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(54) CIRCUIT AND METHOD FOR GENERATING LIGHT-EMITTING CONTROL SIGNAL, AND PIXEL CIRCUIT DRIVING METHOD

SCHALTUNG UND VERFAHREN ZUR ERZEUGUNG EINES LICHTEMITTIERENDEN STEUERSIGNALS UND PIXELSCHALTUNGSANSTEUERUNGSVERFAHREN

CIRCUIT ET PROCÉDÉ POUR GÉNÉRER UN SIGNAL DE COMMANDE D'ÉMISSION DE LUMIÈRE, ET PROCÉDÉ DE PILOTAGE DE CIRCUIT DE PIXEL

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Description

TECHNICAL FIELD

[0001] The present disclosure relates to the field of display technologies, and more particularly to a circuit and method for generating a light emission control signal and a method of driving a pixel circuit.

BACKGROUND

[0002] Active matrix organic light-emitting diode (AMOLED) display panels have been presented that have in-cell touch sensors, where the cathode of the organic light-emitting diode (OLED) is divided into a plurality of separate electrode areas, each serving as a touch sensor to which a touch scan signal is applied during a touch sense phase.

[0003] Due to its working principle, such an in-cell touch sensor has a strict requirement for the cathode-to-ground capacitance (self-capacitance) of the OLED. I.e., influence of potential additional capacitance (e.g., capacitance between the anode and cathode of the OLED) on the self-capacitance should be avoided at the largest extent in an AMOLED pixel circuit to ensure a good accuracy for touch sensing. Currently, there is no satisfactory solution that can meet such a requirement.

[0004] EP 2736174 A1 discloses an inverter including first, second, third, and fourth transistors, where each of the first, second, third, and fourth transistors is a P-type thin film transistor. The inverter further includes a first capacitor.

[0005] CN 104850270 A discloses a driving method and driving circuit of a touch control module set. According to the driving method, the touch control electrode as well as all the signal lines and control lines below the touch control electrode are synchronously driven, so that the influence of capacitance on the touch control electrode can be offset.

[0006] Thus, there is a need for an improved working mechanism for the AMOLED pixel circuit having in-cell touch sensors.

SUMMARY

[0007] The present invention is defined by the independent claim 1. It would be advantageous to provide a circuit for generating a light emission control signal for an AMOLED pixel circuit having in-cell touch sensors, which light emission control signal may turn off the OLED in the pixel circuit during a touch sense phase such that an influence of the capacitance between the anode and cathode of the OLED on the touch sensor-to-ground capacitance is reduced. It would also be desirable to provide a method for generating the light emission control signal using the circuit and a method of driving the AMOLED pixel circuit using the light emission control signal.

[0008] According to an aspect of the present disclosure, a method for generating a light emission control signal using a light emission control signal generation circuit is provided. The light emission control signal generation circuit is for use with an active matrix organic light-emitting diode (AMOLED) pixel circuit of an AMOLED touch display device. The AMOLED touch display device is configured to operate in a display phase and a touch sense phase that occur alternatingly in a time-divisional manner. The AMOLED pixel circuit comprises an in-cell touch sensor, wherein the light emission control signal generation circuit comprises: a first transistor having a gate electrode connected to a first control line, a first electrode for being supplied with a voltage of a first level, and a second electrode connected to a first node, the first control line configured to transfer a first control signal; a second transistor having a gate electrode for being supplied with a first clock signal, a first electrode for being supplied with a voltage of a second level, and a second electrode connected to the first node; a first capacitor having a terminal connected to the first node and another terminal for being supplied with a second clock signal; a third transistor having a gate electrode connected to the first control line, a first electrode for being supplied with the voltage of the first level, and a second electrode connected to a light emission control line; and a fourth transistor having a gate electrode connected to the first node, a first electrode connected to a second control line, and a second electrode connected to the light emission control line, the second control line configured to transfer a second control signal, the second control signal having the second level during the display phase and being a signal resulting from superposition of a touch scan signal on the voltage of the first level during the touch sense phase. The third transistor and the fourth transistor are configured such that only one of the third transistor and the fourth transistor is turned on at any given time under control of the first control signal and a voltage at the first node. The display phase comprises a first period of time corresponding to a half period of the first clock signal and a second period of time corresponding to one or more periods of the first clock signal. The method comprises: receiving, during the first period of time of the display phase, the first clock signal at the first level, the second clock signal, as an inverted version of the first clock signal, at the second level, and the first control signal at the second level, such that the third transistor is turned on to output the voltage of the first level via the light emission control line as the light emission control signal; receiving, during the second period of time of the display phase, the first control signal at the first level such that the fourth transistor is turned on to output the second control signal via the light emission control line as the light emission control signal; and receiving, during the touch sense phase, the first control signal at the first level such that the fourth transistor is turned on to output the second control signal via the light emission control line as the light emission control signal.

[0009] According to an aspect of the present disclo-

sure, a method of driving the AMOLED pixel circuit using the light emission control signal generated by the method as described above is provided. The AMOLED pixel circuit further comprises an OLED, the light emission control line and a light emission control transistor. The OLED comprises a cathode connected to a first power source and serving as a touch sensor. The light emission control transistor has a gate electrode connected to the light emission control line and configured to control ON/OFF of a current flowing through the OLED. The method comprises applying the light emission control signal to the light emission control line to cause the AMOLED pixel circuit to operate to: turn off the light emission control transistor and perform a data write operation, during the first period of time of the display phase; turn on the light emission control transistor to perform an OLED light emission operation, during the second period of time of the display phase; and turn off the light emission control transistor to perform a touch sense operation with the OLED turned off, during the touch sense phase.

[0010] In an embodiment, the light emission control transistor is a P-type thin film transistor.

[0011] In an embodiment, a reset operation is performed by the AMOLED pixel circuit prior to the data write operation during the first period of time of the display phase.

[0012] In an embodiment, the touch scan signal is synchronously superposed on signals applied to all other external terminals of the AMOLED pixel circuit at the same time when the light emission control signal is applied to the light emission control line and the touch scan signal is applied to the first power source, during the touch sense phase.

[0013] In an embodiment, the display phase and the touch sense phase occur alternatingly to the AMOLED pixel circuit in a time-divisional manner.

[0014] These and other aspects of the present disclosure will be apparent from and elucidated with reference to the embodiment(s) described hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015]

FIG. 1 shows a circuit diagram of a circuit for generating a light emission control signal for an AMOLED pixel circuit having in-cell touch sensors according to an embodiment of the present disclosure;

FIGS. 2(a) to 2(e) show timing diagrams of operations for generation of the light emission control signal using the circuit as shown in FIG. 1;

FIG. 3 shows a circuit diagram of an exemplary AMOLED pixel circuit to which the light emission control signal generated in accordance with the operations as shown in FIGS. 2(a) to 2(e) is to be applied; and

FIGS. 4(a) to 4(d) show timing diagrams of operations of the AMOLED pixel circuit as shown in FIG. 3 in a display phase and a touch sense phase.

DETAILED DESCRIPTION

[0016] Embodiments of the present disclosure will be described in detail with reference to the accompanying drawings.

[0017] FIG. 1 shows a circuit diagram of a circuit for generating a light emission control signal for an AMOLED pixel circuit having in-cell touch sensors according to an embodiment of the present disclosure. As shown in the figure, the circuit includes a first transistor T1, a second transistor T2, a third transistor T3, a fourth transistor T4 and a first capacitor Cg. Under control of a control signal transferred by a first control line GO, a first clock signal CK, a second clock signal CB, a voltage of a first level VGH, a voltage of a second level VGL and a control signal transferred by a second control line VGL_1, the circuit outputs a desired light emission control signal via a light emission control line EM.

[0018] More specifically, the first transistor T1 has a gate electrode connected to the first control line GO, a first electrode for being supplied with the voltage of the first level VGH, and a second electrode connected to a first node N. The first control line GO transfers a first control signal. In an example, the first control signal may be provided by a gate driver on array (GOA) circuit of the AMOLED display. However, the first control signal may also be provided by a separate timing generation circuit.

[0019] The second transistor T2 has a gate electrode for being supplied with the first clock signal CK, a first electrode for being supplied with the voltage of the second level VGL, and a second electrode connected to the first node N.

