichage émettant de la lumière selon la revendication 5, dans lequel le deuxième signal de commande comprend un signal de sélection (SEn-1) provenant d'une ligne de balayage précédente, et le troisième signal de commande (EMn).

10. Dispositif d'affichage émettant de la lumière selon la revendication 9, dans lequel
le circuit de pixel comporte en outre un cinquième commutateur (M6) couplé en parallèle avec le quatrième commutateur (M5) ; et
les quatrième et cinquième commutateurs (M5, M6) sont respectivement fermés en réponse au signal de sélection

(SEn-1) provenant de la ligne de balayage précédente et au troisième signal de commande (EMn).

11. Dispositif d'affichage émettant de la lumière selon la revendication 5, dans lequel le premier signal de commande comprend un signal de sélection (SEn-1) provenant d'une ligne de balayage précédente et un signal de sélection (SEn) provenant de la ligne de balayage en cours ; et
le deuxième signal de commande comprend un signal de sélection (SEn-1) provenant de la ligne de balayage précédente et le troisième signal de commande (EMn).

12. Dispositif d'affichage émettant de la lumière selon la revendication 1, dans lequel
les première et seconde unités de stockage (C1, C2) sont couplées en série entre la première électrode principale et l'électrode de commande du premier transistor (M1),
le circuit de pixel comporte en outre un quatrième commutateur (M5) couplé entre l'électrode de commande du premier transistor et le point de contact des première et seconde unités de stockage (C1, C2) et réagissant au deuxième signal de commande.

13. Dispositif d'affichage émettant de la lumière selon la revendication 1, comportant en outre
un premier circuit d'attaque (20) destiné à fournir le signal de sélection ; le premier signal de commande, le deuxième signal de commande et le troisième signal de commande ; et
un second circuit d'attaque (30) destiné à fournir le courant de données ;
dans lequel le premier circuit d'attaque et le second circuit d'attaque sont couplés au panneau d'affichage, montés sous la forme d'un type de puce à circuit intégré sur le panneau d'affichage, ou directement formés dans les mêmes couches des lignes de balayage, des lignes de données et du premier commutateur sur le substrat.

14. Procédé pour attaquer un dispositif d'affichage émettant de la lumière ayant un circuit de pixel (11) comprenant un commutateur (M2) pour la transmission d'un courant de données (I_{DATA}) depuis une ligne de données (Dm) en réponse à un signal de sélection provenant d'une ligne de balayage (Sn), un transistor (M1) ayant une première électrode principale, une seconde électrode principale et une électrode de commande pour délivrer en sortie un courant d'attaque (I_{OLED}) en réponse au courant de données (I_{DATA}), et un élément émetteur de lumière (OLED) destiné à émettre de la lumière correspondant au courant d'attaque (I_{OLED}) provenant du transistor (M1), le procédé comprenant :

le stockage d'une première tension correspondant à une tension de seuil du transistor (M1) dans des première et seconde unités de stockage (C1, C2) formées entre l'électrode de commande et la première électrode principale du transistor (M1) ;
le stockage d'une deuxième tension, correspondant à une tension de grille du transistor (M1), lorsque le courant de données circule à travers le transistor (M1), dans la première unité de stockage (C1) formée entre l'électrode de commande et la première électrode principale du transistor (M1) ;
le couplage des première et seconde unités de stockage (C1, C2) pour établir la tension entre l'électrode de commande et la première électrode principale du transistor (M1) en tant que troisième tension ; et
la transmission du courant d'attaque (I_{OLED}) du transistor (M1) à l'élément émetteur de lumière (OLED) ;

dans lequel le courant d'attaque (I_{OLED}) provenant du transistor (M1) est déterminé de façon à correspondre à la troisième tension.

15. Procédé selon la revendication 14, dans lequel
le stockage de la première tension dans les première et seconde unités de stockage (C1, C2) comprend un couplage en parallèle des première et seconde unités de stockage (C1, C2) ; et
le stockage de la deuxième tension dans la première unité de stockage (C1) comprend un couplage de la première unité de stockage (C1) entre l'électrode de commande et la première électrode principale du transistor (M1), et une interception électrique d'une extrémité de la seconde unité de stockage (C2) et de l'électrode de commande du transistor (M1),
dans lequel la troisième tension est déterminée par un couplage en parallèle des première et seconde unités de stockage (C1, C2).

16. Procédé selon la revendication 14, dans lequel
le stockage de la première tension dans les première et seconde unités de stockage (C1, C2) comprend un couplage en série des première et seconde unités de stockage (C1, C2) ; et
le stockage de la seconde tension dans la première unité de stockage (C1) comprend le couplage de la première

unité de stockage (C1) entre l'électrode de commande et la première électrode principale du transistor (M1), et l'interception électrique d'une extrémité de la seconde unité de stockage (C2) et de l'électrode de commande du transistor (M1) ,
dans lequel la troisième tension est déterminée par le couplage en série des première et seconde unités de stockage (C1, C2).

17. Procédé selon l'une quelconque des revendications 14 à 16, dans lequel
le stockage de la première tension dans les première et seconde unités de stockage (C1, C2) comprend en outre la connexion en diode du transistor (M1) et l'interception électrique du transistor et de l'élément émetteur de lumière (OLED) .

18. Procédé selon la revendication 17, dans lequel
le stockage de la seconde tension dans la première unité de stockage (C1) comprend en outre la connexion en diode du transistor (M1) et l'interception électrique du transistor et de l'élément émetteur de lumière (OLED).

