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(54) PIXEL CIRCUIT, DISPLAY PANEL AND DISPLAY DEVICE

PIXELSCHALTUNG, ANZEIGETAFEL UND ANZEIGEVORRICHTUNG

CIRCUIT DE PIXELS, PANNEAU D'AFFICHAGE ET DISPOSITIF D'AFFICHAGE

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(73) Proprietors:
- **BOE Technology Group Co., Ltd.**
  Beijing 100015 (CN)
- **Beijing BOE Optoelectronics Technology Co., Ltd.**
  Beijing 100176 (CN)

(72) Inventor: **YANG, Shengji**
Beijing 100176 (CN)

(74) Representative: **Klunker IP**
Patentanwälte PartG mbB
Destouchesstraße 68
80796 München (DE)

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Description

TECHNICAL FIELD OF THE DISCLOSURE

[0001] The present invention relates to a pixel circuit, a display panel and a display apparatus.

BACKGROUND

[0002] With rapid development of display technologies, display apparatuses with touch function are becoming more and more popular due to their advantages such as visualized operation. According to different relative positions of the touch screen panel relative to the display panel, existing display apparatuses with touch function can be generally classified into two categories, the on cell touch screen panel and the in cell touch screen panel. Compared with the on cell touch screen panel, the in cell touch screen panel has smaller thickness and higher light transmittance.

[0003] US 2009/273590 A1 discloses a driving method for driving a display apparatus, the display apparatus including: NxM light emitting units; M scan lines; N data lines; a driving circuit provided for each of the light emitting units to serve as a circuit having a signal writing transistor, a device driving transistor, a capacitor and a first switch circuit; and a light emitting device.

[0004] CN 203179480 U discloses a pixel unit control circuit applicable to AMOLEDs (Active Matrix OLED) and a display device provided with the same. The pixel unit control circuit comprises a data input end, a power supply input end and a display control unit. The display control unit comprises a driving switch tube, a reset module, a charging module and a switch module. The reset module is for resetting grid voltage of the driving switch tube. The charging module is for charging compensation voltage for a grid of the driving switch tube. The value of compensation voltage is equal to the difference between electric potential of the data input terminal and threshold voltage of the driving switch tube. The switch module is for conduction of a source electrode of the driving switch tube with the input end of a power supply and for conduction of a drain electrode and an organic light-emitting diode.

[0005] As for existing display apparatuses, the OLED (Organic Light Emitting Diode) as a current type light emitting device is more and more applied to high performance display areas due to its characteristics such as self light emitting, fast response, wide angle of view and ability of being fabricated on a flexible substrate. According to different driving manners, OLED display apparatuses can be classified into two categories, the PMOLED (Passive Matrix Driving OLED) and the AMOLED (Active Matrix Driving OLED). The AMOLED display is expected to become the next generation new flat display in place of the LCD (Liquid Crystal Display) due to its advantages such as low fabrication cost, high response speed, energy saving, DC driving applicable to portable devices, large operating temperature range. In existing AMOLED display panels, each OLED is driven to emit light by a pixel driving circuit composed of multiple TFTs (Thin Film Transistors) within one pixel unit on the array substrate to realize display. The pixel driving circuit directly determines the quality of the light emitting display of the OLED. Therefore, the design of the pixel driving circuit is key technological content of the AMOLED. Fig. 1 is a schematic circuit structure diagram of a normal pixel driving circuit. As shown in Fig. 1, the pixel driving circuit comprises a switch TFT T1, a driving TFT T2 and a storage capacitor C, and T1 and T2 here are both P channel driving TFTs. A gate of T1 is connected to a scan line Scan[1], a source of T1 is connected to a data voltage line Data, and a drain of T1 is connected to terminal B of the capacitor C. Terminal A of C is connected to a drain of T2. Terminal B of C is also connected to a gate of T2, a source of T2 is connected to an operating voltage Vdd, and a drain of T2 is connected to a corresponding OLED. When Scan[1] scans to a row of pixel circuit to be a low voltage level, T1 is controlled to turn on, and the data voltage Vdd is written to terminal B of C. When the scan of this row is over, Scan[1] becomes a high voltage level, and T1 is turned off. The data voltage stored in C drives T2 to make it generate current to drive the OLED to ensure that the OLED keeps emitting light within the time of one frame. The saturation current of T2 (i.e., the current following through the OLED) $I_{OLED}=K(V_{GS}-V_{th})^2$, where K is a current constant related to T2, V_{GS} is voltage of the gate relative to the source of T2, and V_{th} is a threshold voltage of T2. It can be seen that I_{OLED} is related to the threshold voltage V_{th} of T2. In addition, due to fabrication process, device aging and so on, in such a 2T1C pixel driving circuit, the threshold voltage V_{th} of the driving TFTs at each pixel point would drift, that is, the threshold voltages of the driving TFTs at different pixel points are not uniform, which is easy to make the current flowing through the OLED at each pixel point varies with Vth, such that the display brightness of the display screen is not uniform, influencing the display effect of the whole picture.

[0006] On the other hand, the in cell TSP (Touch Screen Panel) fabricates a sensor for touch and a driving circuit in each pixel unit on the array substrate by the array process as well. If the sensor and the driving circuit of TSP are superimposed in an AMOLED pixel unit, it is necessary to add a certain number of driving circuit TFTs. Therefore, certain space of the pixel unit needs to be occupied additionally, but the free space in the pixel unit is limited. This dramatically limits the simultaneous fabrication of the in cell touch screen panel and the AMOLED driving circuit.

SUMMARY

[0007] It is an object of the present invention to provide a pixel circuit and a display apparatus which may avoid the influence of a threshold drift of a driving circuit on the display effect and improve the integration level of an in cell touch screen panel circuit and a pixel driving circuit.

[0008] The object is achieved by the features of the respective independent claims. Further embodiments and developments are defined in the dependent claims.

[0009] In the pixel circuit provided by the present disclosure, a pixel compensation module and a touch detection module are integrated, and the pixel compensation module and the touch detection module share a data voltage line and scan signal lines. As such, it is possible to reduce the number of signal lines, such that the pitch of pixels is dramatically reduced and IC cost is decreased, achieving higher pixel density. At the same time, in the pixel circuit provided by the present disclosure, the operating current flowing through the electroluminescent unit is not influenced by the threshold voltage of the corresponding driving transistor, and it is possible to avoid nonuniformity in brightness of display caused by threshold voltage drift of driving transistors.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010]

Fig. 1 is a circuit structure diagram of a normal pixel driving circuit;

Fig. 2 is a schematic circuit structure diagram of a pixel circuit provided by an embodiment of the present disclosure;

Fig. 3 is a time sequence diagram of key signals in a driving method for a pixel circuit provided by an embodiment of the present disclosure;

Figs. 4a-4c are schematic diagrams of current directions and voltage values of a pixel circuit provided by an embodiment of the present disclosure under different time sequences;

Fig. 5 is a schematic diagram of potential change of the pixel electrode in a pixel circuit provided by the present disclosure;

Fig. 6 is a schematic diagram of positional relation between pixel circuits and pixels in a display panel provided by an embodiment of the present disclosure.

DETAILED DESCRIPTION

[0011] In the following, specific implementations of the present disclosure are further described in connection with figures and embodiments. The following embodiments are only for more clearly illustrating the technical solutions of the present disclosure, but not for limiting the protection scope of the present disclosure. In the figures, the same reference symbols represent the same elements.

[0012] Fig. 2 is a schematic circuit structure diagram of a pixel circuit provided by an embodiment of the present disclosure. As shown in Fig. 2, the pixel circuit comprises:
a pixel compensation module 100, a light emitting module 200 and a touch detection module.