[0020] The first capacitor Cg has a terminal connected to the first node N and another terminal for being supplied with the second clock signal CB. The second clock signal CB may be an inverted version of the first clock signal CK.

[0021] The third transistor T3 has a gate electrode connected to the first control line GO, a first electrode for being supplied with the voltage of the first level VGH, and a second electrode connected to the light emission control line EM.

[0022] The fourth transistor T4 has a gate electrode connected to the first node N, a first electrode connected to the second control line VGL 1, and a second electrode connected to the light emission control line EM. The second control line VGL_1 transfers a second control signal.

[0023] Under control of the first control signal and a voltage at the first node N, only one of the third transistor T3 and the fourth transistor T4 is turned on at any given time. In other words, the voltage of the first level and the second control signal from the second control line VGL_1 are selectively output via the light emission control line EM to provide the light emission control signal.

[0024] In the example as illustrated, the transistors T1

to T4 may be P-type thin film transistors, which are turned on when the gate electrodes thereof are at a low level and turned off when the gate electrode thereof are at a high level. In addition, the first level is a high level, and the second level is a low level. However, embodiments of the present disclosure are not limited thereto. The type of the transistors and the level logic of the first level and the second level may be selected based on the fabrication processes of the circuit and the AMOLED pixel circuit with which it is used.

[0025] FIGS. 2(a) to 2(e) show timing diagrams of operations for generation of the light emission control signal using the circuit as shown in FIG. 1. As shown in the figures, the operations include five processes 1, 2, 3, 4 and 5 as indicated by the numbers in the figures, wherein process 1 corresponds to an initial state of the circuit, processes 2 to 4 correspond to a display phase of the AMOLED display, and process 5 corresponds to a touch sense phase of the AMOLED display. As is known, the display phase and the touch sense phase occur alternatingly in a time-divisional manner. Further, the display phase includes a first period of time corresponding to a half period of the first clock signal CK (illustrated as process 2) and a second period of time corresponding to one or more periods of the first clock signal CK (illustrated as processed 3 and 4).

[0026] The operations for generation of the light emission control signal are described below with reference to FIG. 1 and FIGS. 2(a) to 2(e). In the initial state (process 1), the first control signal from the first control line GO is at a high level such that the first transistor T1 and the third transistor T3 are turned off. The first clock signal CK is at a low level such that the second transistor T2 is turned on, and the voltage of the second level (i.e., the low level) VGL is applied to the first node N through the second transistor T2. The fourth transistor T4 is then turned on such that the second control signal from the second control line VGL_1 is output to the light emission control line EM through the fourth transistor T4.

[0027] In the first period of time (process 2) of the display phase, the first clock signal CK is at a high level such that the second transistor T2 is turned off. The first control signal from the first control line GO is at a low level such that the first transistor T1 and the third transistor T3 are turned on, and the voltage of the first level (i.e., the high level) VGH is applied to the first node N through the first transistor T1. The fourth transistor T4 is then turned off. The voltage of the first level VGH is output to the light emission control line EM through the third transistor T3.

[0028] In process 3 of the second period of time of the display phase, the first control signal from the first control line GO is at a high level such that the first transistor T1 and the third transistor T3 are turned off. The first clock signal CK is at a low level such that the second transistor T2 is turned on, and the voltage of the second level (i.e., the low level) VGL is applied to the first node N through the second transistor T2. The fourth transistor T4 is then turned on such that the second control signal from the second control line VGL_1 is output to the light emission control line EM through the fourth transistor T4.

[0029] In process 4 of the second period of time of the display phase, the first control signal from the first control line GO is at a high level such that the first transistor T1 and the third transistor T3 are turned off. The first clock signal CK is at a high level such that the second transistor T2 is turned off. The second clock signal CB transitions from the high level in process 3 to a low level, and thus pulls the voltage at the first node N from a low level down to an even lower level by way of the first capacitor Cg. The fourth transistor T4 is then turned on such that the second control signal from the second control line VGL_1 is output to the light emission control line EM through the fourth transistor T4.

[0030] In the touch sense phase (process 5), the first control signal from the first control line GO is at a high level such that the first transistor T1 and the third transistor T3 are turned off. The first clock signal CK is at a low level such that the second transistor T2 is turned on, and the voltage of the second level (i.e., the low level) VGL is applied to the first node N through the second transistor T2. The fourth transistor T4 is then turned on such that the second control signal from the second control line VGL_1 is output to the light emission control line EM through the fourth transistor T4.

[0031] In this way, the desired light emission control signal is output via the light emission control line EM. As shown, the second control signal from the second control line VGL_1 is at the second level during the display phase, and is a signal resulting from superposition of a touch scan signal (indicated by a square wave in FIG. 2(e)) on the voltage of the first level VGH during the touch sense phase. As a result, the light emission control signal is, during the display phase, an inverted signal of the first control signal provided by the first control signal GO and is, during the touch sense phase, a signal resulting from superposition of the touch scan signal on the voltage of the first level VGH.

[0032] FIG. 3 shows a circuit diagram of an exemplary AMOLED pixel circuit to which the light emission control signal generated in accordance with the operations as shown in FIGS. 2(a) to 2(e) is to be applied. This pixel circuit includes an OLED with a cathode (not shown), the light emission control line EM and light emission control transistors M4, M6. The cathode of the OLED is connected to a first power source ELVSS. The light emission control transistors M4, M6 each have a gate electrode connected to the light emission control line EM and are configured to control ON/OFF of a current flowing through the OLED. Further, for the AMOLED pixel circuit having in-cell touch sensors, the cathode of the OLED is divided into a plurality of separate electrodes, each of which may be used as a touch sensor to which the touch scan signal is applied in the touch sense phase.

[0033] More specifically, the pixel circuit includes transistors M1 to M6, a storage capacitor C1 and the OLED. Transistor M1 has a gate electrode connected to a reset

signal line "Reset", a first electrode connected to a reference level line Vint, and a second electrode connected to node N1. Transistor M3, which operates as a driving transistor, has a gate electrode connected to node N1, a first electrode connected to a second electrode of transistor M4, and a second electrode connected to a first electrode of transistor M6. Transistor M5 has a gate electrode connected to a gate scan signal line "Gate", a first electrode connected to a data line Vdata, and a second electrode connected to the first electrode of transistor M3. Transistor M4 has a first electrode connected to a second power source ELVDD. Transistor M2 has a gate electrode connected to the gate scan signal line "Gate", a first electrode connected to node N1, and a second electrode connected to the second electrode of transistor M3. Transistor M6 has a first electrode connected to the second electrode of transistor M3 and a second electrode connected to the anode of the OLED. A terminal of the storage capacitor is connected to node N1, and another terminal thereof is connected to the second power source ELVDD. Under control of the signals from the reset signal line "Reset", the gate scan signal line "Gate" and the light emission control line EM, the pixel circuit stores the voltage from the data line Vdata into the storage capacitor C1, and then converts it to a current I_{OLED} that flows through the OLED, thereby achieving a display function. In this example, transistors M1 to M6 may be P-type thin film transistors.

[0034] FIGS. 4(a) to 4(d) show timing diagrams of operations of the AMOLED pixel circuit as shown in FIG. 3 in a display phase and a touch sense phase, wherein "EM" is indicative of the light emission control signal that is generated by the circuit and method in accordance with the above embodiments of the present disclosure and which is to be applied to the pixel circuit of FIG. 3. As shown in the figures, the operations include four processes 1, 2, 3 and 4 as indicated by the numbers in the figures, wherein processes 1 to 3 correspond to the display phase of the AMOLED display, and process 4 corresponds to the touch sense phase of the AMOLED display. Further, the display phase includes a first period of time (illustrated as processes 1 and 2) and a second period of time (illustrated as process 3).

[0035] The operations of the pixel circuit are described below in detail with reference to FIG. 3 and FIGS. 4(a) to 4(d).

[0036] A reset operation is performed in process 1 of the first period of time of the display phase, where transistor M1 is turned on and the other transistors are turned off such that the voltage at node N1 is reset to the reference level (with a potential of 0 V). It will be understood that in some embodiments the reset operation may not occur in the pixel circuit.