FIG.1

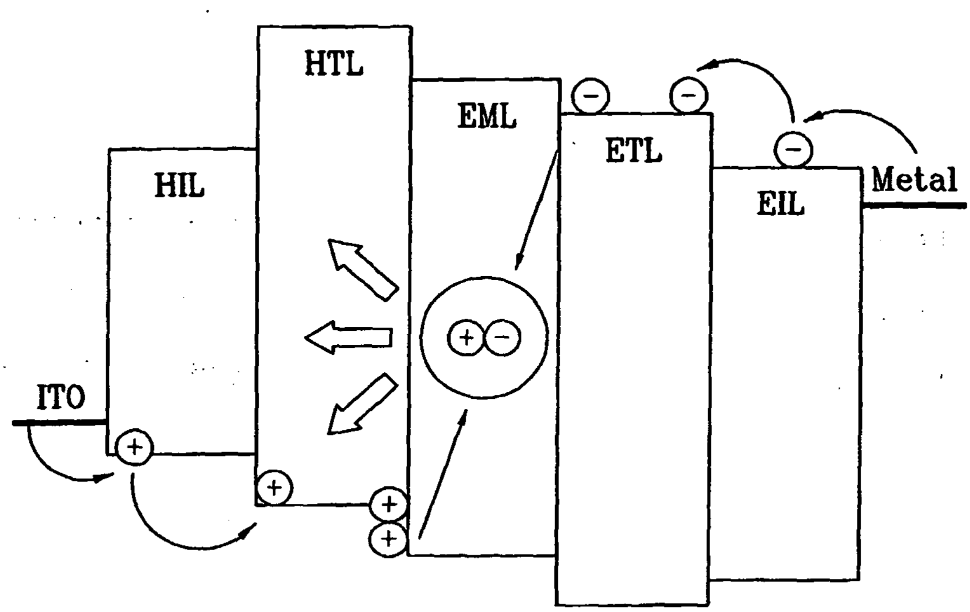


FIG.2

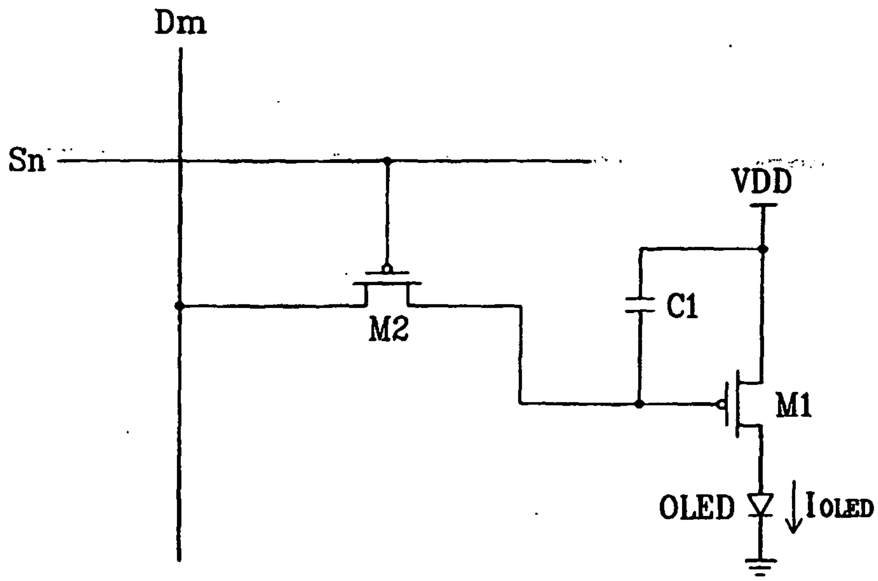


FIG.3

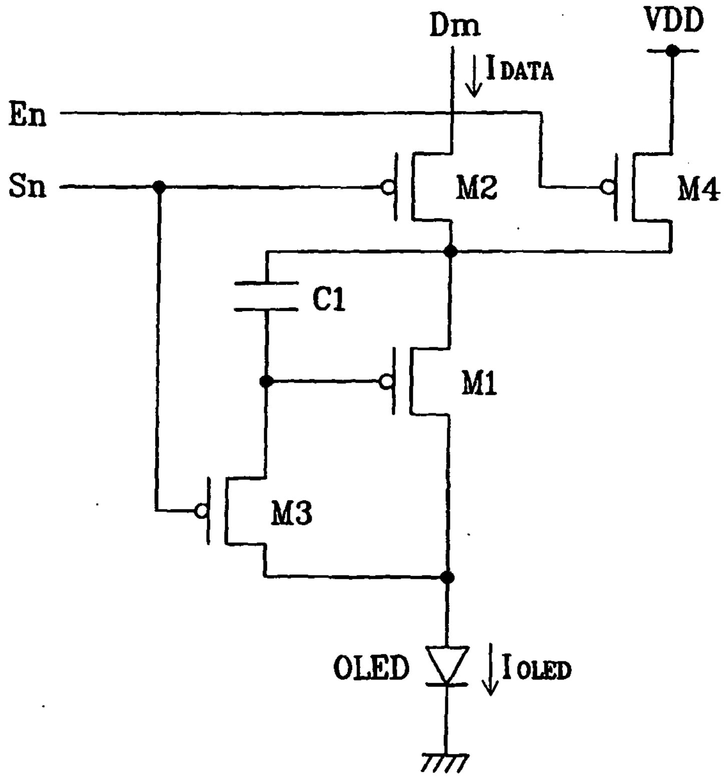


FIG.4

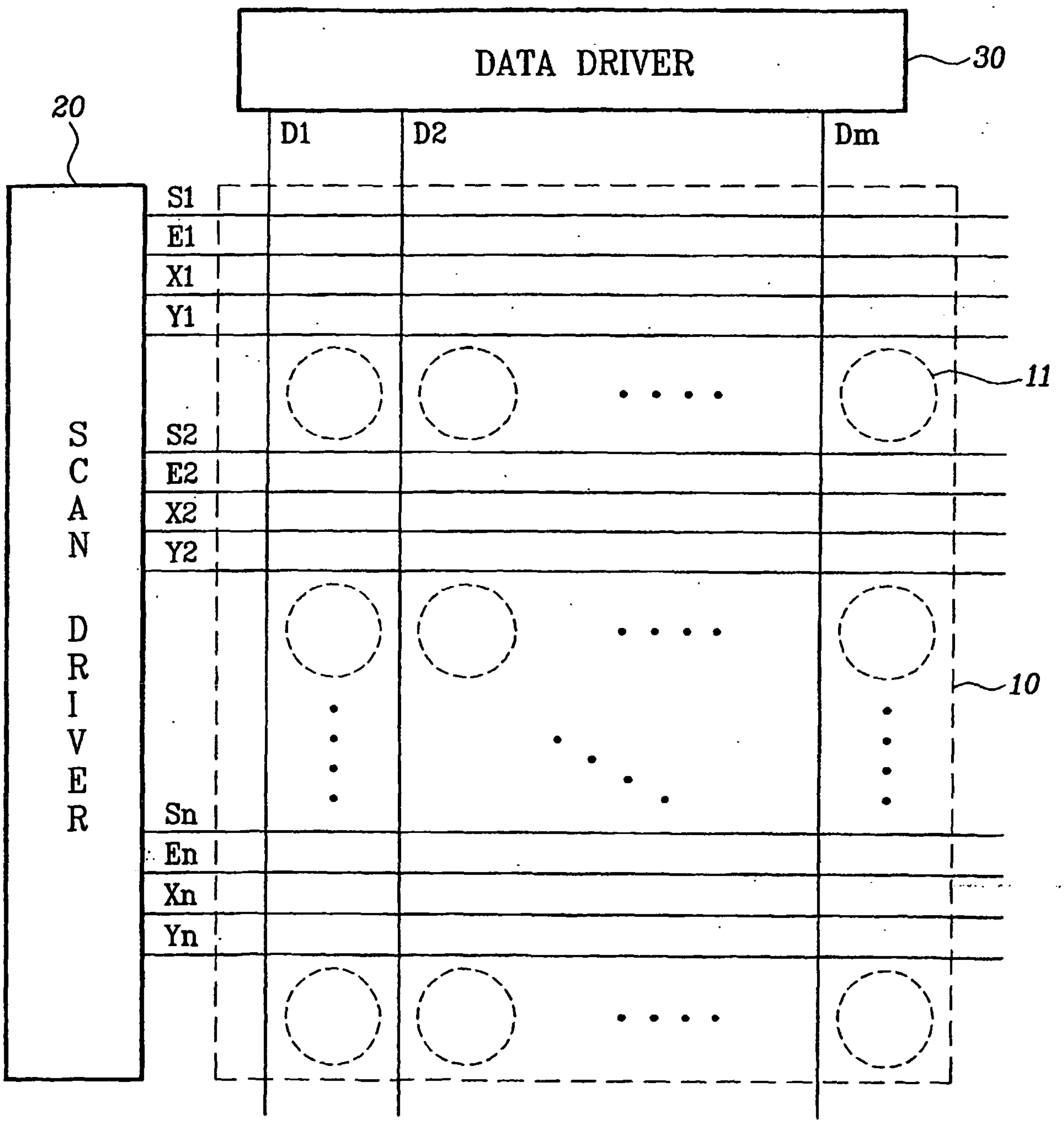

DATA DRIVER
30
20
D1
D2
Dm
S1
E1
X1
Y1
11
S2
E2
X2
Y2
SCAN DRIVER
10
Sn
En
Xn
Yn

FIG.5

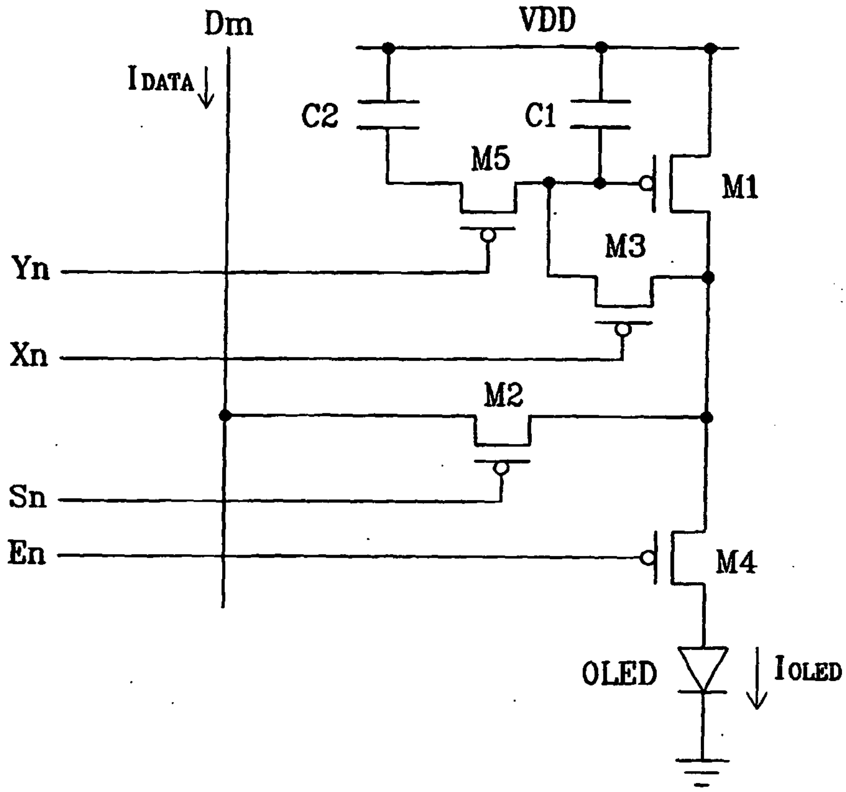

