



US007935959B2

(12) **United States Patent**
Tang et al.

(10) **Patent No.:** **US 7,935,959 B2**
(45) **Date of Patent:** **May 3, 2011**

(54) **ACTIVE MATRIX ORGANIC
ELECTRO-LUMINESCENCE DISPLAY
PANEL**

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(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 1192 days.

(21) Appl. No.: **11/563,524**

(22) Filed: **Nov. 27, 2006**

(65) **Prior Publication Data**

US 2008/0030451 A1 Feb. 7, 2008

(30) **Foreign Application Priority Data**

Aug. 4, 2006 (TW) 95128590 A

(51) **Int. Cl.**

H01L 51/50 (2006.01)

H01L 51/52 (2006.01)

(52) **U.S. Cl.** **257/40; 257/59; 257/72; 257/88;**
257/E51.003; 257/E51.018; 257/E51.006;
438/34; 438/73; 438/82; 438/99

(58) **Field of Classification Search** 257/40,
257/59, 72, 88, E25.008, E25.01, E25.012,
257/E25.014, E25.016, E25.019, E25.02,
257/E51.003, E51.006, E51.018; 438/34,
438/73, 82, 99

See application file for complete search history.

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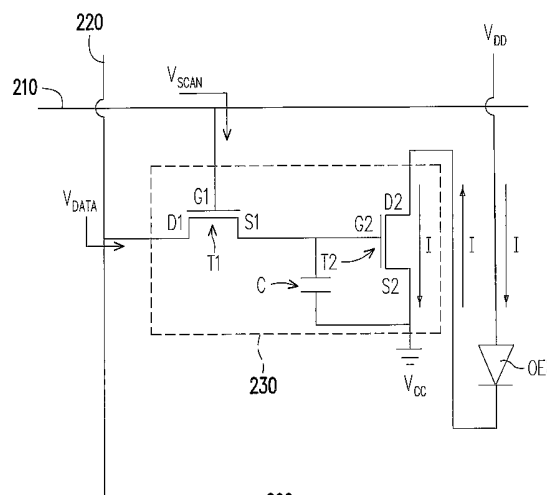
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(57) **ABSTRACT**

An active matrix organic electro-luminescence display panel including a substrate, an organic electro-luminescence device array, and a driving circuit array is provided. The organic electro-luminescence device array includes numerous organic electro-luminescence devices which are arranged in array one the substrate, and the driving circuit array includes numerous driving circuits arranged in array on the substrate. The driving circuit is suitable for driving the corresponding organic electro-luminescence device through a high voltage source and a low voltage source. Additionally, the driving circuit includes a scan line, a data line, and a control unit. The control unit is electrically coupled with the scan line, the data line, and the low voltage source. The organic electro-luminescence device is electrically coupled between the control unit and the high voltage source. Further, the corresponding organic electro-luminescence device is electrically coupled between the control unit and the high voltage source.

17 Claims, 28 Drawing Sheets



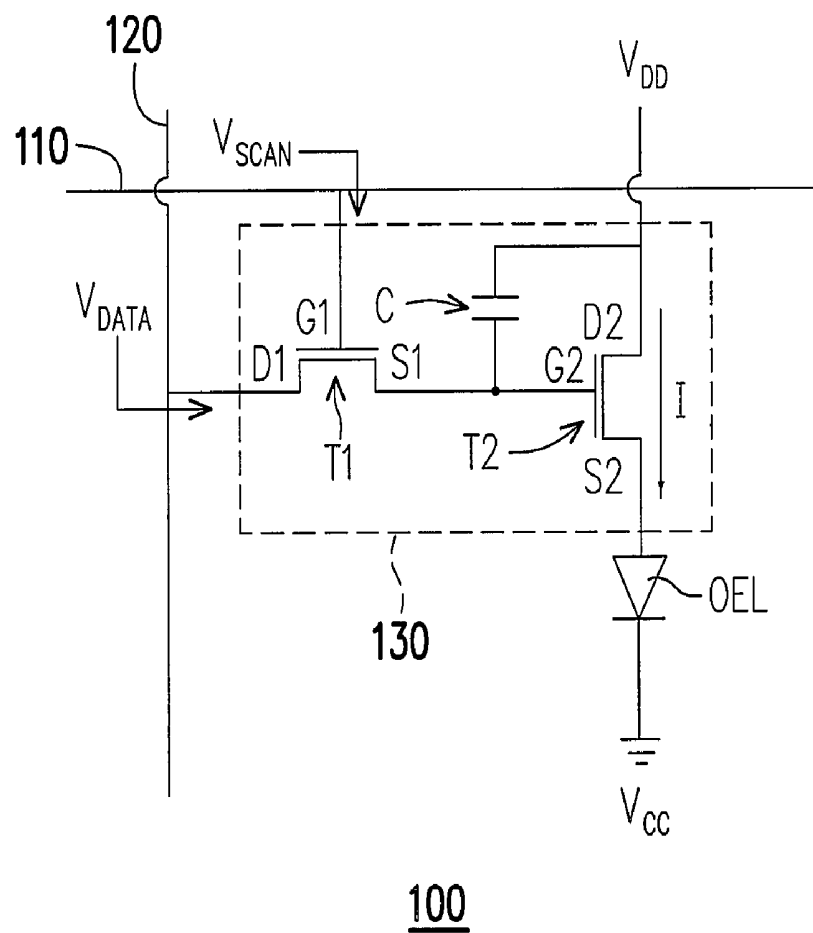


FIG. 1 (PRIOR ART)

