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(54) **Light-emitting display device**

Lichtemittierende Anzeigevorrichtung

Dispositif d'affichage électroluminescent

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Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a light-emitting display, and more specifically, to an organic light-emitting display using luminescence of an organic material.

Discussion of the Background

[0002] Generally, an organic light-emitting display emits light with an organic light-emitting element that uses luminescence of an organic material. NxM organic light-emitting cells, arranged in a matrix form, may be driven with a voltage or current to display images. The organic light-emitting cell may also be called an organic LED (light-emitting diode) because it has diode characteristics, and it may include an anode (ITO), an organic thin film, and a cathode (metal). The organic thin film may have a multi-layer structure including an emitting layer (EML), an electron transport layer (ETL), and a hole transport layer (HTL) for balancing electrons and holes to improve luminescence efficiency. The organic thin film may further include an electron injecting layer (EIL) and a hole injecting layer (HIL).

[0003] Organic light-emitting cells may be driven by a passive matrix driving method or an active matrix driving method, which may use a thin film transistor (TFT) or a MOSFET. The passive matrix organic EL display may be constructed having an anode and a cathode that are perpendicular to each other, and a line may be selected to drive the light-emitting cells. The active matrix display may comprise a TFT coupled to each ITO pixel electrode, and it may be driven by a voltage maintained by a capacitor coupled to the gate ofthe TFT.

[0004] A conventional active matrix organic light-emitting display will now be explained.

[0005] FIG. 1 is an equivalent circuit diagram showing a pixel of a conventional active matrix organic light-emitting display. Referring to FIG. 1, the pixel circuit may include an organic LED OLED, a switching transistor SM, a driving transistor DM, and a capacitor Cst. The two transistors SM and DM may be PMOS transistors.

[0006] When the switching transistor SM turns on in response to a select signal applied to its gate from a signal line Sn, a data voltage V_{DATA} from a data line Dm is supplied to the gate of the driving transistor DM. Then, a current I_{OLED}, corresponding to a voltage V_{GS} charged between the gate and source ofthe driving transistor DM according to the capacitor Cst, may flow through the driving transistor DM, thereby causing the organic LED OLED to emit light. Here, the current I_{OLED} may be represented by Equation 1.

[Equation 1]

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

[0007] In the pixel circuit of FIG. 1, a current corresponding to the data voltage may be supplied to the organic LED, thereby causing it to emit light with at a luminance corresponding to the current. The data voltage may have multiple values in a specific range in order to represent a predetermined gray scale.

[0008] As Equation 1 shows, however, the current I_{OLED} varies with the threshold voltage V_{TH} of the driving transistor DM. Accordingly, the organic light-emitting display may not display correct images because the driving transistors of the pixels may have different threshold voltages.

SUMMARY OF THE INVENTION

[0009] The present invention provides a light-emitting display having a pixel circuit that may compensate for the threshold voltage of a driving transistor.

[0010] The present invention provides a light-emitting display that may reduce the influence of kickback caused by parasitic capacitance existing in the pixel circuit.

[0011] Additional features of the invention will be set forth in the description which follows, and in part will be apparent from the description, or may be learned by practice ofthe invention.

[0012] The present invention discloses a light-emitting display comprising a plurality of data lines transmitting a data voltage, a plurality of scan lines transmitting a select signal, and a plurality of pixel circuits coupled to the scan lines and the data lines. A pixel circuit includes first, second, third, and fourth transistors, a first capacitor, and a light-emitting element. The first and second transistors are serially coupled to each other and turned on in response to a first control signal. The first capacitor is coupled in parallel with the first and second transistors. The third transistor supplies the data voltage to a first electrode of the first capacitor in response to the select signal. The fourth transistor outputs a current corresponding to its gate-source voltage, which is based on a voltage of the first capacitor. The light-emitting element emits light in response to the current from the fourth transistor.

[0013] The present invention also discloses a light-emitting display comprising a plurality of data lines transmitting a data voltage, a plurality of scan lines transmitting select signals including first and second select signals, and a plurality of pixel circuits coupled to the scan lines and the data lines. A pixel circuit includes first through sixth transistors, first and second capacitors, and a light-emitting element. The first transistor includes a first electrode coupled to a data line and a second electrode turned on in response to the second select signal to transmit the data voltage, and the first capacitor is charged with a voltage corresponding to the data voltage. The second and third transistors are serially coupled to each other, coupled in parallel with the first capacitor, and turned on in response to the first select signal. The fourth transistor outputs a current corresponding to the voltage charged in the first capacitor. The fifth and sixth transistors are serially coupled to each other and turned on in response to the first select signal to diode-connect the fourth transistor. The second capacitor is coupled between a first electrode of the first capacitor and a control electrode of the fourth transistor, and it is charged with a voltage corresponding to the threshold voltage of the fourth transistor. The light-emitting element emits light corresponding to the current output from the fourth transistor.

[0014] The present invention discloses a light-emitting display comprising a plurality of data lines transmitting a data voltage, a plurality of scan lines transmitting select signals including first and second select signals, and a plurality of pixel circuits coupled to the scan lines and the data lines. A pixel circuit includes first, third, fourth and fifth transistors, a first capacitor, and a light-emitting element. The first transistor includes a first electrode coupled to a data line, and a second electrode is turned on in response to the second select signal to transmit the data voltage. The first capacitor is charged with a voltage corresponding to the data voltage. The third transistor outputs a current corresponding to the voltage charged in the first capacitor. The fourth and fifth transistors are serially coupled to each other and turned on in response to the first select signal to diode-connect the third transistor. The light-emitting element emits light corresponding to the current output from the third transistor.

[0015] It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and together with the description serve to explain the principles ofthe invention.

[0017] FIG. 1 is an equivalent circuit diagram showing a pixel of a conventional active matrix organic light-emitting display.

[0018] FIG. 2 shows a configuration of an organic light-emitting display according to a first exemplary embodiment not falling within the scope of the appended claims..

[0019] FIG. 3 is an equivalent circuit diagram showing a pixel circuit of the organic light-emitting display of FIG. 2.

[0020] FIG. 4 shows waveforms that may be applied to pixel circuits of exemplary embodiments of the present invention.

[0021] FIG. 5 is an equivalent circuit diagram showing a pixel circuit according to a second exemplary embodiment of the present invention.

[0022] FIG. 6 is an equivalent circuit diagram showing a pixel circuit according to a third exemplary embodiment of the present invention.

[0023] FIG. 7 is an equivalent circuit diagram showing a pixel circuit according to a fourth exemplary embodiment ofthe present invention.

DETAILED DESCRIPTION OF THE EXEMPLARY EMBODIMENTS

[0024] The following detailed description shows and describes exemplary embodiments of the present invention, simply by way of illustration of the best mode contemplated by the inventors of carrying out the invention. As will be realized, the invention is capable of modification in various obvious respects, all without departing from the invention. Accordingly, the drawings and description are to be regarded as illustrative in nature, and not restrictive. To clarify the present invention, parts which are not described in the specification are omitted, and parts for which similar descriptions are provided have the same reference numerals.

[0025] FIG. 2 shows the configuration of an organic light-emitting display according to a first exemplary embodiment of the present invention.

[0026] Referring to FIG. 2, the organic light-emitting display may include an organic light-emitting display panel 100, a scan driver 200, a data driver 300, and a light emission control signal driver 400.

[0027] The organic light-emitting display panel 100 may include a plurality of data lines D_1 to D_m arranged in a column direction, a plurality of scan lines S_1 to S_n arranged in a row direction, a plurality of light emission control lines E_1 to E_n, and a plurality of pixel circuits 110. The data lines D_1 to D_m may transmit data signals corresponding to video signals to the pixel circuits 110, and the scan lines S_1 to S_n may transmit select signals to the pixel circuits 110.

