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(54) **Electroluminescent display device and pixel circuit therefor**

Elektrolumineszenzanzeigevorrichtung und Pixelschaltung dafür

Dispositif d'affichage électroluminescent et circuit de commande de pixel approprié

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Description

BACKGROUND OF THE INVENTION**(a) Field of the Invention**

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

(b) Description of the Related Art

[0002] In general, an organic electroluminescent (EL) display is a display device that electrically excites a phosphorous organic compound in a plurality of organic light emitting diodes (OLEDs) to emit light. The organic EL display voltage- or current-drives NxM organic emitting cells to display images. An organic emitting cell of the organic EL display includes an anode (ITO), an organic thin film, and a cathode layer (metal). The organic thin film has a multi-layer structure including an emitting layer (EML), an electron transport layer (ETL), and an 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 an 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 MOSFETs. The passive matrix method forms cathodes and anodes to cross (or cross over) with (or perpendicular to) each other, and selects lines to drive the organic emitting cells. The active matrix method connects a TFT and a capacitor with each indium tin oxide (ITO) pixel electrode to thereby maintain a predetermined voltage according to a capacitance of the capacitor. The active matrix method can further be classified as a voltage programming method or a current programming method according to signal forms supplied for maintaining a voltage at a capacitor.

[0004] FIG. 1 shows a conventional pixel circuit for driving an organic EL element using TFTs and representatively illustrates a pixel circuit coupled to a data line Dm and a scan line Sn from among NxM pixel circuits (or cells). As shown, a driving transistor M1 is coupled to an organic EL element OLED to supply a current for light emission thereto. The current of the driving transistor M1 is controlled by a data voltage applied through a switching transistor M2. A capacitor Cst (or a storage capacitor) for maintaining the applied voltage for a predetermined time is coupled between a source and a gate of the driving transistor M1. A gate of the transistor M2 is coupled to a scan line Sn, and a source thereof is coupled to a data line Dm.

[0005] In operation, when the transistor M2 is turned on by a select signal applied to the gate of the transistor M2, a data voltage is applied to the gate of the transistor M1 through the data line Dm, and the current flows to the organic EL element OLED through the transistor M1 in correspondence to the data voltage applied to the gate of the transistor M1 to thus generate light emission.

[0006] The current flowing to the organic EL element OLED in this instance 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 a current flowing to the organic EL element OLED, V_{gs} is a voltage between the gate and the source of the transistor M1, V_{th} is a threshold voltage of the transistor M1, V_{data} is a data voltage, and β is a constant.

[0007] As given in Equation 1, a current corresponding to the applied data voltage (V_{data}) is supplied to the organic EL element OLED, and the organic EL element OLED then emits light in correspondence to the supplied current in the pixel circuit of FIG. 1.

[0008] In addition, a voltage (V_{DD}) supply line for supplying the voltage of V_{DD} to the pixel circuit is shown in FIG. 1 as a horizontal line or a vertical line. Referring now to FIG. 2, when multiple transistors are driven, the voltage (V_{DD}) supply line applied to the pixel circuit can be represented as a horizontal line. In the case of FIG. 2, loads (impedance) at the transistors are increased, a large amount of currents are spent, and a voltage drop is generated between a voltage supply point of a first transistor of an input terminal and a voltage supply point of a transistor of a last terminal. As such, the voltage of V_{DD} applied to a right pixel circuit 20 of the voltage (V_{DD}) supply line is lower than the voltage of V_{DD} applied to a left pixel circuit 25, and a long range (LR) uniformity problem is generated in FIG. 2. The voltage drop

problem of the voltage (VDD) supply line is varied depending on design conditions to which the input of the voltage (VDD) supply line is coupled.

[0009] Also, a short range (SR) uniformity problem is generated because the amount of currents supplied to the organic EL element OLED is varied by a deviation of the threshold voltage (Vth) of a thin-film transistor (TFT) caused by non-uniformity of the manufacturing process, in addition to a brightness difference generated by a voltage drop of the above-described voltage (VDD) supply line.

[0010] To solve the problems, FIG. 3 shows a pixel circuit for preventing non-uniformity of brightness caused by variation of the threshold voltage (Vth) at the driving transistor M1, and FIG. 4 shows a drive timing diagram for driving the circuit of FIG. 3.

[0011] It is needed in the circuit of FIGs. 3 and 4 for a data voltage for driving a deriving transistor to correspond to the voltage of VDD while a control signal of a signal line AZn is at a low-level. Further, when the control signal of the signal line AZn is at a high-level and a low-level data voltage is applied to a data line Dm, the voltage between a gate and a source of a driving transistor M 1 is given in Equation 2.

Equation 2

$$V_{gs} = V_{th} - \frac{C1}{C1 + C2} (VDD - Vdata)$$

where Vth is a threshold voltage at the transistor M1, Vdata is a data voltage, and VDD. is a power supply voltage. However, since the data voltage is divided by capacitors (or capacitances) C1 and C2 as is shown from Equation 2, the pixel circuit of FIG. 3 is restricted in that it must either have a high data voltage (Vdata) or a high capacitance at the capacitor C1 to compensate for the capacitances at the capacitors C1 and C2.

[0012] . Fig. 6 shows a pixel circuit known from EP 1 441 325 A2 which may overcome some of the abovementioned problems. However, it has a problem that variations of the power supply voltage may deteriorate uniformity of display brightness. EP 1 441 325 A2 was published after the priority date of the present invention.

SUMMARY OF THE INVENTION

[0013] It is an aspect of the present invention to provide a display device adapted to compensate a deviation of a threshold voltage of a driving transistor included in a pixel circuit and for representing uniform brightness.

[0014] It is another aspect of the present invention to provide a display device adapted to compensate a difference of a voltage drop amount between pixel circuits generated by a driving voltage line and for representing uniform brightness.

[0015] Accordingly, a first aspect of the invention provides a pixel circuit having a first scan signal input for a previous scan signal, a second scan signal input for a current scan signal, and a data input for a data voltage. The pixel circuit comprises first through fifth transistors, a storage capacitor, a threshold voltage compensation capacitor, and a display element. The first transistor has a first electrode connected to a first supply line for a first supply voltage. The second transistor has a first electrode connected to a gate electrode of the first transistor, a second electrode connected to a second electrode of the first transistor, and a gate electrode connected to the first scan signal input. The storage capacitor has a first electrode connected to the first supply line. The threshold voltage compensation capacitor has a first electrode connected to a second electrode of the storage capacitor and a second electrode connected to the gate electrode of the first transistor. The third transistor has a first electrode connected to the first electrode of the threshold voltage compensation capacitor, a second electrode connected to the data input, and a gate electrode connected to the second scan signal input. The fourth transistor has a first electrode connected to the first electrode of the threshold voltage compensation capacitor and a gate electrode connected to the first scan signal input. The fifth transistor has a first electrode connected to the second electrode of the first transistor. The display element has a first electrode connected to a second electrode of the fifth transistor and a second electrode connected to a power supply input for a third supply voltage. According to the invention a second electrode of the fourth transistor is connected to a second supply line for a second supply voltage.

[0016] Preferably a gate electrode of the fifth transistor is connected to the first scan signal input.

[0017] The pixel circuit may further comprise an emission control input for an emission control signal, wherein a gate electrode of the fifth transistor is connected to the emission control input.

