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(54) LIQUID CRYSTAL DISPLAY PANEL, THIN FILM TRANSISTOR ARRAY SUBSTRATE AND DETECTION METHODS THEREFOR

(76) Inventors: **Kuang-Hsiang Lin**, Taoyuan County (TW); **Yuan-Hao Chang**, Taipei City (TW)

Correspondence Address:
JIANQ CHYUN INTELLECTUAL PROPERTY OFFICE
7 FLOOR-1, NO. 100
ROOSEVELT ROAD, SECTION 2
TAIPEI 100 (TW)

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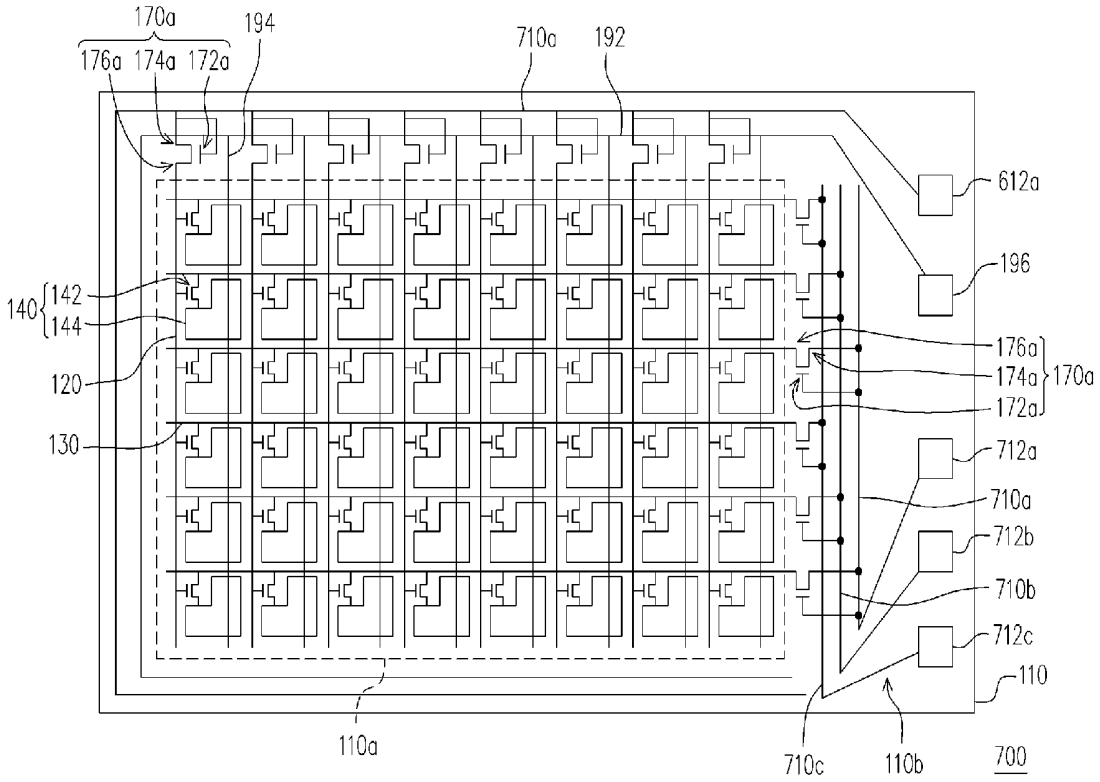
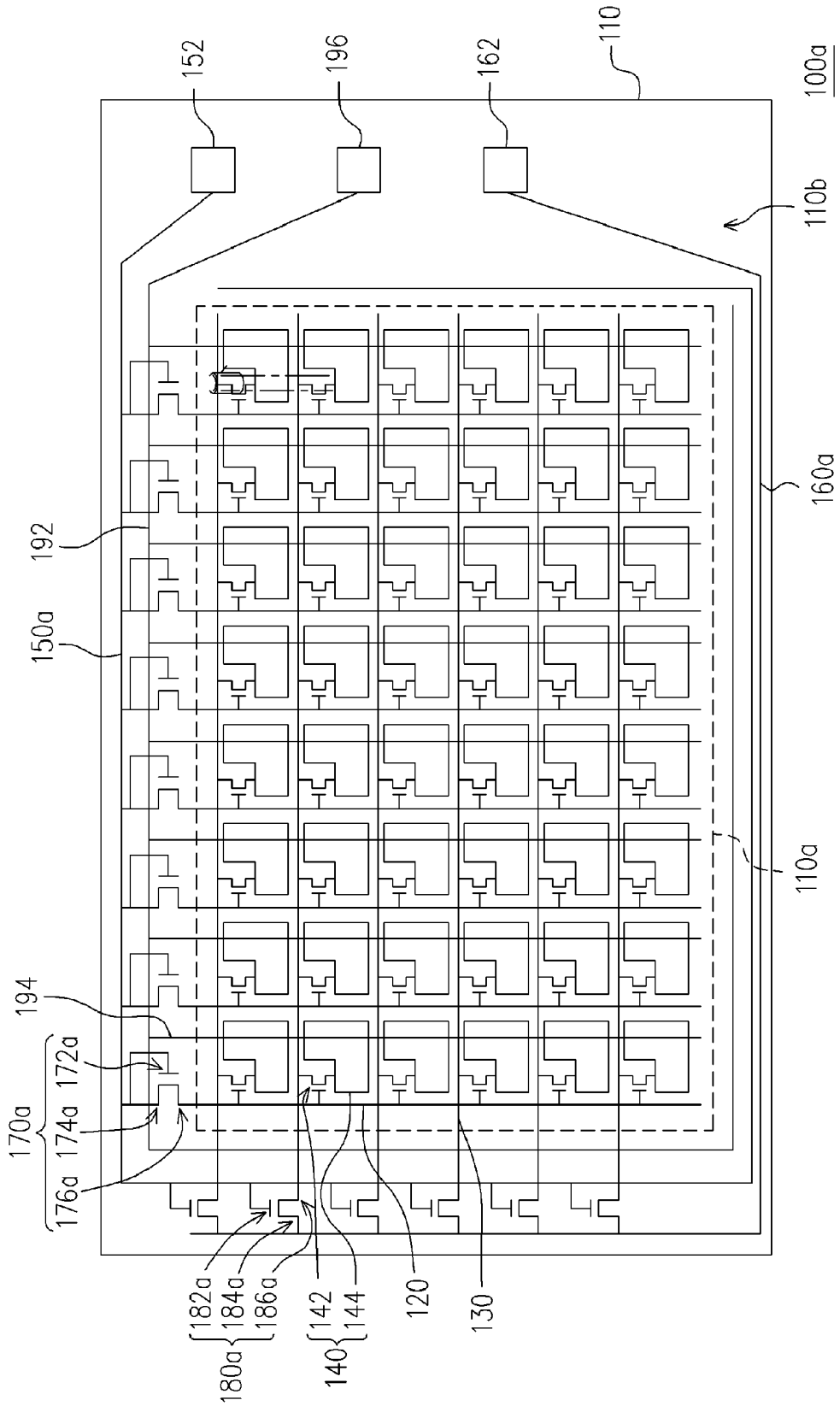
(57) **ABSTRACT**