[0013] The pixel compensation module 100 comprises a first switch unit T1, a second pixel circuit provided by the present disclosure, the operating current flowing through the electroluminescent unit is not influenced by the threshold voltage of the corresponding driving transistor, and it is possible to avoid nonuniformity in brightness of display caused by threshold voltage drift of driving transistors.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014]

Fig. 1 is a circuit structure diagram of a normal pixel driving circuit;
Fig. 2 is a schematic circuit structure diagram of a pixel circuit provided by an embodiment of the present disclosure;
Fig. 3 is a time sequence diagram of key signals in a driving method for a pixel circuit provided by an embodiment of the present disclosure;
Figs. 4a-4c are schematic diagrams of current directions and voltage values of a pixel circuit provided by an em-

bodiment of the present disclosure under different time sequences;

Fig. 5 is a schematic diagram of potential change of the pixel electrode in a pixel circuit provided by the present disclosure;

Fig. 6 is a schematic diagram of positional relation between pixel circuits and pixels in a display panel provided by an embodiment of the present disclosure.

DETAILED DESCRIPTION

[0015] In the following, specific implementations of the present disclosure are further described in connection with figures and embodiments. The following embodiments are only for more clearly illustrating the technical solutions of the present disclosure, but not for limiting the protection scope of the present disclosure. In the figures, the same reference symbols represent the same elements.

[0016] Fig. 2 is a schematic circuit structure diagram of a pixel circuit provided by an embodiment of the present disclosure. As shown in Fig. 2, the pixel circuit comprises:

a pixel compensation module 100, a light emitting module 200 and a touch detection module.

[0017] The pixel compensation module 100 comprises a first switch unit T1, a second switch unit T2, a third switch unit T3, a fourth switch unit T4, a fifth switch unit T5, a pixel driving unit DT1, and an energy storage unit C1. A first terminal of the first switch unit T1 is connected to an operating voltage Vdd, a second terminal of the first switch unit T1 is connected to an input terminal of the pixel driving unit DT1, a first terminal of the fifth switch unit T5 is connected to an output terminal of the pixel driving unit DT1, and a second terminal of the fifth switch unit T5 is connected to the light emitting module; control terminals of the first switch unit T1 and the fifth switch unit T5 are both connected to a first scan signal line Em, and a control tenninal of the pixel driving unit DT1 is connected to a second terminal b of the energy storage capacitor C1.

[0018] A first terminal of the second switch unit T2 is connected to the input terminal of the pixel driving unit DT1, a second tenninal of the second switch unit T2 is connected to the second terminal b of the energy storage unit C1, and a control tenninal of the second switch unit T2 is connected to a second scan signal line Scan[1].

[0019] A first terminal of the third switch unit T3 is connected to the second terminal b of the energy storage unit C1, a second terminal of the third switch unit T3 is connected to a low voltage level Vcom, a control terminal of the third switch unit T3 is connected to a third scan signal line Scan[2].

[0020] A first terminal of the fourth switch unit T4 is connected to the output terminal of the pixel driving unit DT1, a second terminal of the fourth switch unit T4 is connected to a data voltage line Data, and a control tenninal of the fourth switch unit T4 is connected to the second scan signal line Scan[1].

[0021] A first terminal a of the energy storage unit C1 is connected to the operating voltage Vdd.

[0022] The touch detection module comprises a detection sub-module 310 and an output sub-module 320. The detection sub-module 310 is connected to the third scan signal line Scan[2], a second operating voltage Vint, and the data voltage line Data respectively for detecting a touch signal; the output sub-module is connected to the second scan signal line Scan[1], a touch signal read line Y-read line and the detection sub-module 310 respectively for outputting a touch detection signal to the touch signal read line Y-read line according to an input of the second scan signal line Scan[1].

[0023] In the pixel circuit provided in the present disclosure, a pixel compensation module and a touch detection module are integrated, and the pixel compensation module and the touch detection module share a data voltage line and scan signal lines. As such, it is possible to reduce the number of signal lines, such that the pitch of pixels is dramatically reduced and IC cost is decreased, achieving higher pixel density. At the same time, the operating current flowing through the electroluminescent unit is not influenced by the threshold voltage of the corresponding driving transistor, solving the nonuniformity in brightness of display caused by threshold voltage drift of driving transistors.

[0024] Here, the second operating voltage Vint is used to provide driving pulses required to detect a touch.

[0025] For example, the light emitting module 200 can comprise an electroluminescent element whose anode is connected to the second terminal of T5.

[0026] In embodiments of the present disclosure, the electroluminescent element can be various normal devices with electroluminescent function including LED (Light Emitting Diode) or OLED (Organic Light Emitting Diode). In embodiments of the present disclosure, OLED is taken as an example for description.

[0027] Further, the energy storage unit is a capacitor. However, in practical applications, the energy storage unit can adopt other elements with energy storage function.

[0028] Further, as shown in Fig. 2, the output sub-module 320 comprises a sixth switch unit T6 whose first terminal is connected to the touch signal read line Y-read Line, whose second terminal is connected to the detection sub-module 310, and whose control terminal is connected to the second scan signal line Scan[1].

[0029] Further, the detection sub-module 310 comprises a seventh unit T7, a touch signal driving unit DT2, a sensing capacitor C2 and a touch electrode d, a first terminal of the seventh switch unit T7 is connected to the data voltage line Data, a second terminal of the seventh switch unit T7 is connected to a control terminal of the touch signal driving unit

DT2, a control terminal of the seventh switch unit is connected to the third scan signal line Scan[2]; an input terminal of the touch signal driving unit DT2 is connected to the second operating voltage Vint, an output terminal of the touch signal driving unit DT2 is connected to the sixth switch unit T6; the sensing capacitor C2 is connected between the input terminal and the control terminal of the touch signal driving unit DT2; the touch electrode d is connected to the control terminal of DT2. Since one terminal of C2 is also connected to the control terminal of DT2, that one terminal of C2 connected to the control terminal of DT2 is also connected to the touch electrode d.

[0030] Further, respective switch units and driving units are TFTs.

[0031] Further, as shown in Fig. 2, each TFT is of P channel type. Now, the input terminal of the driving unit is a source of a TFT, the output terminal of the driving unit is a drain of the TFT and the control terminal of the driving unit is a gate of the TFT. For each switch unit, the control terminal is also a gate of a TFT, and the first terminal and the second terminal correspond to a source and a drain of the TFT respectively.

[0032] It is easy to understand that, the transistors corresponding to the driving units and the switch units here can be transistors whose source and drain can be exchanged, or according to different types of channels, the first terminals of each switch unit and each driving unit can be drains of transistors and the second terminals can be sources of the transistors. The circuit structure obtained by reversing the source and the drain of each transistor in the pixel circuit provided in the present disclosure by those skilled in the art without creative work and able to achieve the same or similar technical effects as those of the technical solutions provided in the present disclosure should also fall in the protection scope of the present disclosure.

[0033] Using the same type of transistors can realize unification of process procedures such as to improve the yield of the products. It can be understood by those skilled in the art that the types of the transistors can be not completely the same in practical applications. For example, T1 and T5 can be N channel transistors, and T4 and T6 can be P channel transistors. As long as two switch units whose control terminals are connected to the same scan signal line can have the same ON/OFF state, the technical solutions provided in the present application can be realized. The implementations described in the present disclosure should not be understood as limiting of the protection scope of the present disclosure.

[0034] Next, the operating principles of the pixel circuit in Fig. 2 will be described in connection with Fig. 3 and Fig. 4. In order to facilitate the description, for example, respective switch units and driving units are P channel TFTs, and the energy storage unit is a capacitor. Fig. 3 is a possible time sequence diagram of scan signals on respective scan signal lines and the data voltage Vdata on the data voltage line within one frame when the pixel circuit provided in the present disclosure operates, which can be divided into three phases that are represented respectively as a first phase W1 (the phase in which the pixel compensation module resets and the touch detection module resets), a second phase W2 (the phase in which the pixel compensation module charges and the touch detection module detects), and a third phase W3 (the phase in which the pixel compensation module emits light and the touch detection module halts) in Fig. 3. Figs. 4a-4c are schematic diagrams of current directions and voltage values of the pixel circuit of an embodiment of the present disclosure under different time sequences. In the above respective phases W1-W3, the current directions and the voltage values of the pixel circuit are shown respectively in Fig. 4a, Fig. 4b, and Fig. 4c.