[0018] The fifth transistor may be of a different polarity type as the first, second, third, and fourth transistors.

[0019] Preferably, the fifth transistor is an NMOS transistor and wherein the first electrode of the display element is an anode and the second electrode of the display element is a cathode.

[0020] A second aspect of the invention provides a display device comprising an electro luminescent display panel, a scan driver, and a data driver. The electro luminescent display panel includes a plurality of scan lines arranged in a first direction and a plurality of data lines arranged in a second direction crossing the first direction. The scan driver is connected to the scan lines and the data driver is connected to the data lines. The electro luminescent display panel comprises a plurality of pixel circuits formed at a pixel area defined by two adjacent data lines and two adjacent scan lines. According to the invention the pixel circuits are pixel circuits according to the first aspect of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] The accompanying drawings, 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:

[0022] FIG. 1 shows a conventional pixel circuit for driving an organic EL element;

[0023] FIG. 2 shows a configuration diagram of a voltage supply line in a display panel of a general organic EL display;

[0024] FIG. 3 shows a conventional pixel circuit;

[0025] FIG. 4 shows a drive timing diagram for driving the circuit of FIG. 3;

[0026] FIG. 5 shows a brief diagram of a light emission display according to certain exemplary embodiments of the present invention;

[0027] FIG. 6 shows an equivalent circuit diagram of a pixel circuit as known from EP 1 441 325 A2;

[0028] FIG. 7 shows a driving waveform diagram for driving the pixel circuit shown in FIG. 6;

[0029] FIG. 8 shows a pixel circuit according to a first exemplary embodiment of the present invention;

[0030] FIG. 9 shows a pixel circuit according to a second exemplary embodiment of the present invention; and

[0031] FIG. 10 shows a display panel of an organic EL display to which a pixel circuit according to the first exemplary embodiment is applied.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0032] In the following detailed description, only certain exemplary embodiments of the present invention are shown and described, simply by way of illustration. As those skilled in the art would realize, the described embodiments may be modified in various different ways, all without departing from the scope of the present invention. Accordingly, the drawings and description are to be regarded as illustrative in nature, and not restrictive. To clarify the present invention, certain components which are not described in the specification can be omitted, and like reference numerals indicate like components.

[0033] FIG. 5 shows a brief diagram of a light emission display according to certain exemplary embodiments of the present invention.

[0034] As shown, the light emission display includes an organic EL display panel 100, a scan driver 200, and a data driver 300.

[0035] The organic EL display panel 100 includes a plurality of data lines D1 to Dm arranged in a column direction, a plurality of scan lines S1 to Sn arranged in a row direction, and a plurality of pixel circuits 10. The data lines D1 to Dm apply data voltages for displaying image signals to the pixel circuits 10, and the scan lines S1 to Sn apply select signals to the pixel circuits 10. Each pixel circuit 10 is formed at a pixel area defined by two adjacent data lines D1 to Dm, and two adjacent scan lines S1 to Sn.

[0036] The scan driver 200 sequentially applies select signals to the scan lines S1 to Sn, and the data driver 300 applies the data voltage for displaying image signals to the data lines D1 to Dm.

[0037] The scan driver 200 and/or the data driver 300 can be coupled to the display panel 100, or can be installed, in a chip format, in a tape carrier package (TCP) coupled to the display panel 100. The same can be coupled to the display panel 100, and installed, in a chip format, on a flexible printed circuit (FPC) or a film coupled to the display panel 100. Differing from this, the scan driver 200 and/or the data driver 300 can be installed on a glass substrate of the display panel 100 and can be substituted for a driving circuit formed in layers identical with that of the scan lines, the data lines, and TFTs on the glass substrate.

[0038] FIG. 6 shows an equivalent circuit diagram of a pixel circuit as known from EP 1 441 325 A2. For ease of description, FIG. 6 shows a pixel circuit coupled to the m-th data line Dm and the n-th scan line Sn. In addition, as to terminology of the scan lines, the scan line for applying the current select signal is referred to as the "current scan line," and the scan line which has transmitted a select signal before the current select signal is transmitted is referred to as the "previous scan line."

[0039] As shown in FIG. 6, the pixel circuit (e.g., the pixel circuit 10 of FIG. 5) includes transistors M1', M2', M3', M4' and M5', capacitors Cst and Cvth, and an organic EL element OLED.

[0040] The transistor M1' is a driving transistor for driving the organic EL element OLED. The transistor M1' is coupled between a power source for supplying the voltage VDD and the organic EL element OLED and controls the current

flowing to the organic EL element OLED through the transistor M5' according to the voltage applied to the gate of the transistor M1'. The transistor M2' has a first electrode coupled to the capacitor Cvth and a second electrode coupled to an anode electrode of the organic EL element OLED through the transistor M5'. The transistor M2' diode-connects the transistor M1' in response to the select signal provided by the previous scan line Sn-1.

[0041] The gate of the transistor M1' is coupled to a first capacitor electrode A of the capacitor Cvth, and the transistor M4' is coupled in parallel between a second capacitor electrode B of the capacitor Cvth and the power source for supplying the voltage VDD. The transistor M4' supplies the voltage VDD to a second capacitor electrode B of the capacitor Cvth in response to the select signal provided by the previous scan line Sn-1.

[0042] The transistor M3' transmits the data provided by the data line Dm to the second capacitor electrode B of the capacitor Cvth in response to the select signals provided by the current scan line Sn.

[0043] The transistor M5' is coupled between a drain of the transistor M1' and an anode of the organic EL element OLED, and can interrupt an electrical connection of the drain of the transistor M1' and the organic EL element OLED in response to the select signals provided by the previous scan line Sn-1.

[0044] The organic EL element OLED emits light in correspondence to the input current supplied thereto through the transistor M5'. A voltage of VSS coupled to a cathode of the organic EL element OLED is lower than the voltage VDD. The voltage of VSS can include a ground voltage.

[0045] An operation of the pixel circuit as known from EP 1 441 325 A2 will be described with reference to FIG. 7.

[0046] In the interval of T1, the transistor M2' is turned on and the transistor M1' is diode-connected when a low-level scan voltage is applied to the previous scan line Sn-1. Hence, the voltage between the gate and the source of the transistor M1' is varied until it reaches the threshold voltage (Vth) at the transistor M1'. In this instance, the voltage applied to the gate of the transistor M1', that is, the first capacitor electrode A of the capacitor Cvth, becomes the sum voltage of the power supply voltage and the threshold voltage (VDD+Vth) since the voltage VDD is applied to the source of the transistor M1'. Also, the transistor M4' is turned on, and the voltage of VDD is applied to the second capacitor electrode B of the capacitor Cvth.

[0047] Therefore, the voltage between both electrodes of the capacitor Cvth is given in Equation 3.

Equation 3

$$V_{Cvth} = V_{CvthA} - V_{CvthB} = (VDD + Vth) - VDD = Vth$$

where VCvth is a voltage at both electrodes of the capacitor Cvth, VCvthA is a voltage at the first capacitor electrode A of the capacitor Cvth, and VCvthB is a voltage at the second capacitor electrode B of the capacitor Cvth.

[0048] Also, the transistor M5' has a different channel type from the transistor M2' or is doped to have a different type of major carriers from the transistor M2' or is an N-type channel. As such, the transistor M5' is turned off in the interval of T1 to prevent the current flowing from the transistor M1' to the organic EL element OLED, and the transistor M3' is turned off since a high-level signal is applied to the current scan line Sn.