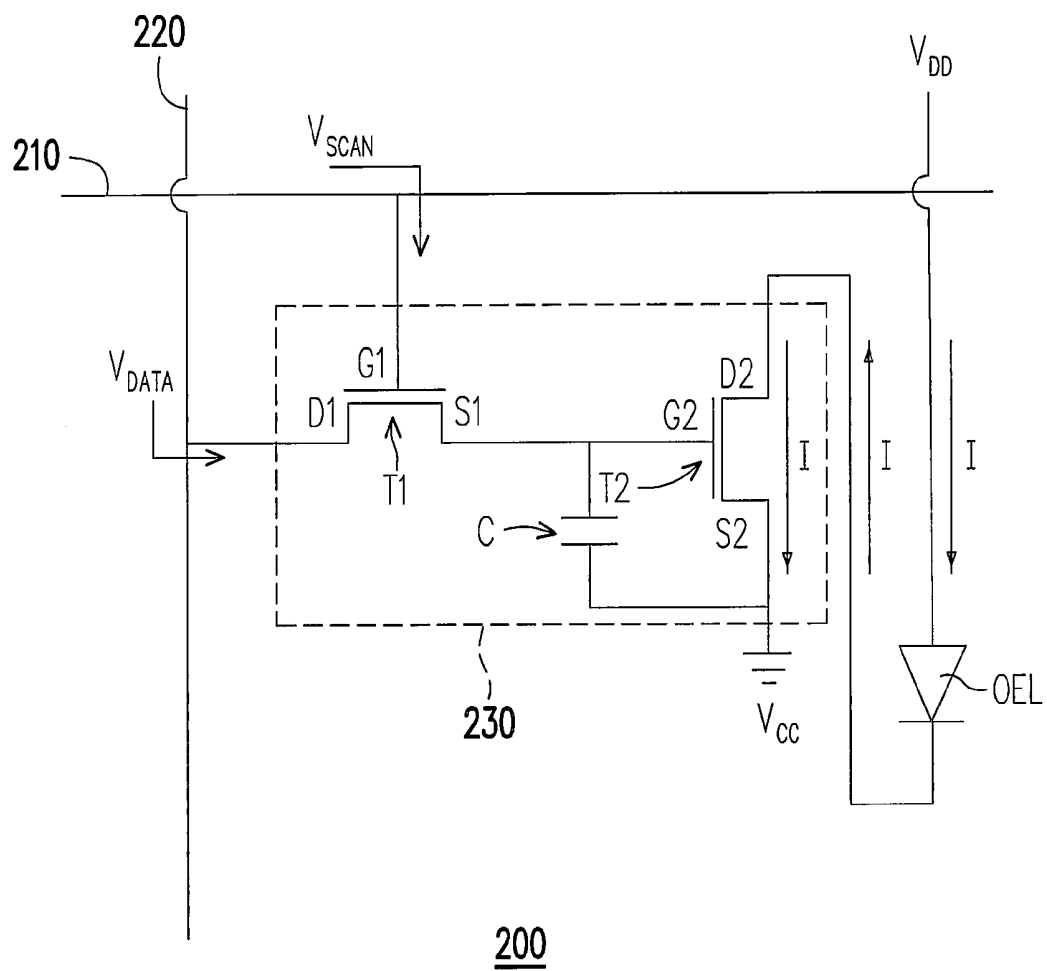


FIG. 2

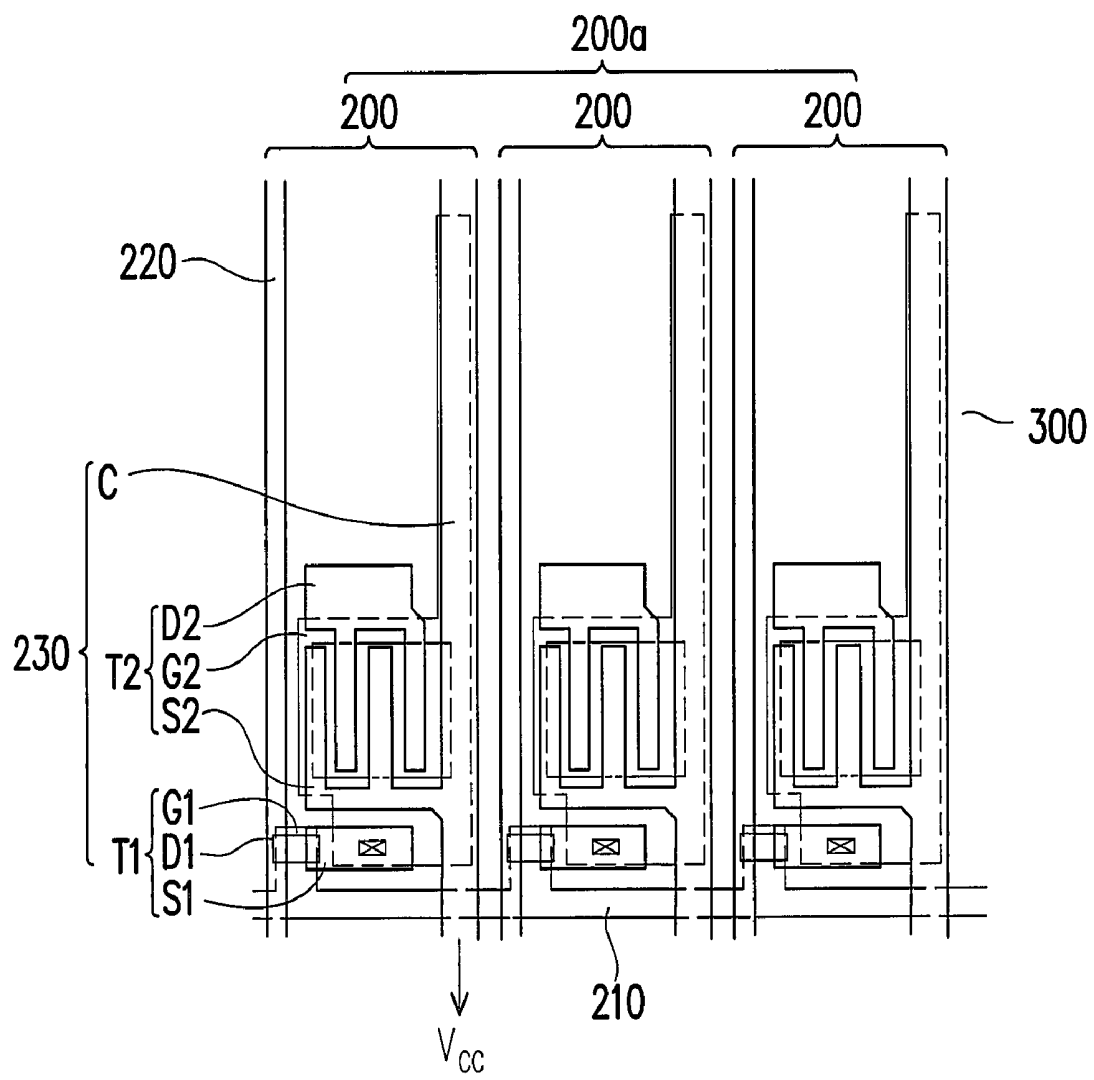


FIG. 3A

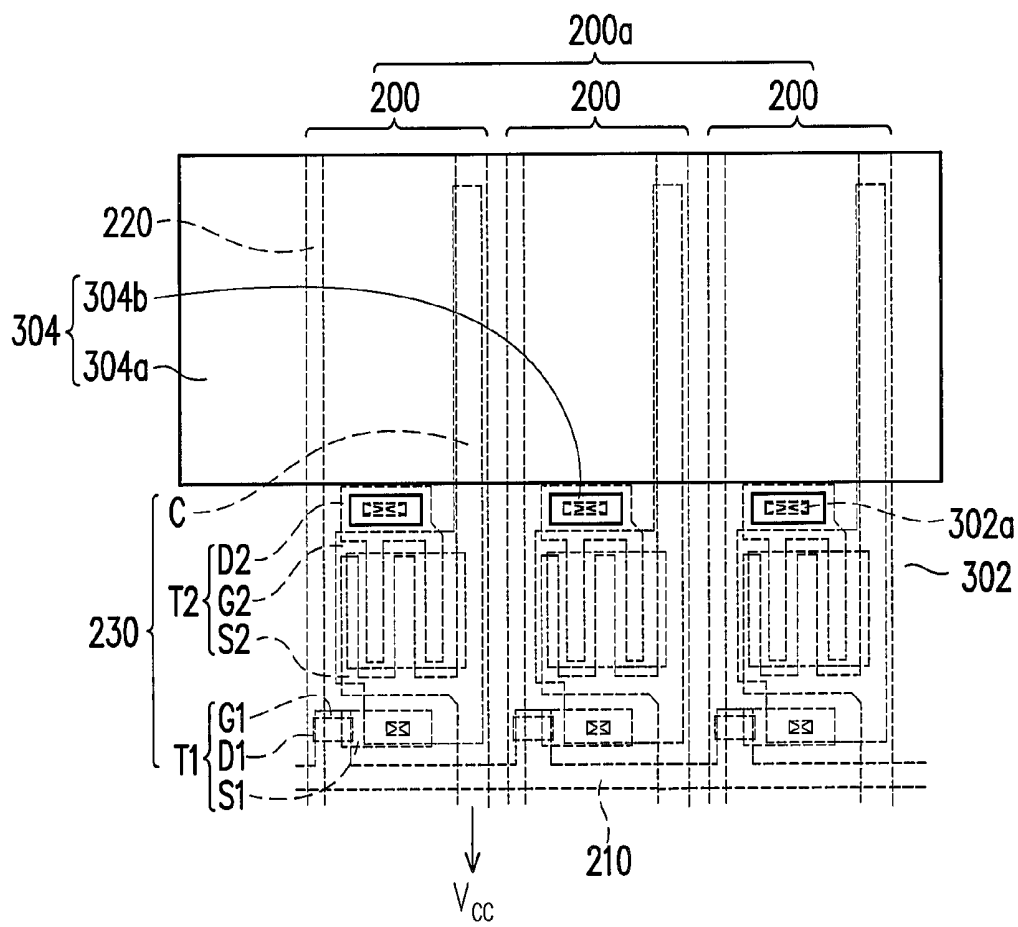


FIG. 3B

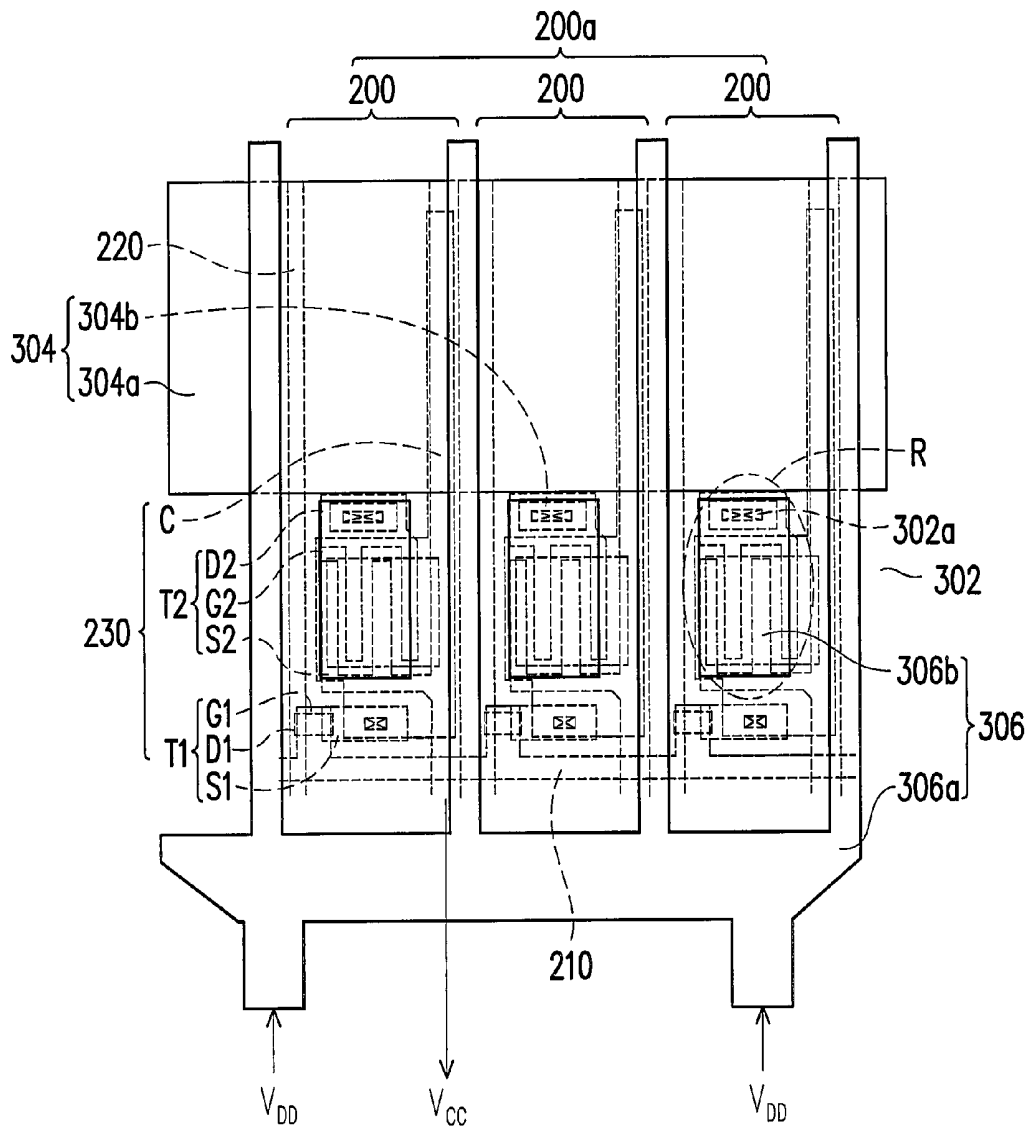


FIG. 3C

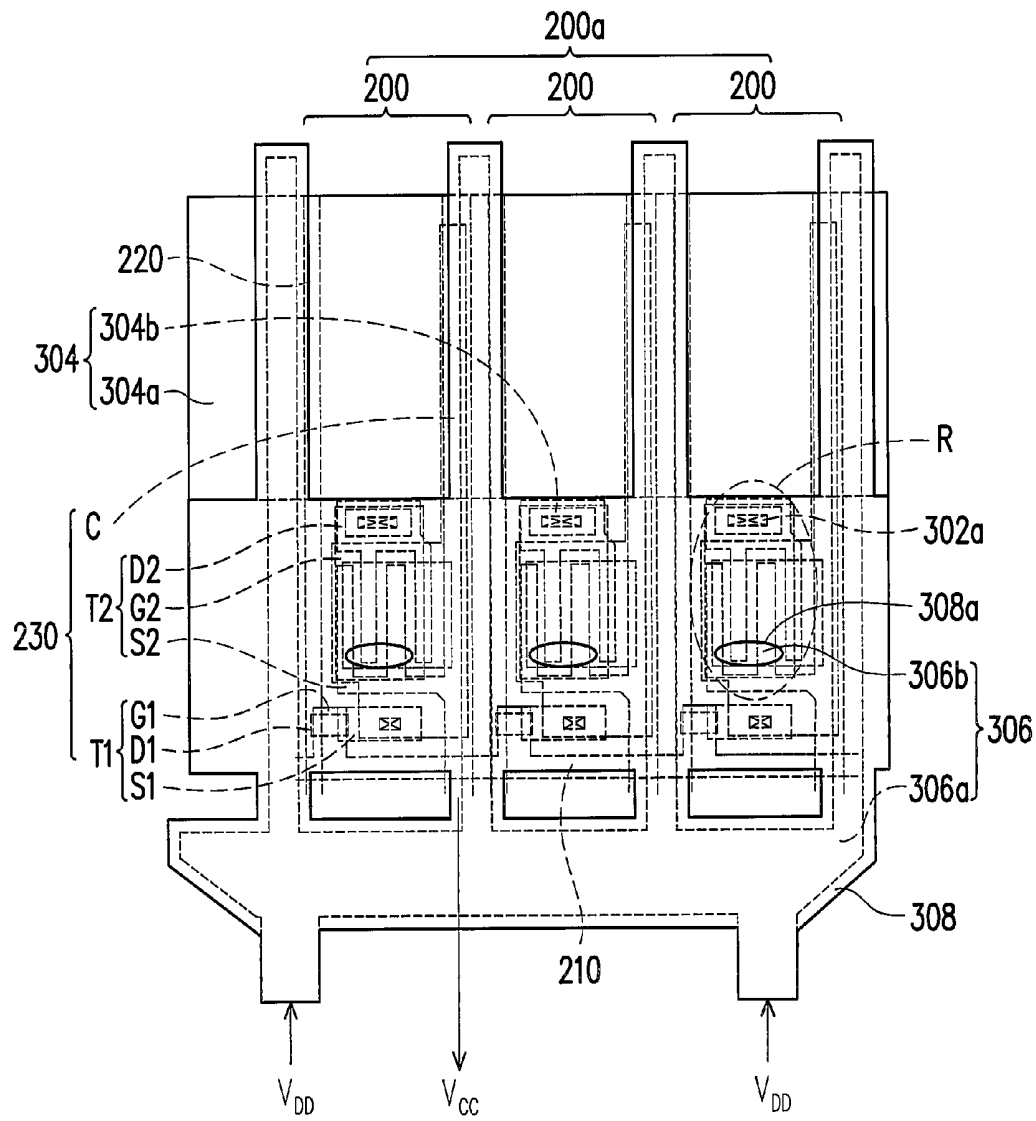


FIG. 3D

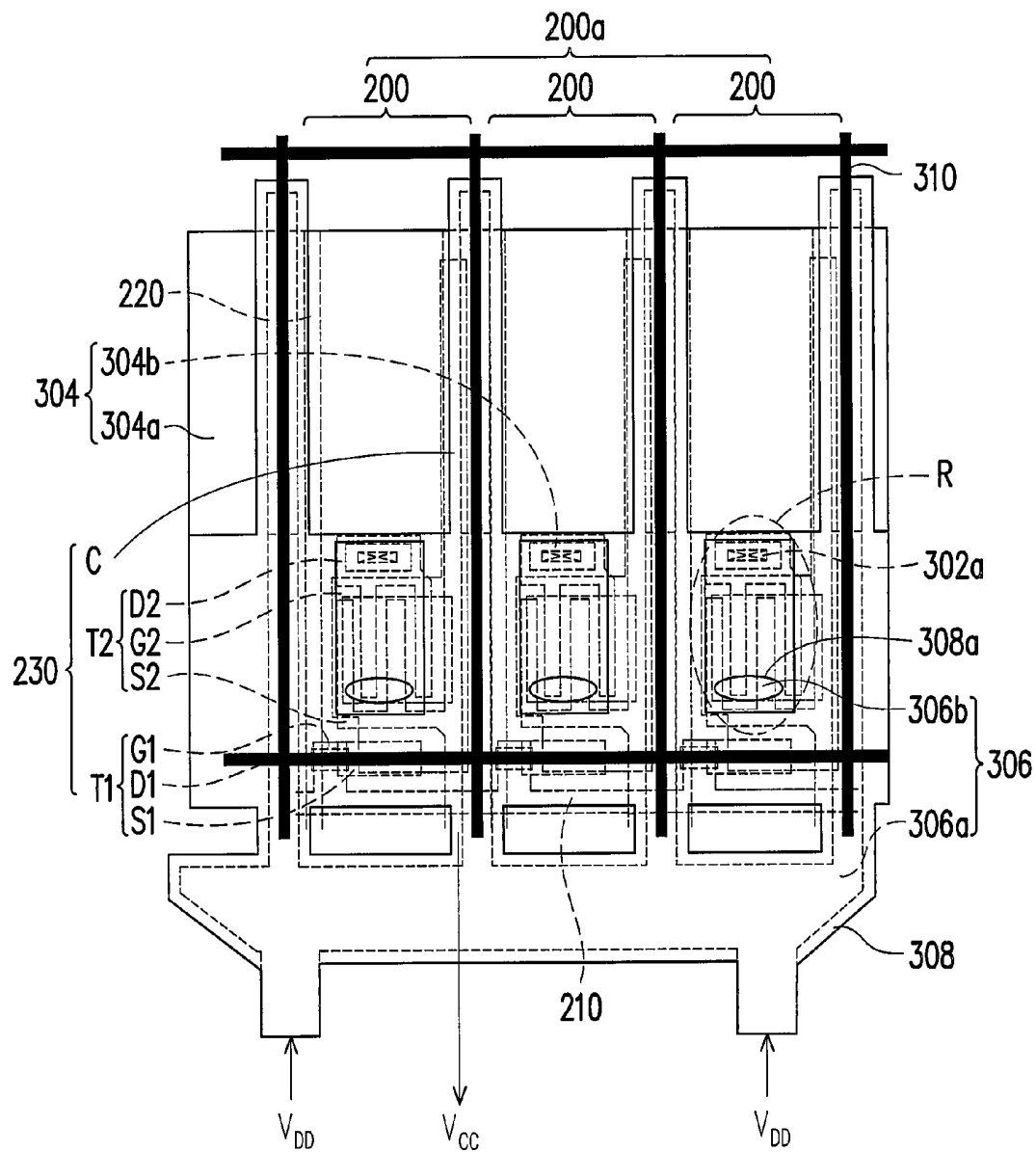


FIG. 3E

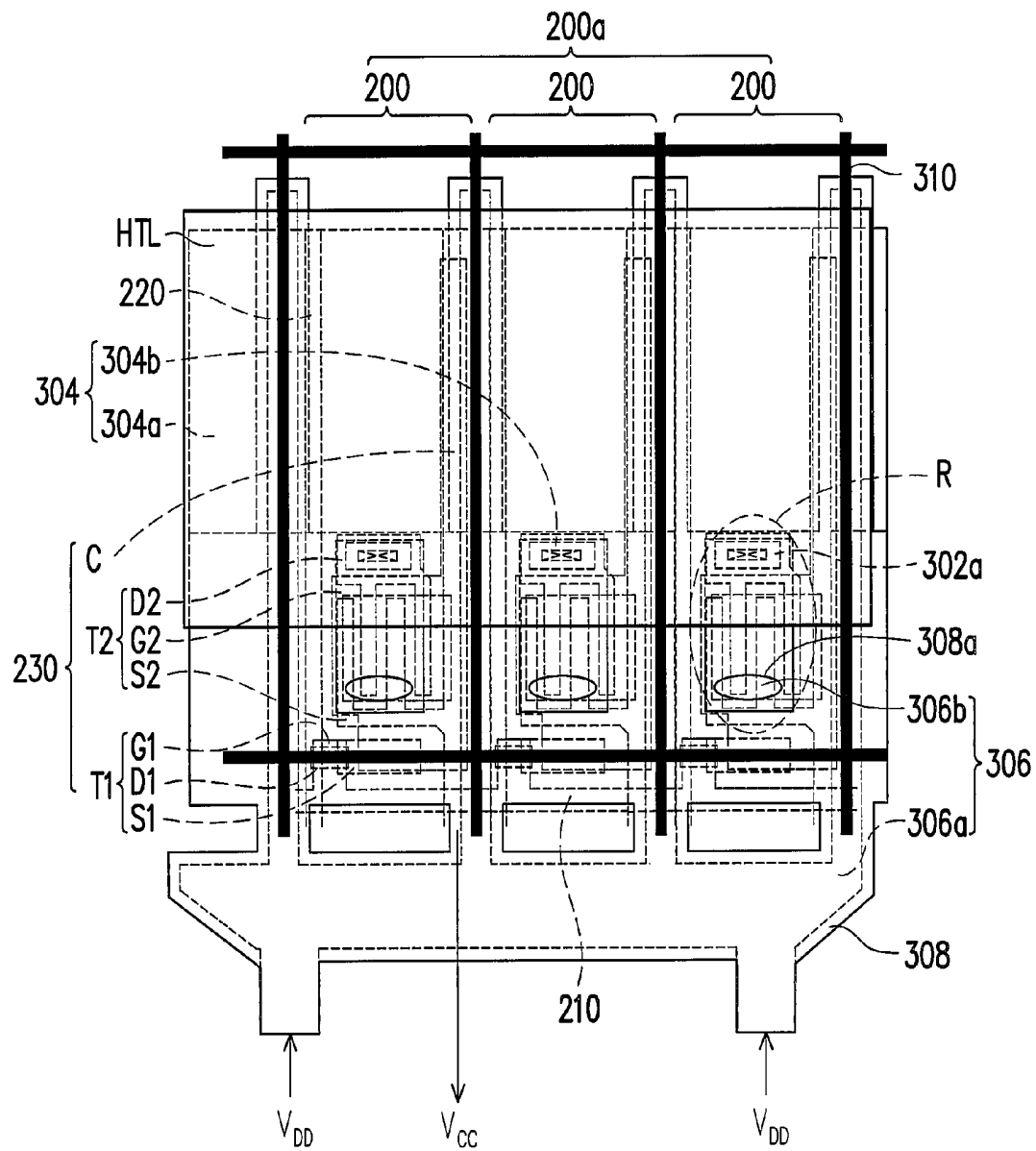


FIG. 3F

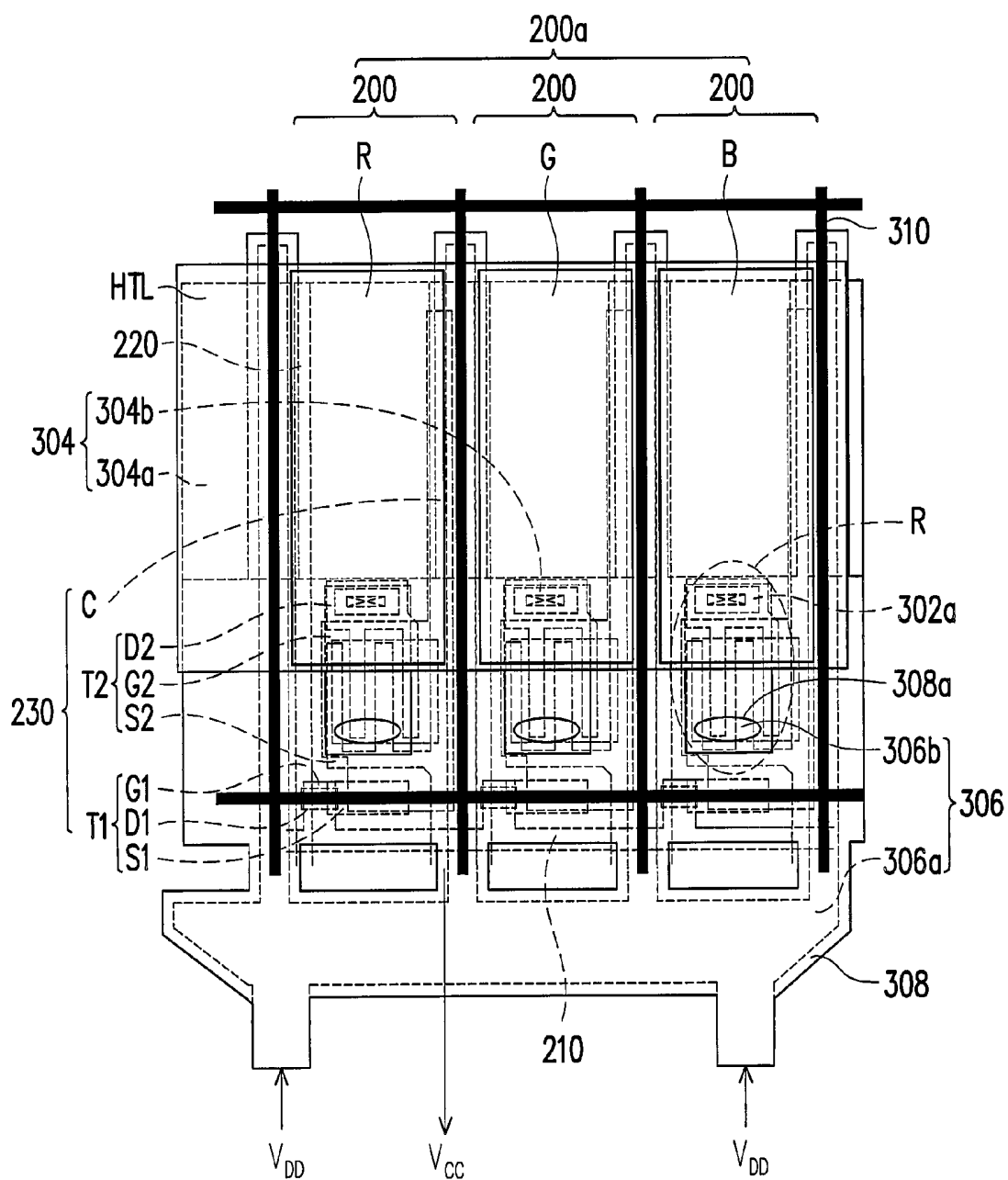


FIG. 3G

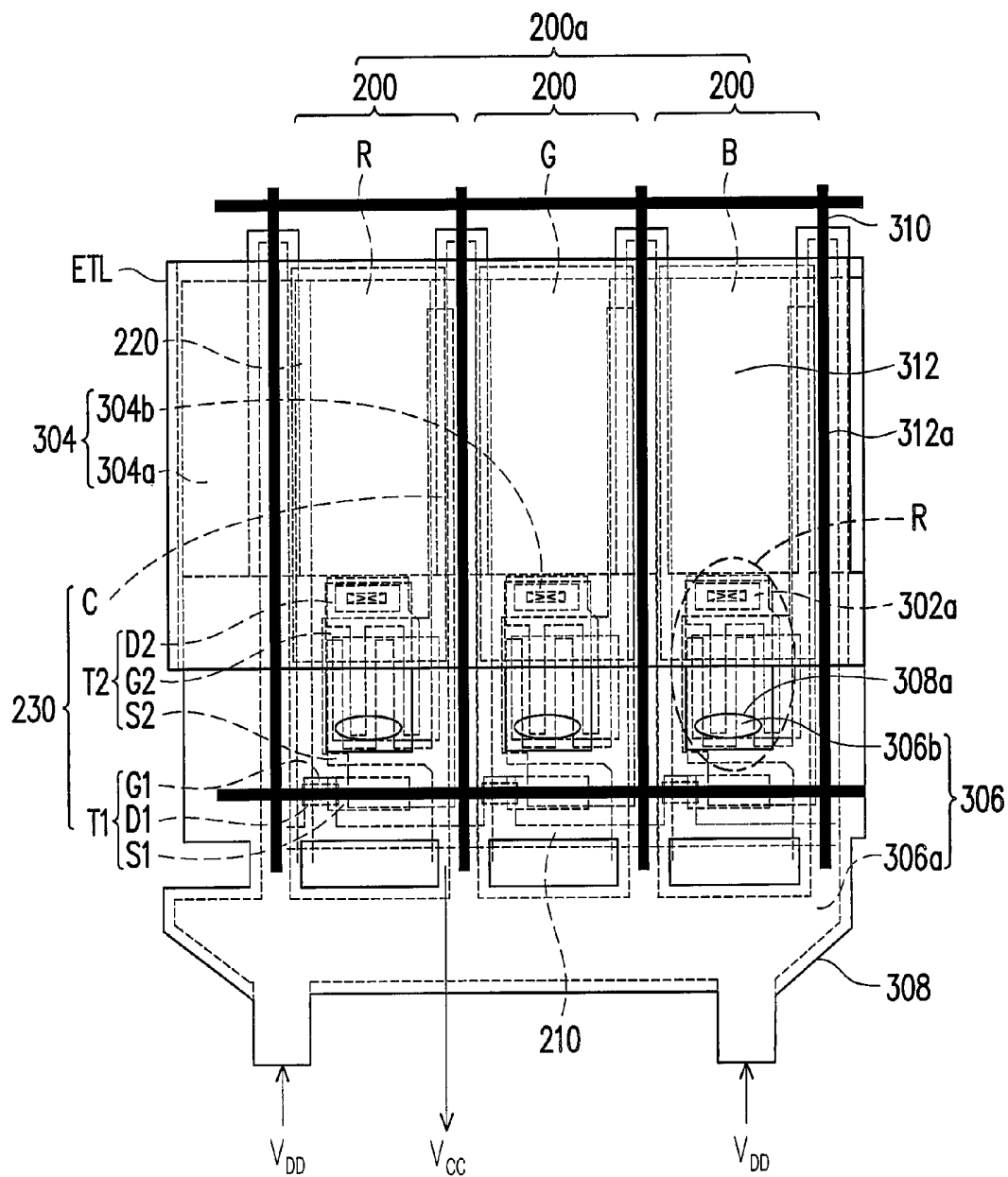


FIG. 3H

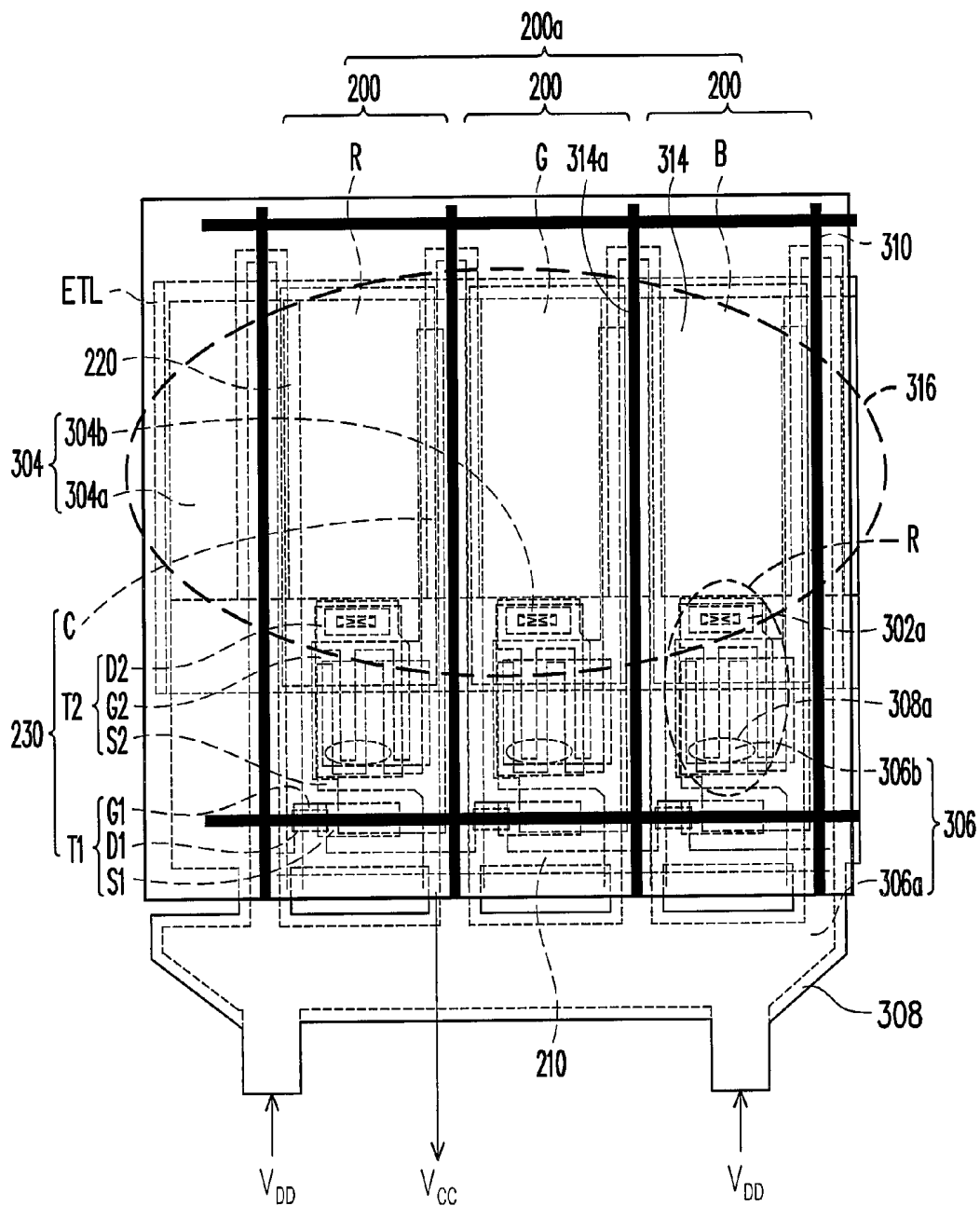


FIG. 31

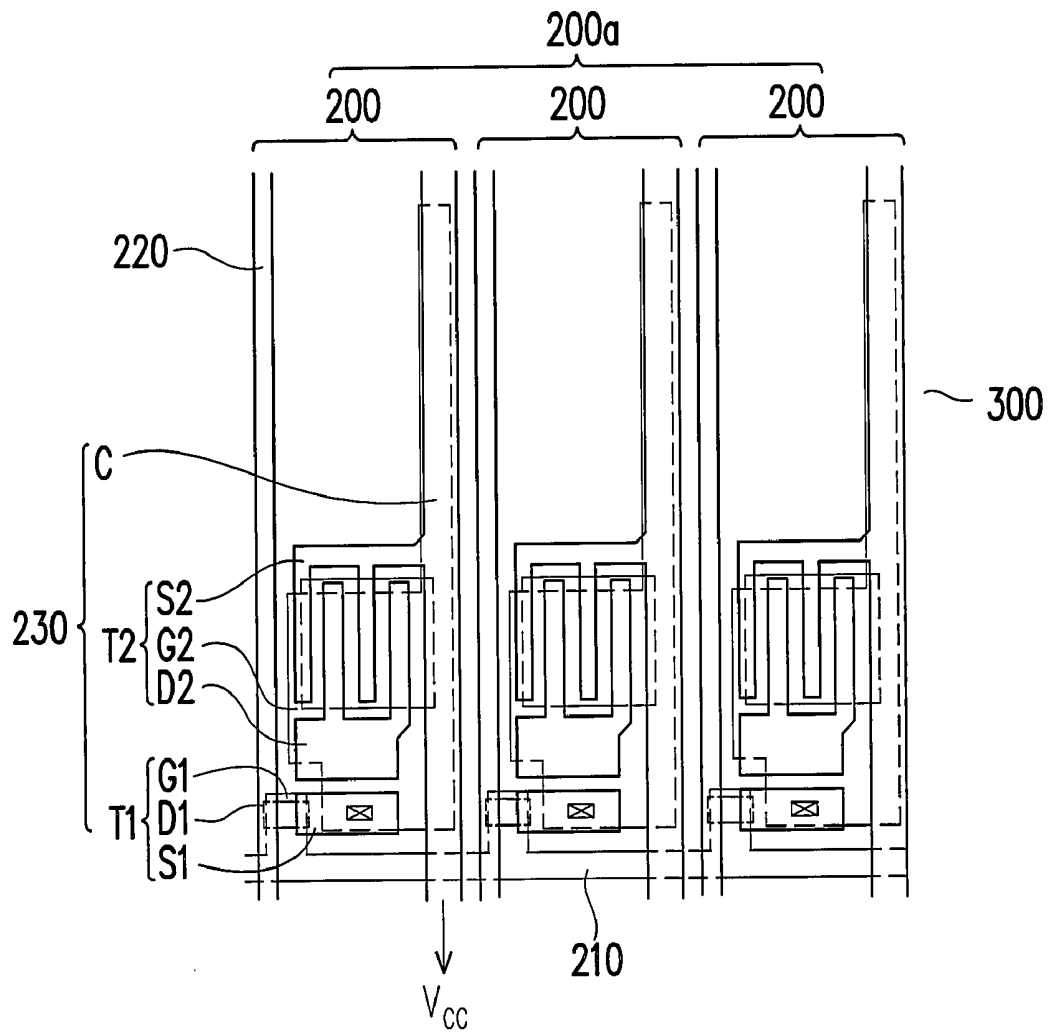


FIG. 4A

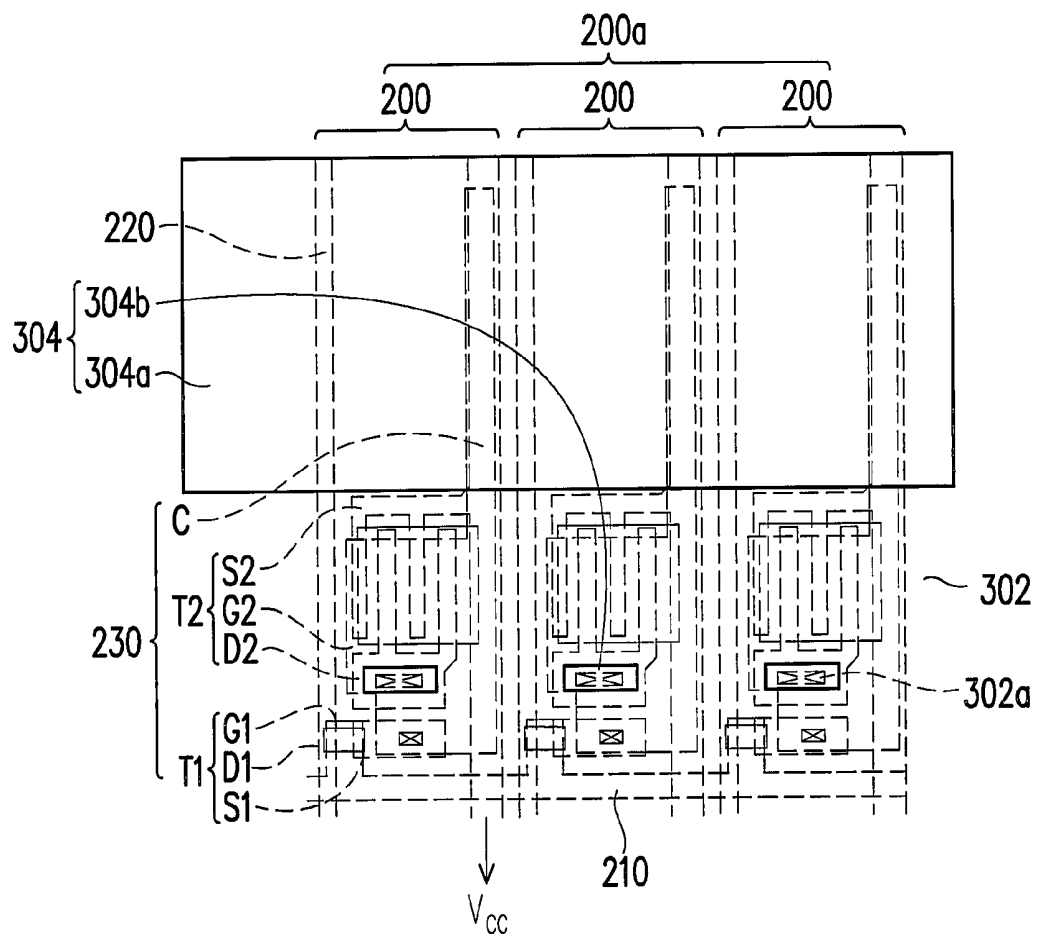


FIG. 4B

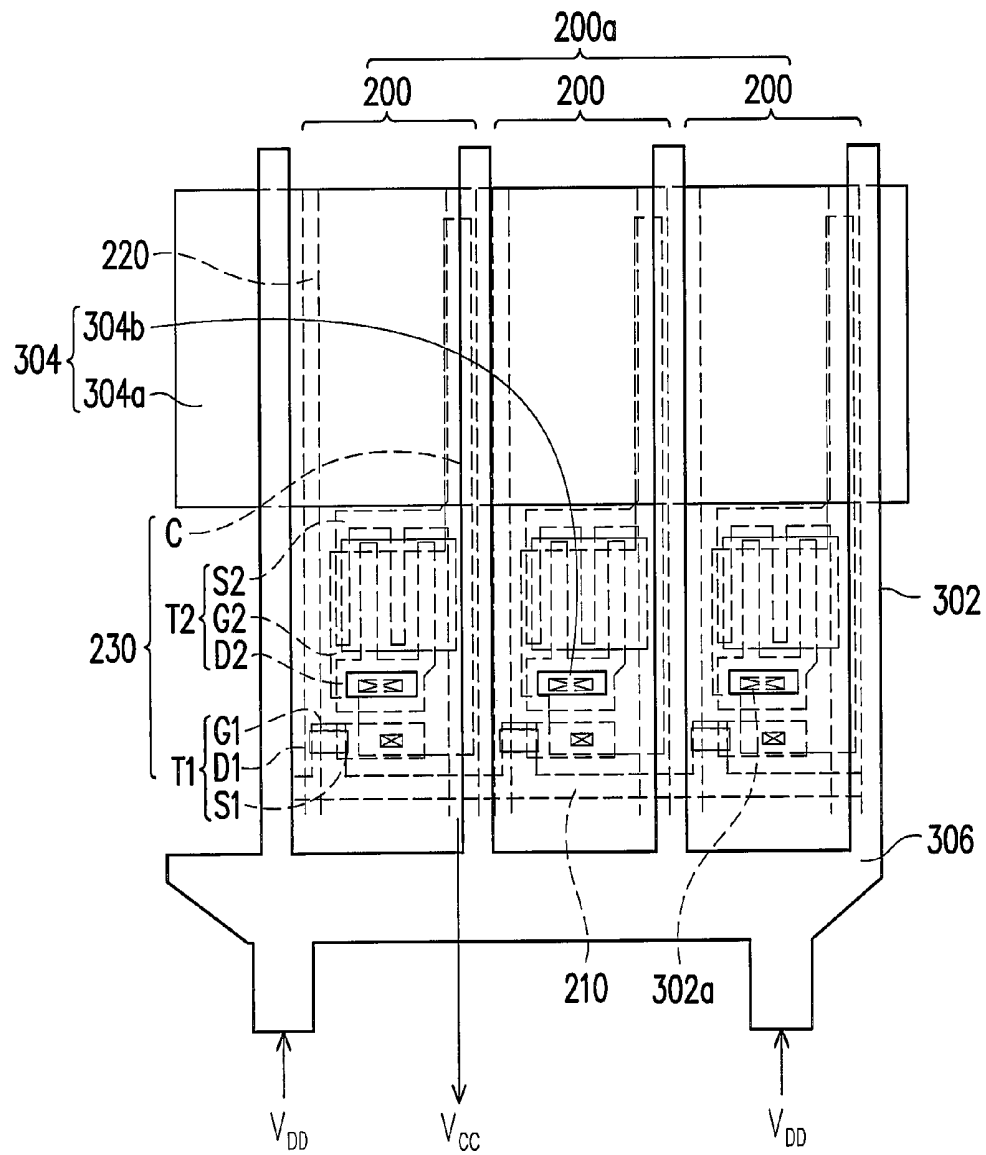


FIG. 4C

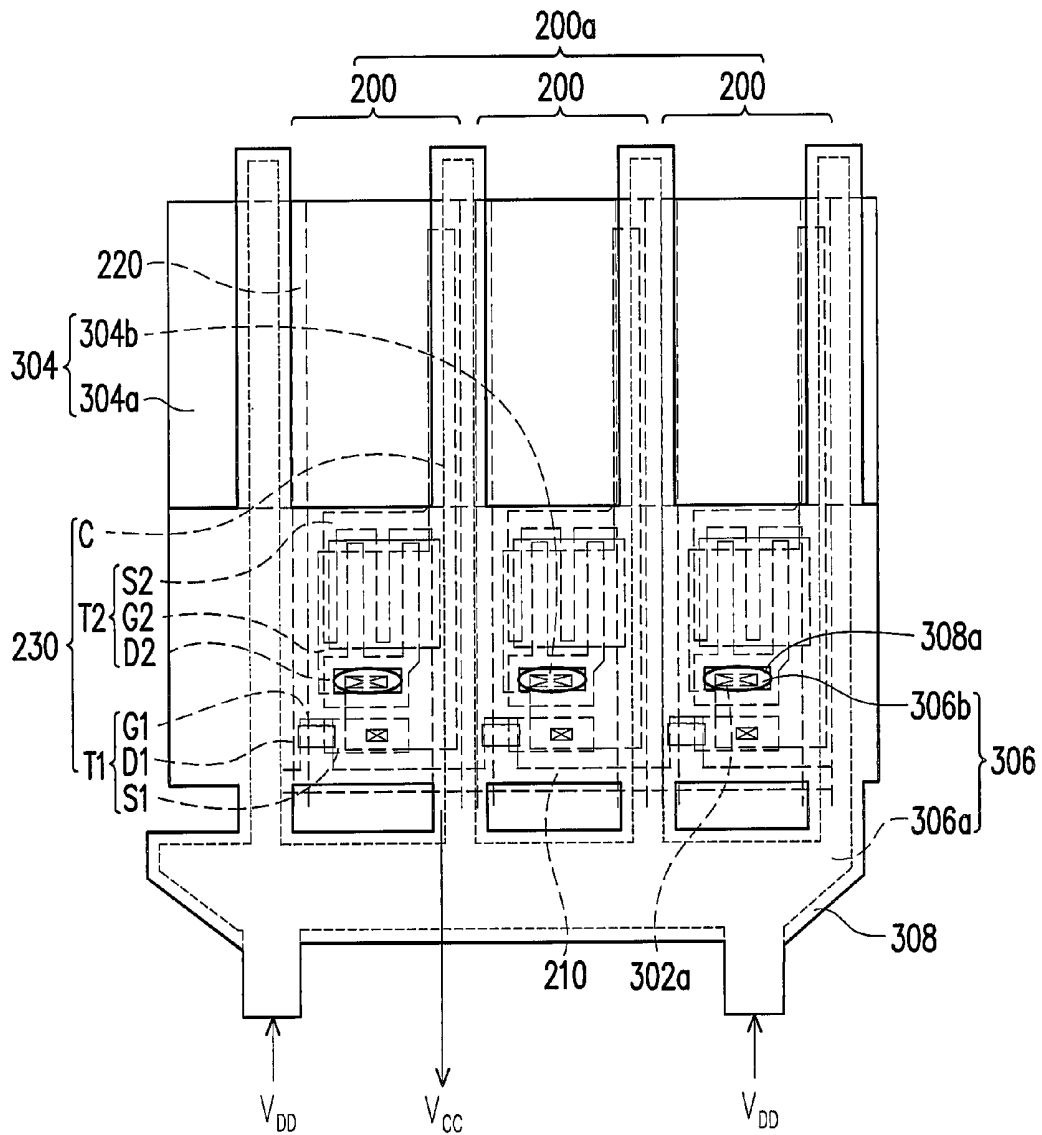


FIG. 4D

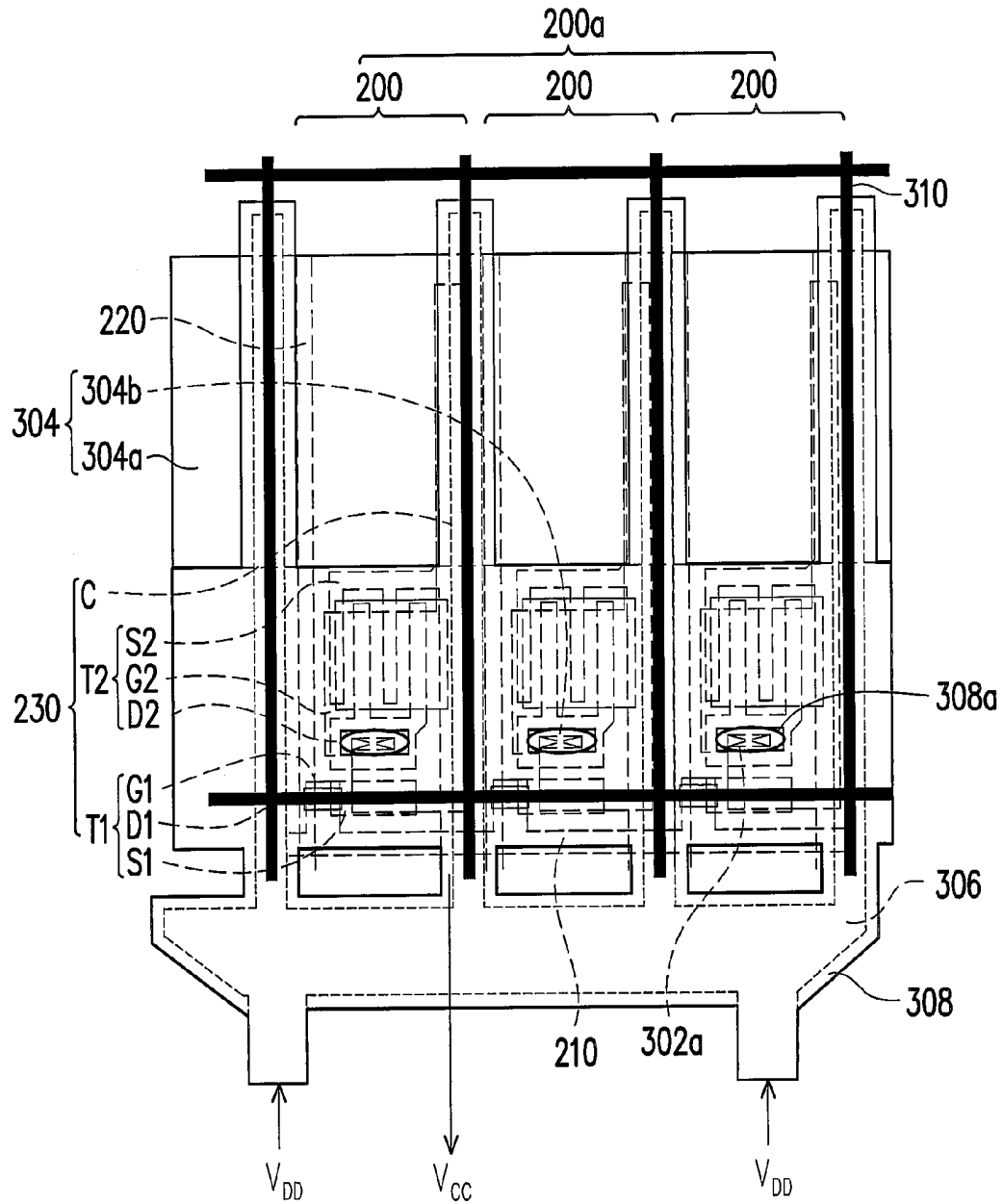


FIG. 4E

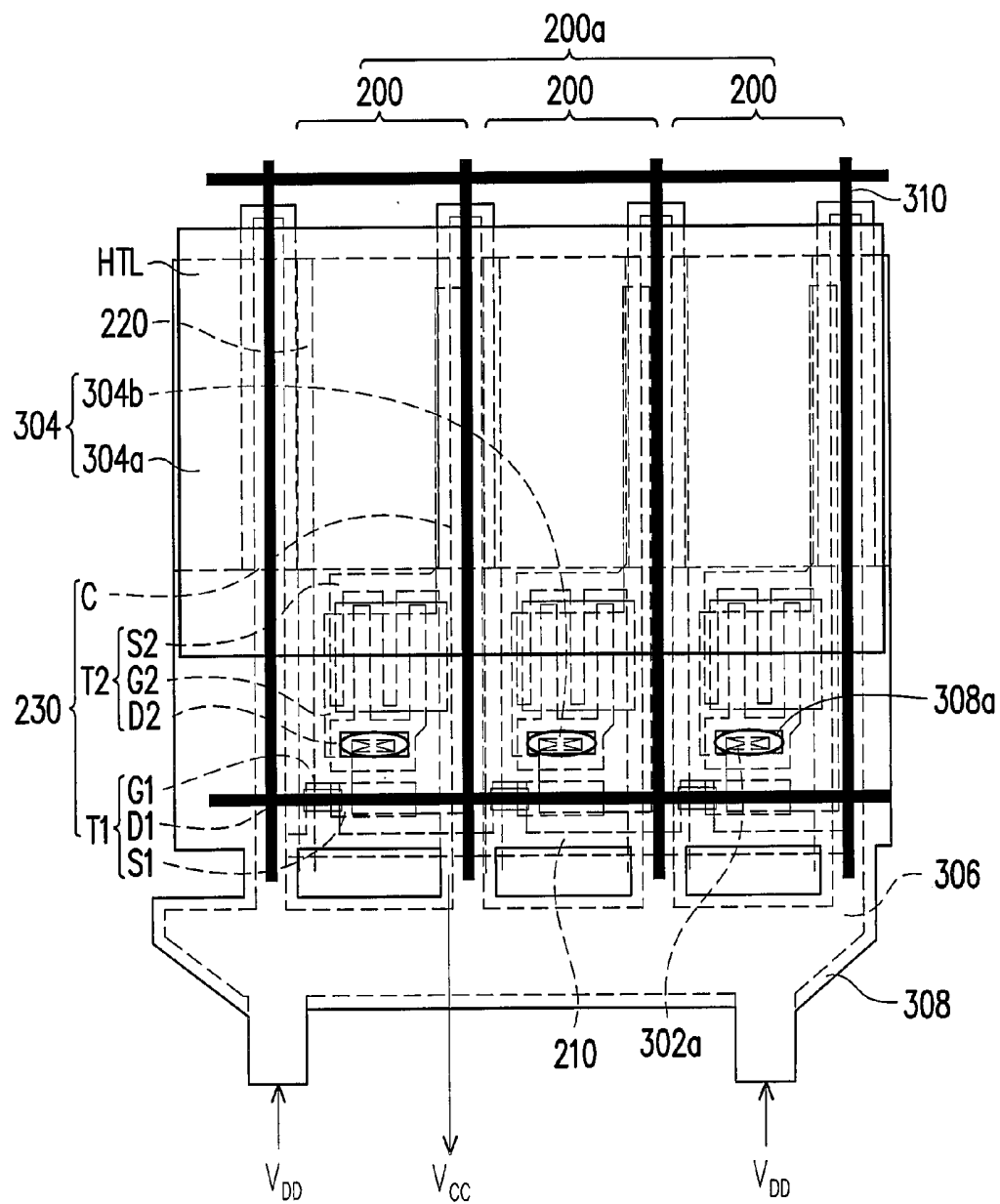


FIG. 4F

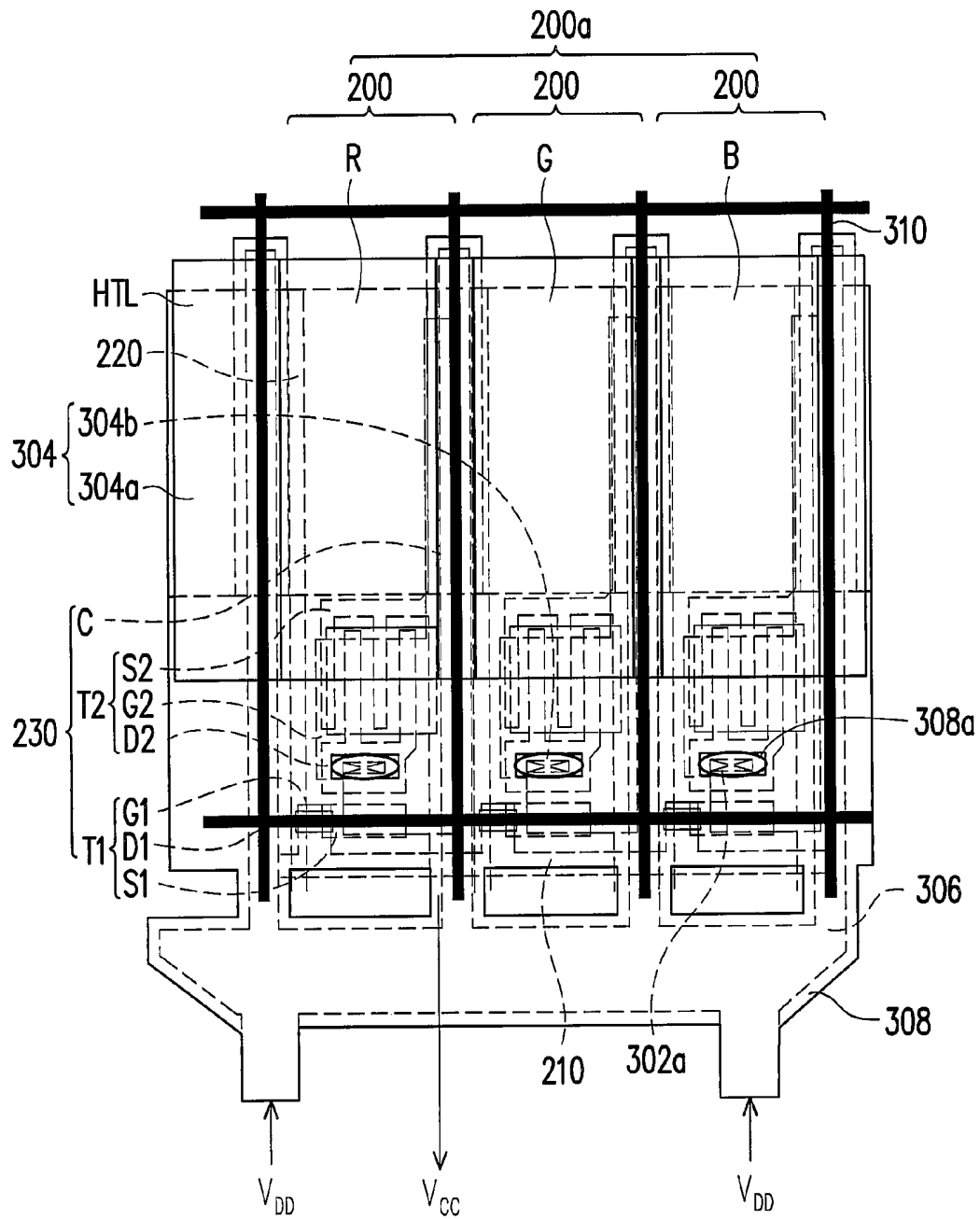


FIG. 4G

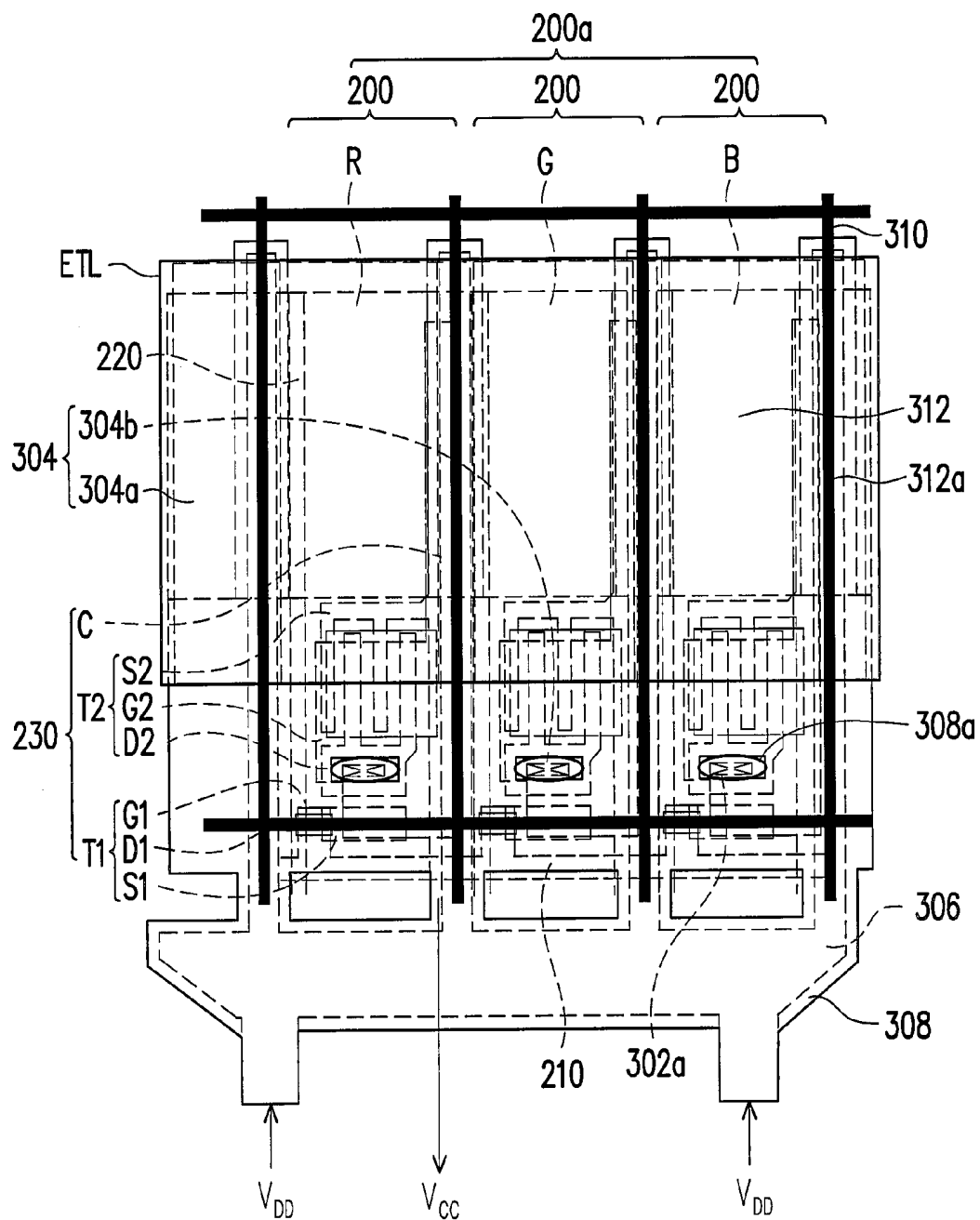


FIG. 4H

FIG. 41

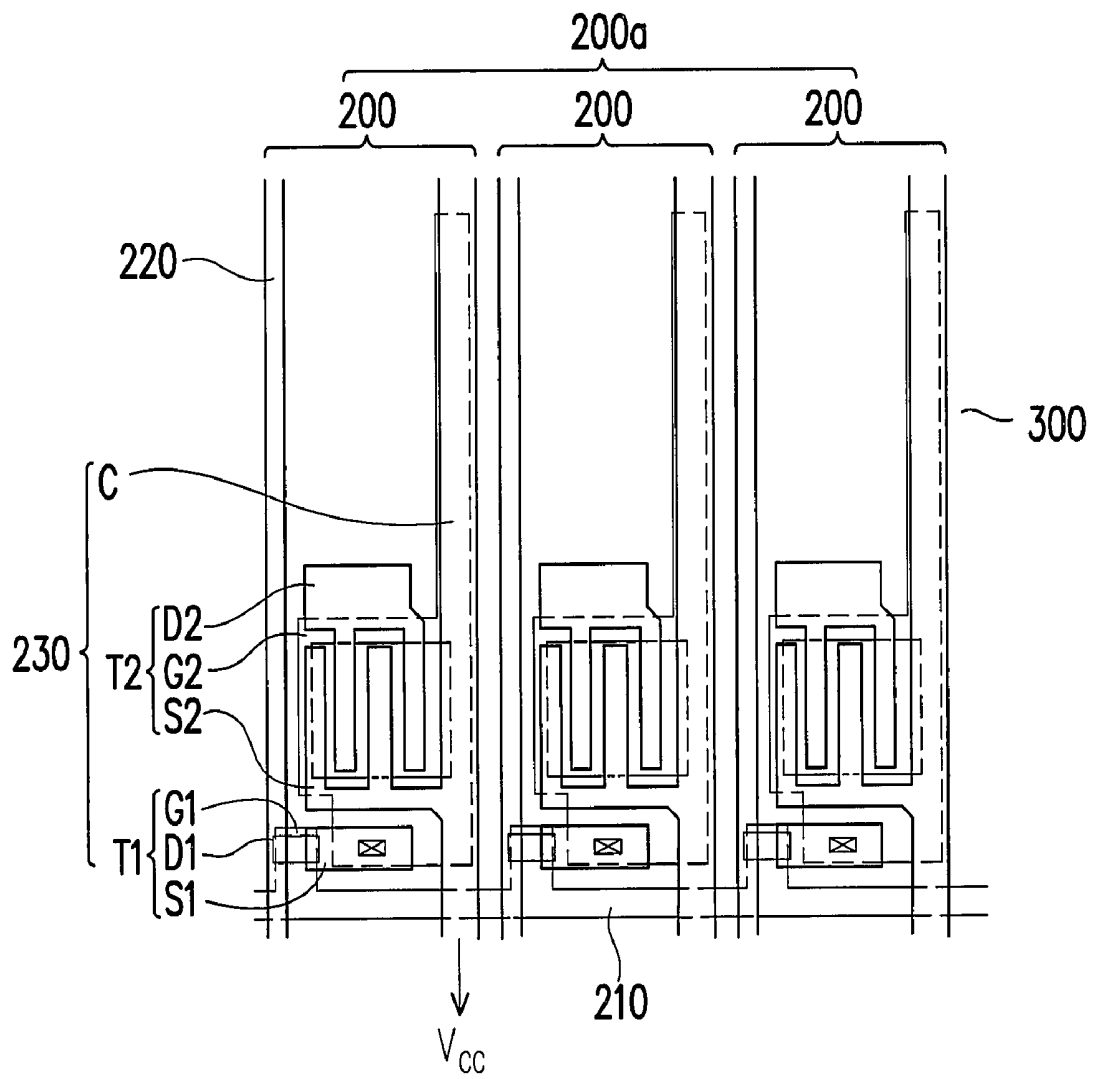


FIG. 5A

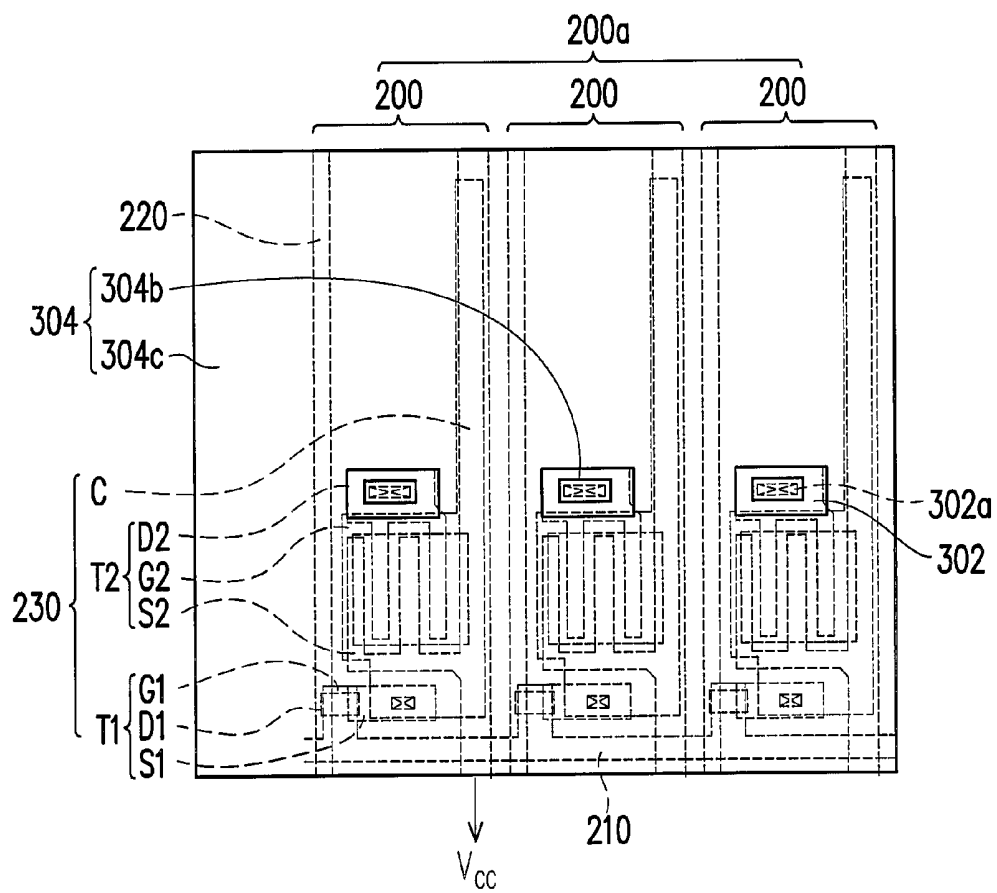


FIG. 5B

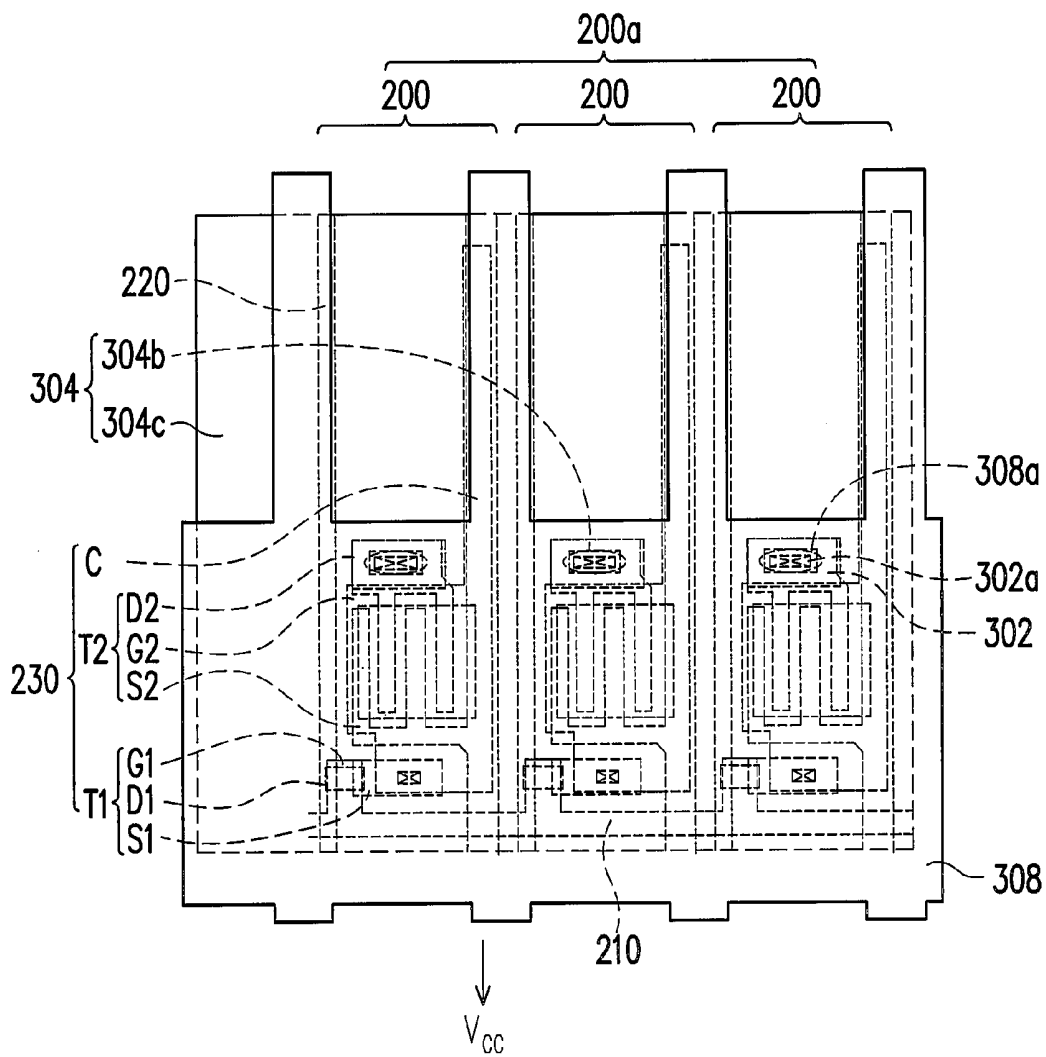


FIG. 5C

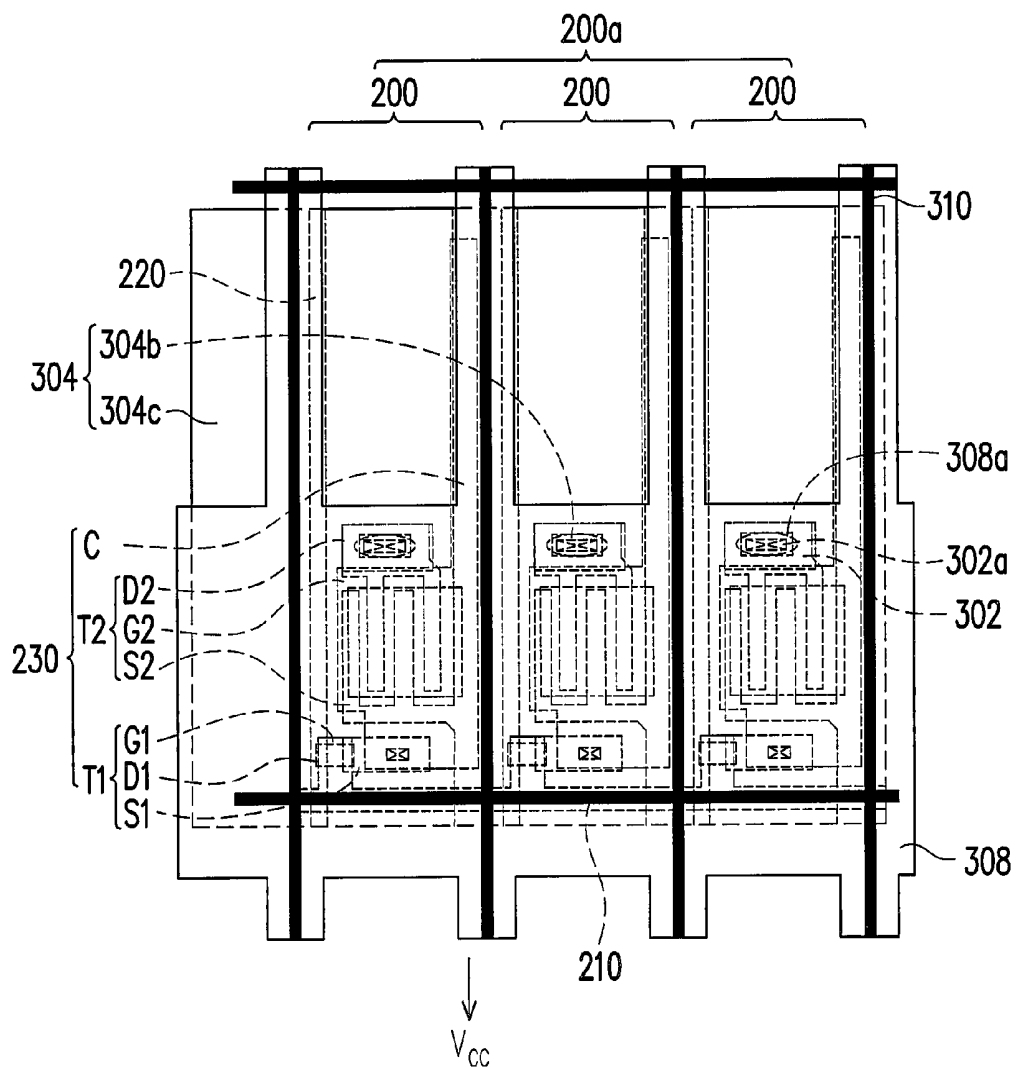


FIG. 5D

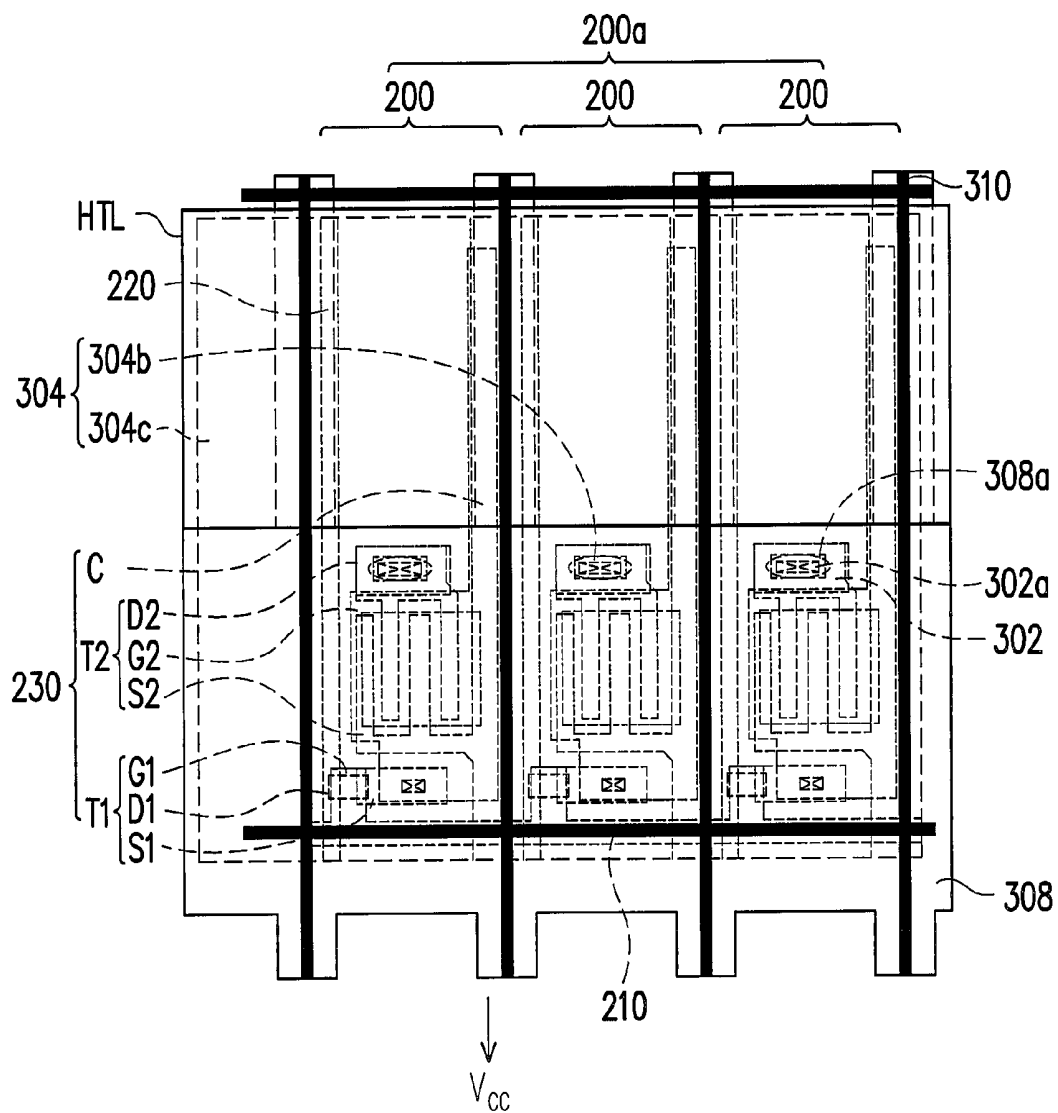


FIG. 5E

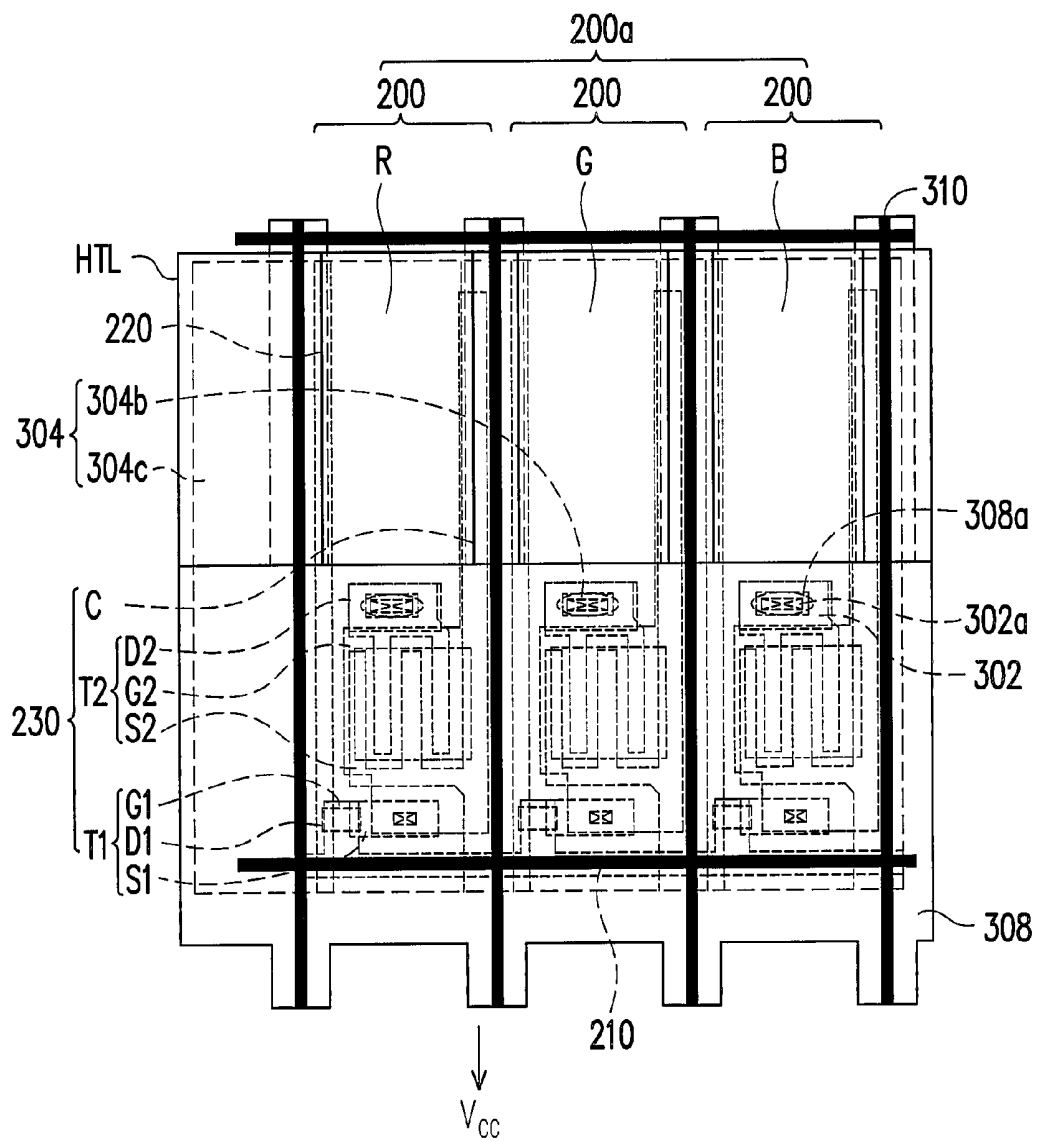


FIG. 5F

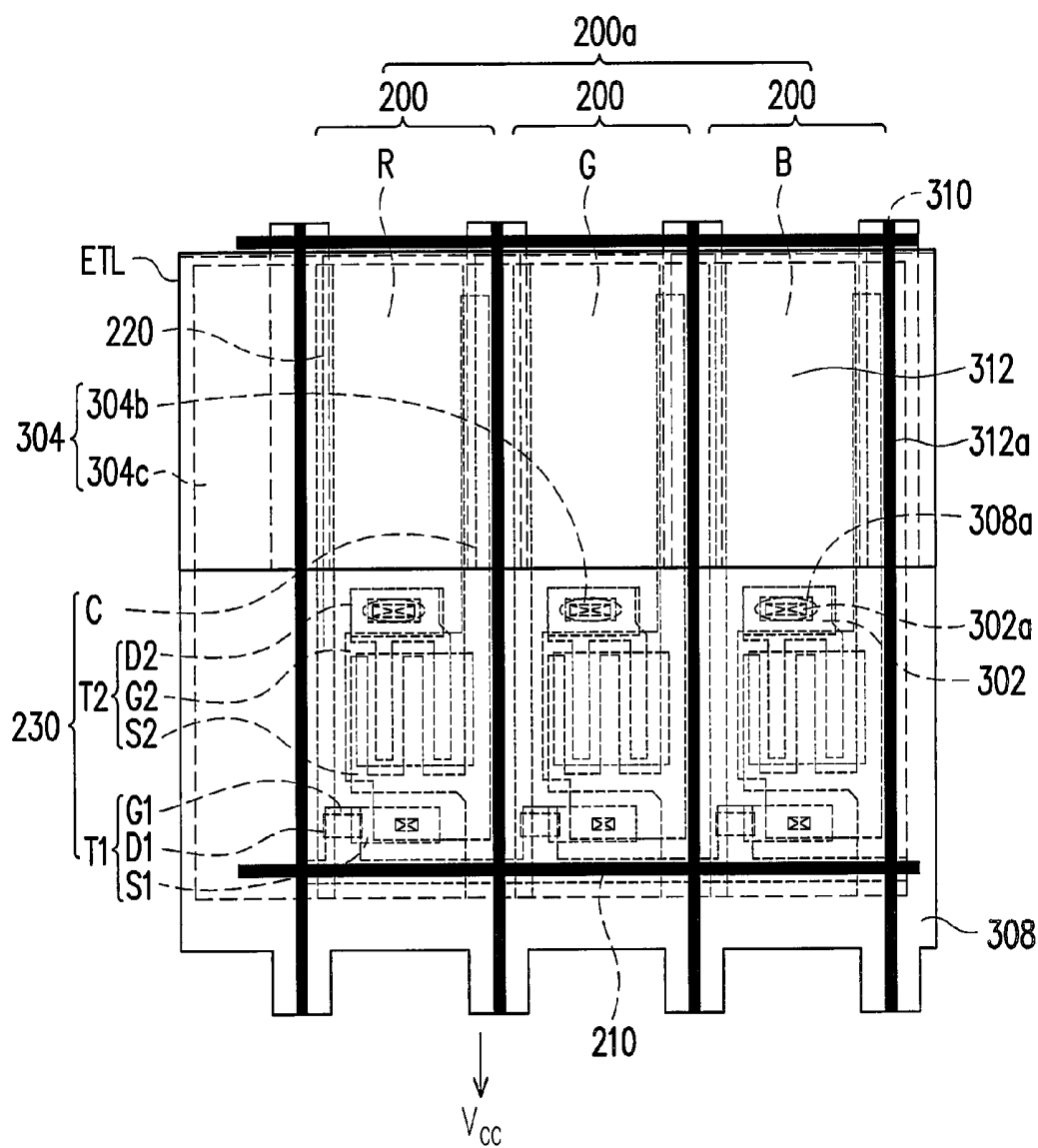


FIG. 5G

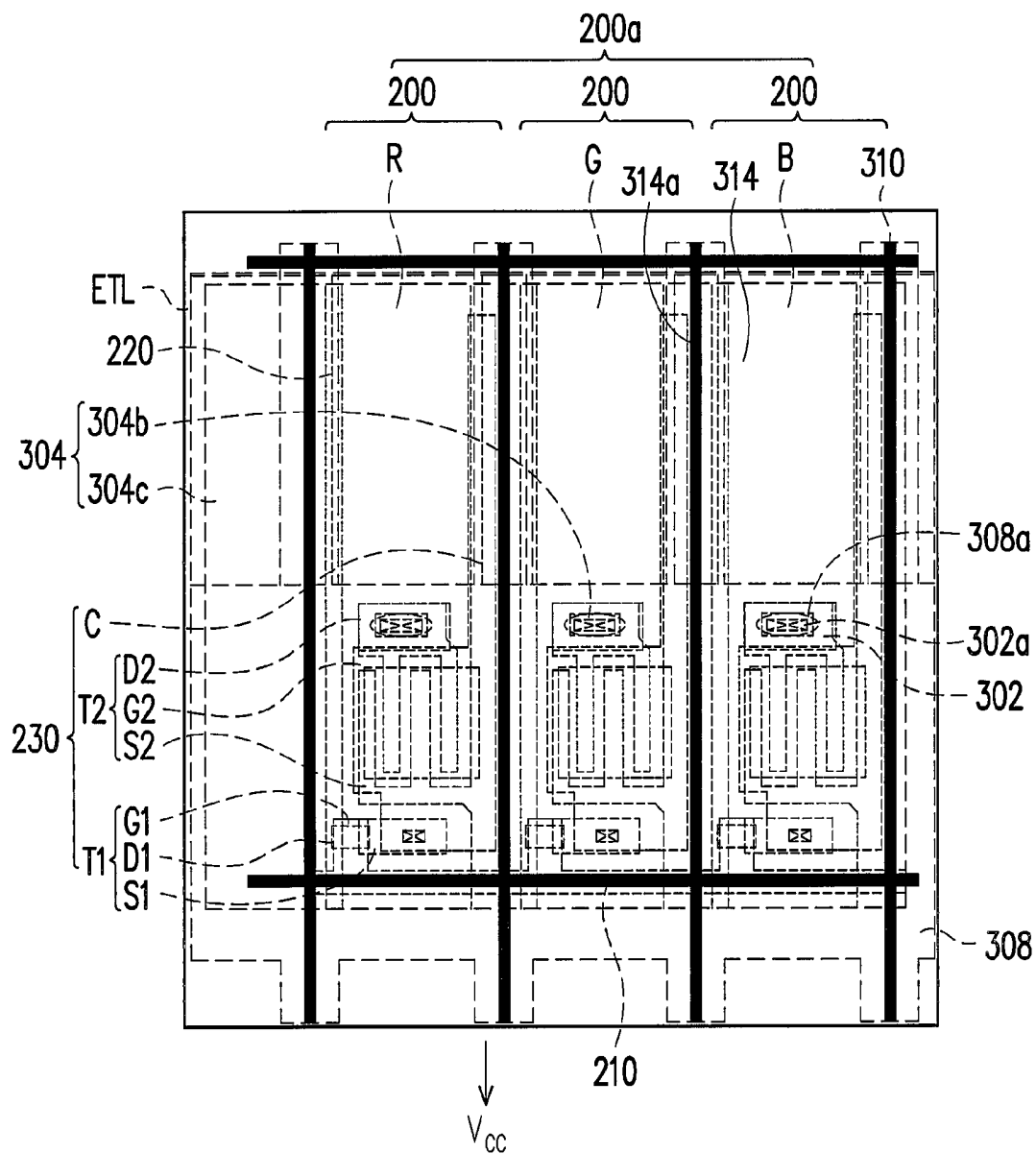


FIG. 5H

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ACTIVE MATRIX ORGANIC ELECTRO-LUMINESCENCE DISPLAY PANEL

CROSS-REFERENCE TO RELATED APPLICATION

This application claims the priority benefit of Taiwan application serial no. 95128590, filed Aug. 4, 2006. All disclosure of the Taiwan application is incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an active matrix organic electro-luminescence display panel, and more particularly, to an active matrix organic electro-luminescence display panel with a stable image quality.

2. Description of Related Art

Currently, information telecommunication industry has become a mainstream industry, especially for those portable communication display products, which have become a focus of the development. Flat-panel displays are communication interfaces between human and information, thus, the development of the flat-panel displays is especially important. The following techniques are currently applied to the flat-panel display: plasma display panel (PDP), liquid crystal display (LCD), electro-luminescent display, light emitting diode (LED), vacuum fluorescent display, field emission display (FED) and electro-chromic display. Compared with other flat-panel display techniques, the organic electro-luminescence display panel has a tremendous application potential to become a mainstream of the next generation of flat-panel displays due to its advantages of self-luminescence, no viewing-angle dependence, saving power, simple manufacturing process, low cost, low working temperature, high response speed and full-color.

FIG. 1 is a circuit diagram of a conventional driving circuit. Referring to FIG. 1, the conventional driving circuit 100 is suitable for driving an organic electro-luminescence device OEL through a high voltage source V_{DD} and a low voltage source V_{CC} . The conventional driving circuit 100 includes a scan line 110, a data line 120 and a control unit 130. The control unit 130 is electrically coupled with the scan line 110, the data line 120 and the high voltage source V_{DD} , and the organic electro-luminescence device OEL is electrically coupled between the control unit 130 and the low voltage source V_{CC} . Generally, the high voltage source V_{DD} is a positive voltage, and the voltage of the low voltage source V_{CC} is generally 0 volt (in a state of being grounded).