[0035] In the first phase W1, referring to Fig. 3, Scan[2] at this time is at a lowvoltage level, other scan signal lines and the data voltage line are at high voltage levels. Referring to Fig. 4a, in the pixel compensation module 100, only T3 is turned on, now point b is connected to the low voltage level Vcom (for example a grounded line), and the potential of the point b is 0 V, which resets the voltage signal of the last frame in the capacitor C1.

[0036] In the touch detection module, T7 is turned on, and T6 and DT2 are turned off, realizing the reset of the touch detection module. After reset, the potential of the touch electrode d is equal to the voltage applied to the Data line now (for example, Vdata). Since the capacitor C2 is also connected to the touch electrode d, the potential of the touch electrode d is kept to be Vdata. As can be seen, Scan[2] is equivalent to the reset scan signal line Reset line of the pixel compensation module 100 and the touch detection module.

[0037] In the second phase W2, referring to Fig. 3, now Scan[1] is at a low voltage level, other scan signal lines are at high voltage levels, and the voltage at the Data line remains unchanged. Referring to Fig. 4b, in the pixel compensation module 100, T2 and T4 are turned on, and T1, T3 and T5 are turned off. Since point b is grounded before, the pixel driving unit DT1 is turned on, and the Data line charges point b through T4→DT1→T2 until point b is charged to Vdata-Vth (the potential difference between the gate and the source of DT1 is Vth, and Vth is the threshold voltage of DT1). At the same time, since the potential of point a is always Vdd and the potential of point b always remains at Vdata-Vth after the charging is finished, and in addition, since the turning off of T5 makes the current not flow through OLED, the life loss of OLED is indirectly reduced.

[0038] In the touch detection module, referring to Fig. 4b, T7 is turned off, and T6 is turned on. Fig. 5 is a schematic diagram of potential change of the pixel electrode in the pixel circuit provided in the present disclosure. In the second phase W2, as shown in Fig. 5, when a finger touches, referring to the dashed line part of the figure, the potential Vd of the touch electrode d decreases (for example decrease by Vf), directly causing the gate potential of DT2 to decrease to reach the turning-on condition of DT2. Now, Vint inputs an electric singal to Y-read line through DT2 and T6. After

the finger touch causes Vd to be directly decreased by Vf, Vd decreases to 0 continuously due to the discharge of the capacitor C2. However, if there is no finger touch at this time, referring to the solid line part, the potential Vd of the touch electrode d will not decrease, but still remain at Vdata. Now, DT2 is turned off, and no electrical signal can be detected in Y-read line.

[0039] Only when the gate-source voltage of DT2 satisfies the turning-on condition of the MOS transistor, there is a signal passing through DT2. Such a phase of "waiting" for the gate potential of DT2 to decrease is a buffer phase for the touch signal driving unit, and the main cause of the decrease is the touch of a finger.

[0040] Now, if a finger touches, the potential of the touch electrode d will be directly caused to decrease, and the turning-on condition of DT2 is reached. At this point, the I&V characteristic curve is in the amplification region, DT2 as an amplification TFT will turn on and amplify the signal of coupling pulses, and Y-Read line collects the signal in the Y direction. Scan[1] as the scan signal in the X direction (row direction) also has the collection function (since the signal in the Y direction can be collected only when Scan[1] is at a low voltage level, and Scan[1] in pixels of a specific row is a low voltage level signal at a specific time; as such, it is possible to determine which row Scan[1] has scanned according to the time of the collected touch signal to further determine the coordinates of X). In such a way, the X, Y coordinates of the finger touch position are determined. Such a procedure only needs a finger to perform touch, and the coordinate position can be collected any time.

[0041] It can be seen that, in an embodiment of the present disclosure, Scan[1] functions as the X direction touch signal read line X-read line.

[0042] In the third phase W3, as shown in Fig. 3, only Em is at a low voltage level, and other scan signal lines are at high voltage levels. As shown in Fig. 4c, in the pixel compensation module 100, now T1 and T5 are turned on, and T2, T3 and T4 are turned off. Vdd makes OLED start to emit light through T1→DT1→T5.

[0043] In the touch detection module, none of the devices operates, and the touch detection module is at a halt state, such as to reduce the impact on the display procedure.

[0044] Therefore, according to the current characteristic of TFT in the saturation region, it is possible to obtain the current flowing through the pixel driving unit DT1 as:

$$\begin{aligned} IOLED &= K(V_{GS}-V_{th})^2 = K[Vdd-(Vdata-Vth)-Vth]^2 \\ &= K(Vdd-Vdata)^2. \end{aligned}$$

[0045] It can be seen from the above equation that the operating current IOLED is no longer affected by Vth, but only related to the difference between Vdd and Vdata, which fully solves the problem of threshold voltage (Vth) drift of the driving TFTs caused by the fabrication process and long time operation, eliminates its influence on IOLED, and ensures normal operation of OLED.

[0046] The present disclosure also provides a display panel comprising the above pixel circuit.

[0047] Optionally, the pixel circuits are distributed periodically on the display panel. In practical applications, it is not necessary for all the positions corresponding to respective pixels to each adopt the pixel circuit provided by embodiments of the present disclosure (for example, among three pixels, one is provided with the pixel circuit provided by embodiments of the present disclosure, and the other pixels are provided with normal pixel circuits) to realize the detection of the touch signal. As shown in Fig. 6, one pixel circuit (PU) provided by embodiments of the present disclosure is arranged every three pixels.

[0048] The present disclosure also provides a display apparatus comprising the above display panel.

[0049] The display apparatus here can be any product or means with display function such as an electronic paper, a cell phone, a tablet, a TV set, a display, a notebook computer, a digital photo frame, a navigator and so on.

Claims

1. A pixel circuit comprising a pixel compensation module (100), a light emitting module (200) and a touch detection module; wherein
   the pixel compensation module (100) comprises first to fifth switch units (T1, T2, T3, T4, T5), a pixel driving unit (DT1) and an energy storage unit (C1);
   control terminals of the first switch unit (T1) and the fifth switch unit (T5) are both connected to a first scan signal line (Em), a first terminal of the first switch unit (T1) is connected to an operating voltage (Vdd), a second terminal of the first switch unit (T1) is connected to an input terminal of the pixel driving unit (DT1), a first terminal of the fifth switch unit (T5) is connected to an output terminal of the pixel driving unit (DT1), a second terminal of the fifth switch unit (T5) is connected to the light emitting module (200);

control terminals of the second switch unit (T2) and the fourth switch unit (T4) are both connected to a second scan signal line (Scan[1]), a second terminal of the second switch unit (T2) is connected to a second terminal of the energy storage unit (C1) and a control terminal of the pixel driving unit (DT1), a second terminal of the fourth switch unit (T4) is connected to a data voltage line (Data);

a control terminal of the third switch unit (T3) is connected to a third scan signal line (Scan[2]), a first terminal of the third switch unit (T3) is connected to the second terminal of the energy storage unit (C1), a second terminal of the third switch unit (T3) is connected to a low voltage level line (Vcom);

the touch detection module comprises a detection sub-module (310) and an output sub-module (320), the detection sub-module (310) is connected to the third scan signal line (Scan[2]), a second operating voltage (Vint), the data voltage line (Data) respectively for detecting a touch signal, the output sub-module (320) is connected to the second scan signal line (Scan[1]), a touch signal read line (Y-read line) and the detection sub-module (310) respectively for outputting a touch detection signal to the touch signal read line (Y-read line) according to the input of the second scan signal line (Scan[1]),