[0049] In the interval of T2, the transistor M3' is turned on and the data voltage of Vdata is charged in the capacitor Cst when a low-level scan voltage is applied to the current scan line Sn. Also, the voltage which corresponds to the sum of the data voltage (Vdata) and the threshold voltage (Vth) at the transistor M1' is applied to the gate of the transistor M1' since the capacitor Cvth is charged with the voltage which corresponds to the threshold voltage (Vth) at the transistor M1'.

[0050] That is, the voltage (Vgs) between the gate and the source of the transistor M1' is given in Equation 4, and the current given in Equation 5 is supplied to the organic EL element OLED through the transistor M1'.

Equation 4

$$Vgs = (Vdata + Vth) - VDD$$

Equation 5

$$I_{OLED} = \frac{\beta}{2} (V_{gs} - V_{th})^2 = \frac{\beta}{2} ((V_{data} + V_{th} - V_{DD}) - V_{th})^2 = \frac{\beta}{2} (V_{DD} - V_{data})^2$$

where I_{OLED} is a current flowing to the organic EL element OLED, V_{gs} is a voltage between the source and the gate of the transistor M1', V_{th} is a threshold voltage at the transistor M1', V_{data} is a data voltage, and β is a constant.

[0051] As can be derived from Equation 5, a substantially constant or uniform current can be applied to the organic EL element OLED since the deviations of the threshold voltages of V_{th} are compensated by the capacitor C_{vth} if the threshold voltage of V_{th} at the transistor M1' for each pixel are different. Therefore, a non-uniform brightness problem or luminescence imbalance caused by locations of pixels is overcome.

[0052] However, in the above described case, the voltage V_{DD} is dropped because of the internal resistance of the voltage (V_{DD}) supply line when the current flows to the driving transistor M1' when programming the data voltage. In this instance, the dropped voltage is in proportion to the current flowing from the voltage (V_{DD}) supply line. Accordingly, a non-uniformity in the brightness of the organic EL element OLED may result because when the same data voltage (V_{data}) is applied, different voltages (V_{gs}) may be applied to the driving transistor M1', and different currents (I_{OLED}) may flow to the organic EL element (OLED) as can be derived from Equation 5.

[0053] FIG. 8 shows a pixel circuit according to the first exemplary embodiment of the present invention. The first exemplary embodiment includes a compensation device 80 that includes the transistor M4" and the capacitor C_{vth} .

[0054] As shown, the pixel circuit according to the first exemplary embodiment differs from the pixel circuit as known from EP 1 441 325 A2 by applying a compensation voltage (V_{sus}) to the source of the transistor M4". An operation of the pixel circuit shown in FIG. 8 will be described.

[0055] In a first interval (e.g., the interval T1 of FIG. 1), when a low-level voltage is applied to the previous scan line S_{n-1} , the transistor M1' is diode-connected, and the voltage between the gate and the source of the transistor M1' is varied until it reaches the threshold voltage (V_{th}) at the transistor M1'. Hence, the voltage which corresponds to the sum of the voltage V_{DD} and the threshold voltage (V_{th}) at the transistor M1' is applied to the gate of the transistor M1', that is, the first capacitor electrode A of the capacitor C_{vth} .

[0056] Also, when the transistor M4" is turned on, the compensation voltage (V_{sus}) is applied to the second capacitor electrode B of the capacitor C_{vth} , and the voltage given in Equation 6 is charged in the capacitor C_{vth} .

Equation 6

$$V_{C_{vth}} = (V_{DD} + V_{th}) - V_{sus}$$

[0057] In the first interval, the transistors M3' and M5' are maintained at an off or interruption state.

[0058] In a second interval (e.g., the interval T2 of FIG. 1), a low-level voltage is applied to the current scan line S_n , and the transistor M3' is turned on. Therefore, the data voltage (V_{data}) is charged in the capacitor C_{st} , and the voltage between the gate and the source of the transistor M1' is given in Equation 7 since the capacitor C_{vth} is charged with the voltage given in Equation 6.

Equation 7

$$V_{gs} = (V_{data} + (V_{DD} + V_{th} - V_{sus})) - V_{DD} = V_{data} + V_{th} - V_{sus}$$

[0059] Accordingly, the current flowing to the organic EL element is given in Equation 8.

Equation 8

$$I_{OLED} = \frac{\beta}{2}(V_{gs} - V_{th})^2 = \frac{\beta}{2}((V_{data} + V_{th} - V_{sus}) - V_{th})^2 = \frac{\beta}{2}(V_{data} - V_{sus})^2$$

[0060] As can be derived from Equation 8, the current flowing to the organic EL element of the first exemplary embodiment is not influenced by the voltage VDD, and the brightness deviation caused by the voltage drop in the voltage (VDD) supply line is compensated.

[0061] In the pixel circuit according to the first exemplary embodiment of the present invention, no voltage drop problem caused by a current leakage is generated since the compensation voltage Vsus forms no current path differing from the power supply voltage VDD. Therefore, substantially the same compensation voltage Vsus can be applied to the pixel circuits, and a uniform current corresponding to the data voltage (Vdata) can flow to the organic EL element OLED.

[0062] Further, as can be derived from Equation 7 in the first exemplary embodiment, an absolute value of a value obtained by subtracting the compensation voltage Vsus from the sum of the data voltage (Vdata) and the threshold voltage (Vth) at the transistor M1' can be established to be greater than an absolute value of the threshold voltage (Vth) at the transistor M1'. As such, a voltage having the same level as that of the voltage VDD can be used for the compensation voltage Vsus.

[0063] Referring to FIG. 8, P-type transistors are used for the transistors M2', M3', M4" and an N-type transistor is used for the M5' transistor but the transistor types of the present invention are not limited to those shown. The transistors can be realized by any switches for on and off switching in response to control signals. Also, it is shown for the transistors M1', M2', M3', M4" and M5' to include TFTs which respectively have a gate electrode, a drain electrode, and a source electrode formed on a glass substrate of the display panel (e.g., the display panel 100 of FIG. 5) as a control electrode and two other electrodes, but the transistors are not limited to TFTs. The transistors can be realized by any transistors, each having a first electrode, a second electrode, and a third electrode, and outputting an output corresponding to a signal applied to the first and second electrodes to the third electrodes. Of course, those skilled in the art would recognize that the voltage polarities and levels may be different when other transistors are used.

[0064] FIG. 9 shows a pixel circuit according to the second exemplary embodiment of the present invention. The second exemplary embodiment includes a compensation device 90 that includes the transistor M4" and the capacitor Cvth.

[0065] The pixel circuit of FIG. 9 differs from the pixel circuit according to the first exemplary embodiment by controlling the transistor M5" by using a separate signal line En.

[0066] As shown, an N-type transistor is used for the transistor M5" for exemplary purposes, and the present invention is not thereby limited. The transistor M5" controls a light emission period of the pixel circuit of FIG. 9 independent from a select period of the previous scan line Sn-1 by the use of the separate signal line En to control the transistor M5".

[0067] In general, according to the foregoing, FIG. 10 shows a panel (e.g., the panel 100 of FIG. 5) to which the pixel circuit according to the first exemplary embodiment is applied.

