



(11)

EP 3 276 601 A1

(12)

EUROPEAN PATENT APPLICATION
published in accordance with Art. 153(4) EPC

(43) Date of publication:
31.01.2018 Bulletin 2018/05

(51) Int Cl.:
G09G 3/32 (2016.01)

(21) Application number: **15886030.4**

(86) International application number:
PCT/CN2015/088414

(22) Date of filing: **28.08.2015**

(87) International publication number:
WO 2016/150101 (29.09.2016 Gazette 2016/39)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
MA

(30) Priority: **26.03.2015 CN 201510138231**

(71) Applicant: **BOE Technology Group Co., Ltd.**
Beijing 100015 (CN)

(72) Inventors:
• **SUN, Tuo**
Beijing 100176 (CN)
• **MA, Zhanjie**
Beijing 100176 (CN)

(74) Representative: **Brötz, Helmut et al**
Rieder & Partner mbB
Patentanwälte - Rechtsanwalt
Corneliusstrasse 45
42329 Wuppertal (DE)

(54) **OLED PIXEL DRIVE CIRCUIT AND DRIVE METHOD, AND OLED DISPLAY DEVICE**

(57) An OLED pixel drive circuit, a drive method, and an OLED display device are provided. The OLED pixel drive circuit comprises a reset module (1), a first capacitor (C1), a first transistor (T1), a charging control module (2), a drive transistor (M1) and a light-emitting control module (3); the reset module (1) is connected to two ends of the first capacitor (C1) and configured to make the two ends of the first capacitor (C1) have an initial voltage; a first electrode of the first transistor (T1) is connected to the charging control module (2), a second electrode thereof is connected to a first end of the first capacitor (C1), and a control electrode thereof is connected to a second end of the first capacitor (C1); the charging control module (2) is connected to the first transistor (T1) and a data line (Data); a control electrode of the drive transistor (M1) is connected to the second end of the first capacitor (C1), a first electrode thereof is connected to a high voltage end (VDD), and a second electrode thereof is connected to the light-emitting control module (3); and the light-emitting control module (3) is connected to the light-emitting device (4), wherein the difference between a threshold voltage of the first transistor (T1) and a threshold voltage of the drive transistor (M1) is less than a preset value. The OLED pixel drive circuit can keep the luminance of the OLED pixel within one frame picture stable.

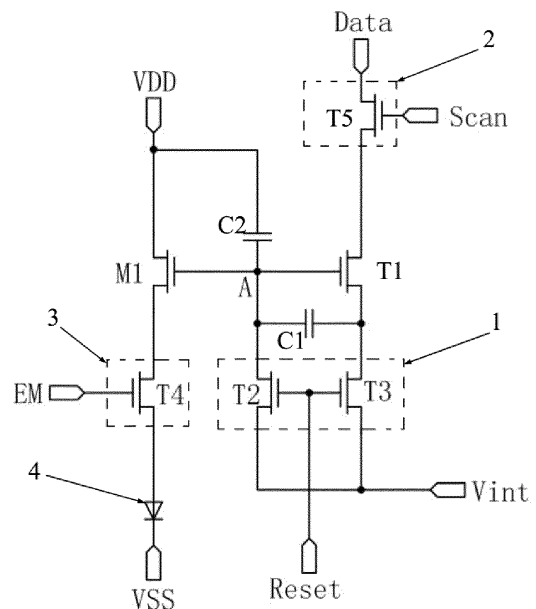


Fig.1

EP 3 276 601 A1

Description

TECHNICAL FIELD

[0001] The present disclosure relates to an OLED pixel drive circuit, an OLED pixel drive method, and an OLED display device.

BACKGROUND

[0002] An active matrix organic light emitting diode (hereinafter referred to as AMOLED) display panel utilizes OLED to emit lights with different luminance, so that pixel display corresponding to OLED has corresponding luminance. Compared with a conventional thin film transistor liquid crystal display panel (TFT LCD), AMOLED display panel has a faster response speed, a higher contrast and a broader angle of view, and is an important development direction of the display panel.

[0003] Current that drives OLED to emit light can be represented by the following equation:

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

where V_{gs} is a voltage difference between a gate and a source of a driving transistor, β is a parameter related to process parameter and characteristic size of the driving transistor, and V_{th} is a threshold voltage of the driving transistor.

[0004] According to the above equation, the driving current that drives a light-emitting device OLED to emit light is related to the threshold voltage V_{th} of the driving transistor. In the actual application, the threshold voltage V_{th} of the driving transistor would change in the light-emitting phase, which would affect light-emitting luminance of the light-emitting device OLED, such that the luminance is non-uniform in the process of light emitting, and then the display effect of the AMOLED display panel would be affected badly.

SUMMARY

[0005] There are provided in the present disclosure an OLED pixel drive circuit, an OLED pixel drive method and an OLED display device, which can control the variation amplitude of light-emitting luminance of a light-emitting device within a preset range, so that it is helpful to make luminance of OLED pixel displayed within one frame picture maintain stable.

[0006] According to one aspect of the present disclosure, there is provided an OLED pixel drive circuit for driving a light-emitting device in an OLED pixel to emit light, comprising a reset module, a first capacitor, a first transistor, a charging control module, a driving transistor and a light-emitting control module; the reset module is connected to two terminals of the first capacitor and con-

figured to charge the two terminals of the first capacitor, so that the two terminals of the first capacitor have an initial voltage; a first electrode of the first transistor is connected to the charging control module, a second electrode thereof is connected to a first terminal of the first capacitor, and a control electrode thereof is connected to a second terminal of the first capacitor; the charging control module is connected to the first transistor and a data line and configured to control the first transistor to be connected with or disconnected from the data line; a control electrode of the driving transistor is connected to the second terminal of the first capacitor, a first electrode thereof is connected to a high voltage terminal, and a second electrode thereof is connected to the light-emitting control module; the light-emitting control module is connected to the light-emitting device and configured to control the driving transistor to be connected with or disconnected from the light-emitting device, wherein a difference value between a threshold voltage of the first transistor and a threshold voltage of the driving transistor is less than a preset value.