wherein the output sub-module (320) comprises a sixth switch unit (T6) whose first terminal is connected to the touch signal read line (Y-read line) and whose second terminal is connected to the detection sub-module (310), and the detection sub-module (310) comprises a seventh switch unit (T7), a touch signal driving unit (DT2), a sensing capacitor (C2) and a touch electrode (d), a first terminal of the seventh switch unit (T7) is connected to the data voltage line (Data), a second terminal of the seventh switch unit (T7) is connected to a control terminal of the touch signal driving unit (DT2), a control terminal of the seventh switch unit (T7) is connected to the third scan signal line (Scan[2]); an input terminal of the touch signal driving unit (DT2) is connected to the second operating voltage (Vint), an output terminal of the touch signal driving unit (DT2) is connected to the sixth switch unit (T6); the sensing capacitor (C2) is connected between the input terminal and the control terminal of the touch signal driving unit (DT2); the touch electrode (d) is connected to the control terminal of the touch signal driving unit (DT2),

characterized in that

a first terminal of the second switch unit (T2) is connected to the input terminal of the pixel driving unit (DT1), and a first terminal of the fourth switch unit (T4) is connected to the output terminal of the pixel driving unit (DT1), and a control terminal of the sixth switch unit (T6) is connected to the control terminal of the fourth switch unit (T4) and connected to the control terminal of the second switch unit (T2), and the control terminal of the seventh switch unit (T7) is connected to the control terminal of the third switch unit (T3).

2. The pixel circuit according to claim 1, wherein the light emitting module (200) comprises an electroluminescent element whose anode is connected to the second terminal of the fifth switch unit (T5).

3. The pixel circuit according to claim 1 or 2, wherein the energy storage unit (C1) is a capacitor.

4. The pixel circuit according to any one of claims 1 to 3, wherein the respective switch units and driving units are TFTs.

5. The pixel circuit according to claim 4, wherein each TFT is of P channel type; the control terminal of the driving units is a gate of a TFT, the input terminal of the driving unit is a source, the output terminal of the driving unit is a drain; the control terminal of each switch unit is a gate of a TFT, the first terminal and the second terminal of each switch unit are correspond to a source and a drain respectively.

6. A display panel comprising pixel circuits according to any one of claims 1 to 5.

7. The display panel according to claim 6, wherein the pixel circuits are distributed periodically on the display panel.

8. A display apparatus comprising a display panel according to claim 6 or 7.

Patentansprüche

1. Pixelschaltung mit einem Pixelkompensationsmodul (100), einem Lichtemissionsmodul (200) und einem Berührungserfassungsmodul; wobei

das Pixelkompensationsmodul (100) erste bis fünfte Schalteinheiten (T1, T2, T3, T4, T5), eine Pixelansteuereinheit (DT1) und eine Energiespeichereinheit (C1) aufweist;

Steueranschlüsse der ersten Schalteinheit (T1) und der fünften Schalteinheit (T5) beide verbunden sind mit einer ersten Abtastsignalleitung (Em), ein erster Anschluss der ersten Schalteinheit (T1) mit einer Betriebsspannung (Vdd) verbunden ist, ein zweiter Anschluss der ersten Schalteinheit (T1) mit einem Eingangsanschluss der Pixelan-

steuereinheit (DT1) verbunden ist, ein erster Anschluss der fünften Schalteinheit (T5) mit einem Ausgabeanschluss der Pixelansteuereinheit (DT1) verbunden ist, ein zweiter Anschluss der fünften Schalteinheit (T5) mit dem Lichtemissionsmodul (200) verbunden ist;
Steueranschlüsse der zweiten Schalteinheit (T2) und der vierten Schalteinheit (T4) beide mit einer zweiten Abtastsignalleitung (Scan[1]) verbunden sind, ein zweiter Anschluss der zweiten Schalteinheit (T2) mit einem zweiten Anschluss der Energiespeichereinheit (C1) und einem Steueranschluss der Pixelansteuereinheit (DT1) verbunden ist, ein zweiter Anschluss der vierten Schalteinheit (T4) mit einer Datenspannungsleitung (Data) verbunden ist;
ein Steueranschluss der dritten Schalteinheit (T3) mit einer dritten Abtastsignalleitung (Scan[2]) verbunden ist, ein erster Anschluss der dritten Schalteinheit (T3) mit dem zweiten Anschluss der Energiespeichereinheit (C1) verbunden ist, ein zweiter Anschluss der dritten Schalteinheit (T3) mit einer Low-Spannungspegelleitung (Vcom) verbunden ist;
das Berührungserfassungsmodul ein Erfassungssubmodul (310) und ein Ausgabesubmodul (320) aufweist, wobei das Erfassungssubmodul (310) mit der dritten Abtastsignalleitung (Scan[2]), einer zweiten Betriebsspannung (Vint), der Datenspannungsleitung (Data) jeweils zum Erfassen eines Berührungssignals verbunden ist, das Ausgabesubmodul (320) mit der zweiten Abtastsignalleitung (Scan[1]), einer Berührungssignalleseleitung (Y-Leseleitung) und dem Erfassungssubmodul (310) jeweils zum Ausgeben eines Berührungserfassungssignals an die Berührungssignalleseleitung (Y-Leseleitung) gemäß der Eingabe der zweiten Abtastsignalleitung (Scan[1]) verbunden ist,
wobei das Ausgabesubmodul (320) eine sechste Schalteinheit (T6) aufweist, dessen erster Anschluss mit der Berührungssignalleseleitung (Y-Leseleitung) verbunden ist und dessen zweiter Anschluss mit dem Erfassungssubmodul (310) verbunden ist, und
das Erfassungssubmodul (310) eine siebte Schalteinheit (T7), eine Berührungssignalansteuereinheit (DT2), ein Erfassungskondensator (C2) und eine Berührungselektrode (d) aufweist, wobei ein erster Anschluss der siebten Schalteinheit (T7) mit der Datenspannungsleitung (Data) verbunden ist, ein zweiter Anschluss der siebten Schalteinheit (T7) mit einem Steueranschluss der Berührungssignalansteuereinheit (DT2) verbunden ist, ein Steueranschluss der siebten Schalteinheit (T7) mit der dritten Abtastsignalleitung (Scan[2]) verbunden ist; ein Eingabeanschluss der Berührungssignalansteuereinheit (DT2) mit der zweiten Betriebsspannung (Vint) verbunden ist, ein Ausgabeanschluss der Berührungssignalansteuereinheit (DT2) mit der sechsten Schalteinheit (T6) verbunden ist; der Erfassungskondensator (C2) zwischen dem Eingabeanschluss und dem Steueranschluss der Berührungssignalansteuereinheit (DT2) verbunden ist; die Berührungselektrode (d) mit dem Steueranschluss der Berührungssignalansteuereinheit (DT2) verbunden ist,
dadurch gekennzeichnet, dass
ein erster Anschluss der zweiten Schalteinheit (T2) mit dem Eingabeanschluss der Pixelansteuereinheit (DT1) verbunden ist, und ein erster Anschluss der vierten Schalteinheit (DT4) mit dem Ausgabeanschluss der Pixelansteuereinheit (DT1) verbunden ist, und
ein Steueranschluss der sechsten Schalteinheit (T6) mit dem Steueranschluss der vierten Schalteinheit (T4) und mit dem Steueranschluss der zweiten Schalteinheit (T2) verbunden ist, und der Steueranschluss der siebten Schalteinheit (T7) mit dem Steueranschluss der dritten Schalteinheit (T3) verbunden ist.