[0028] The scan driver 200 may sequentially generate the select signals and supply them to the scan lines S_1 to S_n. A scan line transmitting the current select signal may be called a "current scan line," and a scan line transmitting the select signal before the current select signal is transmitted may be called a "previous scan line".

[0029] The data driver 300 may generate a data voltage corresponding to a video signal and supply the data voltage to the data lines D_1 to D_m. The light emission control signal driver 400 may sequentially apply a light emission control signal, for controlling light emission of organic light-emitting elements, to the light emission control lines E_1 to E_n.

[0030] Various methods may be used to couple the scan driver 200, the data driver 300, and/or the light emission control signal driver 400 to the display panel 100. For example, they may be mounted in the form of chip on a tape carrier package coupled to the display panel, they may be mounted in the form of chip on a flexible printed circuit or a film attached to and coupled to the display panel, and they may be directly mounted on the panel's glass substrate. Alternatively, they may be replaced by a driving circuit formed of the same layers as the scan lines, data lines, and thin film transistors on the glass substrate.

[0031] FIG. 3 is an equivalent circuit diagram showing a pixel circuit 110 according to a first exemplary embodiment not falling within the scope of the appended claims. Referring to FIG. 3, the pixel circuit may include five transistors M1, M2, M3, M4 and M5, two capacitors Cst and Cvth, and an organic LED OLED. The five transistors M1 to M5 may be PMOS transistors.

[0032] The transistor M1 drives the organic LED OLED, and it may be coupled between a power supply for providing a power supply voltage V_{DD} and the organic LED OLED. The transistor M1 controls the current that flows through the organic LED OLED, via the transistor M2, in response to a voltage applied to the gate of the transistor M1. The transistor M3 may diode-connect the transistor M1 in response to a select signal from the previous scan line Sn-1.

[0033] The gate of the transistor M1 may be coupled to node A of the capacitor Cvth. The capacitor Cst and the transistor M4 may be coupled in parallel to each other and between node B of the capacitor Cvth and the power supply providing the voltage V_{DD}. The transistor M4 may provide the voltage V_{DD} to node B of the capacitor Cvth in response to the select signal from the previous scan line Sn-1. Alternatively, the transistor M4 may be coupled to a power supply voltage that differs from the power supply voltage V_{DD}.

[0034] The transistor M5 may deliver a data signal transmitted from the data line Dm to node B of the capacitor Cvth in response to the select signal from the current scan line Sn. The transistor M2 may be coupled between the drain of the transistor M1 and the anode of the organic LED OLED, and it may block the drain of the transistor M 1 from the organic LED OLED in response to the select signal from the light emission control line En. The organic LED OLED emits light in response to a current input thereto from the transistor M1 via the transistor M2.

[0035] The operation of the pixel circuit 110 will now be explained with reference to FIG. 4, which shows waveforms that may be applied to the pixel circuit 110.

[0036] Applying a low level scan voltage to the previous scan line Sn-1, during a period D1, turns on the transistor M3 and diode-connects the transistor M1. Accordingly, the gate-source voltage of the transistor M1 may reach the threshold voltage Vth of the transistor M1. Here, the voltage that may be applied to the gate of the transistor M1, that is, node A of the capacitor Cvth, corresponds to the sum ofthe power supply voltage V_{DD} and the threshold voltage Vth ofthe transistor M1 because its source is coupled to the power supply voltage V_{DD}. Furthermore, applying the low level scan voltage to the previous scan line Sn-1 turns on the transistor M4, thereby supplying the power supply voltage V_{DD} to node B of the capacitor Cvth. Equation 2 represents the voltage V_{Cvth} that may be charged in the capacitor Cvth.

[Equation 2]

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

[0037] Here, V_{CvthA} and V_{CvthB} are the voltages applied to nodes A and B ofthe capacitor Cvth, respectively.

[0038] During the period D1, a high level signal may be applied to the light emission control line En, thus turning off the transistor M2. This prevents the current flowing through the transistor M1 from flowing to the organic LED OLED. Furthermore, a high level signal may be applied to the current scan line Sn to turn off the transistor M5.

[0039] Applying a low level scan voltage to the current scan line Sn, during the following period D2, turns on the transistor M5, thereby supplying a data voltage Vdata to node B of the capacitor Cvth. Additionally, the gate of the transistor M 1 may be provided with a voltage corresponding to the sum of the data voltage Vdata and its threshold voltage Vth because the capacitor Cvth is charged with a voltage corresponding to the threshold voltage Vth ofthe transistor M1. That is, Equation 3 represents the gate-source voltage Vgs of the transistor M1. Here, the light emission control line En may be provided with a high level signal, which keeps the transistor M2 turned off.

[Equation 3]

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

[0040] During a period D3, the transistor M2 may be turned on in response to a low-level light emission control signal of the light emission control line En, thereby providing the current I_{OLED}, corresponding to the gate-source voltage Vgs of the transistor M1, to the organic LED OLED to emit light. Equation 4 represents the current I_{OLED}.

[Equation 4]

$$I_{OLED} = \frac{\beta}{2}(Vgs - Vth)^2 = \frac{\beta}{2}((Vdata + Vth - VDD) - Vth)^2 = \frac{\beta}{2}(VDD - Vdata)^2$$

[0041] Here, I_{OLED} is the current flowing in the organic LED OLED, Vgs is the gate-source voltage of the transistor M1, and Vth is the threshold voltage of the transistor M1. Additionally, Vdata is the data voltage and β is a constant. Equation 4 shows that the display panel may be stably driven because the current I_{OLED} is determined by the data voltage Vdata and the power supply voltage V_{DD}, irrespective of the threshold voltage Vth of the driving transistor M1.

[0042] The signal waveforms shown in FIG. 4 are exemplary, and they may be modified. For example, the starting point of the high level signal applied to the light emission control line En may lag behind the starting point of the low level select signal applied to the previous scan line Sn-1. Furthermore, the end point ofthe high level signal applied to the light emission control line En may lag behind the end point ofthe low level select signal applied to the current scan line Sn.

[0043] As described above, applying the low level select signal to the previous scan line Sn-1 turns off the transistors M3 and M4, and applying the low level select signal to the current scan line Sn turns on the transistor M5, thereby providing node B ofthe capacitor Cst with the data voltage. Accordingly, the voltage corresponding to the data voltage may be charged in the capacitor Cst while the driving transistor M1 is turned on. According to the voltage charged in the capacitor Cst, the gate-source voltage Vgs of the driving transistor M1 maybe continuously maintained, even when the switching transistor M5 is turned off and the data voltage is not supplied to node B.

[0044] However, parasitic capacitance existing in node B may generate a voltage variation ΔV in the voltage supplied to node B, which may result in a voltage shift in node B. This voltage shift is called kickback, and the voltage variation ΔV is called kickback voltage. The kickback may generate a sticking image when displaying images and degrade the display panel's display characteristics. When the kickback voltage is greater than a gray-scale level interval, the display quality of the display panel may significantly deteriorate, such that images with the same gray scales may be displayed differently.

[0045] Exemplary embodiments of the present invention for solving the effect of the kickback will now be explained in detail.

[0046] FIG. 5 is an equivalent circuit diagram showing a pixel circuit according to a second exemplary embodiment of the present invention. This pixel circuit differs from the pixel circuit of the first exemplary embodiment in that dual transistors M4_1 and M4_2 are employed to reduce the kickback voltage at node B.