Dm
VDD
IDATA
C2
C1
M5
M1
M3
Yn
Xn
M2
Sn
En
M4
OLED
IOLED

FIG.6

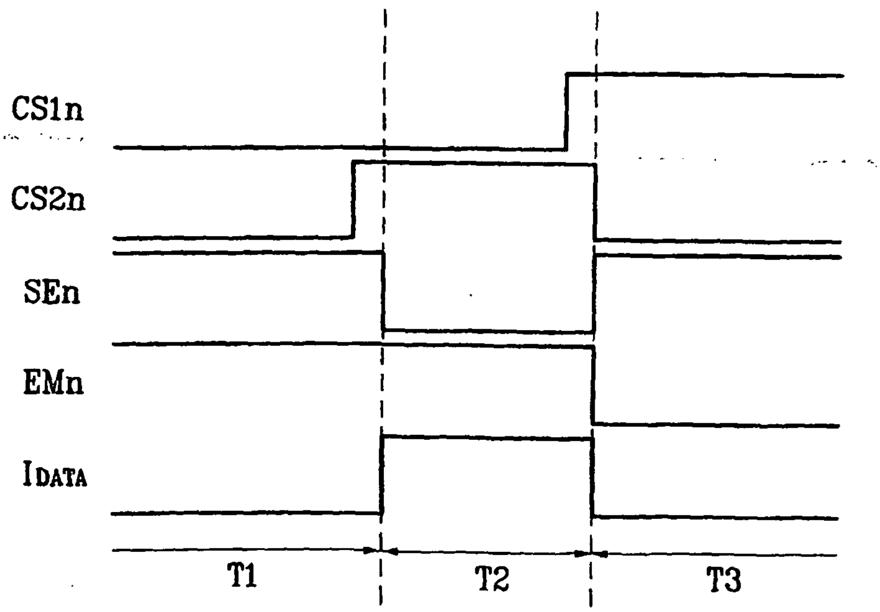

CS1n
CS2n
SEn
EMn
IDATA
T1
T2
T3

FIG. 7

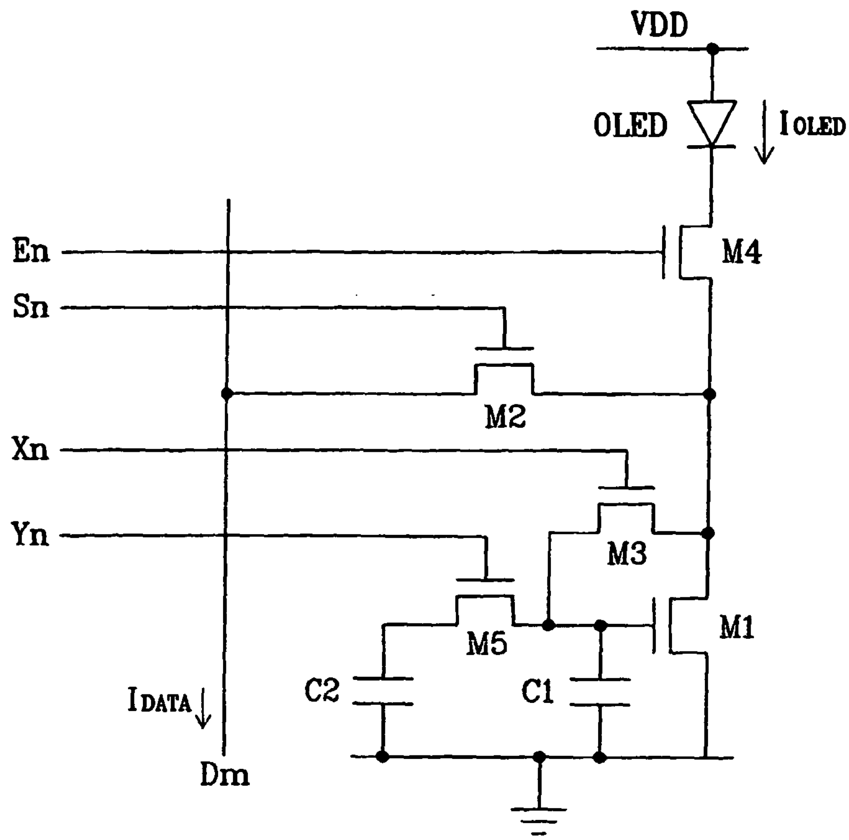

VDD
OLED
IOLED
En
Sn
M4
M2
Xn
Yn
M3
M5
M1
C2
C1
IDATA
Dm

FIG. 8

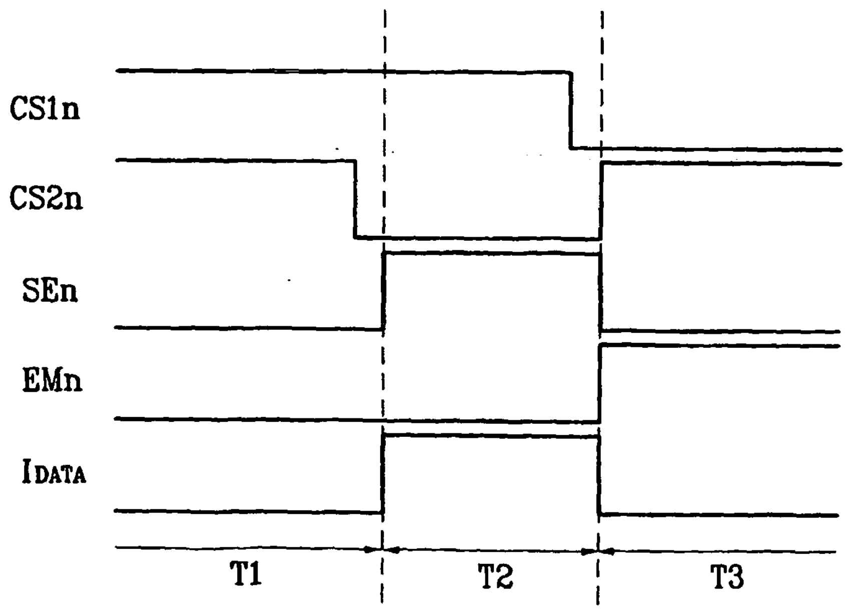