[0037] A data write operation is performed in process 2 of the first period of time of the display phase, where transistors M2, M3 and M5 are turned on, and transistors M1, M4 and M6 are turned off. As the voltage at node N1 has previously been reset to the reference level of 0 V, the driving transistor M3 is turned on. The signal on the data line Vdata charges node N1 through transistors M5, M3 and M2, in turn, until the voltage at node N1 is charged to Vdata-|Vth| (i.e., the voltage difference between the gate and source of transistor M3 is |Vth|). In this process, since the voltage of the right terminal of the storage capacitor C1 is always maintained at ELVDD, the voltage at node N1 will be maintained at Vdata-|Vth| after completion of the charging. Further, as transistor M6 is turned off, no current will flow through the OLED, reducing the loss in the lifespan of the OLED.

[0038] An OLED light emission operation is performed in the second period of time (process 3) of the display phase, where transistors M1, M2 and M5 are turned off, and transistors M3, M4 and M6 are turned on, such that the current flows from the second power source ELVDD to the first power source ELVSS through transistors M4, M3 and M6 as well as the OLED, in turn, causing the OLED to emit light.

[0039] It can be derived from the saturation current formula of the transistor that:

$$\begin{aligned} I_{OLED} &= K(V_{GS}-Vth)^2 \\ &= K[(Vdata-|Vth|)-Vdd-Vth]^2 \\ &= K(Vdata-Vdd)^2 \end{aligned}$$

where K represents a constant value determined by the mobility and parasitic capacitance of the driving transistor M3, V_{GS} represents a voltage difference between the gate and source of the driving transistor M3, and Vth represents a threshold voltage of the driving transistor M3.

[0040] As can be seen from the above formula, the working current I_{OLED} is no longer related to Vth, but only to Vdd and Vdata. Therefore, the influence of drift of the threshold voltage (Vth) resulting from the fabrication process and long-term operation of the driving transistor on I_{OLED} is eliminated.

[0041] A touch sense operation is performed in the touch sense phase (process 4), where the light emission control signal from the light emission control line EM is a pulled-up voltage signal (a high level voltage superposed with a touch scan signal) such that transistors M4 and M6 are turned off, and thus the OLED. At this time, the anode of the OLED is in a float state, and hence it is unnecessary to account for capacitance between the anode and the cathode serving as a touch sensor. As such, the driving frequency may be effectively increased due to a reduced load of the touch sensor. Furthermore, the touch scan signal is synchronously superposed on the signals applied to all other external terminals, including the reset signal line "Reset", the gate scan signal line "Gate", the reference level line Vint, the second power source ELVDD and the data line Vdata, at the same time when the light emission control signal is applied to the

light emission control line EM and the touch scan signal is applied to the cathode electrode of the OLED (the first power source ELVSS), such that all the transistors remain in their previous states (either turned on or off), thus offsetting the influence of potential additional capacitance on the touch sensor.

[0042] It will be understood that the light emission control signal generated by the circuit and method in accordance with the embodiments of the present disclosure is not intended to be applied only to the specific pixel circuit as illustrated, but may be applicable to any other AMOLED pixel circuit having in-cell touch sensors that operates based on the principle of the present disclosure (i.e., performing the touch sense operation with the OLED turned off).

[0043] Various modifications, adaptations to the foregoing exemplary embodiments of this disclosure may become apparent to those skilled in the relevant arts in view of the foregoing description, when read in conjunction with the accompanying drawings. Any and all modifications will still fall within the scope of the non-limiting and exemplary embodiments of this disclosure. Furthermore, other embodiments of the disclosures set forth herein will come to mind to one skilled in the art to which these embodiments of the disclosure pertain having the benefit of the teachings presented in the foregoing descriptions and the associated drawings.

[0044] Therefore, it is to be understood that the embodiments of the disclosure are not to be limited to the specific embodiments disclosed and that modifications and other embodiments are intended to be included within the scope of the appended claims. Although specific terms are used herein, they are used in a generic and descriptive sense only and not for purposes of limitation.

Claims

1. A method for generating a light emission control signal using a light emission control signal generation circuit for use with an active matrix organic light-emitting diode (AMOLED) pixel circuit of an AMOLED touch display device, wherein the AMOLED touch display device is configured to operate in a display phase (2, 3, 4) and a touch sense phase (5) that occur alternatingly in a time-divisional manner, wherein the AMOLED pixel circuit comprises an in-cell touch sensor, wherein the light emission control signal generation circuit comprises: a first transistor (T1) having a gate electrode connected to a first control line (GO), a first electrode for being supplied with a voltage of a first level (VGH), and a second electrode connected to a first node, the first control line (GO) configured to transfer a first control signal; a second transistor (T2) having a gate electrode for being supplied with a first clock signal (CK), a first electrode for being supplied with a voltage of a second level (VGL), and a second electrode connected to the first node; a first capacitor (Cg) having a terminal connected to the first node and another terminal for being supplied with a second clock signal (CB); a third transistor (T3) having a gate electrode connected to the first control line (GO), a first electrode for being supplied with the voltage of the first level (VGH), and a second electrode connected to a light emission control line (EM); and a fourth transistor (T4) having a gate electrode connected to the first node, a first electrode connected to a second control line (VGL_1), and a second electrode connected to the light emission control line (EM), the second control line (VGL 1) configured to transfer a second control signal, wherein the third transistor (T3) and the fourth transistor (T4) are configured such that only one of the third transistor (T3) and the fourth transistor (T4) is turned on at any given time under control of the first control signal and a voltage at the first node, and wherein the display phase (2, 3, 4) comprises a first period of time (2) corresponding to a half period of the first clock signal (CK) and a second period of time (3, 4) corresponding to one or more periods of the first clock signal (CK),
characterized in the method performed by said light emission control signal generation circuit, the method comprising:

receiving and maintaining, during the first period of time (2) of the display phase, the first clock signal (CK) at the first level, the second clock signal (CB), as an inverted version of the first clock signal (CK), at the second level, and the first control signal at the second level, such that the third transistor (T3) is turned on to output the voltage of the first level via the light emission control line (EM) as the light emission control signal;
receiving and maintaining, during the second period of time (3, 4) of the display phase, the first control signal at the first level such that the fourth transistor (T4) is turned on to output the second control signal via the light emission control line (EM) as the light emission control signal; and
receiving and maintaining, during the touch sense phase (5), the first control signal at the first level such that the fourth transistor (T4) is turned on to output the second control signal via the light emission control line (EM) as the light emission control signal,
wherein the second control signal having the second level during the display phase (2, 3, 4) and being a signal resulting from superposition of a touch scan signal on the voltage of the first level (VGH) during the touch sense phase (5).

2. A method of driving the AMOLED pixel circuit using the light emission control signal generated by the

method of claim 1, wherein the AMOLED pixel circuit further comprises an organic light-emitting diode (OLED), the light emission control line (EM) and a light emission control transistor (M4, M6), wherein the OLED comprises a cathode connected to a first power source (ELVSS) and serving as a touch sensor, and wherein the light emission control transistor (M4, M6) has a gate electrode connected to the light emission control line (EM) and configured to control ON/OFF of a current flowing through the OLED,
the method of driving the AMOLED pixel circuit further comprising: applying the light emission control signal to the light emission control line (EM) to cause the AMOLED pixel circuit to operate to:

turn off the light emission control transistor (M4, M6) and perform a data write operation, during the first period of time (2) of the display phase;
turn on the light emission control transistor (M4, M6) to perform an OLED light emission operation, during the second period of time (3, 4) of the display phase; and
turn off the light emission control transistor (M4, M6) to perform a touch sense operation with the OLED turned off, during the touch sense phase (5).

3. The method of claim 2, wherein the light emission control transistor (M4, M6) is a P-type thin film transistor.

4. The method of claim 2, further comprising performing, by the AMOLED pixel circuit, a reset operation prior to the data write operation during the first period of time (2) of the display phase.

5. The method of claim 2, further comprising synchronously superposing the touch scan signal on signals applied to all other external terminals of the AMOLED pixel circuit at the same time when the light emission control signal is applied to the light emission control line (EM) and the touch scan signal is applied to the first power source (ELVSS), during the touch sense phase (5).

6. The method of claim 2, wherein the display phase and the touch sense phase occur alternatingly to the AMOLED pixel circuit in a time-divisional manner.