[0007] Exemplarily, the preset value can be 20 mV.

[0008] Alternatively, the threshold voltage of the first transistor and the threshold voltage of the driving transistor can be the same.

[0009] Exemplarily, the reset module comprises a second transistor and a third transistor; a control electrode of the second transistor is connected to a reset signal terminal, a first electrode thereof is connected to an input voltage terminal, and a second electrode thereof is connected to the second terminal of the first capacitor; a control electrode of the third transistor is connected to the reset signal terminal, a first electrode thereof is connected to an input voltage terminal, and a second electrode thereof is connected to the first terminal of the first capacitor.

[0010] Exemplarily, the charging control module comprises a fifth transistor; a control electrode of the fifth transistor is connected to a gate line, a first electrode thereof is connected to a data line, and a second electrode thereof is connected to the first electrode of the first transistor.

[0011] Exemplarily, the light-emitting control module comprises a fourth transistor; a control electrode of the fourth transistor is connected to a light-emitting signal terminal, a first electrode thereof is connected to a second electrode of the driving transistor, and a second electrode thereof is connected to the light-emitting device.

[0012] Exemplarily, the OLED pixel drive circuit further comprises a second capacitor, whose first terminal is connected to the high voltage terminal, and second terminal is connected to the second terminal of the first capacitor.

[0013] Exemplarily, a voltage of the high voltage terminal is greater than a voltage supplied by the data line.

[0014] Exemplarily, the first transistor has a same size and shape as the driving transistor.

[0015] Alternatively, the first transistor and the driving

transistor are formed through a same composition process.

[0016] Exemplarily, respective transistors are P-type transistors.

[0017] As another technical solution, there is further provided in the present disclosure an OLED pixel drive method that drives a light-emitting device in an OLED pixel to emit light through an OLED pixel drive circuit, the OLED pixel drive circuit comprising a reset module, a first capacitor, a first transistor, a charging control module, a driving transistor and a light-emitting control module; the OLED pixel drive method comprises following steps:

[0018] S1, Two terminals of the first capacitor are charged by the reset module to reset a voltage of the two terminal as an initial voltage;

[0019] S2, under the control of the charging control module, a data line charges the first capacitor via the first transistor, to make a voltage of the second terminal of the first capacitor to $V_{data}+V_{th1}$; the V_{data} is a voltage on the data line, and V_{th1} is a threshold voltage of the first transistor.

[0020] S3, under the control of the light-emitting control module, a driving current is generated according to a voltage of a control electrode and a first electrode of the driving transistor, and the driving transistor is made connected to the light-emitting device, so that the driving current is input to the light-emitting device to make the light-emitting device emit light.

[0021] Exemplarily, in step S2, a range of the voltage on the data line is 0.8-1.5V.

[0022] Exemplarily, respective transistors are P-type transistors; in step S1, a reset signal terminal is input a low level signal, a gate line is input a high level signal, and a light-emitting signal terminal is input a high level signal; in step S2, the reset signal terminal is input the high level signal, the gate line is input the low level signal, and the light-emitting signal terminal is input the high level signal; in step S3, the reset signal terminal is input the high level signal, the gate line is input the high level signal, and the light-emitting signal terminal is input the low level signal.

[0023] According to another aspect of the present disclosure, there is further provided in the present disclosure an OLED display device, comprising the OLED pixel drive circuit provided in the present disclosure.

[0024] The OLED pixel drive circuit provided in the present disclosure comprises the first transistor, and charges the first capacitor via the first transistor, to make the voltage of the second terminal of the first capacitor raise to $V_{data}+V_{th1}$. When the driving current is generated, the driving current can be made related to a difference value between the threshold voltage V_{th1} of the first transistor and the threshold voltage V_{th2} of the second transistor, and the difference value between the threshold voltage V_{th1} of the first transistor and the threshold voltage V_{th2} of the driving transistor is less than the preset value. In this way, the variation of light-

emitting luminance of the light-emitting device can be controlled within the preset range, so as to be helpful to make luminance of OLED pixel displayed within one frame picture maintain stable.

[0025] The OLED pixel drive method provided in the present disclosure charges the first capacitor via the first transistor, to make the voltage of the second terminal of the first capacitor raise to $V_{data}+V_{th1}$. When the driving current is generated, the driving current can be made related to the difference value between the threshold voltage V_{th1} of the first transistor and the threshold voltage V_{th2} of the second transistor, and the threshold voltage of the first transistor is V_{th1} , and the difference value between the threshold voltage V_{th1} of the first transistor and the threshold voltage V_{th2} of the driving transistor is less than the preset value. In this way, the variation of light-emitting luminance of the light-emitting device can be controlled within the preset range, so as to be helpful to make luminance of OLED pixel displayed within one frame picture maintain stable.

[0026] The OLED display device provided in the present disclosure adopts the OLED pixel drive circuit provided in the present disclosure, can control the variation of light-emitting luminance of the light-emitting device within the preset range, which is helpful to make luminance of OLED pixel displayed within one frame picture maintain stable., so that the display effect can be improved.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027]

Fig.1 is a schematic diagram of an OLED pixel drive circuit provided in an implementation of the present disclosure;

Fig.2 is timing diagrams of respective signals in an OLED pixel drive circuit when respective transistors in Fig.1 are P-type transistors;

Fig.3 is a flow diagram of an OLED pixel drive method provided in an implementation of the present disclosure.