CS1n
CS2n
SEn
EMn
IDATA
T1
T2
T3

FIG.9

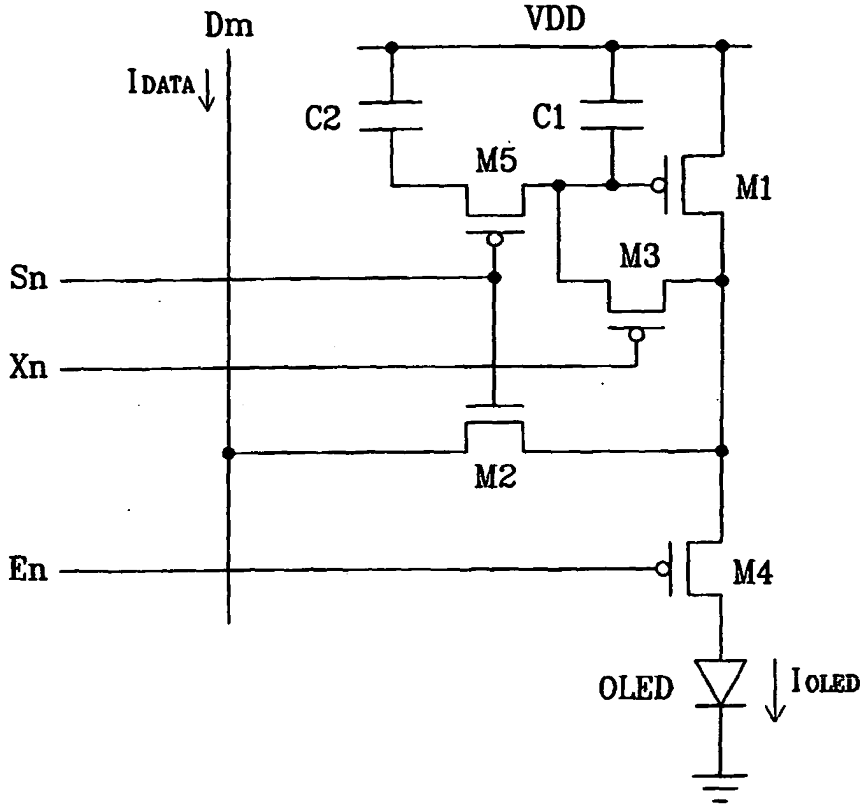

Dm
VDD
IDATA
C2
C1
M5
M1
M3
Sn
Xn
M2
En
M4
OLED
IOLED

FIG.10

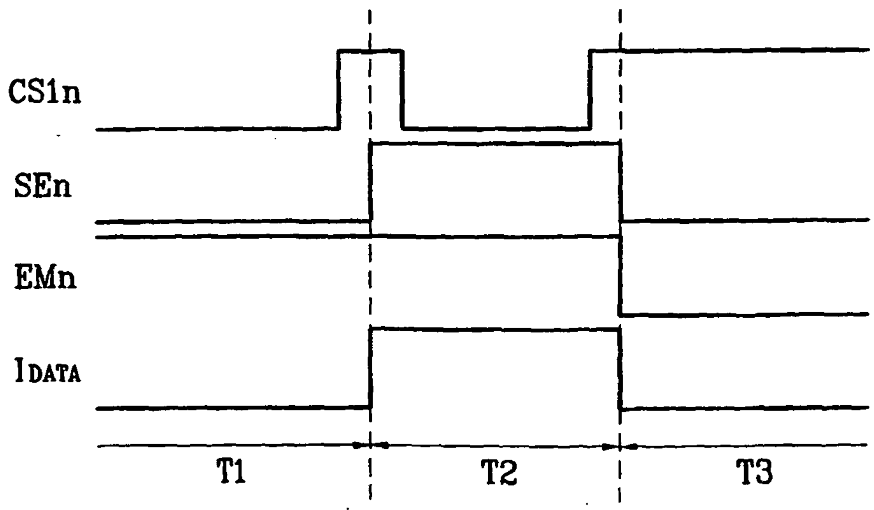

CS1n
SEn
EMn
IDATA
T1
T2
T3

FIG.11

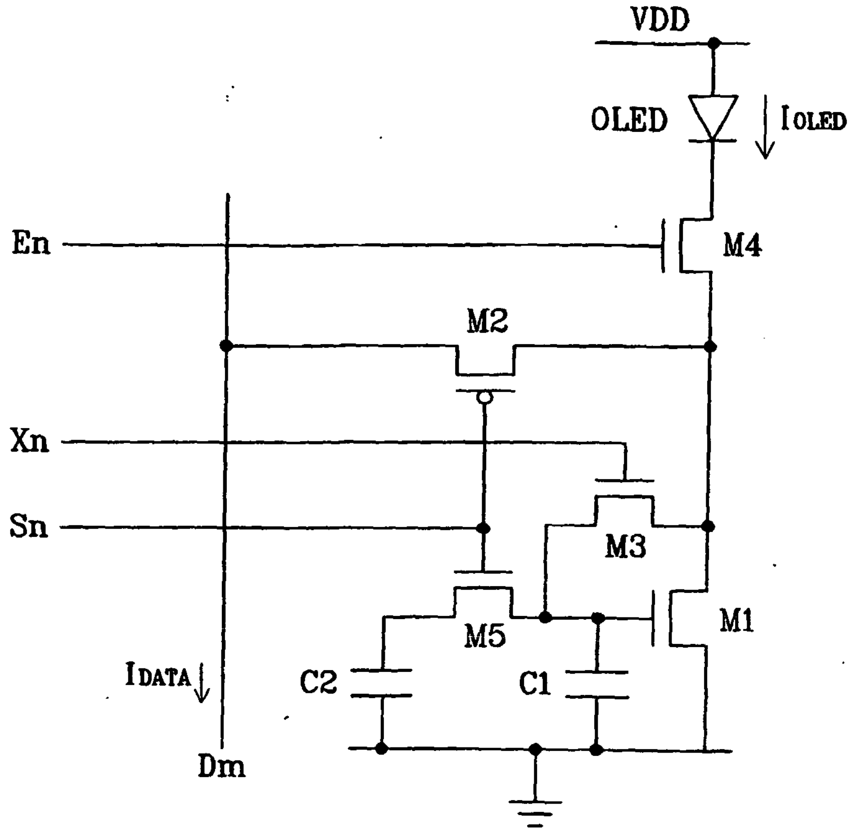

VDD
OLED
IOLED
En
M4
M2
Xn
Sn
M3