[0068] As shown, multiple pixel circuits are coupled to the voltage (VDD) supply line. A parasitic component is provided on the voltage (VDD) supply line on the display panel (e.g., the panel 100 of FIG. 5), and the voltage is dropped by the parasitic component. However, the non-uniform brightness phenomenon on the display panel caused by the voltage drop of the voltage (VDD) supply line is substantially eliminated because the current flowing to the organic EL element OLED is not influenced by the voltage VDD (and/or compensated by the voltage Vsus) according to the present invention.

Claims

1. A pixel circuit having a first scan signal input (Sn-1) for receiving a first scan signal, a second scan signal input (Sn) adjacent said first scan signal input for receiving a second scan signal subsequent to said first scan signal and a data input for receiving a data voltage (Dm), the pixel circuit comprising:

a first transistor (M1') having a first electrode connected to a first supply line for a first supply voltage (VDD);
 a second transistor (M2') having a first electrode connected to a gate electrode of the first transistor (M1'), a second electrode connected to a second electrode of the first transistor (M1'), and a gate electrode connected to the first scan signal input (Sn-1);
 a storage capacitor (Cst) having a first electrode connected to the first supply line (VDD);
 a threshold voltage compensation capacitor (Cvth) having a first electrode connected to a second electrode of the storage capacitor (Cst) and a second electrode connected to the gate electrode of the first transistor (M1');

a third transistor (M3') having a first electrode connected to the first electrode of the threshold voltage compensation capacitor (Cvth), a second electrode connected to the data input (Dm), and a gate electrode connected to the second scan signal input (Sn);

a fourth transistor (M4') having a first electrode connected to the first electrode of the threshold voltage compensation capacitor (Cvth), and a gate electrode connected to the first scan signal input (Sn-1);

a fifth transistor (M5') having a first electrode connected to the second electrode of the first transistor (M1'); and a display element (OLED) having a first electrode connected to a second electrode of the fifth transistor (M5') and a second electrode connected to a power supply input for a third supply voltage (VSS),

characterised in that a second electrode of the fourth transistor (M4') is connected to a second supply line for a second supply voltage (Vsus).

2. The pixel circuit of claim 1, wherein a gate electrode of the fifth transistor (M5') is connected to the first scan signal input (Sn-1).

3. The pixel circuit of claim 1, further comprising an emission control input for receiving an emission control signal (En), wherein a gate electrode of the fifth transistor (M5') is connected to the emission control input (En).

4. The pixel circuit of one of the preceding claims, wherein the fifth transistor (M5') is of a different polarity type as the first, second, third, and fourth transistors (M1', M2', M3', M4').

5. The pixel circuit of claim 4, wherein the fifth transistor (M5') is an NMOS transistor and wherein the first electrode of the display element (OLED) is an anode and the second electrode of the display element (OLED) is a cathode.

6. A display device comprising:

an electro luminescent display panel (100) including a plurality of scan lines (S1...Sn) arranged in a first direction and a plurality of data lines (D1...Dm) arranged in a second direction crossing the first direction;

a scan driver (200) connected to the scan lines (S1...Sn); and

a data driver (300) connected to the data lines (D1...Dm);

wherein the electro luminescent display panel (100) comprises a plurality of pixel circuits (10) formed at a pixel area defined by two adjacent data lines (D1...Dm) and two adjacent scan lines (S1...Sn),

characterised in that the pixel circuits (10) are pixel circuits (10) according to one of the preceding claims.

Patentansprüche

1. Pixelschaltung, aufweisend einen ersten Ansteuersignaleingang (Sn-1) zum Erhalt eines ersten Ansteuersignals, einen zu dem besagten ersten Ansteuersignaleingang benachbarten zweiten Ansteuersignaleingang (Sn) zum Erhalt eines zweiten Ansteuersignals nach dem besagten ersten Ansteuersignal, und einen Dateneingang zum Erhalt einer Datenspannung (Dm), wobei die Pixelschaltung aufweist:

einen ersten Transistor (M1'), der eine erste Elektrode aufweist, die mit einer ersten Versorgungsleitung für eine erste Versorgungsspannung (VDD) verbunden ist;

einen zweiten Transistor (M2'), der eine erste Elektrode, die mit einer Gate-Elektrode des ersten Transistors (M1') verbunden ist, eine zweite Elektrode, die mit einer zweiten Elektrode des ersten Transistors (M1') verbunden ist, und eine Gate-Elektrode, die mit dem ersten Ansteuersignaleingang (Sn-1) verbunden ist, aufweist; einen Speicherkondensator (Cst), der eine erste Elektrode aufweist, die mit der ersten Versorgungsleitung (VDD) verbunden ist;

einen Schwellenspannungs-Kompensationskondensator (Cvth), der eine erste Elektrode, die mit einer zweiten Elektrode des Speicherkondensators (Cst) verbunden ist, und eine zweite Elektrode, die mit der Gate-Elektrode des ersten Transistors (M1') verbunden ist, aufweist;

einen dritten Transistor (M3'), der eine erste Elektrode, die mit der ersten Elektrode des Schwellenspannungs-Kompensationskondensators (Cvth) verbunden ist, eine zweite Elektrode, die mit dem Dateneingang (Dm) verbunden ist, und eine Gate-Elektrode, die mit dem zweiten Ansteuersignaleingang (Sn) verbunden ist, aufweist;

einen vierten Transistor (M4'), der eine erste Elektrode, die mit der ersten Elektrode des Schwellenspannungs-Kompensationskondensators (Cvth) verbunden ist, und eine Gate-Elektrode, die mit dem ersten Ansteuersignaleingang (Sn-1) verbunden ist, aufweist;

einen fünften Transistor (M5'), der eine erste Elektrode aufweist, die mit der zweiten Elektrode des ersten Transistors (M1') verbunden ist; und
 ein Anzeigeelement (OLED), das eine erste Elektrode, die mit einer zweiten Elektrode des fünften Transistors (M5') verbunden ist, und eine zweite Elektrode, die mit einem Spannungsversorgungseingang für eine dritte Versorgungsspannung (VSS) verbunden ist, aufweist,
dadurch gekennzeichnet, dass eine zweite Elektrode des vierten Transistors (M4') mit einer zweiten Versorgungsleitung für eine zweite Versorgungsspannung (Vsus) verbunden ist.

2. Pixelschaltung nach Anspruch 1, wobei eine Gate-Elektrode des fünften Transistors (M5') mit dem ersten Ansteuerungseingang (Sn-1) verbunden ist.

3. Pixelschaltung nach Anspruch 1, weiterhin aufweisend einen Emissionskontrolleingang zum Erhalt eines Emissionskontrollsignals (En), wobei eine Gate-Elektrode des fünften Transistors (M5') mit dem Emissionskontrolleingang (En) verbunden ist.

4. Pixelschaltung nach einem der vorhergehenden Ansprüche, wobei der fünfte Transistor (M5') von einem anderen Polaritätstyp als der erste, zweite, dritte und vierte Transistor (M1', M2', M3', M4') ist.

5. Pixelschaltung nach Anspruch 4, wobei der fünfte Transistor (M5') ein NMOS-Transistor ist und wobei die erste Elektrode des Anzeigeelements (OLED) eine Anode ist und die zweite Elektrode des Anzeigeelements (OLED) eine Kathode ist.