DETAILED DESCRIPTION

[0028] Specific implementations of the present disclosure will be described below in detail by combining with figures. It should be understood that the specific implementations described herein are just used to describe and explain principles of the present disclosure, but not used to limit the scope of the present disclosure.

[0029] The present disclosure provides an implementation of an OLED pixel drive circuit for driving a light-emitting device in an OLED pixel to emit light.

[0030] Fig.1 is a schematic diagram of an OLED pixel drive circuit provided in an implementation of the present disclosure. As shown in Fig.1, in the present implementation, the OLED pixel drive circuit comprises a reset

module 1, a first capacitor C1, a first transistor T1, a charging control module 2, a driving transistor M1 and a light-emitting control module 3. The reset module 1 is connected to two terminals of the first capacitor C1, and configured to charge the two terminals of the first capacitor C1, so that the two terminals thereof have an initial voltage. A difference value between a threshold voltage Vth1 of the first transistor T1 and a threshold voltage Vth2 of the driving transistor M1 is less than a preset value. A first electrode of the first transistor T1 is connected to the charging control module 2, a second electrode thereof is connected to a first terminal of the first capacitor C1, and a control electrode thereof is connected to a second terminal of the first capacitor C1. The charging control module 2 is connected to the first transistor T1 and the data line Data, and is configured to control the first transistor T1 to be connected with or disconnected from the data line Data. A control electrode of the driving transistor M1 is connected to the second terminal of the first capacitor C1, a first electrode thereof is connected to a high voltage terminal VDD, and a second electrode thereof is connected to the light-emitting control module 3. The light-emitting control module 3 is connected to a light-emitting device 4, and configured to control the driving transistor M1 to be connected with or disconnected from the light-emitting device 4.

[0031] In the present implementation, for the first transistor T1, the driving transistor M1 and respective transistors described below, their "control electrodes" are gates, "first electrodes" are sources, and "second electrodes" are drains; of course, it may also be that "first electrodes" are drains, and "second electrodes" are sources.

[0032] When the OLED pixel drive circuit provided in the present implementation drives the light-emitting device 4 to emit light, in a first phase, the reset module 1 charges the two terminals of the first capacitor C1 to reset the voltage of the two terminals of the first capacitor C1 as an initial voltage, and the initial voltage is within a voltage range where the first transistor T1 is turned on.

[0033] In a second phase, the first transistor T1 is turned on by the initial voltage. At the same time, the charging control module 2 controls the data line Data connected with the first transistor T1. Thus, the data line Data can charge the first capacitor C1 via the first transistor T1. Further, this process can be described as follows: a voltage of the first terminal of the first capacitor C1 rises gradually to Vdata+Vth1, where Vdata is a voltage on the data line, and Vth1 is a threshold voltage of the first transistor T1. In the process that the voltage of the first terminal of the first capacitor C1 rises, due to a bootstrap effect, a voltage of the second terminal of the first capacitor C1 rises gradually, and finally rises to Vdata+Vth1.

[0034] In a third phase, a driving current is generated according to a voltage of the control electrode of the driving transistor M1 and a voltage of the first electrode of the same. In particular, the driving current is I_{OLED} . It is

expressed by the following equation:

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

$$= \frac{\beta}{2} (V_{\text{data}} + V_{\text{th1}} - V_{\text{DD}} - V_{\text{th2}})^2$$

[0035] At the same time, the light-emitting control module 3 controls connection of the driving transistor M1 with the light-emitting device 4. In this way, the driving current is input to the light-emitting device 4, so that the light-emitting device 4 emits light.

[0036] It can be known according to the above description, the driving current that drives the light-emitting device 4 to emit light is related to the difference value between the threshold voltage Vth1 of the first transistor T1 and the threshold voltage Vth2 of the driving transistor M1. Since the difference value between Vth1 and Vth2 is less than the preset value, in the process of light emitting, the variation of light-emitting luminance of the light-emitting device 4 can be controlled within a preset range, so that it is helpful to make luminance of OLED pixel displayed within one frame picture maintain stable.

[0037] In the present implementation, alternatively, the preset value can be 20 mV, that is, a maximum difference value between the threshold Vth1 of the first transistor T1 and the threshold voltage Vth2 of the driving transistor M1 is 20mV. In this way, in the process of light emitting, the light-emitting luminance of the light-emitting device 4 can be maintained within a relatively stable range. Further, alternatively, the threshold voltage Vth1 of the first transistor T1 is the same as the threshold voltage Vth2 of the driving transistor M1. In this way, the current that drives the light-emitting device 4 to emit light is:

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

[0038] Thus, the luminance of the light-emitting device 4 is not affected by the threshold voltage Vth2 of the driving transistor M1 completely, so as to ensure the light-emitting luminance of the light-emitting device 4 to maintain stable.

[0039] Exemplarily, the reset module 1 can comprise a second transistor T2, and a third transistor T3. A control electrode of the second transistor T2 is connected to a reset signal terminal Reset, a first electrode thereof is connected to an input voltage terminal Vint, and a second electrode thereof is connected to the second terminal of the first capacitor C1. A control electrode of the third transistor T3 is connected to the reset signal terminal Reset, a first electrode thereof is connected to an input voltage terminal Vint, and a second electrode thereof is connected to the first terminal of the first capacitor C1.