Patentansprüche

1. Verfahren zum Erzeugen eines Lichtemission-Steuersignals unter Verwendung einer Lichtemission-Steuersignalerzeugungsschaltung zur Verwendung mit einer AMOLED-Pixelschaltung (AMOLED: organische Aktivmatrix-Leuchtdiode) einer AMOLED-Berührungsanzeigevorrichtung, wobei die AMOLED-Berührungsanzeigevorrichtung dazu ausgelegt ist, in einer Anzeigephase (2, 3, 4) und einer Berührungserfassungsphase (5) zu arbeiten, die abwechselnd auf eine zeitunterteilte Weise stattfinden, wobei die AMOLED-Pixelschaltung einen zelleninternen Berührungssensor umfasst, wobei die Lichtemission-Steuersignalerzeugungsschaltung Folgendes umfasst: einen ersten Transistor (T1) mit einer Gate-Elektrode, die mit einer ersten Steuerleitung (GO) verbunden ist, einer ersten Elektrode, um mit einer Spannung eines ersten Pegels (VGH) versorgt zu werden, und einer zweiten Elektrode, die mit einem ersten Knoten verbunden ist, wobei die erste Steuerleitung (GO) dazu ausgelegt ist, ein erstes Steuersignal zu übertragen; einen zweiten Transistor (T2) mit einer Gate-Elektrode, um mit einem ersten Taktsignal (CK) versorgt zu werden, einer ersten Elektrode, um mit einer Spannung eines zweiten Pegels (VGL) versorgt zu werden, und einer zweiten Elektrode, die mit dem ersten Knoten verbunden ist; einen ersten Kondensator (Cg) mit einem Anschluss, der mit dem ersten Knoten verbunden ist, und einem anderen Anschluss, um mit einem zweiten Taktsignal (CB) versorgt zu werden; einen dritten Transistor (T3) mit einer Gate-Elektrode, die mit der ersten Steuerleitung (GO) verbunden ist, einer ersten Elektrode, um mit der Spannung des ersten Pegels (VGH) versorgt zu werden, und einer zweiten Elektrode, die mit einer Lichtemission-Steuerleitung (EM) verbunden ist; und einen vierten Transistor (T4) mit einer Gate-Elektrode, die mit dem ersten Knoten verbunden ist, einer ersten Elektrode, die mit einer zweiten Steuerleitung (VGL_1) verbunden ist, und einer zweiten Elektrode, die mit der Lichtemission-Steuerleitung (EM) verbunden ist, wobei die zweite Steuerleitung (VGL_1) dazu ausgelegt ist, ein zweites Steuersignal zu übertragen,
wobei der dritte Transistor (T3) und der vierte Transistor (T4) derart konfiguriert sind, dass nur einer des dritten Transistors (T3) und des vierten Transistors (T4) zu einer jeglichen gegebenen Zeit unter Steuerung des ersten Steuersignals und einer Spannung am ersten Knoten eingeschaltet wird, und wobei die Anzeigephase (2, 3, 4) eine erste Zeitperiode (2), die einer halben Periode des ersten Taktsignals (CK) entspricht, und eine zweite Zeitperiode (3, 4), die einer oder mehreren Perioden des ersten Taktsignals (CK) entspricht, umfasst,
dadurch gekennzeichnet, dass das Verfahren durch die Lichtemission-Steuersignalerzeugungsschaltung durchgeführt wird, wobei das Verfahren Folgendes umfasst:

Empfangen und Aufrechterhalten, während der ersten Zeitperiode (2) der Anzeigephase, des ersten Taktsignals (CK) am ersten Pegel, des zweiten Taktsignals (CB), als eine invertierte Version des ersten Taktsignals (CK), am zwei-

ten Pegel und des ersten Steuersignals am zweiten Pegel, sodass der dritte Transistor (T3) eingeschaltet wird, um die Spannung des ersten Pegels über die Lichtemission-Steuerleitung (EM) als das Lichtemission-Steuersignal auszugeben;

Empfangen und Aufrechterhalten, während der zweiten Zeitperiode (3, 4) der Anzeigephase, des ersten Steuersignals am ersten Pegel, sodass der vierte Transistor (T4) eingeschaltet wird, um das zweite Steuersignal über die Lichtemission-Steuerleitung (EM) als das Lichtemission-Steuersignal auszugeben; und

Empfangen und Aufrechterhalten, während der Berührungserfassungsphase (5), des ersten Steuersignals am ersten Pegel, sodass der vierte Transistor (T4) eingeschaltet wird, um das zweite Steuersignal über die Lichtemission-Steuerleitung (EM) als das Lichtemission-Steuersignal auszugeben,

wobei das zweite Steuersignal den zweiten Pegel während der Anzeigephase (2, 3, 4) aufweist und ein Signal ist, das aus der Überlagerung eines Berührungsabtastsignals an der Spannung des ersten Pegels (VGH) während der Berührungserfassungsphase (5) resultiert.

2. Verfahren zum Ansteuern der AMOLED-Pixelschaltung unter Verwendung des Lichtemission-Steuersignals, das durch das Verfahren nach Anspruch 1 erzeugt wird, wobei die AMOLED-Pixelschaltung ferner eine organische Leuchtdiode (OLED), die Lichtemission-Steuerleitung (EM) und einen Lichtemission-Steuertransistor (M4, M6) umfasst, wobei die OLED eine Kathode umfasst, die mit einer ersten Leistungsquelle (ELVSS) verbunden ist und als ein Berührungssensor dient, und wobei der Lichtemission-Steuertransistor (M4, M6) eine Gate-Elektrode aufweist, die mit der Lichtemission-Steuerleitung (EM) verbunden ist und dazu ausgelegt ist, das EIN/AUS eines durch die OLED fließenden Stroms zu steuern,

wobei das Verfahren zum Ansteuern der AMOLED-Pixelschaltung ferner Folgendes umfasst:

Anlegen des Lichtemission-Steuersignals an die Lichtemission-Steuerleitung (EM), um zu veranlassen, dass die AMOLED-Pixelschaltung für Folgendes arbeitet:

Ausschalten des Lichtemission-Steuertransistors (M4, M6) und Durchführen einer Datenschreiboperation während der ersten Zeitperiode (2) der Anzeigephase;

Einschalten des Lichtemission-Steuertransistors (M4, M6), um eine OLED-Lichtemissionsoperation durchzuführen, während der zweiten Zeitperiode (3, 4) der Anzeigephase; und

Ausschalten des Lichtemission-Steuertransistors (M4, M6), um eine Berührungserfassungsoperation durchzuführen, bei der die OLED ausgeschaltet ist, während der Berührungserfassungsphase (5).

3. Verfahren nach Anspruch 2, wobei der Lichtemission-Steuertransistor (M4, M6) ein P-Typ-Dünnfilmtransistor ist.

4. Verfahren nach Anspruch 2, ferner umfassend Durchführen, durch die AMOLED-Pixelschaltung, einer Rücksetzoperation vor der Datenschreiboperation während der ersten Zeitperiode (2) der Anzeigephase.

5. Verfahren nach Anspruch 2, ferner umfassend synchrones Überlagern des Berührungsabtastsignals an Signalen, die an allen anderen externen Anschlüssen der AMOLED-Pixelschaltung angelegt werden, zur gleichen Zeit, wenn das Lichtemission-Steuersignal an die Lichtemission-Steuerleitung (EM) angelegt wird und das Berührungsabtastsignal an die erste Leistungsquelle (ELVSS) angelegt wird, während der Berührungserfassungsphase (5).

6. Verfahren nach Anspruch 2, wobei die Anzeigephase und die Berührungserfassungsphase abwechselnd an der AMOLED-Pixelschaltung auf eine zeitunterteilte Weise stattfinden.