6. Anzeigevorrichtung, aufweisend:

eine Elektrolumineszenzanzeigetafel (100), die eine Vielzahl von Ansteuerleitungen (S1 ... Sn), die in eine erste Richtung angeordnet sind, und eine Vielzahl von Datenleitungen (D1 ... Dm) aufweist, die in eine zweite Richtung, die die erste Richtung kreuzt, angeordnet sind;
 einen Ansteuertreiber (200), der mit den Ansteuerleitungen (S1 ... Sn) verbunden ist; und
 einen Datentreiber (300), der mit den Datenleitungen (D1 ... Dm) verbunden ist;
 wobei die Elektrolumineszenzanzeigetafel (100) eine Vielzahl von Pixelschaltungen (10) aufweist, die in einem Pixelbereich ausgebildet sind, der von zwei benachbarten Datenleitungen (D1 ...) Dm) und von zwei benachbarten Ansteuerleitungen (S1 ... Sn) definiert wird,
dadurch gekennzeichnet, dass die Pixelschaltungen (10) Pixelschaltungen (10) nach einem der vorhergehenden Ansprüche sind.

Revendications

1. Circuit de pixel comportant une première entrée de signal de balayage (Sn-1) pour recevoir un premier signal de balayage, une deuxième entrée de signal de balayage (Sn) adjacente à ladite première entrée de signal de balayage pour recevoir un deuxième signal de balayage suivant ledit premier signal de balayage et une entrée de données pour recevoir une tension de données (Dm), le circuit de pixel comprenant:

un premier transistor (M1') comportant une première électrode connectée à une première ligne d'alimentation pour une première tension d'alimentation (VDD);
 un deuxième transistor (M2') comportant une première électrode connectée à une électrode de grille du premier transistor (M1'), une deuxième électrode connectée à une deuxième électrode du premier transistor (M1'), et une électrode de grille connectée à la première entrée de signal de balayage (Sn-1);
 un condensateur de stockage (Cst) comportant une première électrode connectée à la première ligne d'alimentation (VDD);
 un condensateur de compensation de tension de seuil (Cvth) comportant une première électrode connectée à une deuxième électrode du condensateur de stockage (Cst) et une deuxième électrode connectée à l'électrode de grille du premier transistor (M1') ;
 un troisième transistor (M3') comportant une première électrode connectée à la première électrode du condensateur de compensation de tension de seuil (Cvth), une deuxième électrode connectée à l'entrée de données (Dm) et une électrode de grille connectée à la deuxième entrée de signal de balayage (Sn);
 un quatrième transistor (M4') comportant une première électrode connectée à la première électrode du condensateur de compensation de tension de seuil (Cvth), et une électrode de grille connectée à la première entrée

de signal de balayage (Sn-1);

un cinquième transistor (M5') comportant une première électrode connectée à la deuxième électrode du premier transistor (M1'); et

un élément d'affichage (diode électro-luminescente organique ou OLED) comportant une première électrode connectée à une deuxième électrode du cinquième transistor (M5') et une deuxième électrode connectée à une entrée d'alimentation pour une troisième tension d'alimentation (VSS),

caractérisé en ce qu'une deuxième électrode du quatrième transistor (M4') est connectée à une deuxième ligne d'alimentation pour une deuxième alimentation (V_{sus}).

2. Circuit de pixel selon la revendication 1, dans lequel une électrode de grille du cinquième transistor (M5') est connectée à la première entrée de signal de balayage (Sn-1).

3. Circuit de pixel selon la revendication 1, comprenant de plus une entrée de commande d'émission pour recevoir un signal de commande d'émission (En), une électrode de grille du cinquième transistor (M5') étant connectée à l'entrée de commande d'émission (En).

4. Circuit de pixel selon l'une des revendications précédentes, dans lequel le cinquième transistor (M5') est d'un type de polarité différent de celui des premier, deuxième, troisième et quatrième transistors (M1 M2', M3', M4').

5. Circuit de pixel selon la revendication 4, dans lequel le cinquième transistor (M5') est un transistor NMOS, et dans lequel la première électrode de l'élément d'affichage (OLED) est une anode et la deuxième électrode de l'élément d'affichage (OLED) est une cathode.

6. Dispositif d'affichage, comprenant:

un panneau d'affichage électro-luminescent (100) comprenant une pluralité de lignes de balayage (S1, ..., Sn) disposées dans une première direction et une pluralité de lignes de données (D1, ..., Dm) disposées dans une deuxième direction croisant la première direction ;

un dispositif d'attaque de balayage (200) connecté aux lignes de balayage (S1, ..., Sn) ; et

un dispositif d'attaque de données (300) connecté aux lignes de données (D1, ..., Dm) ;

dans lequel le panneau d'affichage électro-luminescent (100) comprend une pluralité de circuits de pixel (10) formés en une zone de pixel définie par deux lignes de données adjacentes (D1, ..., Dm) et deux lignes de balayage adjacentes (S1, ..., Sn),

caractérisé en ce que les circuits de pixel (10) sont des circuits de pixel (10) selon l'une des revendications précédentes.

FIG.1
(Prior Art)

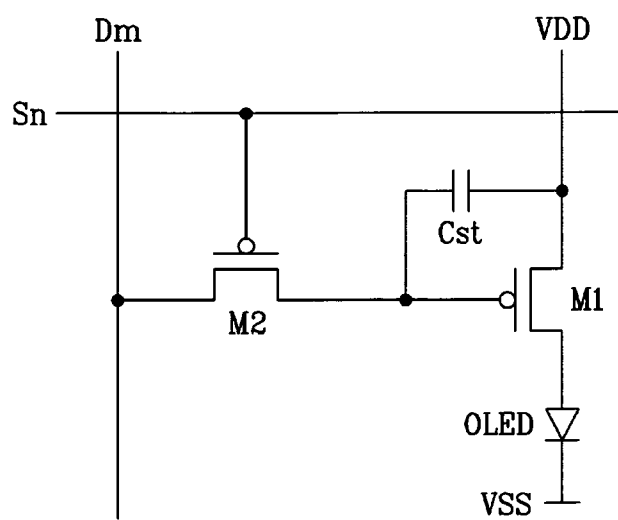


FIG.2
(Prior Art)