[0040] In addition, the charging control module 2 can

comprise a fifth transistor T5. A control electrode of the fifth transistor T5 is connected to a gate line Scan, a first electrode thereof is connected to the data line Data, and a second electrode thereof is connected to the first electrode of the first transistor T1.

[0041] The light-emitting control module 3 can comprise a fourth transistor T4. A control electrode of the fourth transistor T4 is connected to a light-emitting signal terminal EM, a first electrode thereof is connected to the second electrode of the driving transistor M1, and a second electrode thereof is connected to the light-emitting device 4. The light-emitting device 4 is further connected to a low voltage terminal VSS.

[0042] Principle and process that the OLED pixel drive circuit drives the light-emitting device 4 to emit light provided in an implementation will be described in detail below in combination with timings of respective signals by taking respective transistors being P-type transistors as an example.

[0043] Fig.2 shows a timing diagram of respective signals within one period during which the signals drive the light-emitting device 4 to emit light when respective transistors are P-type transistors. As shown in Fig.2, in a first phase t1 within this period, the reset signal terminal Reset is input a low level signal, so that the second transistor T2 and the third transistor T3 are turned on. When the gate line Scan is input a high level signal, the fifth transistor T5 is turned off. When the light-emitting signal terminal EM is input the high level signal, the fourth transistor T4 is turned on. In the case that the second transistor T2 and the third transistor T3 are turned on, the input signal terminal Vint charges the two terminals of the first capacitor C1 via the second transistor T2 and the third transistor T3 respectively, to reset the voltage of the two terminals of the first capacitor C1 as the initial voltage.

[0044] In a second phase t2, the reset signal terminal Reset is input a high level signal, so that the second transistor T2 and the third transistor T3 are turned off. When the gate line Scan is input the low level signal, the fifth transistor T5 is turned on. The light-emitting signal terminal EM is still input the high level signal, so that the fourth transistor T4 is turned off. In the case that the fifth transistor T5 is turned on, the data line Data charges the first capacitor C1 via the fifth transistor T5 and the first transistor T1, so that the voltage of the first terminal of the first capacitor C1 rises to Vdata+Vth1 gradually. It can be understood that, due to the bootstrap effect, the voltage of the second terminal of the first capacitor C1, i.e., the voltage of node A in Fig.1, would also rise to Vdata+Vth1 gradually, as shown in Fig.2.

[0045] In a third phase t3, the reset signal terminal Reset is input the high level signal, so that the second transistor T2 and the third transistor T3 are turned off. The gate line Scan is input the high level signal, so that the fifth transistor T5 is turned off. The light-emitting signal terminal EM is input the low level signal, so that the fourth transistor T4 is turned on. In the case that the fourth transistor T4 is turned on, the driving current generated ac-

cording to the voltage of the control electrode of the driving transistor M1 and the voltage of the first electrode of the same can be input to the light-emitting device 4 via the fourth transistor T4, to drive the light-emitting device 4 to emit light. Furthermore, the driving current I_{OLED} can be represented as follows:

$$I_{OLED} = \frac{\beta}{2} (V_{gs} - V_{th1})^2$$

$$= \frac{\beta}{2} (V_{data} + V_{th1} - V_{DD} - V_{th2})^2$$

[0046] According to the above equation, it can be known that the driving current is related to the difference value between the threshold voltage Vth1 of the first transistor T1 and the threshold voltage Vth2 of the driving transistor M1, and the difference value of Vth1 and Vth2 can be set less than the preset value. Therefore, in the process of light emitting, the value of the driving current I_{OLED} can be controlled within the preset range. That is, the variation range of light-emitting luminance of the light-emitting device 4 within one period can be controlled within the preset range, so as to be helpful to make luminance of OLED pixel displayed within one frame picture maintain stable.

[0047] From the above, it can be known that in the third phase t3, the first terminal of the first capacitor C1 is in a floating state. In this state, charges stored in the first capacitor C1 would lose easily, which results in change of voltage of the node A.

[0048] Alternatively, as shown in Fig.1, the OLED pixel drive circuit can further comprise a second capacitor C2. A first terminal of the second capacitor C2 is connected to a high voltage terminal VDD, a second terminal thereof is connected to the second terminal of the first capacitor C1. The second capacitor C2 is connected to the second terminal of the first capacitor C1 to be able to prevent the voltage of the node A from changing due to floating of the first terminal of the first capacitor C1, so as to avoid the driving current that drives the light-emitting device 4 to emit light from being instable.

[0049] In the present implementation, alternatively, the voltage of the high voltage terminal VDD can be greater than the voltage Vdata provided by the data line Data. In this case, the driving current I_{OLED} can drive the light-emitting device 4 to emit light. When VDD is less than Vdata, the driving current I_{OLED} cannot drive the light-emitting device 4 to emit light. In general, the range of the voltage Vdata provided by the data line Data is 0.8-1.5V

[0050] Alternatively, the first transistor T1 may have a same size and shape as the driving transistor M1, to ensure that the threshold voltage Vth1 of the first transistor T1 and the threshold voltage Vth2 of the driving transistor M1 are equal. Further, the first transistor T1 and the driving transistor M1 are formed through a same composition

process. Such setting can also reduce the number of the composition processes, decrease the cost, and raise production efficiency.

[0051] It should be noted that in the present implementation, the respective transistors are not limited to the P-type transistor. In actual application, the respective transistors can also be N-type transistors. It can be understood that the timing of respective signals is opposite to the timing of respective signals as shown in Fig.2 when the respective transistors are N-type transistors.