As shown in FIG. 1, the control unit 130 in the driving circuit 100 includes two thin film transistors T1, T2 and a capacitor C. The thin film transistor T1 has a gate G1, a source S1 and a drain D1, wherein the gate G1 is electrically coupled with the scan line 110, and the drain D1 is electrically coupled with data line 120. Moreover, the thin film transistor T2 has a gate G2, a source S2 and a drain D2, wherein the gate G2 is electrically coupled with the source S1, and the drain D2 is electrically coupled with the high voltage source V_{DD} , and the source S2 is electrically coupled with the organic electro-luminescence device OEL. It should be noted that, in the conventional driving circuit 100, the capacitor C is electrically coupled between the gate G2 and the drain D2.

When a scan signal V_{SCAN} is transferred to the scan line 110, the thin film transistor T1 is turned on, and at this time, a voltage signal V_{DATA} transferred from the data line 120 is

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applied on the gate G2 of the thin film transistor T2 through the thin film transistor T1, and the voltage signal V_{DATA} applied on the gate G2 is used to control the current I passing through the thin film transistor T2 and the organic electro-luminescence device OEL, so as to control the desirable luminance to be displayed by the organic electro-luminescence device OEL. When the voltage signal V_{DATA} transferred from the data line 120 is applied on the gate G2, the voltage signal V_{DATA} also charges the capacitor C, and its reference voltage is the high voltage source V_{DD} . In other words, when the voltage signal V_{DATA} is applied on the gate G2, a cross voltage ($(V_{DATA}-V_{DD})$) at both terminals of the gate G2 is recorded by the capacitor C. Ideally, when the thin film transistor T1 is turned off, the capacitor C maintains the voltage (V_{DATA}) applied on the gate G2 of the thin film transistor T2 effectively, but in fact, after a long time operation, the voltage V_s of the source S2 of the thin film transistor T2 always has drifted upwards, so that the voltage difference V_{gs} between the gate G2 and the source S2 is gradually reduced, and thus causing the luminance to be displayed by the organic electro-luminescence device OEL to be decayed.

In view of the above, the control unit 130 in the driving circuit 100 still cannot stably control the current I passing through the organic electro-luminescence device OEL, and thus, how to make the current I passing through the organic electro-luminescence device OEL be more stable is an important issue in manufacturing an organic electro-luminescence display panel.

SUMMARY OF THE INVENTION

The present invention is directed to provide an active matrix organic electro-luminescence display panel with a stable image quality.