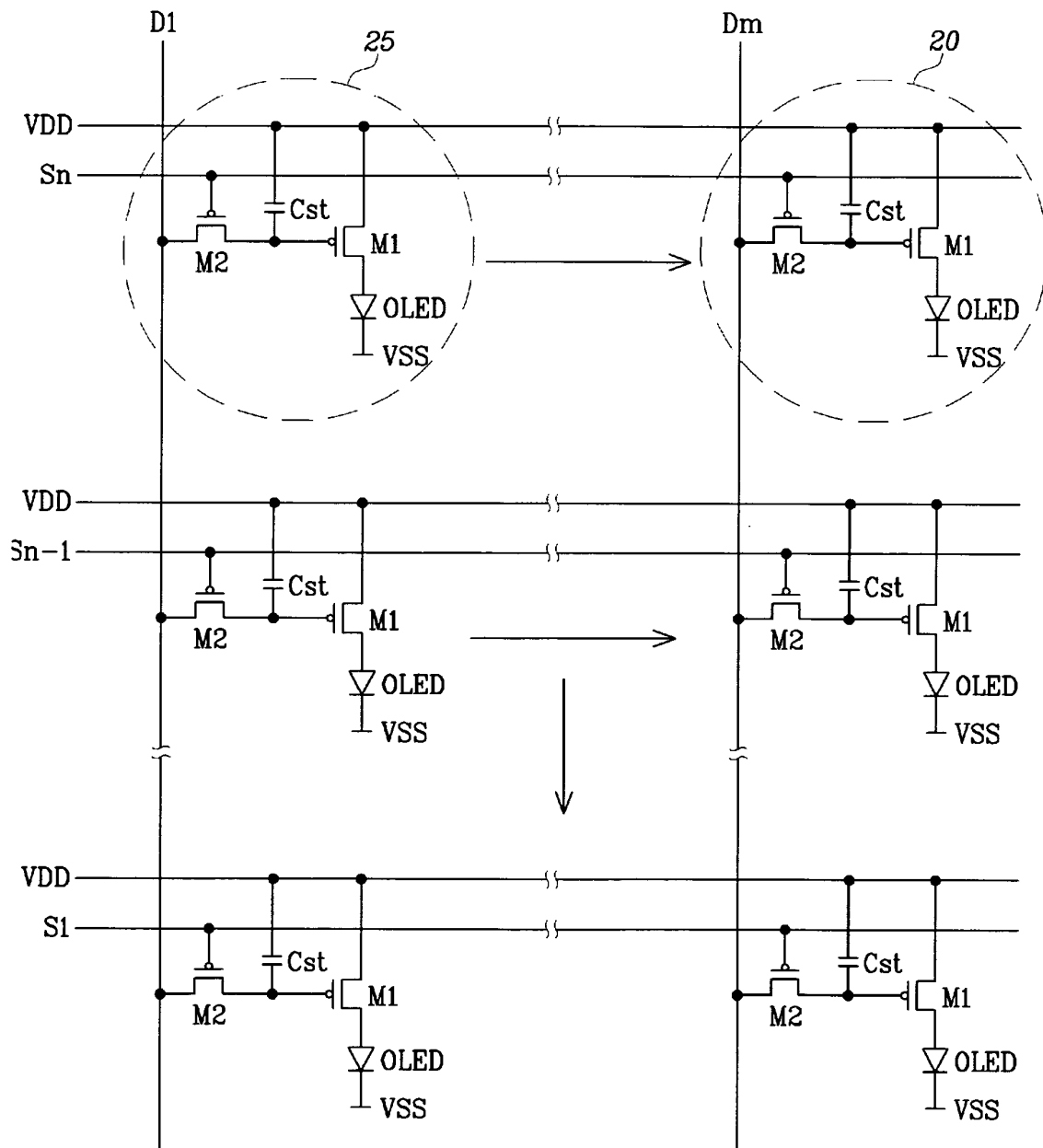


FIG.3
(Prior Art)

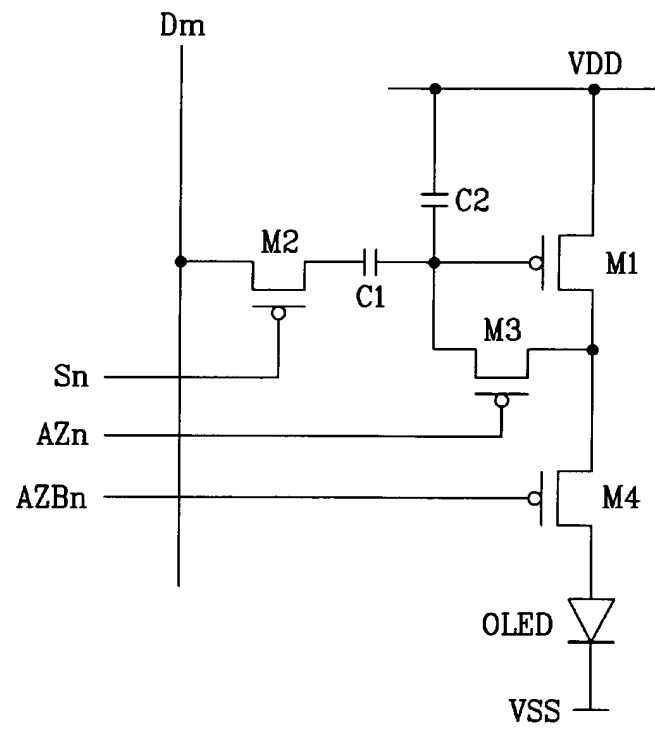


FIG.4
(Prior Art)