[0052] The OLED pixel drive circuit provided in the implementation of the present disclosure comprises a first transistor T1, and charges the first capacitor C1 via the first transistor T1, so that the voltage of the gate of the driving transistor M1 connected to the first capacitor C1 comprises the threshold voltage V_{th1} . As a result, the driving current generated according to the voltages of the control electrode and first electrode of the driving transistor M1 is related to the difference value between the threshold voltage V_{th1} of the first transistor T1 and the threshold voltage V_{th2} of the driving transistor M1, while the difference value between the threshold voltage V_{th1} of the first transistor T1 and the threshold voltage V_{th2} of the driving transistor M1 is less than the preset value. In this way, the variation of light-emitting luminance of the light-emitting device 4 within one period can be controlled within the preset range, to facilitate making the luminance of OLED pixel displayed within one frame picture maintain stable.

[0053] The present disclosure further provides an implementation of an OLED pixel drive method. The OLED pixel drive method drives a light-emitting device in the OLED pixel to emit light based on the OLED pixel drive circuit provided in the implementation of the present disclosure.

[0054] Fig.3 is a flow diagram of an OLED pixel drive method provided in an implementation of the present disclosure. As shown in Fig.3, the OLED pixel drive method comprises following processes:

[0055] In step S1, the two terminals of the first capacitor are charged to reset the voltage of the two terminals as an initial voltage.

[0056] Herein, the initial voltage falls into a voltage range of turning on the first transistor T1. When the second terminal of the first capacitor has the initial voltage, the first transistor whose control electrode is connected to the second terminal of the first capacitor is turned on.

[0057] Exemplarily, in step S1, when respective transistors are P-type transistors, a reset signal terminal is input a low level signal, a gate line is input a high level signal, and a light-emitting signal terminal is input a high level signal.

[0058] In step S2, a data line charges the first capacitor via the first transistor, such that the voltage of the second terminal of the first capacitor raises to $V_{data} + V_{th1}$, wherein V_{data} is the voltage on the data line, and V_{th1} is the threshold voltage of the first transistor.

[0059] Exemplarily, when the voltage of the second ter-

minal of the first capacitor raises to $V_{data} + V_{th1}$, the voltage of the control electrode of the first transistor connected to the second terminal of the first capacitor is $V_{data} + V_{th1}$.

[0060] In step S2, when the respective transistors are P-type transistors, the reset signal terminal is input the high level signal, the gate line is input the low level signal, and the light-emitting signal terminal is input the high level signal.

[0061] In step S3, a driving current is generated according to voltages of the control electrode and the first electrode of the driving transistor, and the driving transistor is connected to the light-emitting device, so that the driving current is input to the light-emitting device to make the light-emitting device emit light.

[0062] Exemplarily, in step S3, when the respective transistors are P-type transistors, the reset signal terminal is input the high level signal, the gate line is input the high level signal, and the light-emitting signal terminal is input the low level signal.

[0063] In the case that the voltage of the control electrode of the first transistor is $V_{data} + V_{th1}$, the generated driving current I_{OLED} is related to the difference value between the threshold voltage of the first transistor and the threshold voltage of the driving transistor (the specific value of the driving current I_{OLED} has already been described in the implementation of the OLED pixel drive circuit, and thus no further description is given herein). By making the difference value between the two threshold voltages less than the preset value, the variation range of light-emitting luminance of the light-emitting device would be controlled within the preset range, so that it is helpful to make luminance of the OLED pixel displayed within one frame picture maintain stable.

[0064] Alternatively, in step S2, the range of the voltage on the data line would be 0.8-1.5V.

[0065] The OLED pixel drive method provided in the implementation of the present disclosure charges the first capacitor via the first transistor, so that the voltage of the second terminal of the first capacitor raises to $V_{data} + V_{th1}$. When the driving current is generated, the driving current is related to the difference value between the threshold voltage of the first transistor and the threshold voltage V_{th} of the driving transistor. Furthermore, by making the difference value between the threshold voltage of the first transistor and the threshold voltage of the driving transistor less than the preset value, the variation amplitude of light-emitting luminance of the light-emitting device would be controlled within the preset range, so that it is helpful to make luminance of the OLED pixel displayed within one frame picture maintain stable.

[0066] The present disclosure further provides an implementation of an OLED display device. In the present implementation, the OLED display device comprises the OLED pixel drive circuit provided in the implementation of the present disclosure.

[0067] The OLED display device provided in the implementation of the present disclosure adopts the OLED

pixel drive circuit provided in the implementation of the present disclosure to be able to control the light-emitting luminance of the light-emitting device within the preset range, which is helpful to make the luminance of the OLED pixel displayed within one frame picture maintain stable, so that the display effect can be raised.

[0068] It can be understood that the above implementation is just an exemplary implementation used to describe the principle of the present disclosure. However, the present disclosure is not limited thereto. For those ordinary skilled in the art, various modifications and improvements can be made, without departing from the spirit and substance of the present disclosure. These modifications and improvements are deemed as falling into the protection scope of the present disclosure. The protection scope of the present disclosure is defined by the Claims.

[0069] The present application claims the priority of a Chinese patent application No. 201510138231.3 filed on March 26, 2015. Herein, the content disclosed by the Chinese patent application is incorporated in full by reference as a part of the present disclosure.