2. Pixelschaltung gemäß Anspruch 1, wobei das Lichtemissionsmodul (200) aufweist: Ein Elektrolumineszenz-Element, dessen Anode mit dem zweiten Anschluss der fünften Schalteinheit (T5) verbunden ist.

3. Pixelschaltung gemäß Anspruch 1 oder 2, wobei die Energiespeichereinheit (C1) ein Kondensator ist.

4. Pixelschaltung gemäß einem der Ansprüche 1 bis 3, wobei die jeweiligen Schalteinheiten und Ansteuereinheiten TFTs sind.

5. Pixelschaltung gemäß Anspruch 4, wobei jeder TFT vom P-Kanal-Typ ist; der Ansteueranschluss der Ansteuereinheiten ein Gate eines TFT ist, der Eingabeanschluss der Ansteuereinheit eine Source ist, der Ausgabeanschluss der Ansteuereinheit ein Drain ist; der Ansteueranschluss jeder Schalteinheit ein Gate eines TFT ist, wobei der erste Anschluss und der zweite Anschluss jeder Schalteinheit einer Source bzw. einem Drain entsprechen.

6. Display-Panel mit Pixelschaltungen gemäß einem der Ansprüche 1 bis 5.

7. Anzeige-Panel gemäß Anspruch 6, wobei die Pixelschaltungen periodisch auf dem Anzeige-Panel verteilt sind.

8. Anzeigevorrichtung mit einem Anzeige-Panel gemäß Anspruch 6 oder 7.

Revendications

1. Circuit de pixel comprenant un module de compensation de pixel (100), un module d'émission de lumière (200) et un module de détection de contact tactile ; dans lequel :

le module de compensation de pixel (100) comprend des première à cinquième unités de commutation (T1, T2, T3, T4, T5), une unité de pilotage de pixel (DT1) et une unité de stockage d'énergie (C1) ;
des bornes de commande de la première unité de commutation (T1) et de la cinquième unité de commutation (T5) sont toutes deux connectées à une première ligne de signal de balayage (Em), une première borne de la première unité de commutation (T1) est connectée à une tension de fonctionnement (Vdd), une seconde borne de la première unité de commutation (T1) est connectée à une borne d'entrée de l'unité de pilotage de pixel (DT1), une première borne de la cinquième unité de commutation (T5) est connectée à une borne de sortie de l'unité de pilotage de pixel (DT1), une seconde borne de la cinquième unité de commutation (T5) est connectée au module d'émission de lumière (200) ;
des bornes de commande de la deuxième unité de commutation (T2) et de la quatrième unité de commutation (T4) sont toutes deux connectées à une deuxième ligne de signal de balayage (Scan[1]), une seconde borne de la deuxième unité de commutation (T2) est connectée à une seconde borne de l'unité de stockage d'énergie (C1) et à une borne de commande de l'unité de pilotage de pixel (DT1), une seconde borne de la quatrième unité de commutation (T4) est connectée à une ligne de tension de données (Data) ;
une borne de commande de la troisième unité de commutation (T3) est connectée à une troisième ligne de signal de balayage (Scan[2]), une première borne de la troisième unité de commutation (T3) est connectée à la seconde borne de l'unité de stockage d'énergie (C1), une seconde borne de la troisième unité de commutation (T3) est connectée à une ligne de niveau de tension bas (Vcom) ;
le module de détection de contact tactile comprend un sous-module de détection (310) et un sous-module de sortie (320), le sous-module de détection (310) est respectivement connecté à la troisième ligne de signal de balayage (Scan[2]), à une seconde tension de fonctionnement (Vint) et à la ligne de tension de données (Data) pour détecter un signal de contact tactile, le sous-module de sortie (320) est respectivement connecté à la deuxième ligne de signal de balayage (Scan[1]), à une ligne de lecture de signal de contact tactile (ligne Y-read) et au sous-module de détection (310) pour émettre en sortie un signal de détection de contact tactile sur la ligne de lecture de signal de contact tactile (ligne Y-read) conformément à l'entrée de la deuxième ligne de signal de balayage (Scan[1]) ; dans lequel :

le sous-module de sortie (320) comprend une sixième unité de commutation (T6) dont une première borne est connectée à la ligne de lecture de signal de contact tactile (ligne Y-read) et dont une seconde borne est connectée au sous-module de détection (310) ; et
le sous-module de détection (310) comprend une septième unité de commutation (T7), une unité de pilotage de signal de contact tactile (DT2), un condensateur de détection (C2) et une électrode de contact tactile (d), une première borne de la septième unité de commutation (T7) est connectée à la ligne de tension de données (Data), une seconde borne de la septième unité de commutation (T7) est connectée à une borne de commande de l'unité de pilotage de signal de contact tactile (DT2), une borne de commande de la septième unité de commutation (T7) est connectée à la troisième ligne de signal de balayage (Scan[2]) ; une borne d'entrée de l'unité de pilotage de signal de contact tactile (DT2) est connectée à la seconde tension de fonctionnement (Vint), une borne de sortie de l'unité de pilotage de signal de contact tactile (DT2) est connectée à la sixième unité de commutation (T6) ; le condensateur de détection (C2) est connecté entre la borne d'entrée et la borne de commande de l'unité de pilotage de signal de contact tactile (DT2) ; l'électrode de contact tactile (d) est connectée à la borne de commande de l'unité de pilotage de signal de contact tactile (DT2) ;

caractérisé en ce que :

une première borne de la deuxième unité de commutation (T2) est connectée à la borne d'entrée de l'unité de pilotage de pixel (DT1) et une première borne de la quatrième unité de commutation (T4) est connectée à la borne de sortie de l'unité de pilotage de pixel (DT1) ; et
une borne de commande de la sixième unité de commutation (T6) est connectée à la borne de commande de la quatrième unité de commutation (T4) et est connectée à la borne de commande de la deuxième unité de commutation (T2), et la borne de commande de la septième unité de commutation (T7) est connectée à la borne de commande de la troisième unité de commutation (T3).

2. Circuit de pixel selon la revendication 1, dans lequel le module d'émission de lumière (200) comprend un élément électroluminescent dont l'anode est connectée à la seconde borne de la cinquième unité de commutation (T5).

3. Circuit de pixel selon la revendication 1 ou 2, dans lequel l'unité de stockage d'énergie (C1) est un condensateur.

4. Circuit de pixel selon l'une quelconque des revendications 1 à 3, dans lequel les unités de commutation respectives et les unités de pilotage respectives sont des transistors à effet de champ - TFT.

5. Circuit de pixel selon la revendication 4, dans lequel chaque TFT est du type à canal P ; la borne de commande de l'unité de pilotage est une grille d'un TFT, la borne d'entrée de l'unité de pilotage est une source, la borne de sortie de l'unité de pilotage est un drain ; la borne de commande de chaque unité de commutation est une grille d'un TFT, la première borne et la seconde borne de chaque unité de commutation correspondent respectivement à une source et à un drain.

6. Écran d'affichage comprenant des circuits de pixel selon l'une quelconque des revendications 1 à 5.

7. Écran d'affichage selon la revendication 6, dans lequel les circuits de pixel sont distribués de façon périodique sur l'écran d'affichage.