Revendications

1. Procédé destiné à générer un signal de commande d'émission de lumière en utilisant un circuit de génération de signal de commande d'émission de lumière à utiliser avec un circuit de pixels à diodes électroluminescentes organiques à matrice active (AMOLED) d'un dispositif d'affichage tactile AMOLED, le dispositif d'affichage tactile AMOLED étant configuré pour fonctionner dans une phase d'affichage (2, 3, 4) et une phase de détection tactile (5) qui se produisent en alternance à la manière d'une répartition dans le temps, le circuit de pixels AMOLED comprenant un capteur tactile en cellule, le circuit de génération de signal de commande d'émission de lumière comprenant : un premier transistor (T1) ayant une électrode de grille reliée à une première ligne de commande (GO), une première électrode destinée à être alimentée avec une tension d'un premier niveau (VGH), et une deuxième électrode reliée à un premier nœud, la première ligne de commande (GO) étant configurée pour transférer un premier signal de commande ; un deuxième transistor (T2) ayant une électrode de grille destinée à être alimentée avec un premier signal d'horloge (CK), une première électrode destinée à être alimentée avec une tension d'un deuxième niveau (VGL), et une deuxiè-

me électrode reliée au premier nœud; un premier condensateur (Cg) ayant une borne reliée au premier nœud et une autre borne destinée à être alimentée avec un deuxième signal d'horloge (CB) ; un troisième transistor (T3) ayant une électrode de grille reliée à la première ligne de commande (GO), une première électrode destinée à être alimentée avec la tension du premier niveau (VGH), et une deuxième électrode reliée à une ligne de commande d'émission de lumière (EM) ; et un quatrième transistor (T4) ayant une électrode de grille reliée au premier nœud, une première électrode reliée à une deuxième ligne de commande (VGL_1), et une deuxième électrode reliée à la ligne de commande d'émission de lumière (EM), la deuxième ligne de commande (VGL 1) étant configurée pour transférer un deuxième signal de commande,
dans lequel le troisième transistor (T3) et le quatrième transistor (T4) sont configurés de telle sorte qu'un seul du troisième transistor (T3) et du quatrième transistor (T4) est allumé à n'importe quel moment donné sous le contrôle du premier signal de commande et d'une tension au premier nœud, et dans lequel la phase d'affichage (2, 3, 4) comprend un premier laps de temps (2) correspondant à une demi-période du premier signal d'horloge (CK) et un deuxième laps de temps (3, 4) correspondant à une ou plusieurs périodes du premier signal d'horloge (CK),
caractérisé en ce que le procédé est réalisé par ledit circuit de génération de signal de commande d'émission de lumière, le procédé comprenant :

la réception et le maintien, pendant le premier laps de temps (2) de la phase d'affichage, du premier signal d'horloge (CK) au premier niveau, du deuxième signal d'horloge (CB), en tant que version inversée du premier signal d'horloge (CK), au deuxième niveau, et du premier signal de commande au deuxième niveau, de telle sorte que le troisième transistor (T3) est allumé pour délivrer la tension du premier niveau par le biais de la ligne de commande d'émission de lumière (EM) en tant que signal de commande d'émission de lumière ;
la réception et le maintien, pendant le deuxième laps de temps (3, 4) de la phase d'affichage, du premier signal de commande au premier niveau de telle sorte que le quatrième transistor (T4) est allumé pour délivrer le deuxième signal de commande par le biais de la ligne de commande d'émission de lumière (EM) en tant que signal de commande d'émission de lumière ; et
la réception et le maintien, dans la phase de détection tactile (5), du premier signal de commande au premier niveau de telle sorte que le quatrième transistor (T4) est allumé pour délivrer le deuxième signal de commande par le biais de la ligne de commande d'émission de lumière (EM) en tant que signal de commande d'émission de lumière,
dans lequel le deuxième signal de commande a le deuxième niveau pendant la phase d'affichage (2, 3, 4) et est un signal résultant de la superposition d'un signal de balayage tactile sur la tension du premier niveau (VGH) pendant la phase de détection tactile (5).

2. Procédé de pilotage du circuit de pixels AMOLED au moyen du signal de commande d'émission de lumière généré par le procédé de la revendication 1, dans lequel le circuit de pixels AMOLED comprend en outre une diode électroluminescente organique (OLED), la ligne de commande d'émission de lumière (EM) et un transistor de commande d'émission de lumière (M4, M6), dans lequel l'OLED comprend une cathode reliée à une première source d'alimentation (ELVSS) et servant de capteur tactile, et dans lequel le transistor de commande d'émission de lumière (M4, M6) a une électrode de grille reliée à la ligne de commande d'émission de lumière (EM) et configurée pour contrôler l'activation/désactivation d'un courant circulant à travers l'OLED,
le procédé de pilotage du circuit de pixels AMOLED comprenant en outre :
l'application du signal de commande d'émission de lumière à la ligne de commande d'émission de lumière (EM) pour faire fonctionner le circuit de pixels AMOLED pour :

éteindre le transistor de commande d'émission de lumière (M4, M6) et réaliser une opération d'écriture de données, pendant le premier laps de temps (2) de la phase d'affichage ;
allumer le transistor de commande d'émission de lumière (M4, M6) pour réaliser une opération d'émission de lumière OLED pendant le deuxième laps de temps (3, 4) de la phase d'affichage ; et
éteindre le transistor de commande d'émission de lumière (M4, M6) pour réaliser une opération de détection tactile avec l'OLED éteinte, pendant la phase de détection tactile (5).

3. Procédé de la revendication 2, dans lequel le transistor de commande d'émission de lumière (M4, M6) est un transistor en couches minces de type P.

4. Procédé de la revendication 2, comprenant en outre la réalisation, par le circuit de pixels AMOLED, d'une opération de réinitialisation avant l'opération d'écriture de données pendant le premier laps de temps (2) de la phase d'affichage.

5. Procédé de la revendication 2, comprenant en outre la superposition synchrone du signal de balayage

tactile sur des signaux appliqués à toutes les autres bornes externes du circuit de pixels AMOLED au même moment que celui où le signal de commande d'émission de lumière est appliqué à la ligne de commande d'émission de lumière (EM) et le signal de balayage tactile est appliqué à la première source d'alimentation (ELVSS), pendant la phase de détection tactile (5).

6. Procédé de la revendication 2, dans lequel la phase d'affichage et la phase de détection tactile se produisent en alternance sur le circuit de pixels AMOLED à la manière d'une répartition dans le temps.

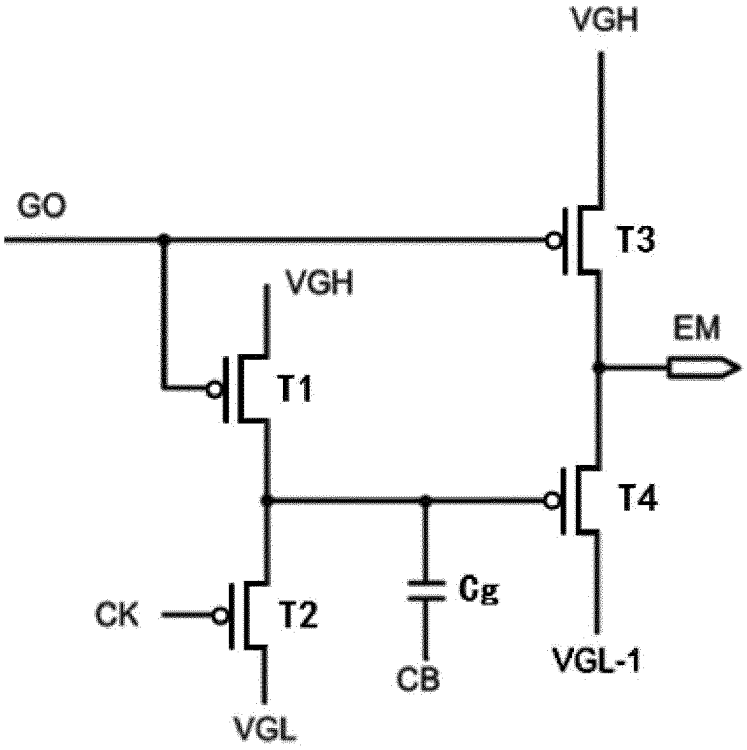
VGH
GO
T3
VGH
EM
T1
T4
Cg
CK
T2
CB
VGL-1
VGL