As embodied and broadly described herein, the present invention provides an active matrix organic electro-luminescence display panel, including a substrate, an organic electro-luminescence device array, and a driving circuit array. The organic electro-luminescence device array includes a plurality of organic electro-luminescence devices arranged in array on the substrate. The driving circuit array includes a plurality of driving circuits arranged in array on the substrate, and the driving circuit is suitable for driving the corresponding organic electro-luminescence device through a high voltage source and a low voltage source. Moreover, each driving circuit comprises a scan line, a data line, and a control unit. The control unit is electrically coupled with the scan line, the data line, and the low voltage source. The corresponding organic electro-luminescence device is electrically coupled between the control unit and the high voltage source.

In one embodiment of the present invention, the voltage of the above high voltage source is V1 volt, the voltage of the low voltage source is V2 volt, and $V1 > V2 = 0$.

The control unit comprises a first thin film transistor, a second thin film transistor, and a capacitor. The first thin film transistor has a first gate, a first source, and a first drain, wherein the first gate is electrically coupled with the scan line, and the first drain is electrically coupled with the data line. The second thin film transistor has a second gate, a second source, and a second drain, wherein the second gate is electrically coupled with the first source, the second source is electrically coupled with the low voltage source, and the second drain is electrically coupled with the organic electro-luminescence device. Moreover, the capacitor is electrically coupled between the second gate and the second source.

In one embodiment of the present invention, the first and second thin film transistors are amorphous silicon thin film

transistors (α -Si TFT), low-temperature poly-silicon thin film transistors (LTPS-TFT), or organic thin film transistors (OTFT).

In one embodiment of the present invention, the organic electro-luminescence device array comprises a plurality of anodes, an anodic bus, a plurality of organic functional layers, and a plurality of cathodes electrically insulated from one another. The anodes are disposed on the substrate, and the anodic bus is electrically coupled with each anode electrode to couple all the anodes with the high voltage source simultaneously. The organic functional layers are disposed on the corresponding anodes, while the cathodes are disposed on the corresponding organic functional layers and electrically coupled with the corresponding second drains, respectively.

In one embodiment of the present invention, the organic functional layers are further disposed over the second drain, the organic electro-luminescence device array further comprises a plurality of redistribution circuits, and each redistribution circuit is electrically coupled between the corresponding second drain and the corresponding cathode, respectively.

In one embodiment of the present invention, the anodes are a plurality of strip-shaped electrodes extending along a direction substantially parallel with the extending direction of the scan line, and the extending direction of the anodic bus is substantially perpendicular to that of the scan line.

In one embodiment of the present invention, the active matrix organic electro-luminescence display panel further comprises a passivation layer covering the driving circuit and part of the anode.