M1
M5
IDATA
C2
C1
Dm

FIG.12

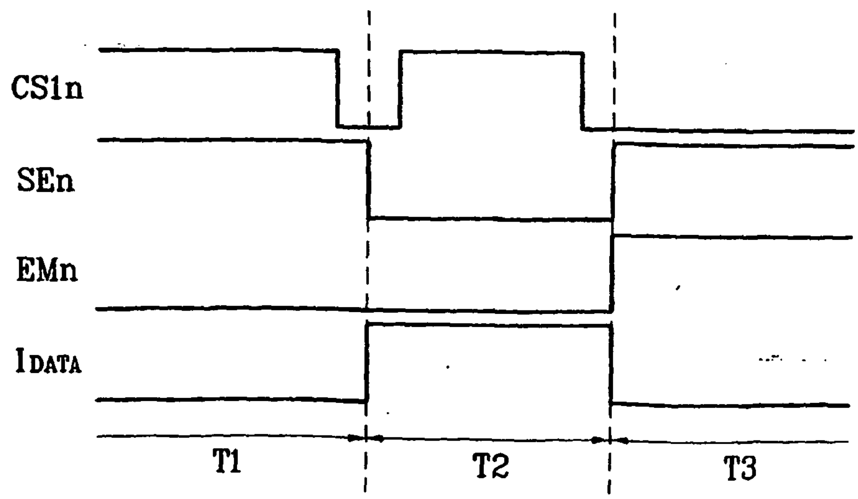

CS1n
SEn
EMn
IDATA
T1
T2
T3

FIG.13

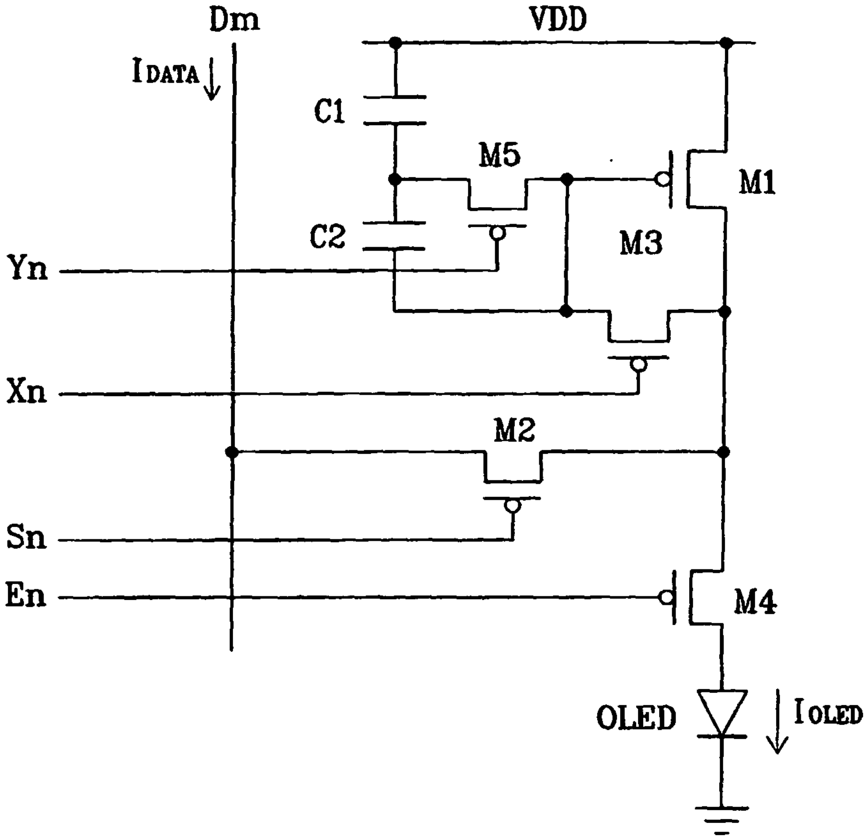


FIG.14

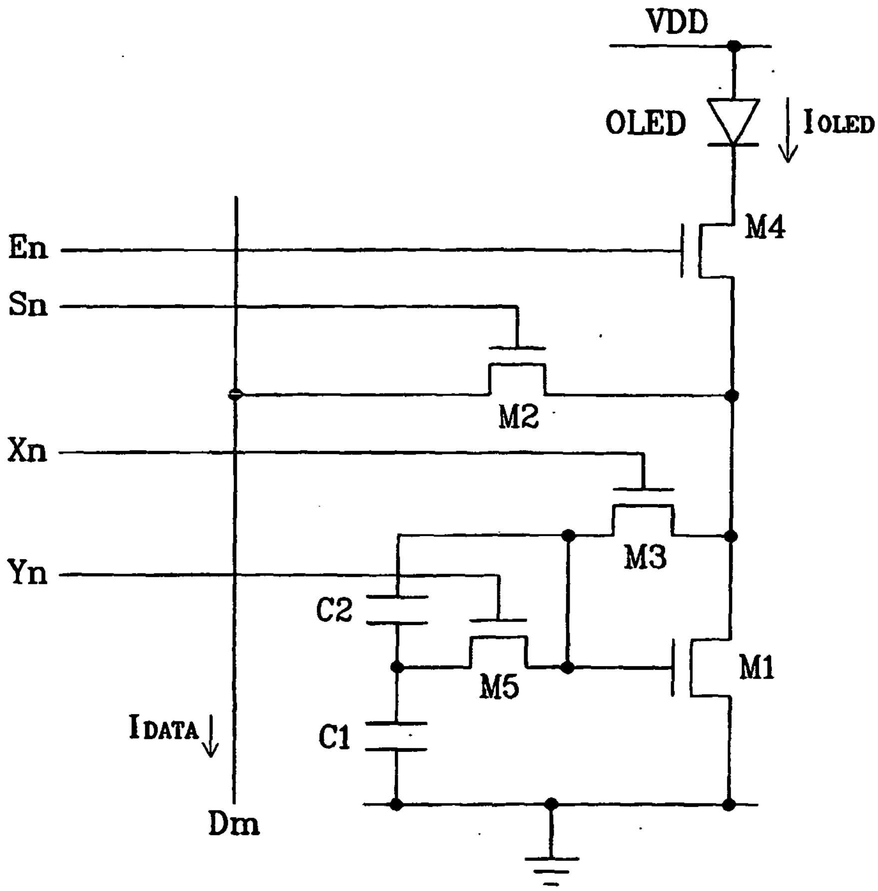


FIG.15

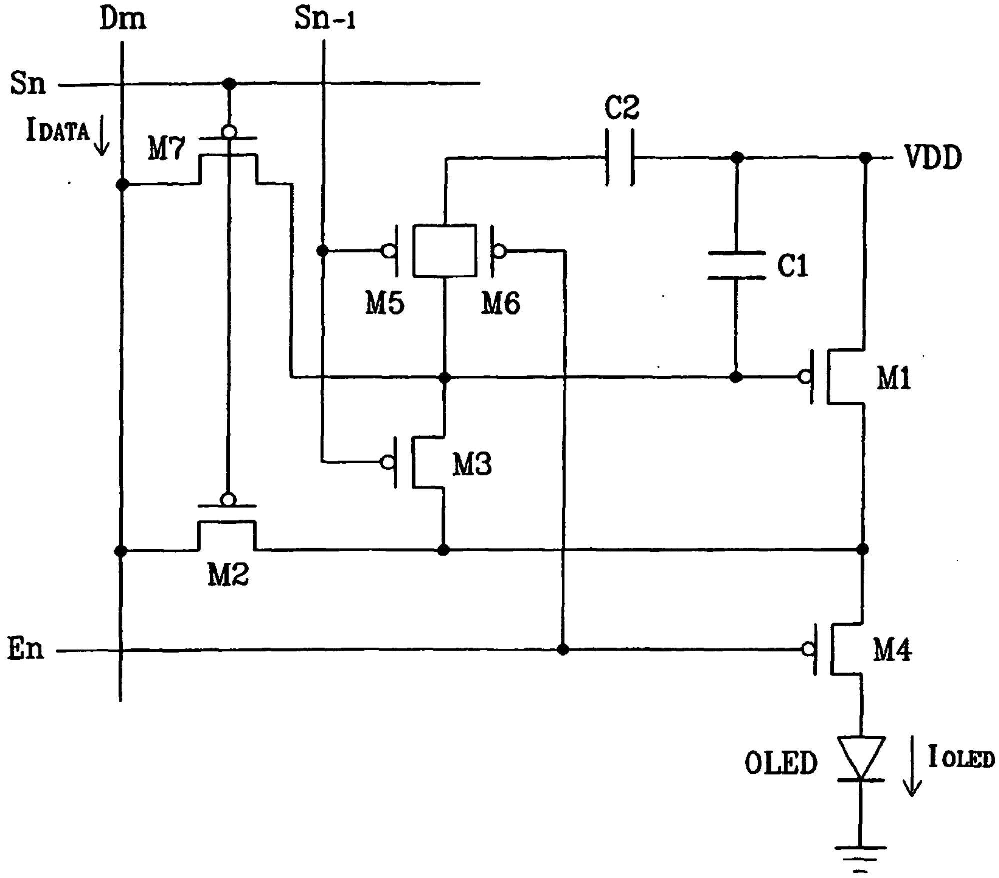
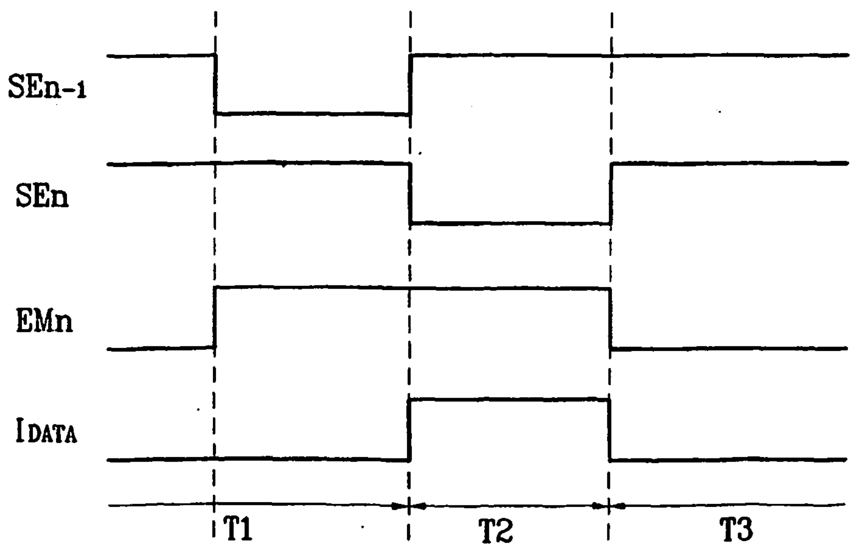

Dm
Sn-1
Sn
IDATA