FIG. 1

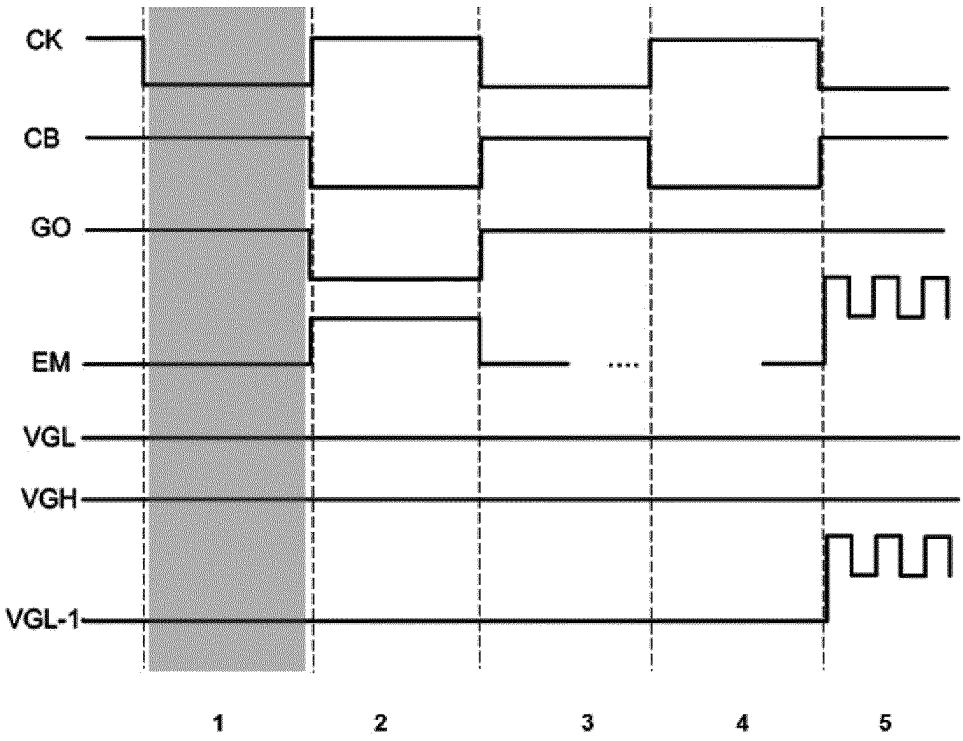
CK
CB
GO
EM
VGL
VGH
VGL-1
1
2
3
4
5

FIG. 2(a)

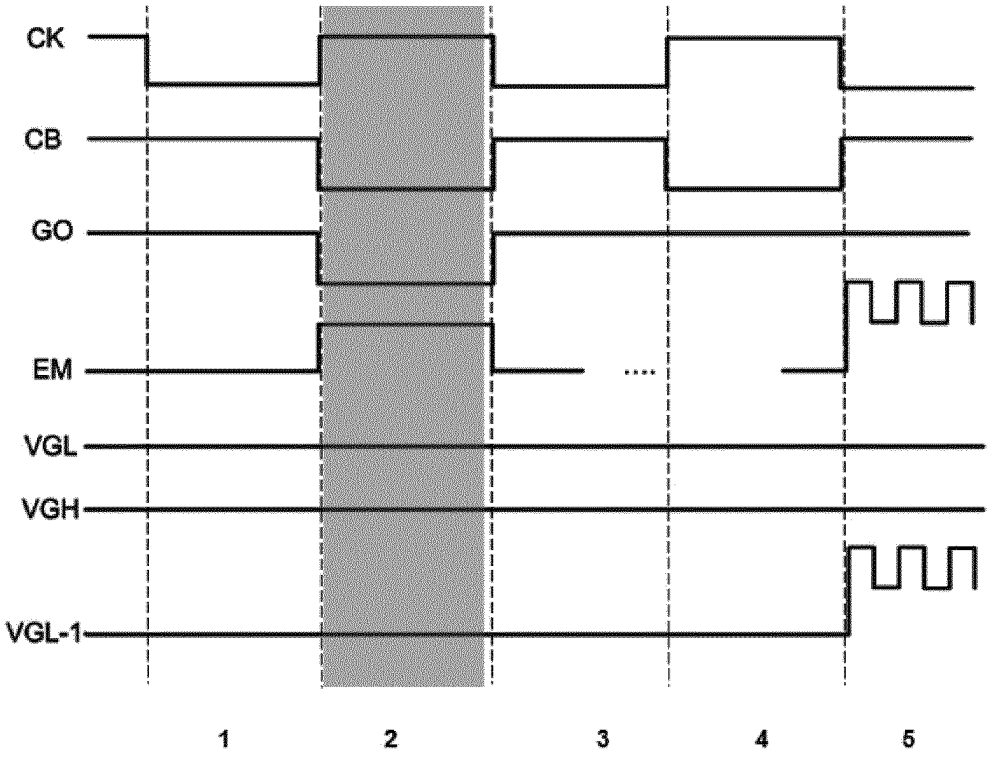

FIG. 2(b)

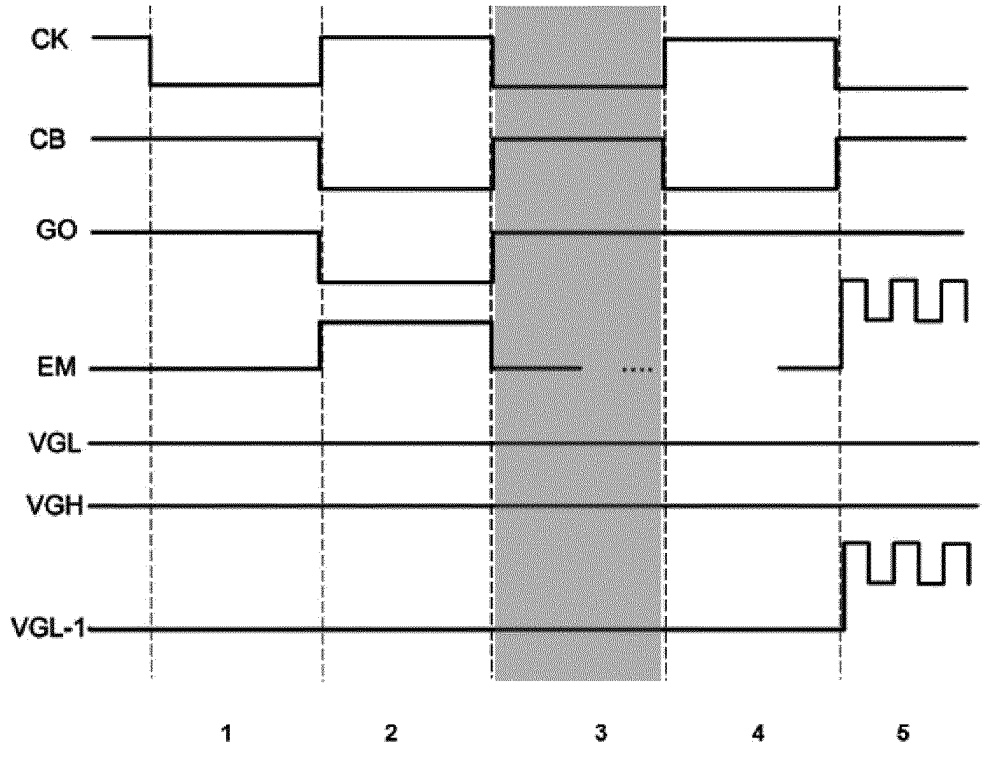

FIG. 2(c)