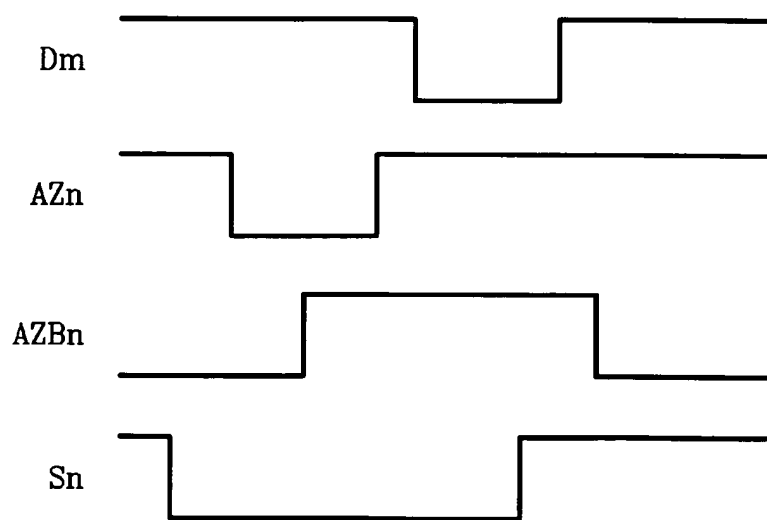


FIG.5

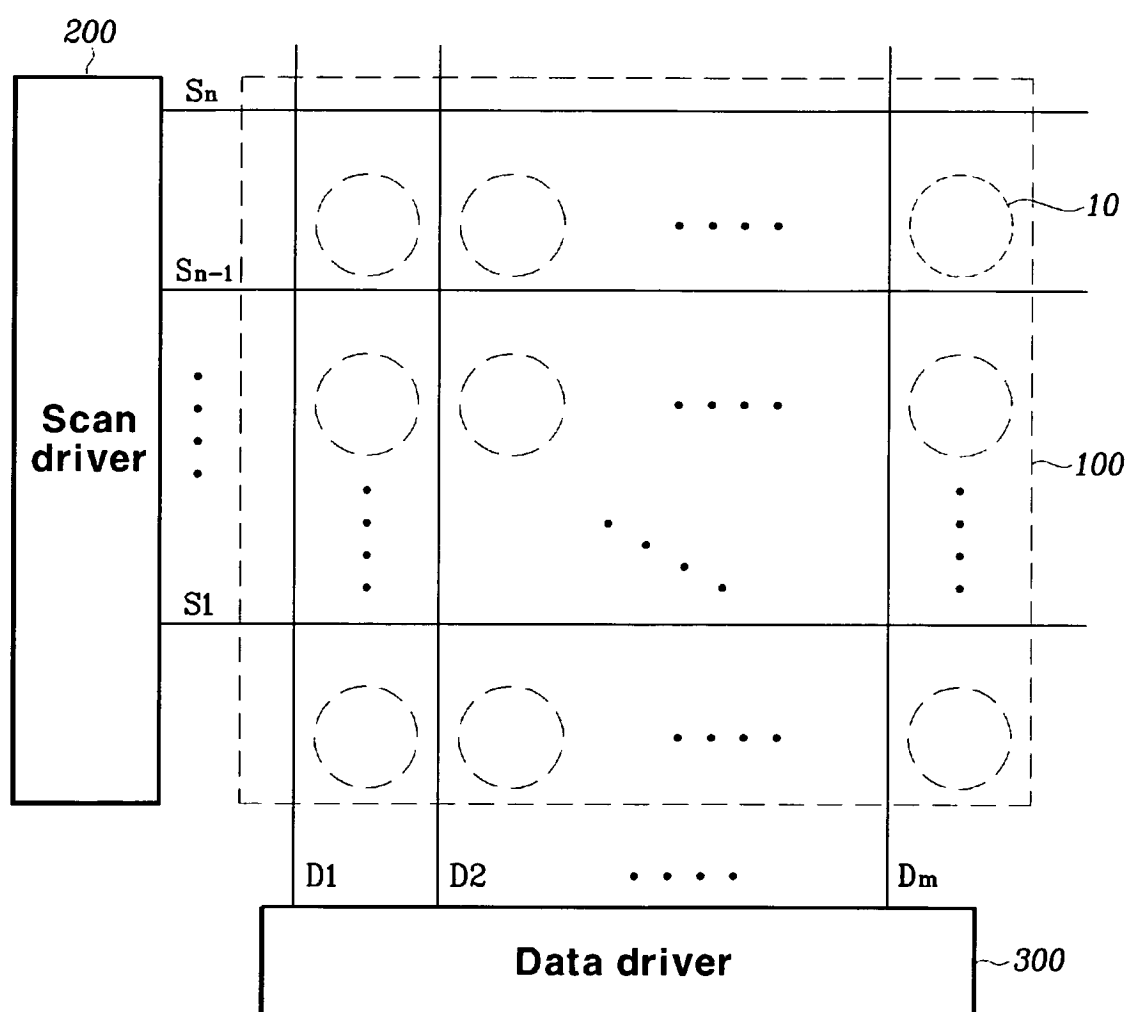


FIG.6

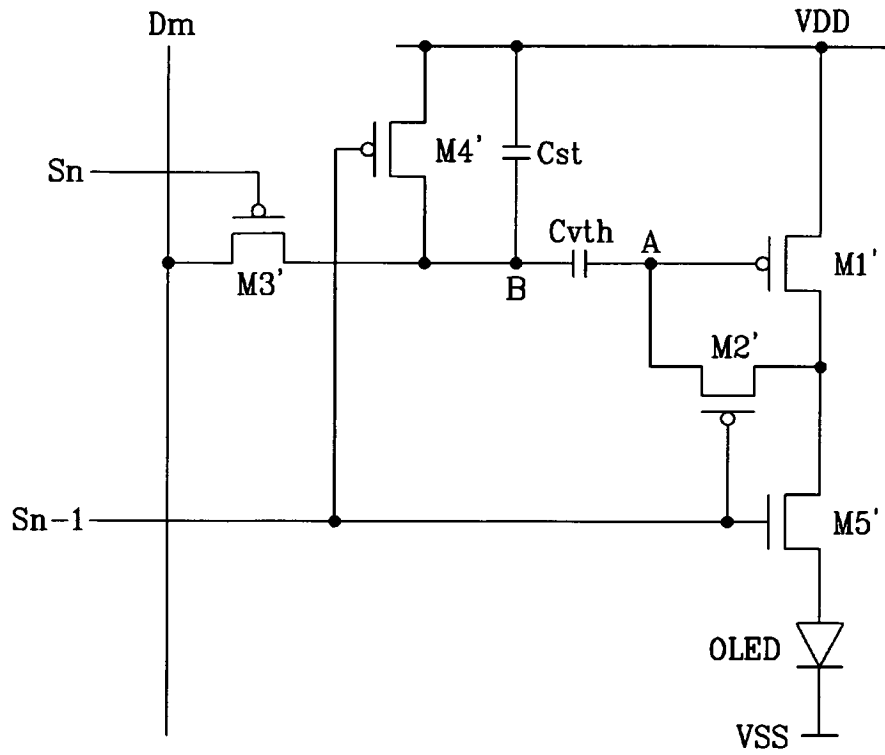


FIG.7

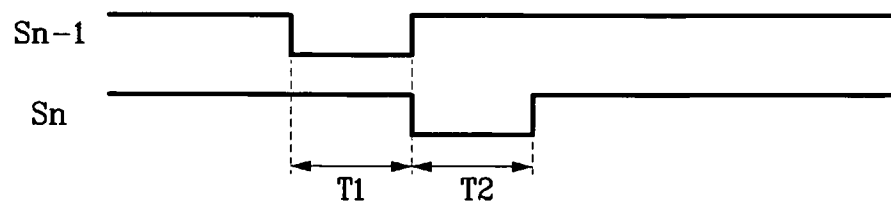


FIG.8

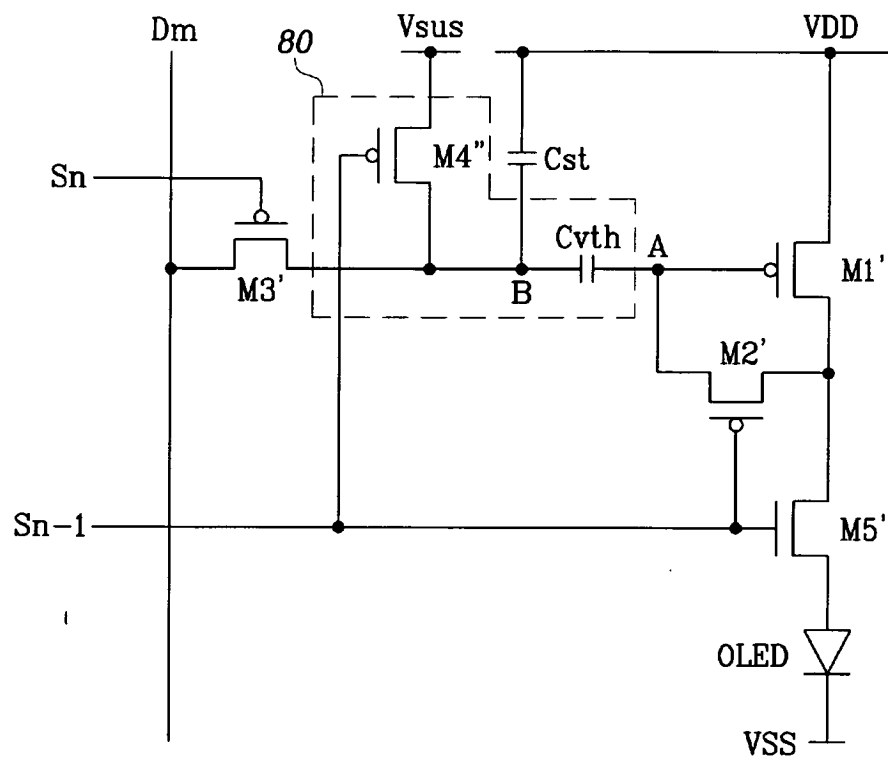


FIG.9

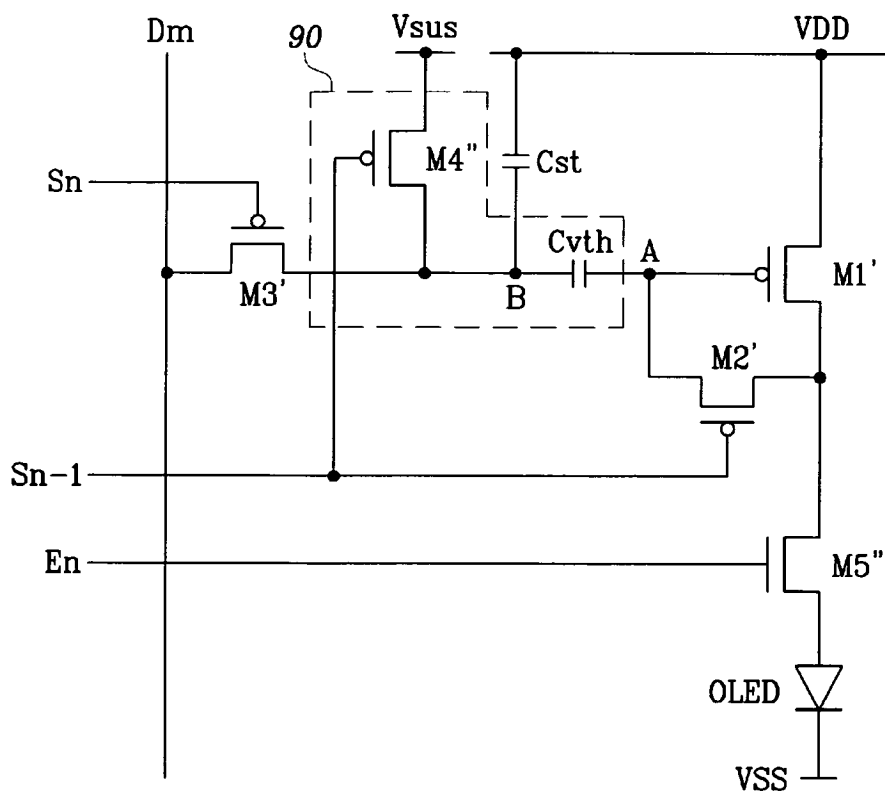
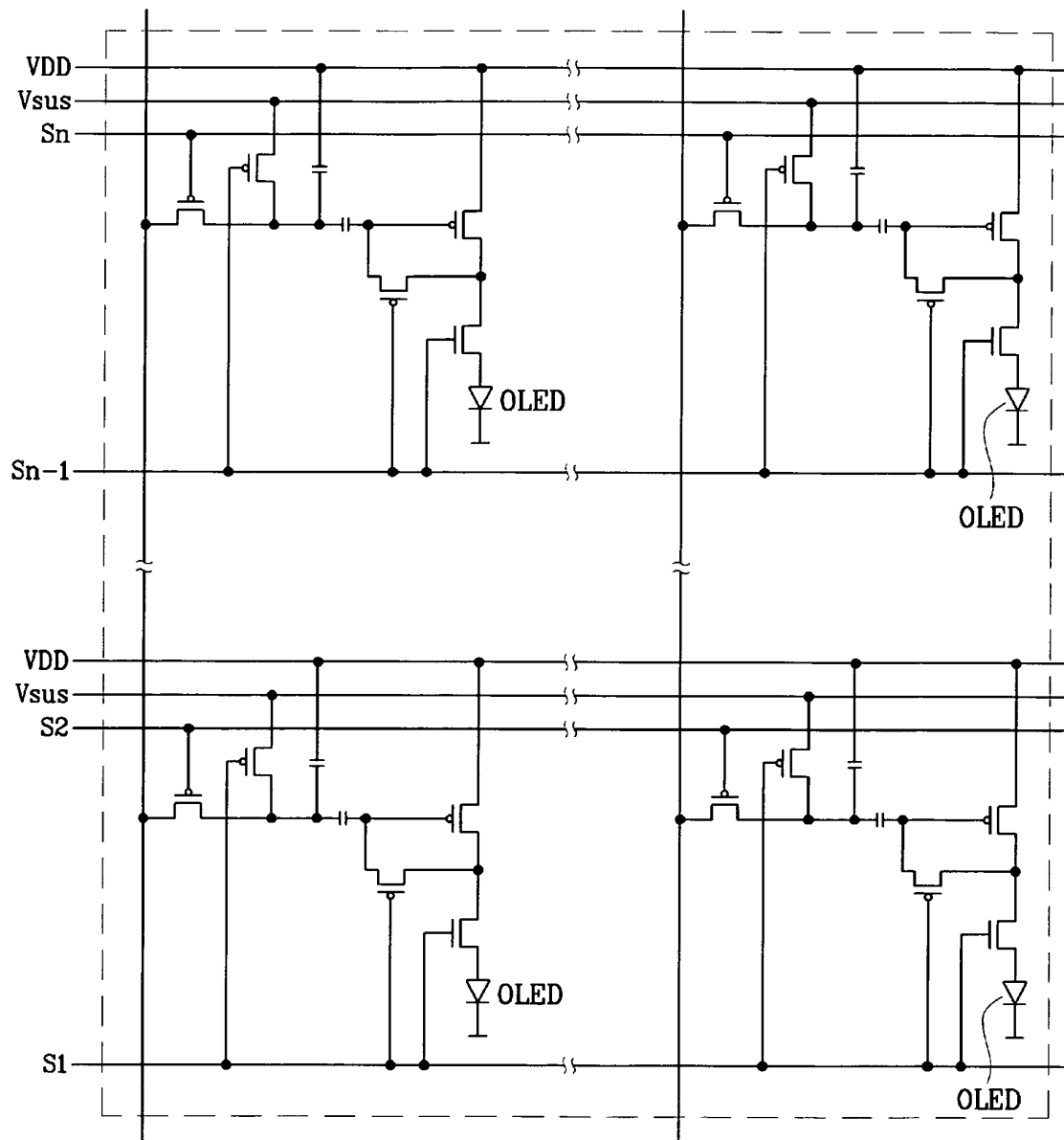


FIG.10



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 1441325 A2 [0012] [0027] [0038] [0054]
- EP 1441325 A [0045]

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摘要(译)

发光显示器包括数据线，扫描线和像素电路。像素电路的像素电路包括：发光元件；第一晶体管，包括控制电极和第一和第二电极，第一晶体管输出对应于第一电极和控制电极之间的电压的电流；第一开关，连接在第一晶体管的控制电极和发光元件之间，用于接收第一控制信号；第一电容器，耦合到第一晶体管；第二电容器，耦合在第一电源和第一电容器之间；第二开关，用于响应第二控制信号耦合第一电容器和第二电源；第三开关，用于响应由一条扫描线提供的选择信号将数据电压施加到第一电容器。从像素到像素的短程晶体管阈值电压变化以及显示器上的第一电源线上的长程电压降都减小了。

Equation 1

$$I_{OLED} = \frac{\beta}{2} (V_{gs} - V_{th})^2 = \frac{\beta}{2} (V_{DD} - V_{data} - |V_{th}|)^2$$