M7
C2
VDD
C1
M5
M6
M1
M3
M2
En
M4
OLED
IOLED

FIG.16


SEn-1
SEn
EMn
IDATA
T1
T2
T3

专利名称(译)	发光显示器，显示面板及其驱动方法		
公开(公告)号	EP1465143B1	公开(公告)日	2006-09-27
申请号	EP2003090385	申请日	2003-11-13
[标]申请(专利权)人(译)	三星斯笛爱股份有限公司		
申请(专利权)人(译)	三星SDI CO.，LTD.		
当前申请(专利权)人(译)	三星SDI CO.，LTD.		
[标]发明人	KWON OH KYONG		
发明人	KWON, OH-KYONG		
IPC分类号	G09G3/32 H01L51/50 G09G3/14 G09G3/20 G09G3/30 G09G3/36 G11C11/00 H05B33/00 H05B33/14		
CPC分类号	G09G3/325 G09G2300/0852 G09G2300/0861 G09G2310/0251 G09G2310/0262 G09G2320/0223 G09G2320/0233		
代理机构(译)	hengelhaupt，Jürgen		
优先权	1020030020432 2003-04-01 KR		
其他公开文献	EP1465143A2 EP1465143A3		
外部链接	Espacenet		

摘要(译)

一种用于补偿晶体管或迁移率的阈值电压并对数据线完全充电的发光显示器。晶体管和第一至第三开关形成在有机EL显示器的像素电路上。晶体管提供用于发出有机EL元件（OLED）的驱动电流。第一开关二极管连接晶体管。第一存储单元存储与晶体管的阈值电压相对应的第一电压。第二开关响应于选择信号传输数据电流。第二存储单元存储与数据电流对应的第二电压。第三开关将驱动电流传输到OLED。通过第一和第二存储单元的耦合确定的第三电压被施加到晶体管以向OLED提供驱动电流。

Equation 1

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