In one embodiment of the present invention, the active matrix organic electro-luminescence display panel further comprises a blocking pattern on the passivation layer, so as to insulate the cathodes from one another.

Moreover, the active matrix organic electro-luminescence display panel comprises an organic material layer disposed on the blocking pattern and a conducting material layer disposed on the organic material layer. The material of the organic material layer and that of the organic functional layer are identical, while the material of the conducting material layer and that of the cathode are identical.

In one embodiment of the present invention, each organic functional layer includes a hole transport layer, an organic electro-luminescence layer, and an electron transport layer. The hole transport layer is disposed on the corresponding anode, the organic electro-luminescence layer on the hole transport layer, and the electron transport layer on the organic electro-luminescence layer.

In one embodiment of the present invention, the organic electro-luminescence device array comprises a common anode, a plurality of organic functional layers, and a plurality of cathodes electrically insulated from one another. The common anode is disposed on the substrate and electrically coupled with the high voltage source. The organic functional layer is disposed on the common anode, the cathodes are respectively disposed on the corresponding organic functional layers, and each cathode is electrically coupled with the corresponding second drain, respectively.

In one embodiment of the present invention, the active matrix organic electro-luminescence display panel further comprises a passivation layer partially capping the driving circuit and part of the common anode.

In one embodiment of the present invention, the active matrix organic electro-luminescence display panel further comprises a blocking pattern on the passivation layer, so as to insulate the cathodes from one another. Moreover, the active matrix organic electro-luminescence display panel further comprises an organic material layer disposed on the blocking

pattern and a conducting material layer disposed on the organic material layer. The material of the organic material layer and that of the organic functional layer are identical, while the material of the conducting material layer and that of the cathode are identical.

In one embodiment of the present invention, each organic functional layer includes a hole transport layer, an organic electro-luminescence layer, and an electron transport layer. The hole transport layer is disposed on the common anode, the organic electro-luminescence layer on the hole transport layer, and the electron transport layer on the organic electro-luminescence layer.

In the present invention, the organic electro-luminescence device is electrically coupled between the control unit and the high voltage source, so that under the control of the control unit, the driving current sequentially passes through the organic electro-luminescence device and the control unit. Thus, the driving circuit in the present invention enables the organic electro-luminescence device to illuminate stably.