8. Appareil d'affichage comprenant un écran d'affichage selon la revendication 6 ou 7.

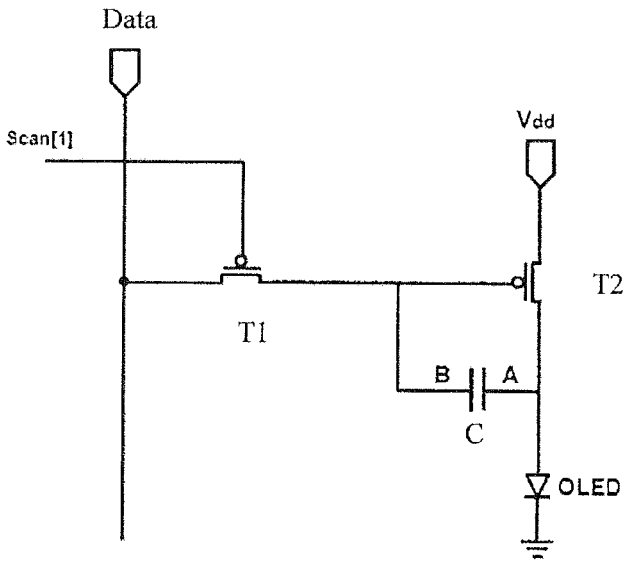

Fig.1

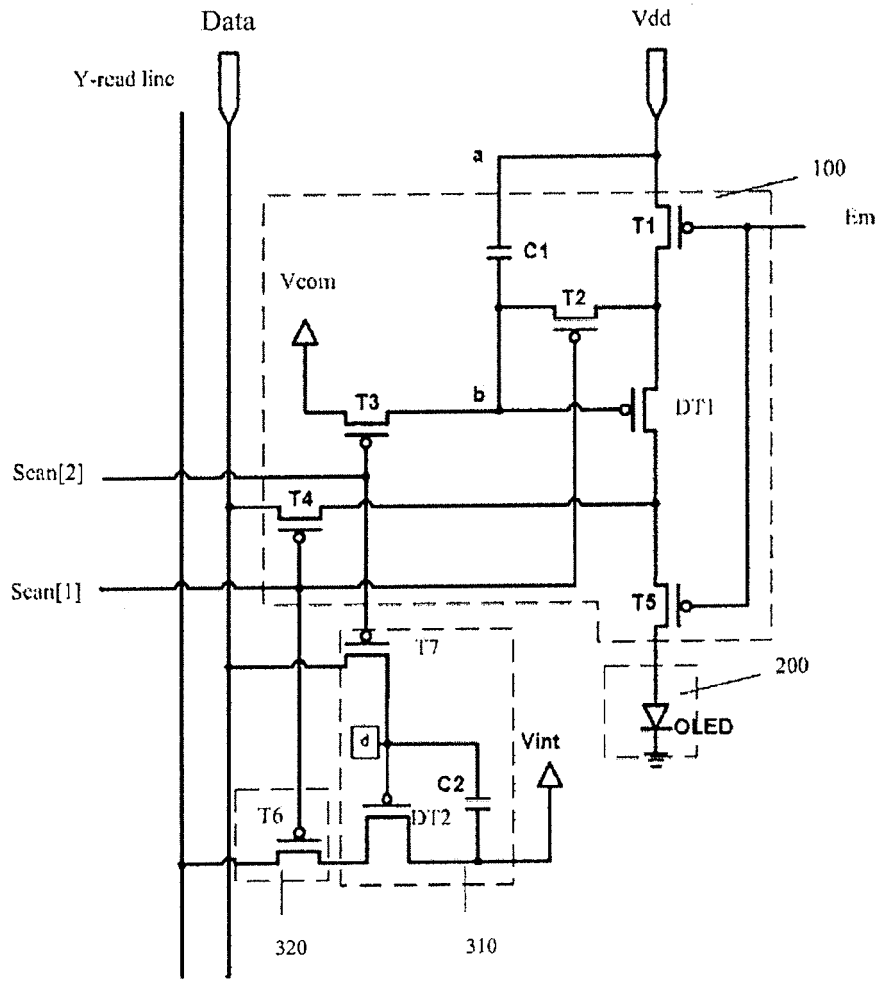
Data
Vdd
Y-read line
a
100
T1
Em
C1
Vcom
T2
T3
b
DT1
Scan[2]
T4
Scan[1]
T5
T7
200
OLED
d
Vint
C2
T6
DT2
320
310