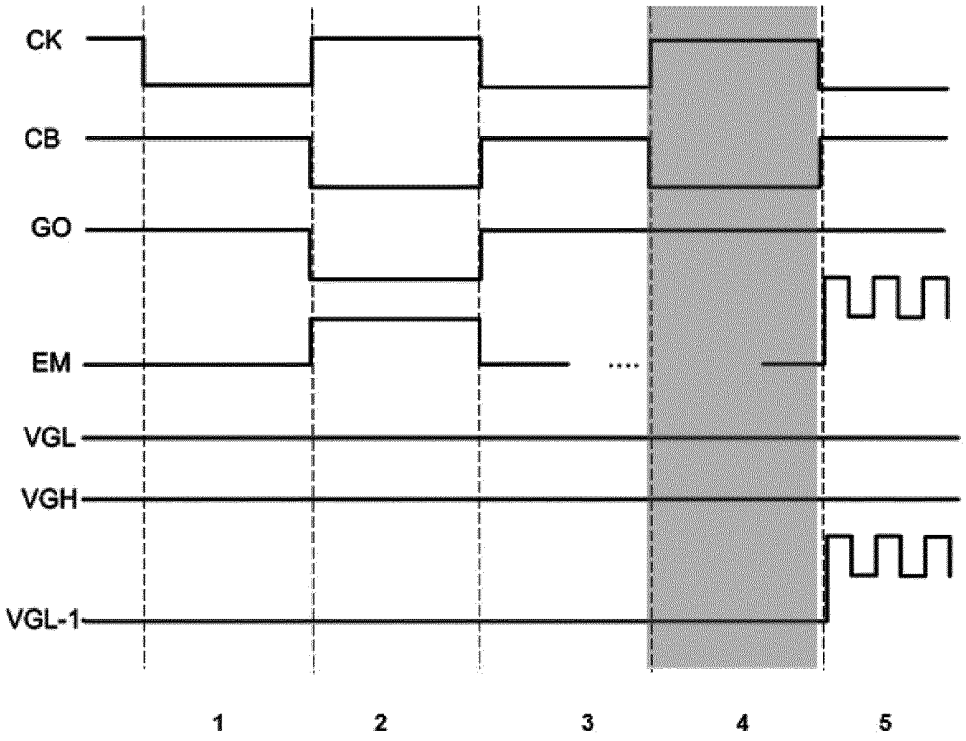

FIG. 2(d)

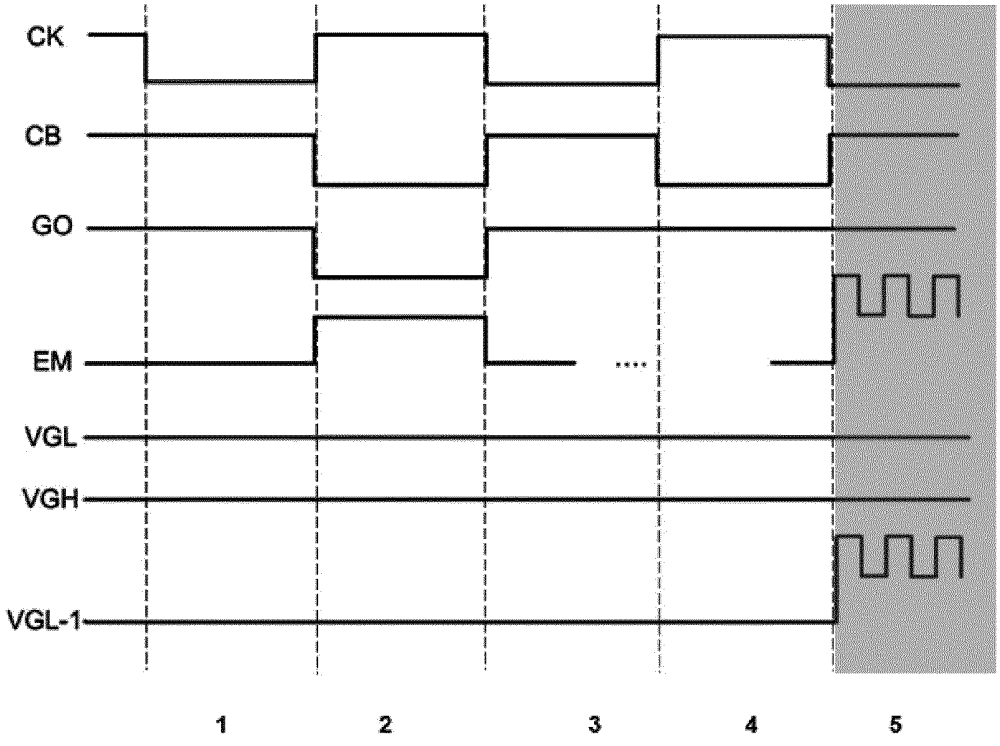

FIG. 2(e)

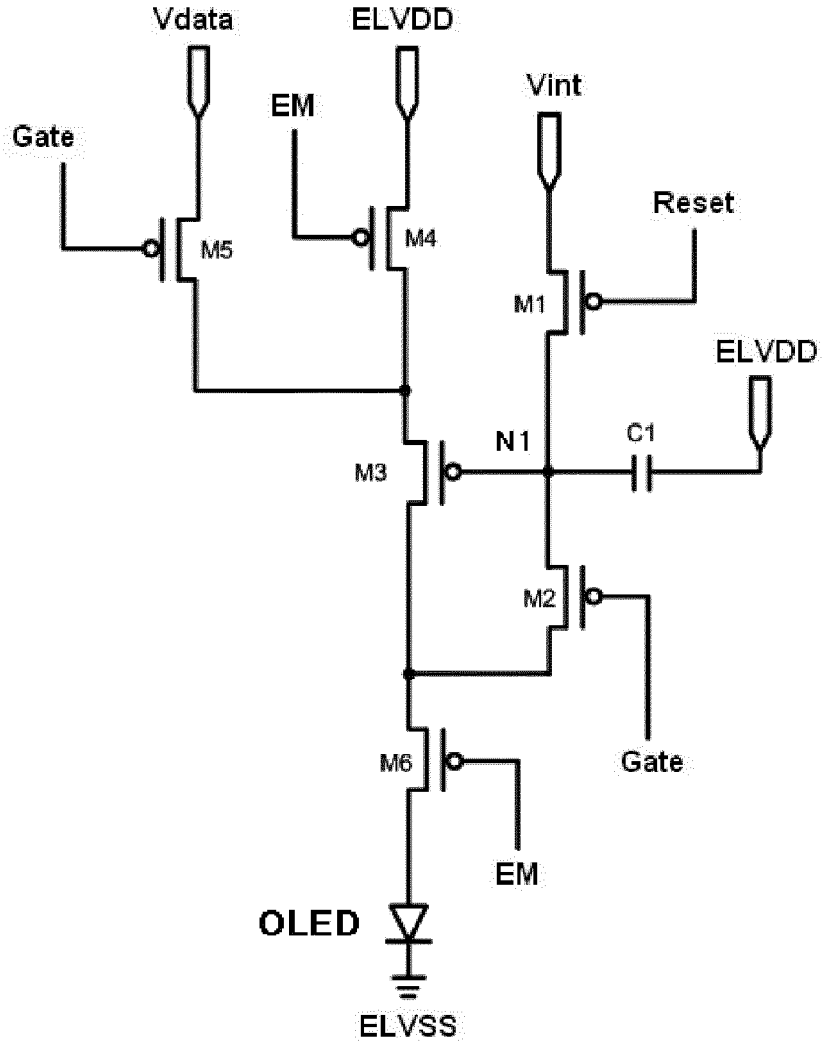
Vdata
ELVDD
Vint
EM
Gate
Reset
M5
M4
M1
ELVDD
N1
C1
M3
M2
M6
Gate
EM
OLED
ELVSS

FIG. 3

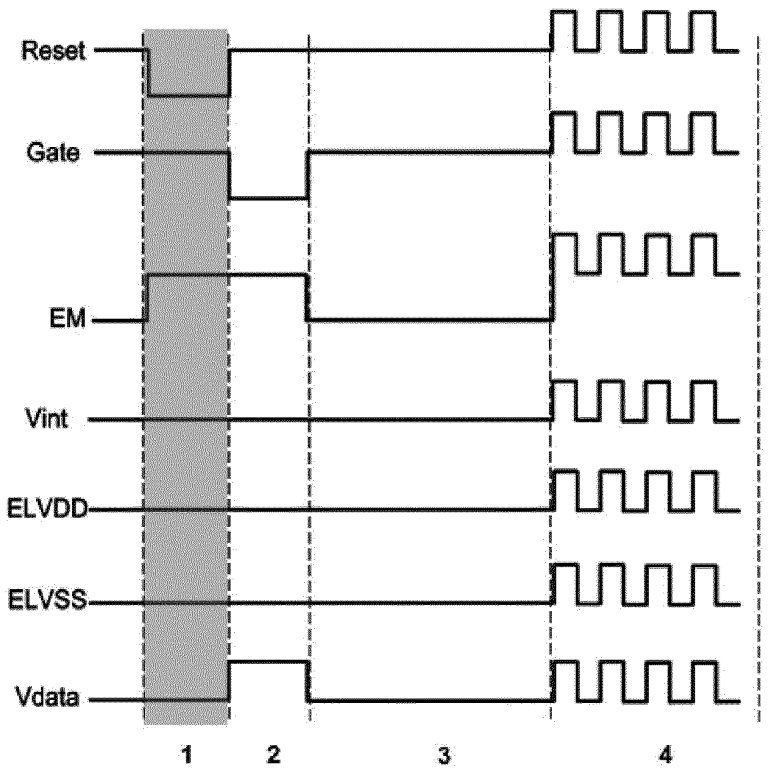
Reset
Gate
EM
Vint
ELVDD
ELVSS
Vdata
1
2
3
4