One or part or all of these and other features and advantages of the present invention will become readily apparent to those skilled in this art from the following description wherein there is shown and described a preferred embodiment of this invention, simply by way of illustration of one of the modes best suited to carry out the invention. As it will be realized, the invention is capable of different embodiments, and its several details are capable of modifications in various, obvious aspects all without departing from the invention. Accordingly, the drawings and descriptions will be regarded as illustrative in nature and not as restrictive.

BRIEF DESCRIPTION OF THE DRAWINGS

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

FIG. 1 is a circuit diagram of a conventional driving circuit.

FIG. 2 is a circuit diagram of a driving circuit according to the present invention.

FIGS. 3A to 3I are schematic views showing the process of manufacturing an active matrix organic electro-luminescence display panel according to a first embodiment of the present invention.

FIGS. 4A to 4I are schematic views showing the process of manufacturing the active matrix organic electro-luminescence display panel according to a second embodiment of the present invention.

FIGS. 5A to 5H are schematic views showing the process of manufacturing the active matrix organic electro-luminescence display panel according to a third embodiment of the present invention.

DESCRIPTION OF EMBODIMENTS

FIG. 2 is a circuit diagram of a driving circuit according to the present invention. Referring to FIG. 2, the driving circuit 200 of the present invention is suitable for driving an organic electro-luminescence device OEL through a high voltage source V_{DD} and a low voltage source V_{CC} . As shown in FIG. 2, the driving circuit 200 includes a scan line 210, a data line 220 and a control unit 230. The control unit 230 is electrically coupled with the scan line 210, the data line 220 and the low voltage source V_{CC} , and the organic electro-luminescence device OEL is electrically coupled between the control unit 230 and the high voltage source V_{DD} . In a preferred embodi-

ment of the present invention, the voltage (V_1 volt) provided by the high voltage source V_{DD} is a positive voltage, and the voltage (V_2 volt) provided by the low voltage source V_{CC} is a positive voltage or a negative voltage, and $V_1 > V_2$. Definitely, the low voltage source V_{CC} also may be grounded, i.e., $V_2 = 0$.

In the driving circuit **200** of the present invention, the control unit **230** can employ various circuit layouts, such as 2T1C architecture and 4T1C architecture. The present invention only takes the 2T1C architecture as an example for illustration, but it is not intended to limit the circuit connection manner to the 2T1C architecture, and those skilled in the art can integrate the driving circuit disclosed in the present invention with a control unit of 4T1C architecture or other architectures.