A thin film transistor (TFT) array substrate including a substrate, pixel units, scan and data lines, inner anti-static rings, first and second thin film transistors is provided. The pixel units are arranged on a display region of the substrate, and the scan and data lines are arranged on the substrate. Each pixel unit is controlled by the corresponding scan and data line. The inner anti-static rings, the first and second TFTs are arranged on a peripheral circuit region of the substrate around the display region. The gate and source of each first TFT are connected to one part of the inner anti-static ring, and the drain of each first TFT is connected to the scan line respectively. The gate and source of each second TFT are connected to the other part of the inner anti-static ring, and the drain of each second TFT is connected to the data line respectively.

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196
162
110
100a
110b
160a
192
150a
110a
194
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170a
174a
176a
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184a
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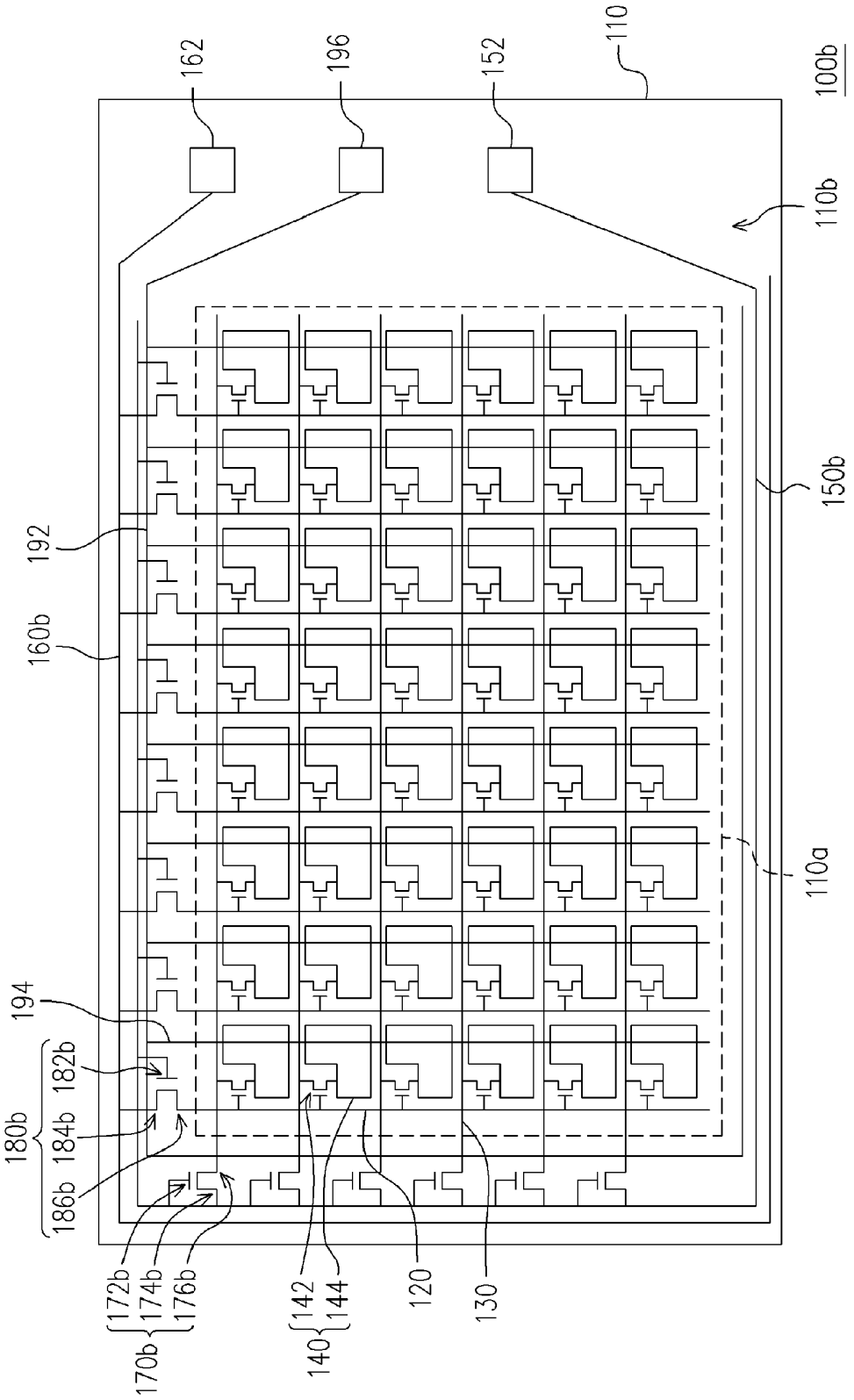
180a
142
144
140
120
130

FIG. 1A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160b
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176b
170b
142
144
140
120
130
110a