FIG. 4(a)

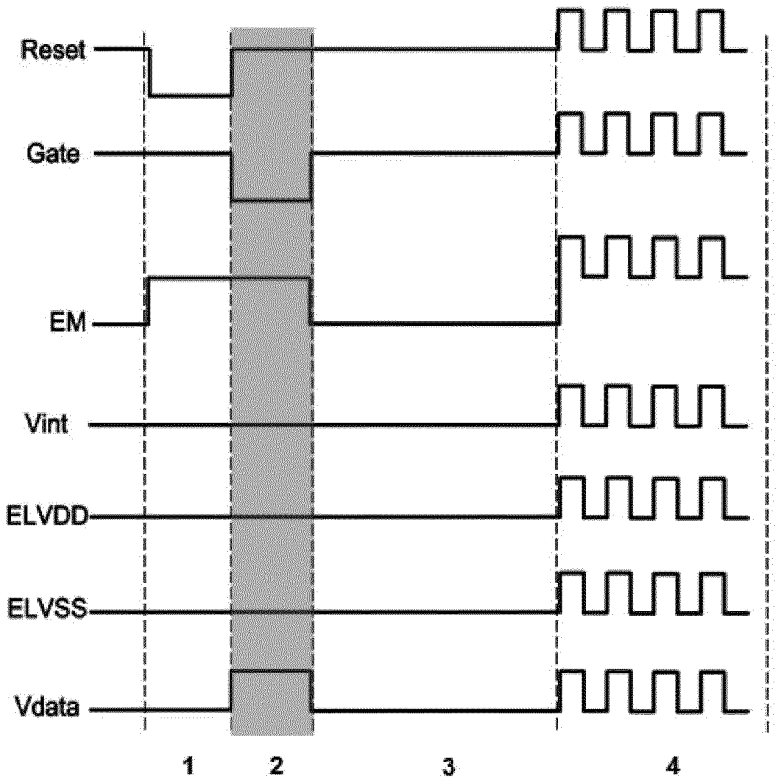
Reset
Gate
EM
Vint
ELVDD
ELVSS
Vdata
1
2
3
4

FIG. 4(b)

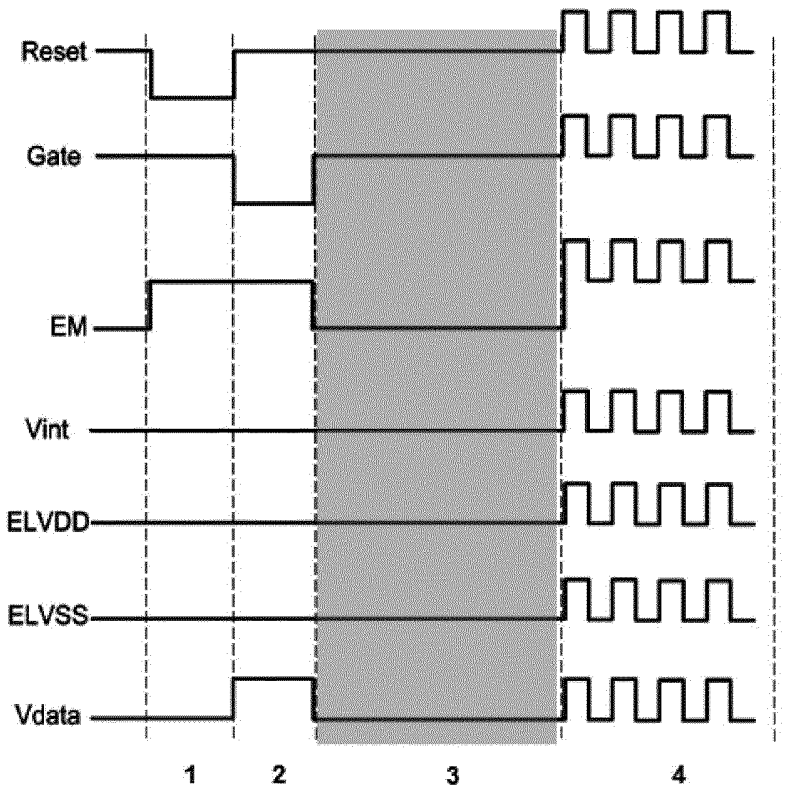
Reset
Gate
EM
Vint
ELVDD
ELVSS
Vdata
1
2
3
4

FIG. 4(c)

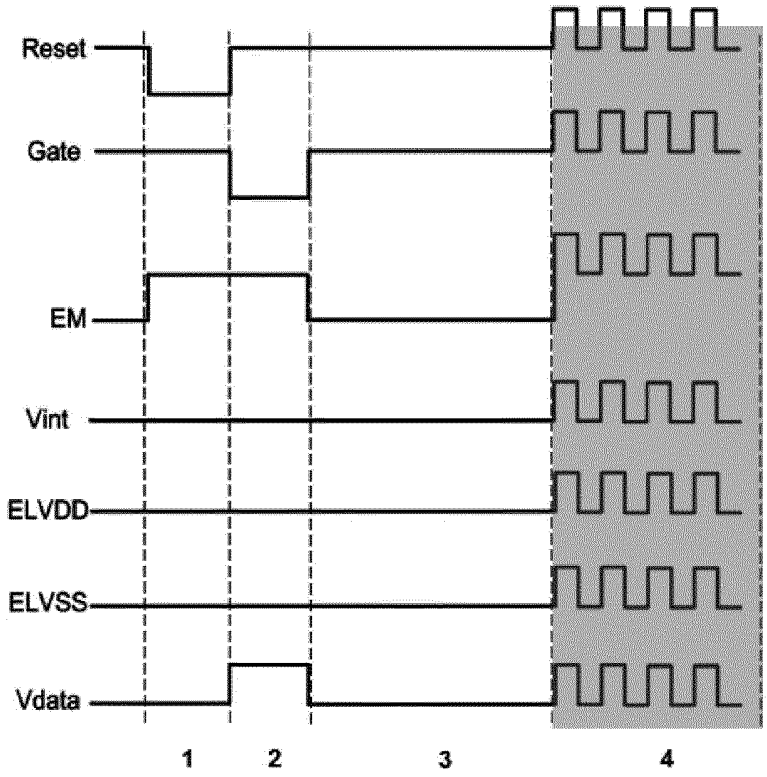
Reset
Gate
EM
Vint
ELVDD
ELVSS
Vdata
1
2
3
4

FIG. 4(d)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 2736174 A1 **[0004]**
- CN 104850270 A **[0005]**

专利名称(译)	产生发光控制信号的电路和方法以及像素电路控制方法		
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申请号	EP2015902137	申请日	2015-12-11
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优先权	201510529204.9 2015-08-26 CN		
其他公开文献	EP3343548A4 EP3343548A1		
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摘要(译)

本公开公开了一种用于为具有单元内触摸传感器的AMOLED像素电路生成发光控制信号的电路和方法，以及像素电路驱动方法。该电路包括第一晶体管T1，第二晶体管T2，第三晶体管T3，第四晶体管T4和第一电容器Cg。 在第一控制线GO传输的控制信号的控制下，第一时钟信号CK，第二时钟信号CB，第一电平VGH的电压，第二电平VGL的电压和第二控制线传输的控制信号 线VGL_1，电路经由发光控制线EM输出期望的发光控制信号。 发光控制信号可以在触摸感测阶段期间关闭像素电路中的OLED，从而减小了OLED的阳极和阴极之间的电容对触摸传感器对地电容的影响。

$$I_{OLED} = K(V_{GS}-Vth)^2$$

$$= K[(Vdata-|Vth|)-Vdd-Vth]^2$$

$$= K(Vdata-Vdd)^2$$