Fig.2

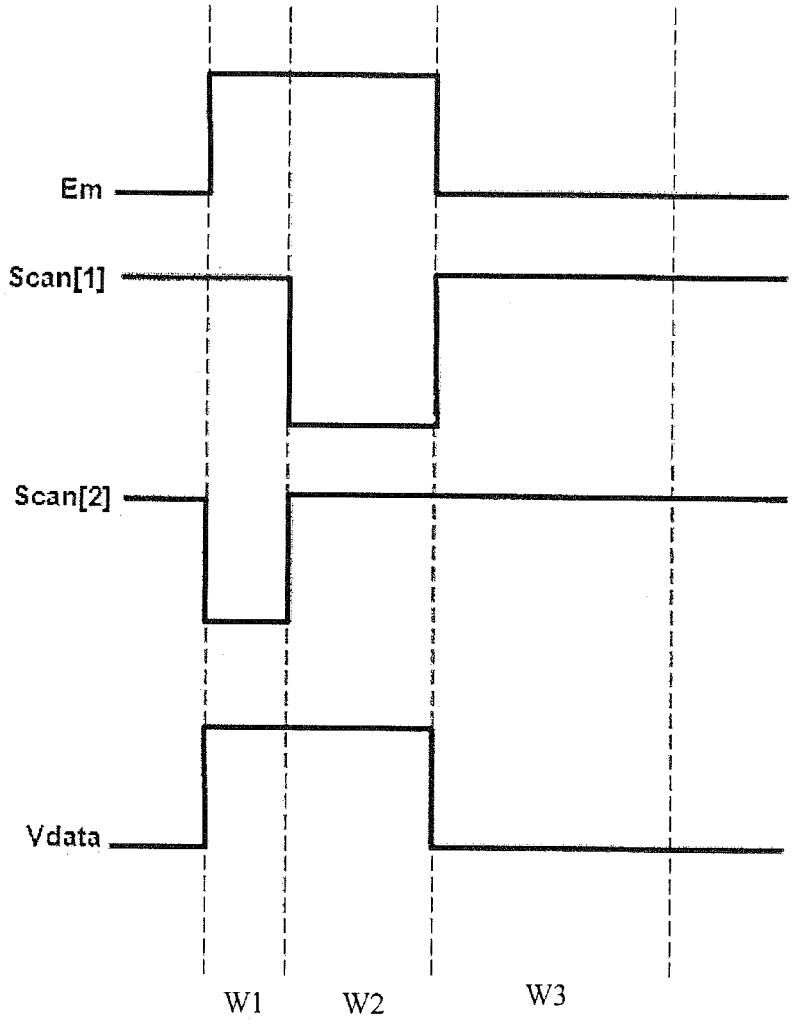

Fig.3

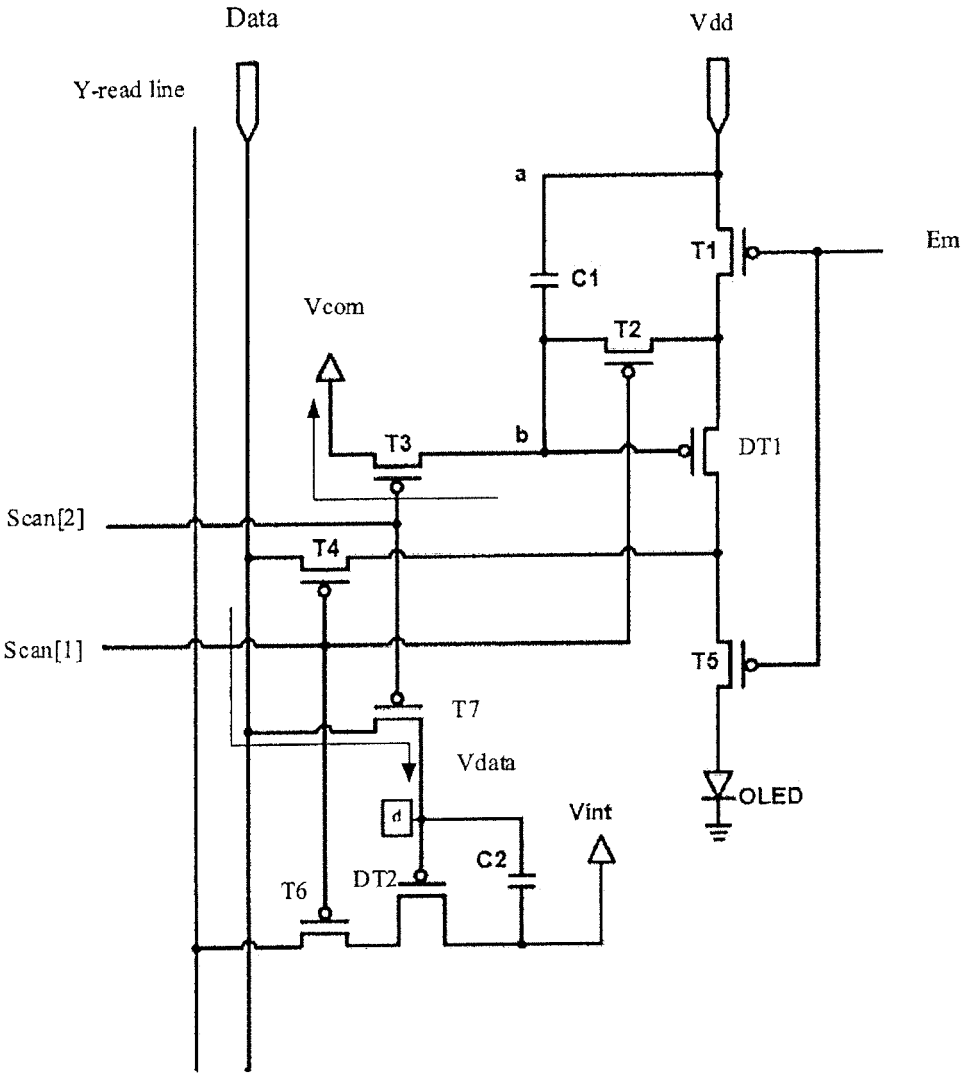
Data
Vdd
Y-read line
a
T1
Em
C1
Vcom
T2
T3
b
DT1
Scan[2]
T4
Scan[1]
T5
T7
Vdata
OLED
d
Vint
C2
T6
DT2

Fig.4a

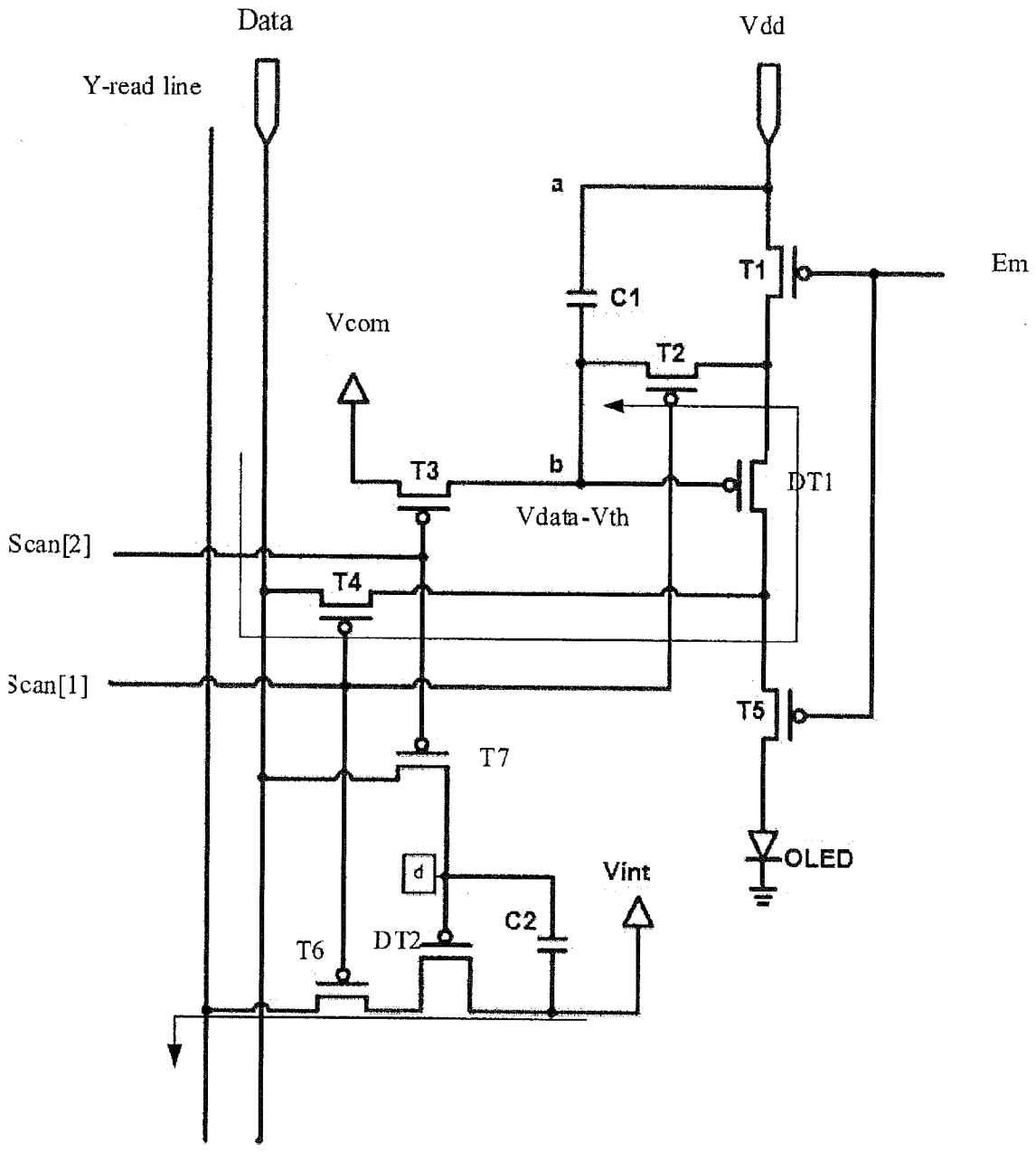
Data
Vdd
Y-read line
a
T1
Em
C1
Vcom
T2
T3
b
DT1
Vdata-Vth
Scan[2]
T4
Scan[1]
T5
T7
OLED
d
Vint
C2
T6
DT2