As shown in FIG. 2, in a preferred embodiment of the present invention, the control unit **230** includes a first thin film transistor **T1**, a second thin film transistor **T2** and a capacitor **C**. The first thin film transistor **T1** has a first gate **G1**, a first source **S1** and a first drain **D1**, wherein the first gate **G1** is electrically coupled with the scan line **210**, and the first drain **D1** is electrically coupled with the data line **220**. The second thin film transistor **T2** has a second gate **G2**, a second source **S2** and a second drain **D2**, wherein the second gate **G2** is electrically coupled with the first source **S1**, the second source **S2** is electrically coupled with the low voltage source V_{CC} , and the second drain **D2** is electrically coupled with the organic electro-luminescence device OEL. Furthermore, it is clearly known from FIG. 2 that, the organic electro-luminescence device OEL has an anode (+) being electrically coupled with the high voltage source V_{DD} and a cathode being electrically coupled with the second drain **D2**.

It should be noted that, in the driving circuit **200** of the present invention, the capacitor **C** is electrically coupled between the second gate **G2** and the second source **S2**, so as to effectively maintain the voltage difference between the second gate **G2** and the second source **S2**, thus avoiding the luminance decay problem caused by the current passing through the organic electro-luminescence device OEL during a long time operation.

In the preferred embodiment of the present invention, the first thin film transistor **T1** and the second thin film transistor **T2** are amorphous silicon thin film transistors, low-temperature poly-silicon thin film transistors or organic thin film transistors (OTFT). Moreover, the first thin film transistor **T1** and the second thin film transistor **T2** can be top gate thin film transistors (top gate TFTs) or bottom gate thin film transistors (bottom gate TFTs).

When a scan signal V_{SCAN} is transferred to the scan line **210**, the thin film transistor **T1** is turned on, and at this time, a voltage signal V_{DATA} transferred from the data line **220** is applied on the gate **G2** of the thin film transistor **T2** through the thin film transistor **T1**, and the voltage signal V_{DATA} applied on the gate **G2** is used to control the current I passing through the thin film transistor **T2** and the organic electro-luminescence device OEL, so as to control the desirable luminance to be displayed by the organic electro-luminescence device OEL. When the voltage signal V_{DATA} transferred from the data line **220** is applied on the second gate **G2**, the voltage signal V_{DATA} also charges the capacitor **C**, and its reference voltage is the low voltage source V_{CC} . In other words, when the voltage signal V_{DATA} is applied on the second gate **G2**, a cross voltage ($|V_{DATA} - V_{CC}|$) on both terminals of the second gate **G2** is recorded by the capacitor **C**. In the driving circuit of the present invention, when the thin film transistor **T1** is turned off, the capacitor **C** effectively maintains the voltage (V_{DATA}) applied on the second gate **G2** of the thin film transistor **T2**. Moreover, after a long time operation, since the

capacitor **C** is electrically coupled between the second gate **G2** and the second source **S2**, the voltage V_s of the second source **S2** does not significantly drift upwards. In other words, the voltage difference V_{gs} between the second gate **G2** and the second source **S2** is not greatly changed, so that the current I passing through the organic electro-luminescence device OEL is effectively controlled, thus, the display quality of the organic electro-luminescence display panel is more stable.