[0047] Referring to FIG. 5, the pixel circuit may include six transistors M1, M2, M3, M4_1, M4_2, and M5, two capacitors Cst and Cvth, and an organic LED OLED. The four transistors M1, M2, M3, and M5, the two capacitors Cst and Cvth, and the organic LED OLED may be identically configured and operated as in the first exemplary embodiment. Hence, detailed explanations thereof are omitted.

[0048] The source ofthe transistor M4_2 may be coupled to the power supply voltage V_{DD}, and its drain may be coupled to the source of the transistor M4_1. The drain of the transistor M4_1 may be coupled to the drain of the transistor M5. That is, the two transistors M4_1 and M4_2 may form dual transistors that are serially coupled to each other. The gates of the transistors M4_1 and M4_2 may be coupled to the previous scan line Sn-1. Accordingly, the two transistors M4_1 and M4_2 may be simultaneously turned on in response to a previous select signal to supply the power supply voltage V_{DD} to an end ofthe capacitor Cst.

[0049] Turning the transistors M4_1 and M4_2 off and turning the transistor M5 may reduce the kickback voltage at node B. Accordingly, a variation in the data voltage applied to node B and a voltage variation in the gate node A of the transistor M1 may decrease. Consequently, a variation in the gate-source voltage Vgs of the transistor M1, caused by the kickback voltage, may decrease, thereby reducing the influence of kickback on the current transmitted to the organic LED OLED.

[0050] When the total channel length of the dual transistors M4_1 and M4_2 is kept constant, the kickback voltage may be more effectively reduced when the channel of the transistor M4_2 is longer than the channel of the transistor M4_1.

[0051] Table 1 shows voltages of node B with the dual transistors M4_1 and M4_2 turned on and turned off, in the case where they each have a channel width W of 5 μm, and the channel length L of the transistor M4_1 plus the channel length L of transistor M4_2 is 20μm.

[Table 1]

Transistor size		Node B voltage		Kickback voltage
M4_1(W/L)	M4_2(W/L)	When turned on	When turned off	
5/15μm	5/5μm	5.0V	5.4917V	0.4917V
5/10μm	5/10μm	5.0V	5.3811V	0.3811V
5/7μm	5/13μm	5.0V	5.3217V	0.3217V
5/5μm	5/15μm	5.0V	5.2834V	0.2834V

[0052] Table 1 shows that as the channel length L ofthe transistor M4_2 increases, the kickback voltage at node B decreases. That is, when the channel of the transistor M4_2 is longer than the channel of the transistor M4_1, the current I_{OLED} corresponding to the data voltage may be more stably supplied to the organic LED OLED, thereby improving the display panel's display characteristics.

[0053] While Table 1 shows the minimum channel length ofthe transistor M4_1 as 5μm, it may be less than 5μm if the transistor's characteristics are secured when it is fabricated with a channel length shorter than 5μm. As the channel length L of the transistor M4_1 shortens, parasitic capacitance decreases, and the influence of kickback may decrease.

[0054] While the pixel circuit shown in FIG. 5 employs the serially coupled dual transistors M4_1 and M4_2, the pixel circuit may alternatively use a dual-gate transistor. While the dual transistors indicate that two transistors formed one source region, one drain region and one gate electrode are coupled to each other, the dual gate transistor indicates that one transistor has one source region, one drain region and two gate electrodes connected each other.

[0055] A third exemplary embodiment of the present invention will now be explained.

[0056] FIG. 6 is an equivalent circuit diagram showing a pixel circuit according to the third exemplary embodiment of the present invention. The pixel circuit differs from the pixel circuit of the first exemplary embodiment in that dual transistors M3_1 and M3_2 are employed to reduce the kickback voltage caused by parasitic capacitance existing between the gate and source of the transistor M1.

[0057] Referring to FIG. 6, the pixel circuit may include six transistors M1, M2, M3_1, M3_2, M4, and M5, two capacitors Cst and Cvth, and an organic LED OLED. The four transistors M1, M2, M4, and M5, the two capacitors Cst and Cvth, and the organic LED OLED may be identically configured and operated as in the first exemplary embodiment. Hence, detailed explanations thereof are omitted.

[0058] The source of the transistor M3_2 may be coupled to the drain of the transistor M1, and its drain may be coupled to the source of the transistor M3_1. The drain of the transistor M3_1 may be coupled to the gate of the transistor M1. That is, the two transistors M3_1 and M3_2 form dual transistors that are serially coupled to each other. The gates ofthe transistors M3_1 and M3_2 may be coupled to the previous scan line Sn-1. Accordingly, the two transistors M3_1 and M3_2 may be simultaneously turned on in response to the previous select signal to diode-connect the transistor M1.

[0059] Turning off the transistors M3_1 and M3_2 and turning on the transistor M5 may reduce the kickback voltage at node A. Accordingly, the influence of voltage variation due to the kickback voltage at gate node A ofthe transistor M1 may be decreased, thereby decreasing a variation in the gate-source voltage Vgs of the transistor M1 caused by the kickback voltage. Consequently, the influence of kickback on the current I_{OLED} transmitted to the organic LED OLED may be reduced.

[0060] When the total channel length of the dual transistors M3_1 and M3_2 is kept constant, the kickback voltage may be more effectively reduced when the channel of the transistor M3_2 is longer than the channel of the transistor M3_1.

[0061] Table 2 shows voltages of node A (i.e. the gate of the transistor M1), with the dual transistors M3_1 and M3_2 turned on and turned off, in the case where they each have a channel width W of 5μm, and the channel length L of the transistor M3_1 plus the channel length L of the transistor M3_2 is 20μm.

[Table 2]

Transistor size		Gate voltage of transistor M1		Kickback voltage
M3_1(W/L)	M3_2(W/L)	When turned on	When turned off	
5/15μm	5/5μm	3.6570V	4.6653V	1.0083V
5/10μm	5/10μm	3.2503V	4.1223V	0.8720V
5/7μm	5/13μm	3.1370V	3.9445V	0.8075V
5/5μm	5/15μm	3.0791V	3.8463V	0.7672V

[0062] Table 2 shows that as the channel length L ofthe transistor M3_2 increases, the kickback voltage at the gate of the transistor M1 decreases. That is, when the channel of the transistor M3_2 is longer than the channel of the transistor M3_1, the current I_{OLED} corresponding to the data voltage may be more stably supplied to the organic LED OLED, thereby improving the display panel's display characteristics.

[0063] While FIG. 6 shows the pixel circuit with the serially coupled dual transistors M3_1 and M3_2, the pixel circuit may alternative use a dual-gate transistor. While Table 2 shows the minimum channel length of the transistor M3_1 as 5μm, it maybe reduced to less than 5μm if the transistor's characteristics are secured even when it is fabricated with a channel length shorter than 5μm. As the channel length of the transistor M3_1 shortens, parasitic capacitance may decrease, and the influence of kickback may decrease.

[0064] A fourth exemplary embodiment of the present invention will now be explained.

[0065] FIG. 7 is an equivalent circuit diagram showing a pixel circuit according to the fourth exemplary embodiment of the present invention. The pixel circuit differs from the pixel circuits of the second and third exemplary embodiments in that dual transistors M4_1 and M4_2 may be employed to reduce the kickback voltage at node B, and dual transistors M3_1 and M3_2 may be used to reduce the kickback voltage caused by parasitic capacitance existing between the gate and source of the transistor M1.