Claims

1. An OLED pixel drive circuit for driving a light-emitting device in an OLED pixel to emit light, wherein the OLED pixel drive circuit comprises a reset module, a first capacitor, a first transistor, a charging control module, a driving transistor and a light-emitting control module;
the reset module is connected to two terminals of the first capacitor and configured to charge the two terminals of the first capacitor, so that the two terminals of the first capacitor have an initial voltage;
a first electrode of the first transistor is connected to the charging control module, a second electrode thereof is connected to a first terminal of the first capacitor, and a control electrode is connected to a second terminal of the first capacitor;
the charging control module is connected to the first transistor and a data line and configured to control the first transistor to be connected with or disconnected from the data line;
a control electrode of the driving transistor is connected to the second terminal of the first capacitor, a first electrode thereof is connected to a high voltage terminal, and a second electrode thereof is connected to the light-emitting control module; and
the light-emitting control module is connected to the light-emitting device and configured to control the driving transistor to be connected with or disconnected from the light-emitting device,
wherein a difference value between a threshold voltage of the first transistor and a threshold voltage of the driving transistor is less than a preset value.

2. The OLED pixel drive circuit according to claim 1, wherein the reset module comprises a second transistor and a third transistor;
a control electrode of the second transistor is connected to a reset signal terminal, a first electrode thereof is connected to an input voltage terminal, and a second electrode thereof is connected to the second terminal of the first capacitor; and
a control electrode of the third transistor is connected to the reset signal terminal, a first electrode thereof is connected to an input voltage terminal, and a second electrode thereof is connected to the first terminal of the first capacitor.
3. The OLED pixel drive circuit according to claim 2, wherein the charging control module comprises a fifth transistor;
a control electrode of the fifth transistor is connected to a gate line, a first electrode thereof is connected to a data line, and a second electrode thereof is connected to the first electrode of the first transistor.
4. The OLED pixel drive circuit according to claim 3, wherein the light-emitting control module comprises a fourth transistor;
a control electrode of the fourth transistor is connected to a light-emitting signal terminal, a first electrode thereof is connected to a second electrode of the driving transistor, and a second electrode thereof is connected to the light-emitting device.
5. The OLED pixel drive circuit according to any one of claims 1-4, wherein the OLED pixel drive circuit further comprises a second capacitor, whose first terminal is connected to the high voltage terminal, and second terminal is connected to the second terminal of the first capacitor.
6. The OLED pixel drive circuit according to any one of claims 1-4, wherein a voltage of the high voltage terminal is greater than a voltage supplied by the data line.
7. The OLED pixel drive circuit according to claim 3, wherein the first transistor has a same size and shape as the driving transistor.
8. The OLED pixel drive circuit according to any one of claims 1-7, wherein the first transistor and the driving transistor are formed through a same composition process.
9. The OLED pixel drive circuit according to claim 4, wherein respective transistors are P-type transistors.
10. The OLED pixel drive circuit according to claim 1, wherein the preset value is 20mV.

11. The OLED pixel drive circuit according to any one of claims 1 to 10, wherein the threshold voltage of the first transistor is the same as the threshold voltage of the driving transistor. 5
12. An OLED pixel drive method that drives a light-emitting device in an OLED pixel to emit light through an OLED pixel drive circuit, the OLED pixel drive circuit comprising a reset module, a first capacitor, a first transistor, a charging control module, a driving transistor and a light-emitting control module; the OLED pixel drive method comprises following steps: 10
- S1, charging two terminals of the first capacitor by the reset module to reset a voltage of the two terminals as an initial voltage; 15
- S2, charging the first capacitor via the first transistor by a data line, under the control of the charging control module, to make a voltage of the second terminal of the first capacitor rise to $V_{data} + V_{th1}$; the V_{data} being a voltage on the data line, and V_{th1} being a threshold voltage of the first transistor; and 20
- S3, generating a driving current according to voltages of a control electrode and a first electrode of the driving transistor, under the control of the light-emitting control module, and making the driving transistor connected to the light-emitting device, so that the driving current is input to the light-emitting device to make the light-emitting device emit light. 25 30
13. The OLED pixel drive method according to claim 12, wherein in step S2, a range of the voltage on the data line is 0.8-1.5V 35
14. The OLED pixel drive method according to claim 12, wherein respective transistors in the OLED pixel drive circuit are P-type transistors; 40
- in step S1, inputting a low level signal to a reset signal terminal, inputting a high level signal to a gate line, and inputting a high level signal to a light-emitting signal terminal; 45
- in step S2, inputting the high level signal to the reset signal terminal, inputting the low level signal to the gate line, and inputting the high level signal the light-emitting signal terminal; and 50
- in step S3, inputting the high level signal to the reset signal terminal, inputting the high level signal to the gate line, and inputting the low level signal to the light-emitting signal terminal. 55
15. An OLED display apparatus, comprising the OLED pixel drive circuit according to any one of claims 1-11.