The present invention will be illustrated below in detail through the embodiments, so as to explain how to fabricate the driving circuit **200** in FIG. 2 on an active matrix organic electro-luminescence display panel.

First Embodiment

FIGS. 3A to 3I are schematic flow charts of the process for manufacturing an active matrix organic electro-luminescence display panel according to a first embodiment of the present invention. Referring to FIG. 3A, firstly, a substrate **300** is provided, which has a driving circuit array **200a** formed thereon. The driving circuit array **200a** includes a plurality of driving circuits **200** arranged in array on the substrate **300**. The elements in each driving circuit **200** (such as a scan line **210**, a data line **220**, a control unit **230**, a first thin film transistor **T1**, a second thin film transistor **T2**, a capacitor **C** and a low voltage source V_{CC}) and the electrical coupling relationship there-between have already been described in the relevant illustration of FIG. 2, which thus will not be described herein any more.

It should be noted that, the above scan line **210**, the data line **220**, and the first thin film transistor **T1**, the second thin film transistor **T2** and the capacitor **C** in the control unit **230** all can be fabricated through the current TFT-array process, such as an amorphous silicon thin film transistor array process, a low-temperature poly-silicon thin film transistor array process or an organic thin film transistor array process.

Referring to FIG. 3B, after the driving circuit array **200a** has been formed, a dielectric layer **302** is further formed on the substrate **300** in the present embodiment to cover the driving circuit array **200a**. The dielectric layer **302** has a plurality of contact windows **302a** corresponding to the second drain **D2** to expose a part of the area of the second drain **D2**. Then, a patterned conductive layer **304** is formed on the dielectric layer **302**, wherein the patterned conductive layer **304** includes a plurality of anodes **304a** and a plurality of contact conductors **304b** respectively coupled with the second drain **D2** through the contact windows **302a**. It should be noted that, the anode **304a** of the present embodiment is a strip-shaped electrode extending along a direction parallel with the extending direction of the scan line **210**, and the anode **304a** is electrically insulated from the contact conductor **304b**. Definitely, the extending direction of the above strip-shaped anode **304a** also can be parallel with that of the data line **220**, or be designed to other extending directions, which are not limited in the present embodiment. Moreover, the patterned conductive layer **304** is made of, for example, indium tin oxide (ITO), indium zinc oxide (IZO), or other transparent/non-transparent conductive materials.

Referring to FIG. 3C, after the patterned conductive layer **304** has been fabricated, a patterned conductive layer **306** is formed on the dielectric layer **302** and on a part of the area of the patterned conductive layer **304**. In the present embodiment, the patterned conductive layer **306** includes an anodic bus **306a** and a plurality of connecting conductors **306b** electrically coupled with the contact conductor **304b**. The anodic bus **306a** is electrically coupled with the anodes **304a**, so that all the anodes **304a** are electrically coupled with the high

voltage source V_{DD} simultaneously. As shown in FIG. 3C, the extending direction of the anodic bus **306a** is perpendicular to that of the scan line **210**, and the anodic bus **306a** is electrically insulated from the connecting conductor **306b**. Definitely, the extending direction of the anodic bus **306a** is changed as the extending direction of the anode **304a** changes, but the extending direction is not limited in the present embodiment. Moreover, the patterned conductive layer **306** is made of, for example, metal, alloy or other transparent/non-transparent conductive materials.

As shown in FIG. 3C, the contact conductor **304b** is electrically coupled with the connecting conductor **306b**, so as to form a so-called re-distribution circuit R. It should be noted that, the re-distribution circuit R formed by the contact conductor **304b** and the connecting conductor **306b** is used to connect the second drain D2 with a subsequently formed cathode **314** (shown in FIG. 3I).

Referring to FIG. 3D, after the patterned conductive layer **306** has been fabricated, a protective layer **308** is formed to cover the driving circuit **200** and a part of the area of the anode **304a**. In the present embodiment, the protective layer **308** covers the re-distribution circuit R and has a plurality of contact windows **308a** for exposing a part of the area of the connecting conductor **306b**. Furthermore, the protective layer **308** also exposes most of the area (area for displaying) of the anode **304a**. Moreover, the protective layer **308** is made of, for example, polyimide, epoxy resin or other materials, and the protective layer **308** mainly aims at protecting the patterned conductive layer **306** from being oxidized or being damaged.

Referring to FIG. 3E, after the protective layer **308** has been fabricated, a blocking pattern **310** is formed on the protective layer **308**. In the present embodiment, the blocking pattern **310** is mainly used for defining the position of the subsequently formed cathode **314** (shown in FIG. 3I). Generally, the blocking pattern **310** is made of a dielectric material, and the sidewall of the blocking pattern **310** has an under-cut profile, so that the subsequently formed film layers can be automatically separated into individual film patterns by the blocking pattern **310**.

Referring to FIGS. 3F to 3H, after the blocking pattern **310** has been formed, an organic functional layer **312** is formed on the anode **304a**. Since the blocking pattern **310** has the function of automatically separating the film layers, an organic material layer **312a** is formed on the blocking pattern **310** while the organic functional layer **312** has been formed, and the material of the organic material layer **312a** is the same as that of the organic functional layer **312**. The organic material layer **312a** in the present embodiment includes a plurality of organic films fabricated by way of evaporation or ink jet printing. As shown in FIGS. 3F to 3H, a hole transport layer HTL, organic electro-luminescence layers R, G, B and an electron transport layer ETL are sequentially formed on the anode **304a** in the present embodiment.

Referring to FIG. 3I, after the organic functional layer **312** (shown in FIG. 3H) has been formed, cathodes **314** electrically insulated from each other are formed on each organic functional layer **312** (shown in FIG. 3H). Since the blocking pattern **310** has the function of automatically separating the film layer, a conducting material layer **314a** is formed on the organic material layer **312a** (shown in FIG. 3H) while the cathodes **314** have been formed, and the conducting material layer **314a** and the cathodes **314** are made of the same material, for example, the aluminum.

In view of the above, the hole transport layer HTL, organic electro-luminescence layers R, G, B, the electron transport layer ETL and the cathodes **314** are not necessarily patterned

through the blocking pattern **310**, but patterned through other methods in the present invention, for example, a shadow mask is utilized to define positions for the subsequently formed film layers.

It should be noted that, after the cathodes **314** electrically insulated from each other have been fabricated, each organic electro-luminescence device OEL is considered to be completed, and at this time, the organic electro-luminescence device array **316** formed by arranging the organic electro-luminescence devices OEL thereon is also considered to be completed.

Second Embodiment

FIGS. 4A to 4I are schematic flow charts of the process for manufacturing the active matrix organic electro-luminescence display panel according to a second embodiment of the present invention. Referring to FIGS. 4A to 4I, the flow of the process for manufacturing the active matrix organic electro-luminescence display panel of the present embodiment is similar to that of the first embodiment, and the main difference there-between lies in the procedures of FIG. 4A and FIG. 4C.

As shown in FIG. 4A, the present embodiment mainly directs to modifying the layout of the second thin film transistor T2, so as to omit the fabrication of the connecting conductor **306b** in FIG. 3C. Specifically, the positions of the second source S2 and the second drain D2 in the first embodiment are exchanged in the present embodiment, so that the second drain D2 can be positioned far away from the anode **304a**, without being covered by the subsequently formed organic electro-luminescence device OEL.

Third Embodiment

FIGS. 5A to 5H are schematic flow charts of the process for manufacturing the active matrix organic electro-luminescence display panel according to a third embodiment of the present invention. Referring to FIGS. 5A to 5H, the flow for manufacturing an active matrix organic electro-luminescence display panel of the present embodiment is similar to that of the first embodiment, and the main difference there-between lies in the procedures of FIG. 5B and FIG. 5C.

As shown in FIG. 5B, the present embodiment mainly directs to modifying the pattern of the strip-shaped anode **304a**, so as to omit the fabrication of the anodic bus **306a** and the connecting conductor **306b** in FIG. 3C. Specifically, the strip-shaped anode **304a** in the first embodiment is modified to a common anode **304c** in the present embodiment. Since the common anode **304c** can be served as an anode for all the organic electro-luminescence devices OEL, the anodic bus **306a** and the connecting conductor **306b** in FIG. 3C are not necessarily fabricated in the present embodiment.

As shown in FIGS. 3I, 4I and 5H, the active matrix organic electro-luminescence display panel of the present invention includes a substrate **300**, an organic electro-luminescence device array **316** and a driving circuit **200a**. The organic electro-luminescence device array **316** includes a plurality of organic electro-luminescence device OEL arranged in array on the substrate **300**. The driving circuit array **200a** includes a plurality of driving circuits **200** arranged in array on the substrate **300**, and the driving circuit **200** is suitable for driving the corresponding organic electro-luminescence device OEL through a high voltage source V_{DD} and a low voltage source V_{CC} . Furthermore, each driving circuit **200** includes a scan line **210**, a data line **220** and a control unit **230**. The control unit **230** is electrically coupled with the scan line **210**,

the data line **220** and the low voltage source V_{CC} , and the corresponding organic electro-luminescence device OEL is electrically coupled between the control unit **230** and the high voltage source V_{DD} .

In view of the above, the driving circuit and the active matrix organic electro-luminescence display panel at least has the following advantages.

1. The driving circuit of the present invention effectively stabilizes the driving current passing through the organic electro-luminescence device, so the present invention makes the active matrix organic electro-luminescence display panel achieve a preferable display quality.

2. The active matrix organic electro-luminescence display panel of the present invention is compatible with the current manufacturing process, which will not cause an excessive burden on the manufacturing cost.

Though the present invention has been disclosed above by the preferred embodiments, they are not intended to limit the present invention.

The above description provides a full and complete description of the preferred embodiments of the present invention. Various modifications, alternate construction, and equivalent may be made by those skilled in the art without changing the scope or spirit of the invention. Accordingly, the above description and illustrations should not be construed as limiting the scope of the invention which is defined by the following claims.

What is claimed is:

1. An active matrix organic electro-luminescence display panel, comprising:

a substrate;

an organic electro-luminescence device array, including a plurality of organic electro-luminescence devices arranged in array on the substrate;

a driving circuit array, including a plurality of driving circuits arranged in array on the substrate, wherein the driving circuits are suitable for driving the corresponding organic electro-luminescence devices through a high voltage source and a low voltage source, and each driving circuit comprising:

a scan line;

a data line; and

a control unit electrically coupled with the scan line, the data line, and the low voltage source, the control unit comprising:

a first thin film transistor having a first gate electrically coupled with the scan line, a first source, and a first drain electrically coupled with the data line; and a second thin film transistor having a second gate electrically coupled with the first source, a second source electrically coupled with the low voltage source, and a second drain directly coupled with an anode of the organic electro-luminescence device; and

a capacitor being electrically coupled between the second gate and the second source; wherein the high voltage source is coupled with a cathode of the organic electro-luminescence device without through the first thin film transistor and the second thin film transistor.

2. The active matrix organic electro-luminescence display panel of claim 1, wherein the voltage of the high voltage source is V_1 volt, the voltage of the low voltage source is V_2 volt, and $V_1 > V_2 = 0$.

3. The active matrix organic electro-luminescence display panel of claim 1, wherein the first thin film transistor and the second thin film transistor are amorphous silicon thin film transistors.

4. The active matrix organic electro-luminescence display panel of claim 1, wherein the first thin film transistor and the second thin film transistor are low-temperature poly-silicon thin film transistors.

5. The active matrix organic electro-luminescence display panel of claim 1, wherein the first thin film transistor and the second thin film transistor are organic thin film transistors (OTFT).

6. The active matrix organic electro-luminescence display panel of claim 1, the organic electro-luminescence device array comprising:

a plurality of anodes disposed on the substrate;

an anodic bus being electrically coupled with the anodes to couple the anodes with the high voltage source V_{DD} simultaneously;

a plurality of organic functional layers disposed on the anodes; and

a plurality of cathodes being electrically insulated from one another and being disposed on the corresponding organic functional layers, wherein each cathode is electrically coupled with the corresponding second drain, respectively.

7. The active matrix organic electro-luminescence display panel of claim 6, wherein the organic functional layer further covers the second drain, and the organic electro-luminescence device array further comprises:

a plurality of redistribution circuits, each redistribution circuit being electrically coupled between the corresponding second drain and the corresponding cathode, respectively.

8. The active matrix organic electro-luminescence display panel of claim 6, wherein the anodes are strip-shaped electrodes extending along with the direction substantially parallel with the extending direction of the scan lines, and the extending direction of the anodic bus is substantially perpendicular to that of the scan lines.

9. The active matrix organic electro-luminescence display panel of claim 6, further comprising:

a passivation layer covering the driving circuits and part of the anodes.

10. The active matrix organic electro-luminescence display panel of claim 9, further comprising:

a blocking pattern disposed on the passivation layer so as to insulate the cathodes from one another.

11. The active matrix organic electro-luminescence display panel of claim 10, further comprising:

an organic material layer disposed on the blocking pattern; and

a conducting material layer disposed on the organic material layer, wherein a material of the organic material layer and that of the organic functional layers are identical, and a material of the conducting material layer and that of the cathodes are identical.

12. The active matrix organic electro-luminescence display panel of claim 6, each organic functional layer comprising:

a hole transport layer disposed on the corresponding anode;

an organic electro-luminescence layer disposed on the hole transport layer; and

an electron transport layer disposed on the organic electro-luminescence layer.

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13. The active matrix organic electro-luminescence display panel of claim 1, wherein the organic electro-luminescence device array comprises:

a common anode disposed on the substrate and electrically coupled with the high voltage source;

a plurality of organic functional layers disposed on the common anode; and

a plurality of cathodes being electrically insulated from one another and being disposed on the corresponding organic functional layers, each cathode being electrically coupled with the corresponding second drain, respectively.

14. The active matrix organic electro-luminescence display panel of claim 13, further comprising:

a passivation layer covering the driving circuits and part of the common anode.

15. The active matrix organic electro-luminescence display panel of claim 14, further comprising:

a blocking pattern disposed on the passivation layer so as to insulate the cathodes from one another.

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16. The active matrix organic electro-luminescence display panel of claim 15, further comprising:

an organic material layer disposed on the insulating pattern; and

a conducting material layer disposed on the organic material layer, wherein a material of the organic material layer and that of the organic functional layers are identical, and a material of the conducting material layer and the cathodes are identical.

17. The active matrix organic electro-luminescence display panel of claim 13, each organic functional layer comprising:

a hole transport layer disposed on the common anode;

an organic electro-luminescence layer disposed on the hole transport layer; and

an electron transport layer disposed on the organic electro-luminescence layer.

* * * * *

专利名称(译)	有源矩阵有机电致发光显示板		
公开(公告)号	US7935959	公开(公告)日	2011-05-03
申请号	US11/563524	申请日	2006-11-27
[标]申请(专利权)人(译)	铼宝科技股份有限公司		
申请(专利权)人(译)	铼宝科技股份有限公司		
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IPC分类号	H01L51/50 H01L51/52		
CPC分类号	G09G3/3233 H01L27/3244 G09G2300/0417 G09G2300/0842 H01L27/3276 H01L27/3246 G09G2320/043		
优先权	095128590 2006-08-04 TW		
其他公开文献	US20080030451A1		
外部链接	Espacenet USPTO		

摘要(译)

提供一种有源矩阵有机电致发光显示面板，包括基板，有机电致发光器件阵列和驱动电路阵列。有机电致发光器件阵列包括多个有机电致发光器件，这些有机电致发光器件以阵列形式布置在基板中，并且驱动电路阵列包括在基板上排列成阵列的多个驱动电路。驱动电路适合于通过高压源和低压源驱动相应的有机电致发光器件。另外，驱动电路包括扫描线，数据线和控制单元。控制单元与扫描线，数据线和低压源电耦合。有机电致发光器件电耦合在控制单元和高压源之间。此外，相应的有机电致发光器件电耦合在控制单元和高压源之间。