[0066] Referring to FIG. 7, the pixel circuit may include seven transistors M1, M2, M3_1, M3_2, M4_1, M4_2, and M5, two capacitors Cst and Cvth, and an organic LED OLED. The three transistors M1, M2, and M5, the two capacitors Cst and Cvth, and the organic LED OLED may be identically configured and operated as in the first exemplary embodiment, of FIG. 3, the transistors M4_1 and M4_2 may be identical to those of the pixel circuit of the second exemplary embodiment, of FIG. 5, and the configuration and operation of the transistors M3_1 and M3_2 may be identical to those of the pixel circuit of the third exemplary embodiment of FIG. 6. Thus, detailed explanations thereof are omitted.

[0067] As shown in FIG. 7, using the transistors M3_1, M3_2 and the transistors M4_1, M4_2 may simultaneously reduce the kickback voltage at node B and the kickback voltage caused by the parasitic capacitance between the gate and source of the transistor M1.

[0068] As described above, exemplary embodiments ofthe present invention use dual transistors to reduce the kickback voltage caused by a parasitic capacitance component existing in the pixel circuit. Particularly, dual transistors having different channel lengths may be coupled in parallel with the capacitor charged with a voltage corresponding to a data voltage to reduce the influence of kickback on an electrode of the capacitor. Furthermore, the kickback voltage caused by parasitic capacitance existing between the gate and source/drain of the transistor driving the organic LED may be reduced using dual transistors having different sizes. This may effectively decrease the influence of kickback on the gate of the driving transistor. Consequently, the influence of kickback may be reduced, thereby improving the display characteristics ofthe light-emitting display.

[0069] It will be apparent to those skilled in the art that various modifications and variation can be made in the present invention without departing from the spirit or scope of the invention. Thus, it is intended that the present invention cover the modifications and variations of this invention provided they come within the scope ofthe appended claims and their equivalents.

Claims

1. A light-emitting display, comprising:

a plurality of data lines transmitting a data voltage;
a plurality of scan lines transmitting a select signal; and
a plurality ofpixel circuits coupled to the scan lines and the data lines,

wherein a pixel circuit comprises:

a first transistor and a second transistor serially coupled to each other and turned on in response to a first control signal;
a first capacitor coupled in parallel with the first transistor and the second transistor;
a third transistor supplying the data voltage to a first electrode of the first capacitor in response to the select signal;
a fourth transistor outputting a current corresponding to a gate-source voltage of the fourth transistor, the gate-source voltage being based on a voltage of the first capacitor; and
a light-emitting element emitting light in response to the current from the fourth transistor.

2. The light-emitting display of claim 1,
wherein a first electrode of the first transistor is coupled to the first electrode of the first capacitor;
wherein a second electrode of the first transistor is coupled to a first electrode of the second transistor; and
wherein a second electrode of the second transistor is coupled to a second electrode of the first capacitor.

3. The light-emitting display of claim 2, wherein the first transistor and the second transistor are a dual-gate transistor.

4. The light-emitting display of claim 2, wherein the first transistor and the second transistor have different sizes.

5. The light-emitting display of claim 4, wherein a channel of the second transistor is longer than a channel of the first transistor.

6. The light-emitting display of claim 1, wherein the pixel circuit further comprises:

a second capacitor coupled between the first electrode of the first capacitor and a gate of the fourth transistor; and
a first switch diode-connecting the fourth transistor in response to the first control signal,
wherein the gate of the fourth transistor is coupled to a second electrode of the second capacitor, and
wherein a source of the fourth transistor is coupled to a second electrode of the first capacitor.

7. The light-emitting display of claim 6, wherein the first switch includes a fifth transistor and a sixth transistor serially coupled to each other and turned on in response to the first control signal.

8. The light-emitting display of claim 7, wherein the fifth transistor and the sixth transistor are a dual-gate transistor.

9. The light-emitting display of claim 8, wherein the pixel circuit further comprises:

a second switch transmitting the current output from the fourth transistor to the light-emitting element in response to a second control signal,
wherein the second control signal is supplied to the pixel circuit after the first control signal and the select signal.

10. The light-emitting display of claim 1, wherein the first control signal is a previous select signal that is applied to the pixel circuit before the select signal.

11. The light-emitting display of claim 1, wherein the light-emitting element uses an organic material to emit light.

12. A light-emitting display, comprising:

a plurality of data lines transmitting a data voltage;
a plurality of scan lines transmitting select signals including a first select signal and a second select signal; and
a plurality ofpixel circuits coupled to the scan lines and the data lines,
wherein a pixel circuit comprises:

a first transistor including a first electrode coupled to a data line and a second electrode turned on in response to the second select signal to transmit the data voltage;
a first capacitor charged with a voltage corresponding to the data voltage;
a second transistor and a third transistor serially coupled to each other, coupled in parallel with the first capacitor, and turned on in response to the first select signal;

a fourth transistor outputting a current corresponding to the voltage charged in the first capacitor;
a fifth transistor and a sixth transistor serially coupled to each other and turned on in response to the first select signal to diode-connect the fourth transistor;
a second capacitor coupled between a first electrode of the first capacitor and a control electrode of the fourth transistor and charged with a voltage corresponding to a threshold voltage of the fourth transistor; and
a light-emitting element emitting light corresponding to the current output from the fourth transistor.

13. The light-emitting display of claim 12, wherein the second transistor and the third transistor have different sizes.

14. The light-emitting display of claim 13,
wherein the second transistor is coupled to the second electrode of the first transistor; and
wherein a channel of the second transistor is shorter than a channel of the third transistor.

15. The light-emitting display of claim 12, wherein the fifth transistor and the sixth transistor have different sizes.

16. The light-emitting display of claim 15,
wherein the fifth transistor is coupled to the control electrode of the fourth transistor; and
wherein a channel of the fifth transistor is shorter than a channel of the sixth transistor.

17. The light-emitting display of claim 12, wherein the pixel circuit further comprises:

a switch transmitting the current output from the fourth transistor to the light-emitting element in response to a control signal,
wherein the control signal is supplied to the pixel circuit after the first select signal and the second select signal.

18. A light-emitting display, comprising:

a plurality of data lines transmitting a data voltage;
a plurality of scan lines transmitting select signals including a first select signal and a second select signal; and
a plurality of pixel circuits coupled to the scan lines and the data lines,
wherein a pixel circuit comprises:

a first transistor including a first electrode coupled to a data line and a second electrode turned on in response to the second select signal to transmit the data voltage;
a first capacitor charged with a voltage corresponding to the data voltage;
a third transistor outputting a current corresponding to the voltage charged in the first capacitor;
a fourth transistor and a fifth transistor serially coupled to each other and turned on in response to the first select signal to diode-connect the third transistor; and
a light-emitting element emitting light corresponding to the current output from the third transistor.

19. The light-emitting display of claim 18, wherein the fourth transistor and the fifth transistor have different sizes.

20. The light-emitting display of claim 19,
wherein the fourth transistor is coupled to a control electrode of the third transistor,
wherein a channel of the fourth transistor is shorter than a channel of the fifth transistor.

21. The light-emitting display of claim 18, wherein the fourth transistor and the fifth transistor are a dual-gate transistor.

22. The light-emitting display of claim 18, wherein the pixel circuit further comprises:

a second capacitor coupled between a first electrode of the first capacitor and a control electrode of the third transistor; and
a second transistor turned on in response to the first select signal and coupled in parallel with the first capacitor.

23. The light-emitting display of claim 22, wherein the pixel circuit further comprises:

a switch transmitting the current output from the third transistor to the light-emitting element in response to a control signal, wherein the control signal is supplied to the pixel circuit after the first select signal and the second select signal.