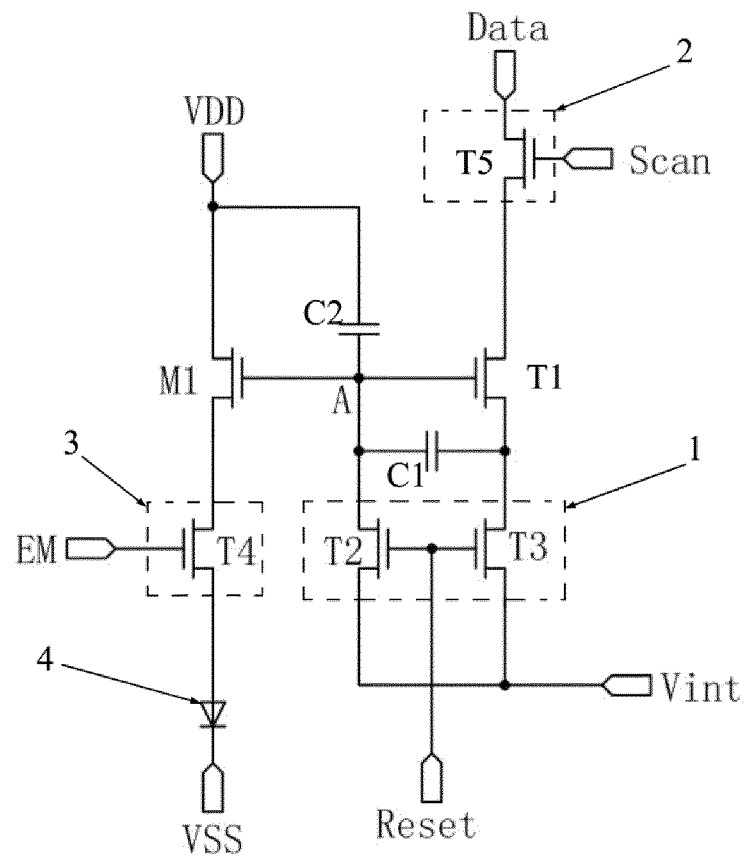


Fig.1

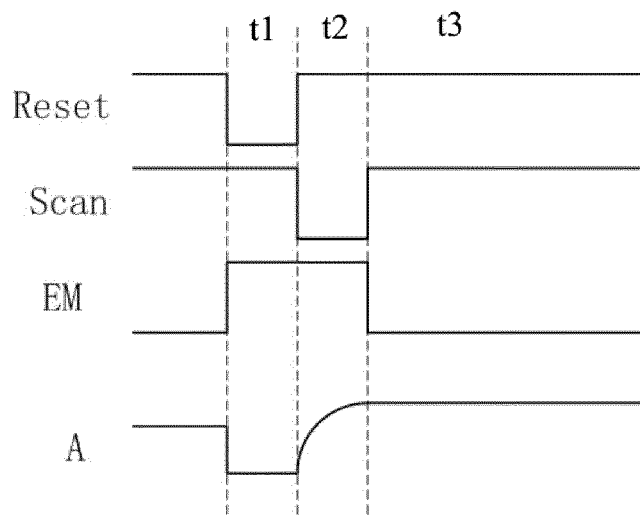


Fig.2

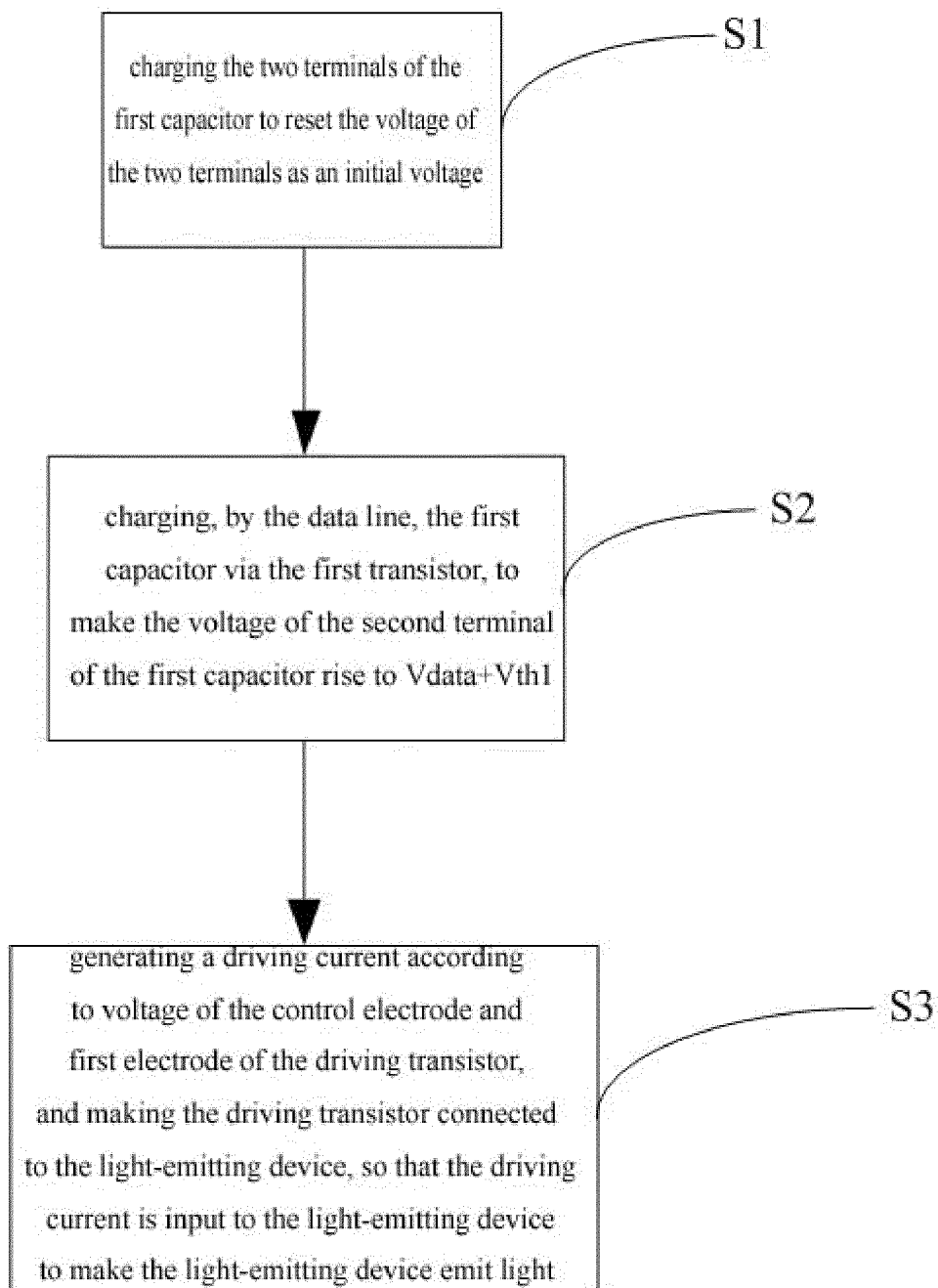


Fig.3

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2015/088414

A. CLASSIFICATION OF SUBJECT MATTER

G09G 3/32 (2006.01) i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

G09G 3

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNABS, CNTXT, VEN: light emitting diode, OLED, TFT, luminescence, data, pixel, drive, display, connect, terminal, capacitor, charge, light, control, transistor, reset, threshold, voltage