Fig.4b

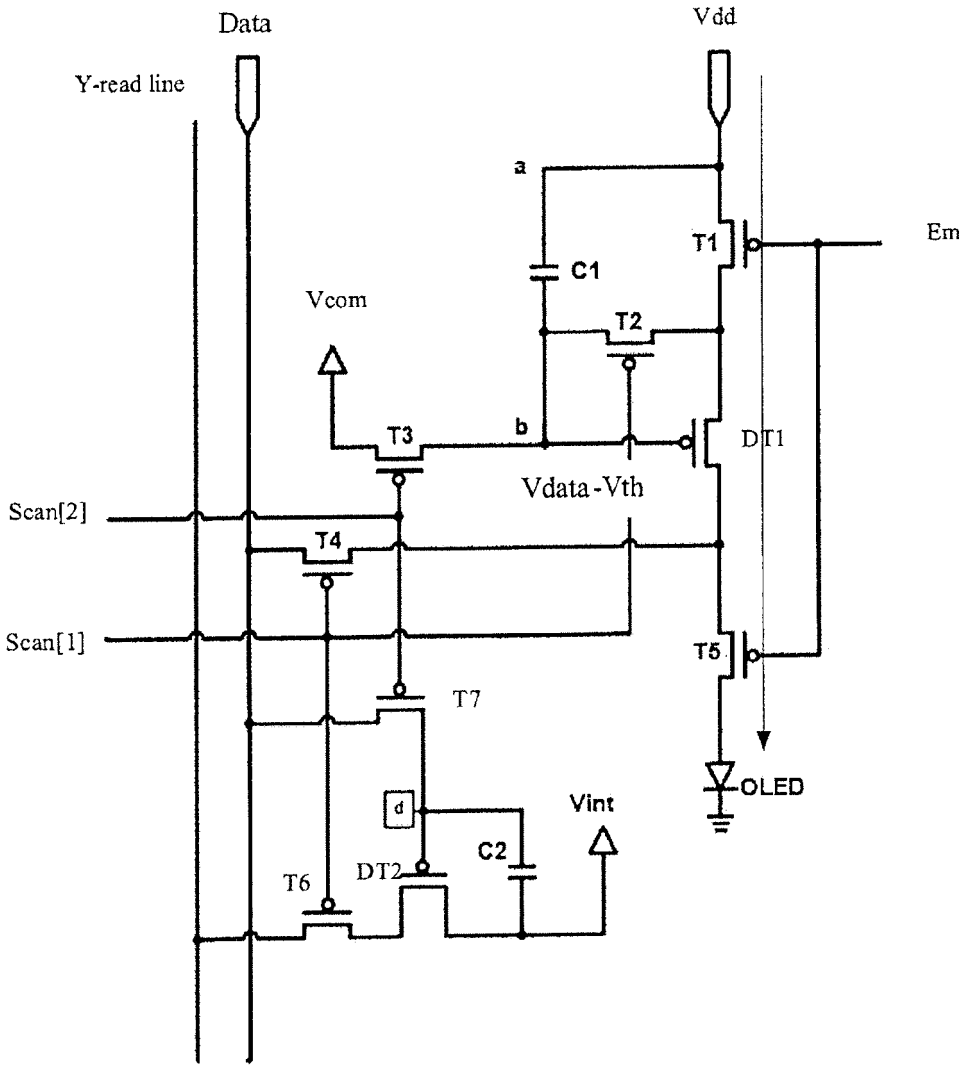
Data
Vdd
Y-read line
a
T1
Em
C1
Vcom
T2
T3
b
DT1
Vdata-Vth
Scan[2]
T4
Scan[1]
T5
T7
OLED
d
Vint
C2
T6
DT2

Fig.4c

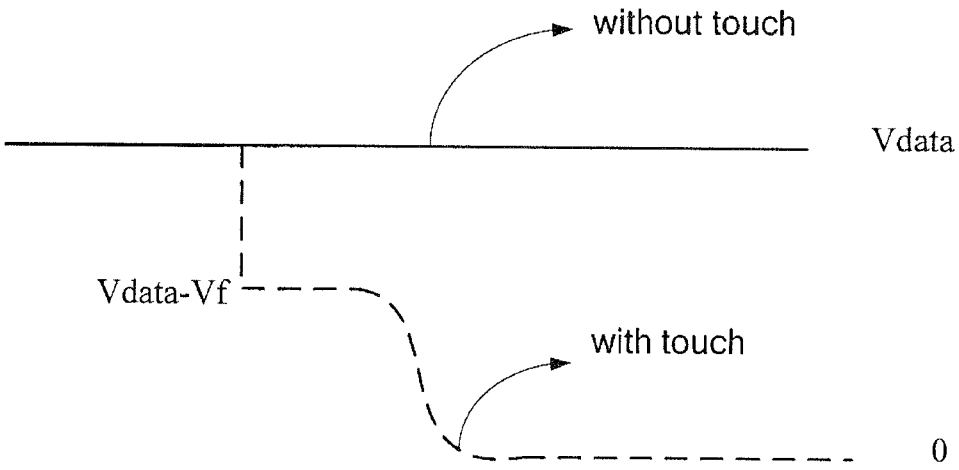
without touch
Vdata
Vdata-Vf
with touch
0

Fig.5

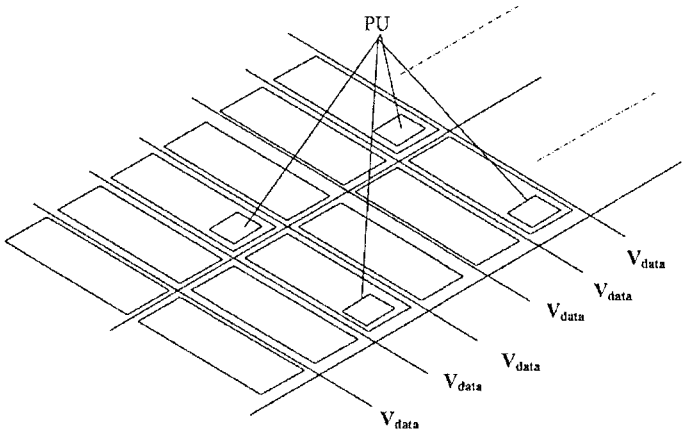
PU
Vdata
Vdata
Vdata
Vdata
Vdata
Vdata

Fig.6

REFERENCES CITED IN THE DESCRIPTION

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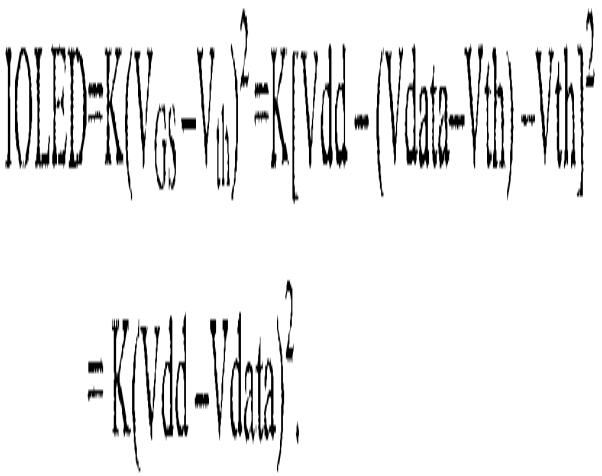
Patent documents cited in the description

- US 2009273590 A1 **[0003]**
- CN 203179480 U **[0004]**

专利名称(译)	像素电路，显示面板和显示设备		
公开(公告)号	EP3163559B1	公开(公告)日	2019-02-20
申请号	EP2014859320	申请日	2014-09-22
[标]申请(专利权)人(译)	京东方科技集团股份有限公司 北京京东方光电科技有限公司		
申请(专利权)人(译)	京东方科技集团股份有限公司. 北京京东方光电科技有限公司.		
当前申请(专利权)人(译)	京东方科技集团股份有限公司. 北京京东方光电科技有限公司.		
[标]发明人	YANG SHENGJI		
发明人	YANG, SHENGJI		
IPC分类号	G09G3/32 G09G3/3233		
CPC分类号	G09G3/32 G09G3/3233 G09G2300/0819 G09G2300/0842 G09G2300/0861 G09G2300/0866 G09G2310/0262 G09G2320/043 G09G2320/045		
优先权	201410302129.8 2014-06-27 CN		
其他公开文献	EP3163559A4 EP3163559A1		
外部链接	Espacenet		

摘要(译)

像素电路，显示面板和显示装置。像素电路包括像素补偿模块，发光模块和触摸检测模块;像素补偿模块包括第一至第五开关单元，像素驱动单元和储能单元;触摸检测模块包括检测子模块和输出子模块。在像素电路中，集成了像素补偿模块和触摸检测模块，像素补偿模块和触摸检测模块共享数据电压线和扫描信号线。这样，可以减少信号线的数量，使得像素的间距显着减小并且IC成本降低，从而实现更高的像素密度。同时，在像素电路中，流过电致发光单元的工作电流不受相应驱动晶体管的阈值电压的影响，并且可以避免由驱动晶体管的阈值电压漂移引起的显示亮度的不均匀性。