Patentansprüche

1. Eine lichtemittierende Anzeige, welche folgendes umfasst:

    eine Mehrzahl von Datenleitungen, die eine Datenspannung übertragen;
    eine Mehrzahl von Abtastleitungen, die ein Auswahlsignal übertragen; und
    eine Mehrzahl von Pixelschaltkreisen, die mit den Abtastleitungen und den Datenleitungen verbunden sind, wobei ein Pixelschaltkreis folgendes umfasst:

        einen ersten Transistor und einen zweiten Transistor, die miteinander in Reihe geschaltet sind und als Antwort auf ein erstes Steuersignal eingeschaltet werden;
        einen ersten Kondensator, der mit dem ersten Transistor und dem zweiten Transistor parallel geschaltet ist;
        einen dritten Transistor, der einer ersten Elektrode des ersten Kondensators als Antwort auf das Auswahlsignal die Datenspannung bereitstellt;
        einen vierten Transistor, der einen einer Gate-Source-Spannung des vierten Transistors entsprechenden Strom ausgibt, wobei die Gate-Source-Spannung auf einer Spannung des ersten Kondensators basiert; und
        wobei ein lichtemittierendes Element als Antwort auf den Strom von dem vierten Transistor Licht emittiert.

2. Die lichtemittierende Anzeige nach Anspruch 1,
wobei eine erste Elektrode des ersten Transistors mit der ersten Elektrode des ersten Kondensators verbunden ist;
wobei eine zweite Elektrode des ersten Transistors mit einer ersten Elektrode des zweiten Kondensators verbunden ist; und
wobei eine zweite Elektrode des zweiten Transistors mit einer zweiten Elektrode des ersten Kondensators verbunden ist.

3. Die lichtemittierende Anzeige nach Anspruch 2, wobei der erste Transistor und der zweite Transistor jeweils ein Dual-Gate-Transistor sind.

4. Die lichtemittierende Anzeige nach Anspruch 2, wobei der erste Transistor und der zweite Transistor verschiedene Größen aufweisen.

5. Die lichtemittierende Anzeige nach Anspruch 4, wobei ein Kanal des zweiten Transistors länger ist als ein Kanal des ersten Transistors.

6. Die lichtemittierende Anzeige nach Anspruch 1, wobei der Pixelschaltkreis ferner folgendes umfasst:

    einen zwischen die erste Elektrode des ersten Kondensators und ein Gate des vierten Transistors geschalteten zweiten Kondensator; und
    einen ersten Schalter, der den vierten Transistor als Antwort auf das erste Steuersignal als Diode schaltet,
    wobei das Gate des vierten Transistors mit einer zweiten Elektrode des zweiten Kondensators verbunden ist, und wobei eine Source des vierten Transistors mit einer zweiten Elektrode des ersten Kondensators verbunden ist.

7. Die lichtemittierende Anzeige nach Anspruch 6, wobei der erste Schalter einen fünften Transistor und einen sechsten Transistor beinhaltet, die miteinander in Reihe geschaltet sind und als Antwort auf das erste Steuersignal eingeschaltet werden.

8. Die lichtemittierende Anzeige nach Anspruch 7, wobei der fünfte Transistor und der sechste Transistor jeweils ein Dual-Gate-Transistor sind.

9. Die lichtemittierende Anzeige nach Anspruch 8, wobei der Pixelschaltkreis ferner folgendes umfasst:

    einen zweiten Schalter, der als Antwort auf ein zweites Steuersignal den Ausgangsstrom von dem vierten Transistor zu dem lichtemittierenden Element überträgt,
    wobei dem Pixelschaltkreis das zweite Steuersignal nach dem ersten Steuersignal und dem Auswahlsignal bereitgestellt wird.

10. Die lichtemittierende Anzeige nach Anspruch 1, wobei das erste Steuersignal ein vorheriges Auswahlsignal ist, das vor dem Auswahlsignal an den Pixelschaltkreis angelegt wird.

11. Die lichtemittierende Anzeige nach Anspruch 1, wobei das lichtemittierende Element ein organisches Material verwendet, um Licht zu emittieren.

12. Eine lichtemittierende Anzeige, welche folgendes umfasst:

eine Mehrzahl von Datenleitungen, die eine Datenspannung übertragen;
eine Mehrzahl von Abtastleitungen, die Auswahlsignale einschließlich eines ersten Auswahlsignals und eines zweiten Auswahlsignals übertragen; und
eine Mehrzahl von Pixelschaltkreisen, die mit den Abtastleitungen und den Datenleitungen verbunden sind, wobei ein Pixelschaltkreis folgendes umfasst:

einen ersten Transistor, der eine erste Elektrode, die mit einer Datenleitung verbunden ist, und eine zweite Elektrode, die als Antwort auf das zweite Auswahlsignal eingeschaltet wird, um die Datenspannung zu übertragen, beinhaltet;
einen ersten Kondensator, der mit einer der Datenspannung entsprechenden Spannung geladen wird;
einen zweiten Transistor und einen dritten Transistor, die miteinander in Reihe geschaltet sind, parallel zu dem ersten Kondensator geschaltet sind und als Antwort auf das erste Auswahlsignal eingeschaltet werden;
einen vierten Transistor, der einen der in dem ersten Kondensator geladenen Spannung entsprechenden Strom ausgibt;
einen fünften Transistor und einen sechsten Transistor, die miteinander in Reihe geschaltet sind und als Antwort auf das erste Auswahlsignal eingeschaltet werden, um den vierten Transistor als Diode zu schalten;
einen zweiten Kondensator, der zwischen eine erste Elektrode des ersten Kondensators und eine Steuerelektrode des vierten Transistors geschaltet ist und mit einer einer Schwellenspannung des vierten Transistors entsprechenden Spannung geladen wird; und
ein lichtemittierendes Element, welches dem Ausgangsstrom von dem vierten Transistor entsprechendes Licht emittiert.

13. Die lichtemittierende Anzeige nach Anspruch 12, wobei der zweite Transistor und der dritte Transistor verschiedene Größen aufweisen.

14. Die lichtemittierende Anzeige nach Anspruch 13,
wobei der zweite Transistor mit der zweiten Elektrode des ersten Transistors verbunden ist; und
wobei ein Kanal des zweiten Transistors kürzer ist als ein Kanal des dritten Transistors.

15. Die lichtemittierende Anzeige nach Anspruch 12, wobei der fünfte Transistor und der sechste Transistor verschiedene Größen aufweisen.

16. Die lichtemittierende Anzeige nach Anspruch 15,
wobei der fünfte Transistor mit der Steuerelektrode des vierten Transistors verbunden ist; und
wobei ein Kanal des fünften Transistors kürzer ist als ein Kanal des sechsten Transistors.

17. Die lichtemittierende Anzeige nach Anspruch 12, wobei der Pixelschaltkreis ferner folgendes umfasst:

einen Schalter, der als Antwort auf ein Steuersignal den Ausgangsstrom von dem vierten Transistor an das lichtemittierende Element überträgt,
wobei dem Pixelschaltkreis das Steuersignal nach dem ersten Auswahlsignal und dem zweiten Auswahlsignal bereitgestellt wird.