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 104680981 A (BOE TECHNOLOGY GROUP CO., LTD.), 03 June 2015 (03.06.2015), description, paragraphs [0036]-[0078], and figures 1-3	1-15
A	CN 104409050 A (BOE TECHNOLOGY GROUP CO., LTD.), 11 March 2015 (11.03.2015), description, paragraphs [0040]-[0070], and figures 1-3	1-15
A	CN 103236238 A (BEIJING BOE OPTOELECTRONICS TECHNOLOGY CO., LTD.), 07 August 2013 (07.08.2013), the whole document	1-15
A	CN 104050923 A (AU OPTRONICS CORP.), 17 September 2014 (17.09.2014), the whole document	1-15
A	KR 100624137 B1 (SAMSUNG SDI CO., LTD.), 13 September 2006 (13.09.2006), the whole document	1-15

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:

“A” document defining the general state of the art which is not considered to be of particular relevance

“E” earlier application or patent but published on or after the international filing date

“L” document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

“O” document referring to an oral disclosure, use, exhibition or other means

“P” document published prior to the international filing date but later than the priority date claimed

“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

“X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

“&” document member of the same patent family

Date of the actual completion of the international search

21 December 2015 (21.12.2015)

Date of mailing of the international search report

31 December 2015 (31.12.2015)

Name and mailing address of the ISA/CN:
State Intellectual Property Office of the P. R. China
No. 6, Xitucheng Road, Jimenqiao
Haidian District, Beijing 100088, China
Facsimile No.: (86-10) 62019451

Authorized officer

LIU, Shikui

Telephone No.: (86-10) 62085842

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2015/088414

5	Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
	CN 104680981 A	03 June 2015	None	
	CN 104409050 A	11 March 2015	None	
10	CN 103236238 A	07 August 2013	WO 2014173021 A1	30 October 2014
			CN 103236238 B	22 July 2015
	CN 104050923 A	17 September 2014	US 2015287364 A1	08 October 2015
	KR 100624137 B1	13 September 2006	US 7978156 B2	12 July 2011
15			US 2007040772 A1	22 February 2007
20				
25				
30				
35				
40				
45				
50				
55				

Form PCT/ISA/210 (patent family annex) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- CN 201510138231 [0069]

专利名称(译)	OLED像素驱动电路和驱动方法，以及OLED显示装置		
公开(公告)号	EP3276601A1	公开(公告)日	2018-01-31
申请号	EP2015886030	申请日	2015-08-28
[标]申请(专利权)人(译)	京东方科技集团股份有限公司		
申请(专利权)人(译)	京东方科技集团股份有限公司.		
当前申请(专利权)人(译)	京东方科技集团股份有限公司.		
[标]发明人	SUN TUO MA ZHANJIE		
发明人	SUN, TUO MA, ZHANJIE		
IPC分类号	G09G3/32 G09G3/3225		
CPC分类号	G09G3/32 G09G2300/0814 G09G2300/0819 G09G2320/0233 G09G2320/045		
优先权	201510138231.3 2015-03-26 CN		
其他公开文献	EP3276601A4		
外部链接	Espacenet		

摘要(译)

提供OLED像素驱动电路，驱动方法和OLED显示装置。OLED像素驱动电路包括复位模块（1），第一电容（C1），第一晶体管（T1），充电控制模块（2），驱动晶体管（M1）和发光控制模块（3）；复位模块（1）连接第一电容（C1）的两端，用于使第一电容（C1）的两端具有初始电压；第一晶体管（T1）的第一电极连接到充电控制模块（2），其第二电极连接到第一电容器（C1）的第一端，其控制电极连接到第二端；充电控制模块（2）连接第一晶体管（T1）和数据线（Data）；驱动晶体管（M1）的控制电极连接到第一电容器（C1）的第二端，其第一电极连接到高压端（VDD），并且其第二电极连接到光-发射控制模块（3）；发光控制模块（3）连接到发光装置（4），其中第一晶体管（T1）的阈值电压与驱动晶体管（M1）的阈值电压之差小于预设值。OLED像素驱动电路可以将OLED像素的亮度保持在一帧图像内稳定。

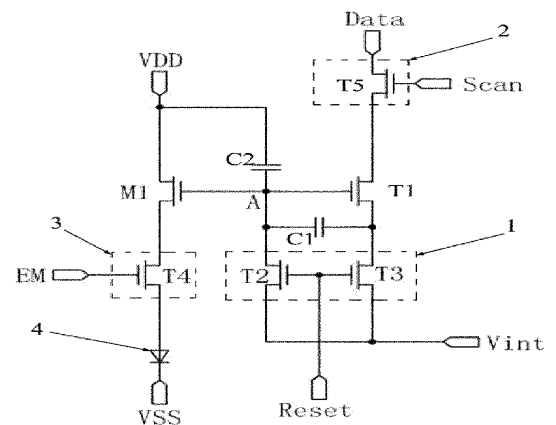


Fig.1