18. Eine lichtemittierende Anzeige, welche folgendes umfasst:

eine Mehrzahl von Datenleitungen, die eine Datenspannung übertragen;
eine Mehrzahl von Abtastleitungen, die Auswahlsignale einschließlich eines ersten Auswahlsignals und eines zweiten Auswahlsignals übertragen; und
eine Mehrzahl von Pixelschaltkreisen, die mit den Abtastleitungen und den Datenleitungen verbunden sind, wobei ein Pixelschaltkreis folgendes umfasst:

einen ersten Transistor, der eine erste Elektrode, die mit einer Datenleitung verbunden ist, und eine zweite Elektrode, die als Antwort auf das zweite Auswahlsignal eingeschaltet wird, um die Datenspannung zu übertragen, beinhaltet;
einen ersten Kondensator, der mit einer der Datenspannung entsprechenden Spannung geladen wird;
einen dritten Transistor, der einen der in dem ersten Kondensator geladenen Spannung entsprechenden Strom ausgibt;
einen vierten Transistor und einen fünften Transistor, die miteinander in Reihe geschaltet sind und als Antwort auf das erste Auswahlsignal eingeschaltet werden, um den dritten Transistor als Diode zu schalten; und
ein lichtemittierendes Element, welches dem Ausgangsstrom von dem dritten Transistor entsprechendes Licht emittiert.

19. Die lichtemittierende Anzeige nach Anspruch 18, wobei der vierte Transistor und der fünfte Transistor verschiedene Größen aufweisen.

20. Die lichtemittierende Anzeige nach Anspruch 19,
wobei der vierte Transistor mit einer Steuerelektrode des dritten Transistors verbunden ist,
wobei ein Kanal des vierten Transistors kürzer ist als ein Kanal des fünften Transistors.

21. Die lichtemittierende Anzeige nach Anspruch 18, wobei der vierte Transistor und der fünfte Transistor jeweils ein Dual-Gate-Transistor sind.

22. Die lichtemittierende Anzeige nach Anspruch 18, wobei der Pixelschaltkreis ferner folgendes umfasst:

einen zwischen eine erste Elektrode des ersten Kondensators und eine Steuerelektrode des dritten Transistors geschalteten Kondensator; und
einen zweiten Transistor, der als Antwort auf das erste Auswahlsignal eingeschaltet wird und parallel zu dem ersten Kondensator geschaltet ist.

23. Die lichtemittierende Anzeige nach Anspruch 22, wobei der Pixelschaltkreis ferner folgendes umfasst:

einen Schalter, der als Antwort auf ein Steuersignal den Ausgangsstrom von dem dritten Transistor zu dem lichtemittierenden Element überträgt,
wobei das Steuersignal dem Pixelschaltkreis nach dem ersten Auswahlsignal und dem zweiten Auswahlsignal bereitgestellt wird.

Revendications

1. Affichage émetteur de lumière comportant :

une pluralité de lignes de données transmettant une tension de données ;
une pluralité de lignes de balayage transmettant un signal de sélection : et
une pluralité de circuits de pixel reliés aux lignes de balayage ainsi qu'aux lignes de données,
dans lequel un circuit de pixel comporte :

un premier transistor ainsi qu'un deuxième transistor reliés en série l'un à l'autre et mis en fonctionnement en réponse à un premier signal de commande ;
un premier condensateur relié en parallèle au premier transistor ainsi qu'au deuxième transistor ;
un troisième transistor fournissant la tension de données à une première électrode du premier condensateur en réponse au signal de sélection ;
un quatrième transistor fournissant en sortie un courant correspondant à une tension grille-source du quatrième transistor, la tension grille-source étant basée sur une tension du premier condensateur ; et
un élément émetteur de lumière émettant de la lumière en réponse au courant en provenance du quatrième transistor.

2. Affichage émetteur de lumière selon la revendication 1,
dans lequel une première électrode du premier transistor est reliée à la première électrode du premier condensateur ;

dans lequel une deuxième électrode du premier transistor est reliée à une première électrode du deuxième transistor ; et

dans lequel une deuxième électrode du deuxième transistor est reliée à une deuxième électrode du premier condensateur.

3. Affichage émetteur de lumière selon la revendication 2, dans lequel le premier transistor ainsi que le deuxième transistor sont un transistor à double grille.

4. Affichage émetteur de lumière selon la revendication 2, dans lequel le premier transistor ainsi que le deuxième transistor ont des tailles différentes.

5. Affichage émetteur de lumière selon la revendication 4, dans lequel un canal du deuxième transistor est plus long qu'un canal du premier transistor.

6. Affichage émetteur de lumière selon la revendication 1, dans lequel le circuit de pixel comporte de plus :

un deuxième condensateur relié entre la première électrode du premier condensateur et une grille du quatrième transistor ; et

un premier commutateur raccordant par diode le quatrième transistor en réponse au premier signal de commande,

dans lequel la grille du quatrième transistor est reliée à une deuxième électrode du deuxième condensateur, et

dans lequel une source du quatrième transistor est reliée à une deuxième électrode du premier condensateur.

7. Affichage émetteur de lumière selon la revendication 6, dans lequel le premier commutateur inclut un cinquième transistor ainsi qu'un sixième transistor reliés en série l'un à l'autre et mis en fonctionnement en réponse au premier signal de commande.

8. Affichage émetteur de lumière selon la revendication 7, dans lequel le cinquième transistor ainsi que le sixième transistor sont un transistor à double grille.

9. Affichage émetteur de lumière selon la revendication 8, dans lequel le circuit de pixel comporte de plus :

un deuxième commutateur transmettant le courant fourni en sortie à partir du quatrième transistor à l'élément émetteur de lumière en réponse à un deuxième signal de commande,

dans lequel le deuxième signal de commande est fourni au circuit de pixel après le premier signal de commande et le signal de sélection.

10. Affichage émetteur de lumière selon la revendication 1, dans lequel le premier signal de commande est un signal de sélection précédent qui est appliqué au circuit de pixel avant le signal de sélection.

11. Affichage émetteur de lumière selon la revendication 1, dans lequel l'élément émetteur de lumière utilise un matériau organique pour émettre de la lumière.

12. Affichage émetteur de lumière comportant :

une pluralité de lignes de données transmettant une tension de données ;

une pluralité de lignes de balayage transmettant des signaux de sélection incluant un premier signal de sélection ainsi qu'un deuxième signal de sélection ; et

une pluralité de circuits de pixel reliés aux lignes de balayage ainsi qu'aux lignes de données,

dans lequel un circuit de pixel comporte :

un premier transistor incluant une première électrode reliée à une ligne de données ainsi qu'une deuxième électrode mise en fonctionnement en réponse au deuxième signal de sélection pour transmettre la tension de données ;

un premier condensateur chargé avec une tension correspondant à la tension de données ;

un deuxième transistor ainsi qu'un troisième transistor reliés en série l'un à l'autre, reliés en parallèle au premier condensateur, et mis en fonctionnement en réponse au premier signal de sélection ;

un quatrième transistor fournissant en sortie un courant correspondant à la tension chargée dans le premier

condensateur ;
un cinquième transistor ainsi qu'un sixième transistor reliés en série l'un à l'autre et mis en fonctionnement en réponse au premier signal de sélection pour raccorder par diode le quatrième transistor ;
un deuxième condensateur relié entre une première électrode du premier condensateur et une électrode de commande du quatrième transistor et chargé avec une tension correspondant à une tension de seuil du quatrième transistor ; et
un élément émetteur de lumière émettant de la lumière correspondant au courant fourni en sortie à partir du quatrième transistor.

13. Affichage émetteur de lumière selon la revendication 12, dans lequel le deuxième transistor ainsi que le troisième transistor ont des tailles différentes.

14. Affichage émetteur de lumière selon la revendication 13,
dans lequel le deuxième transistor est relié à la deuxième électrode du premier transistor ; et
dans lequel un canal du deuxième transistor est plus court qu'un canal du troisième transistor.

15. Affichage émetteur de lumière selon la revendication 12, dans lequel le cinquième transistor ainsi que le sixième transistor ont des tailles différentes.

16. Affichage émetteur de lumière selon la revendication 15,
dans lequel le cinquième transistor est relié à l'électrode de commande du quatrième transistor ; et
dans lequel un canal du cinquième transistor est plus court qu'un canal du sixième transistor.

17. Affichage émetteur de lumière selon la revendication 12, dans lequel le circuit de pixel comporte de plus :

un commutateur transmettant le courant fourni en sortie à partir du quatrième transistor vers l'élément émetteur de lumière en réponse à un signal de commande,
dans lequel le signal de commande est fourni au circuit de pixel après le premier signal de sélection et le deuxième signal de sélection.

18. Affichage émetteur de lumière comportant :

une pluralité de lignes de données transmettant une tension de données ;
une pluralité de lignes de balayage transmettant des signaux de sélection incluant un premier signal de sélection ainsi qu'un deuxième signal de sélection ; et
une pluralité de circuits de pixel reliés aux lignes de balayage ainsi qu'aux lignes de données,
dans lequel un circuit de pixel comporte :

un premier transistor incluant une première électrode reliée à une ligne de données et une deuxième électrode mise en fonctionnement en réponse au deuxième signal de sélection pour transmettre la tension de données ;
un premier condensateur chargé avec une tension correspondant à la tension de données ;
un troisième transistor fournissant en sortie un courant correspondant à la tension chargée dans le premier condensateur ;
un quatrième transistor ainsi qu'un cinquième transistor reliés en série l'un à l'autre et mis en fonctionnement en réponse au premier signal de sélection pour raccorder par diode le troisième transistor ; et
un élément émetteur de lumière émettant de la lumière correspondant au courant fourni en sortie à partir du troisième transistor.

19. Affichage émetteur de lumière selon la revendication 18, dans lequel le quatrième transistor ainsi que le cinquième transistor ont des tailles différentes.

20. Affichage émetteur de lumière selon la revendication 19,
dans lequel le quatrième transistor est relié à une électrode de commande du troisième transistor,
dans lequel un canal du quatrième transistor est plus court qu'un canal du cinquième transistor.

21. Affichage émetteur de lumière selon la revendication 18, dans lequel le quatrième transistor ainsi que le cinquième transistor sont un transistor à double grille.

22. Affichage émetteur de lumière selon la revendication 18, dans lequel le circuit de pixel comporte de plus :

un deuxième condensateur relié entre une première électrode du premier condensateur et une électrode de commande du troisième transistor ; et
un deuxième transistor mis en fonctionnement en réponse au premier signal de sélection et relié en parallèle au premier condensateur.

23. Affichage émetteur de lumière selon la revendication 22, dans lequel le circuit de pixel comporte de plus :

un commutateur transmettant le courant fourni en sortie à partir du troisième transistor vers l'élément émetteur de lumière en réponse à un signal de commande,
dans lequel le signal de commande est fourni au circuit de pixel après le premier signal de sélection et le deuxième signal de sélection.

FIG.1
Prior Art

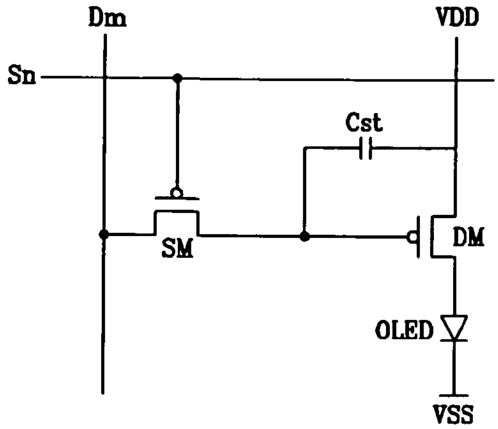


FIG.2

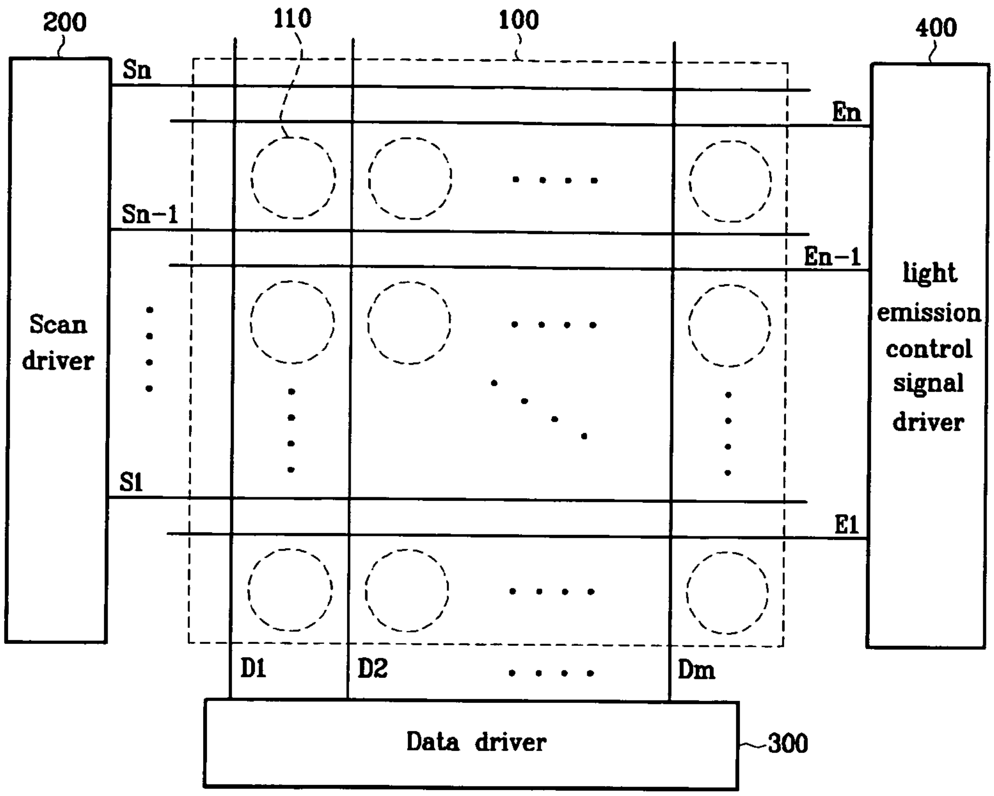

200
110
100
400
Sn
En
Sn-1
En-1
Scan
driver
light
emission
control
signal
driver
S1
E1
D1
D2
Dm
Data driver
300

FIG.3

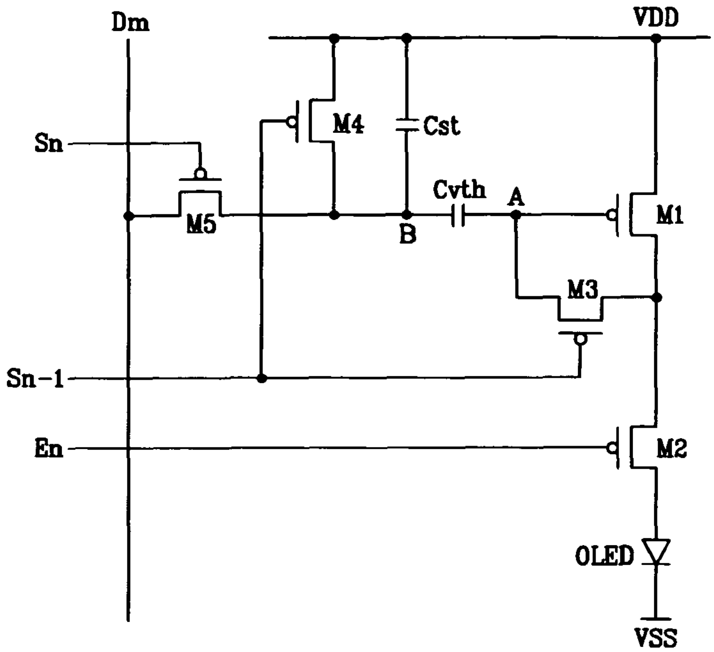


FIG.4

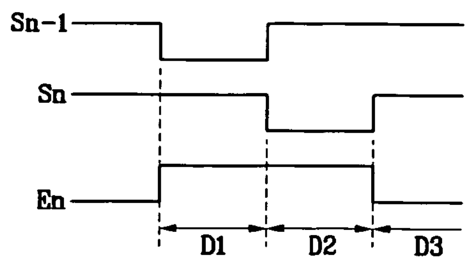


FIG.5

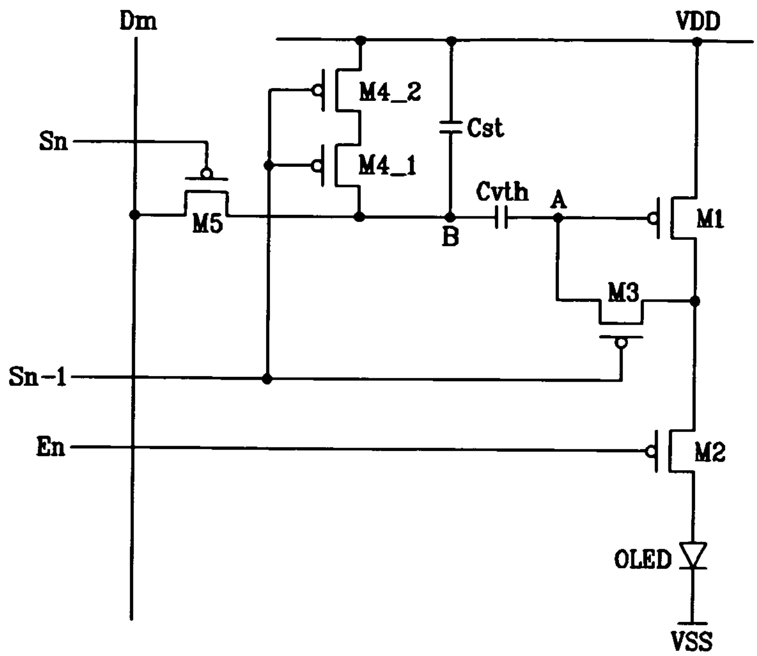


FIG.6

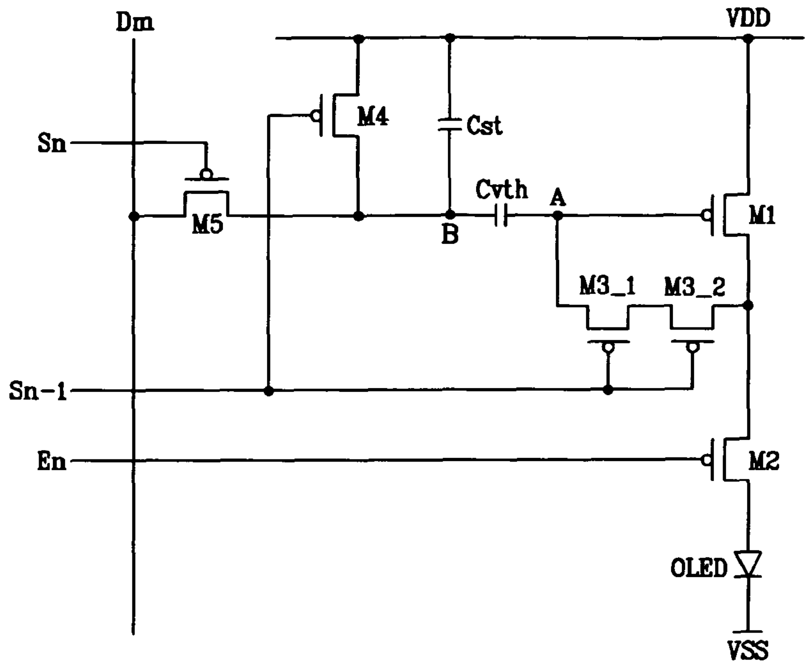
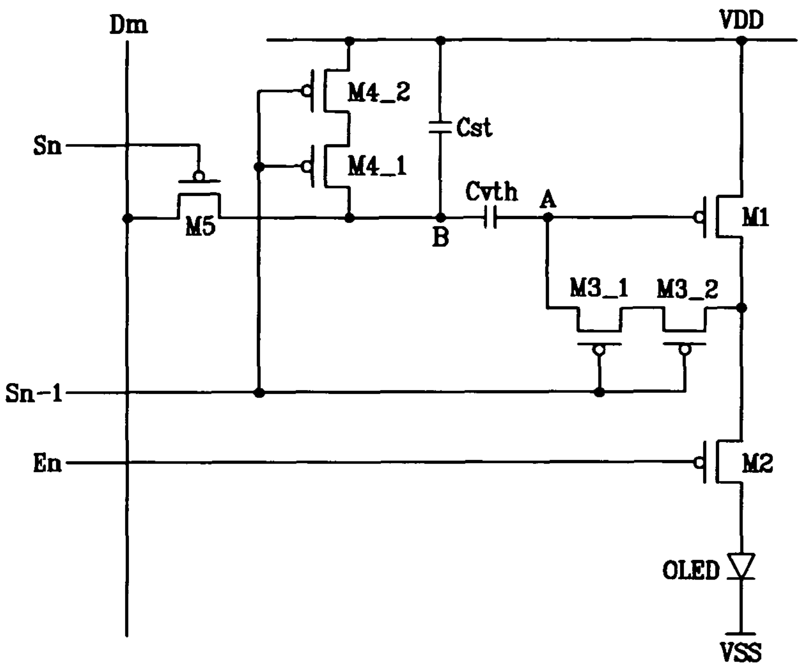


FIG.7



patsnap

专利名称(译)	发光显示装置		
公开(公告)号	EP1591993B1	公开(公告)日	2007-10-10
申请号	EP2005103364	申请日	2005-04-26
[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	EOM KI MYEONG KWAK WON KYU OH CHOON YUL		
发明人	EOM, KI-MYEONG KWAK, WON-KYU OH, CHOON-YUL		
IPC分类号	G09G3/32 H01L51/50 G09F9/30 G09G3/20 G09G3/30 H01L27/32		
CPC分类号	G09G3/3233 G09G2300/0819 G09G2300/0852 G09G2300/0861 G09G2320/0219 G09G2320/043		
代理机构(译)	hengelhaupt，Jürgen		
优先权	1020040030228 2004-04-29 KR 1020040065784 2004-08-20 KR		
其他公开文献	EP1591993A1		
外部链接	Espacenet		

摘要(译)

一种发光显示器的像素电路，其减小由寄生电容产生的反冲的影响。像素电路包括第一至第四晶体管，电容器和发光元件。第一和第二晶体管彼此串联耦合并响应第一控制信号导通。电容器与第一和第二晶体管并联耦合。第三晶体管响应于选择信号将数据电压提供给电容器的第一电极。第四晶体管输出对应于其栅极 - 源极电压的电流，该电流基于电容器的电压。发光元件发出与来自第四晶体管的电流对应的光。

[Equation 1]

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