FIG. 1B

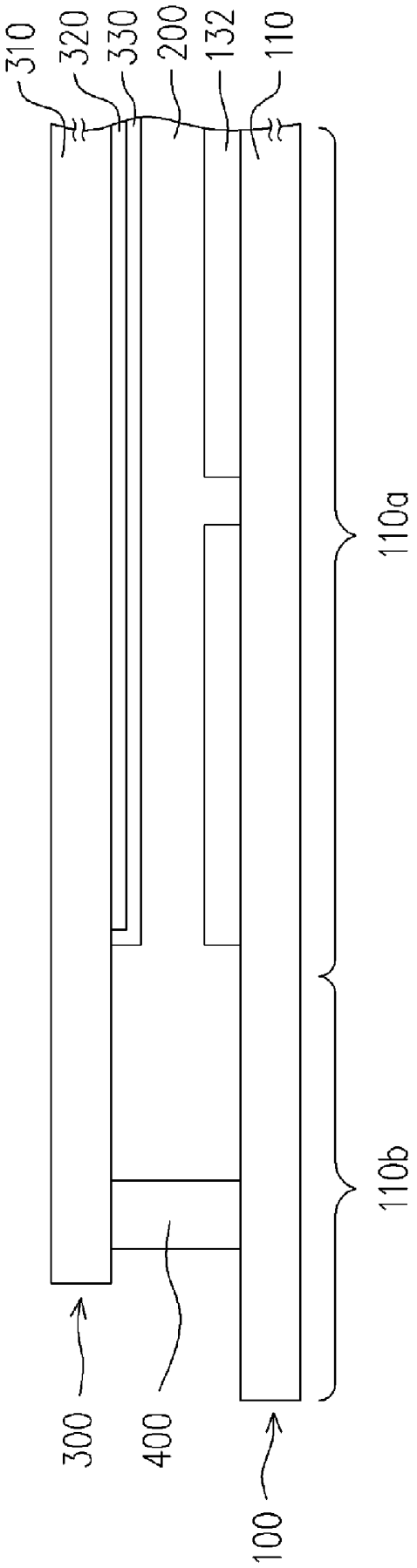
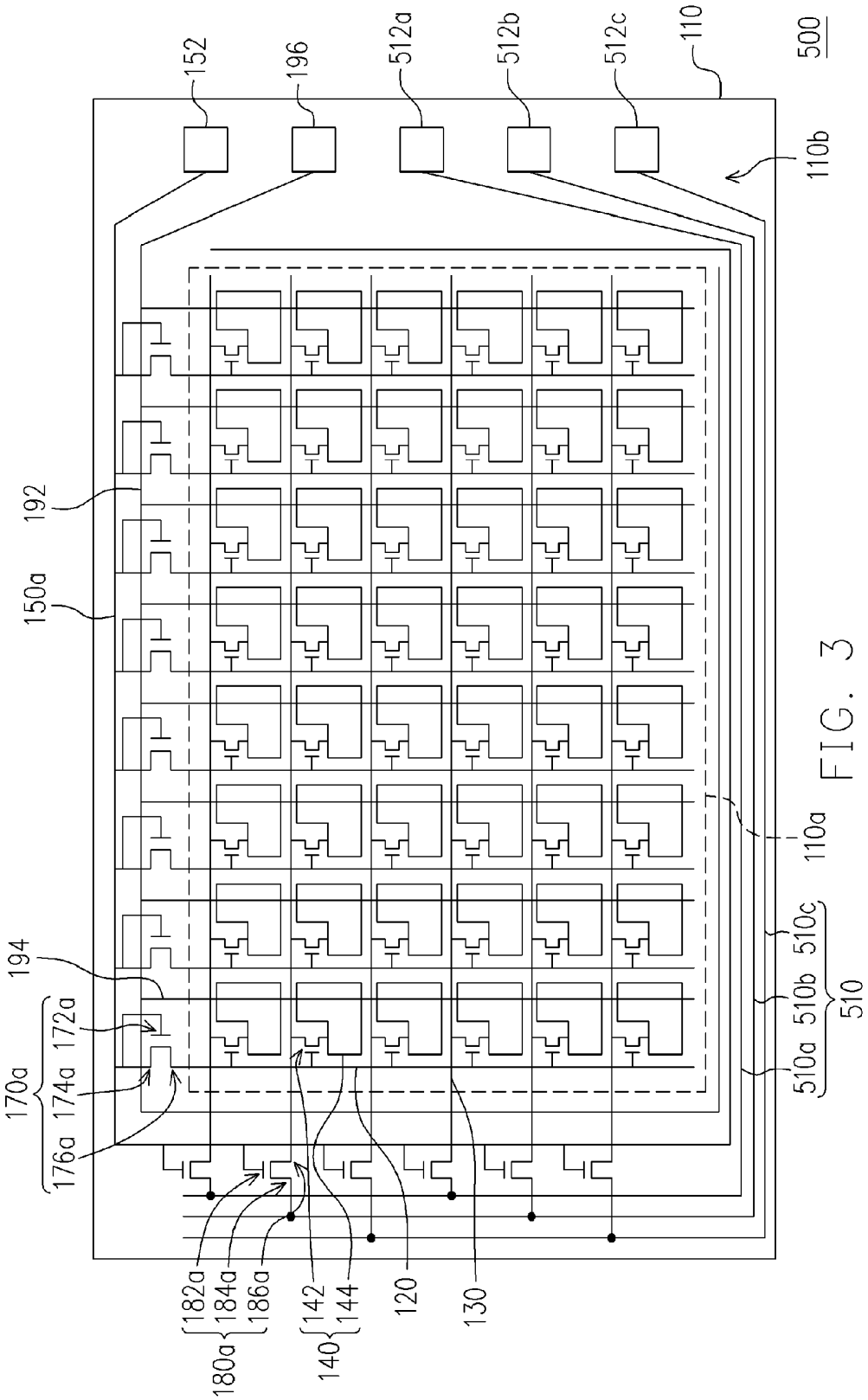


FIG. 2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512b
512c
110
500
110b
192
150a
194
172a
170a
174a
176a
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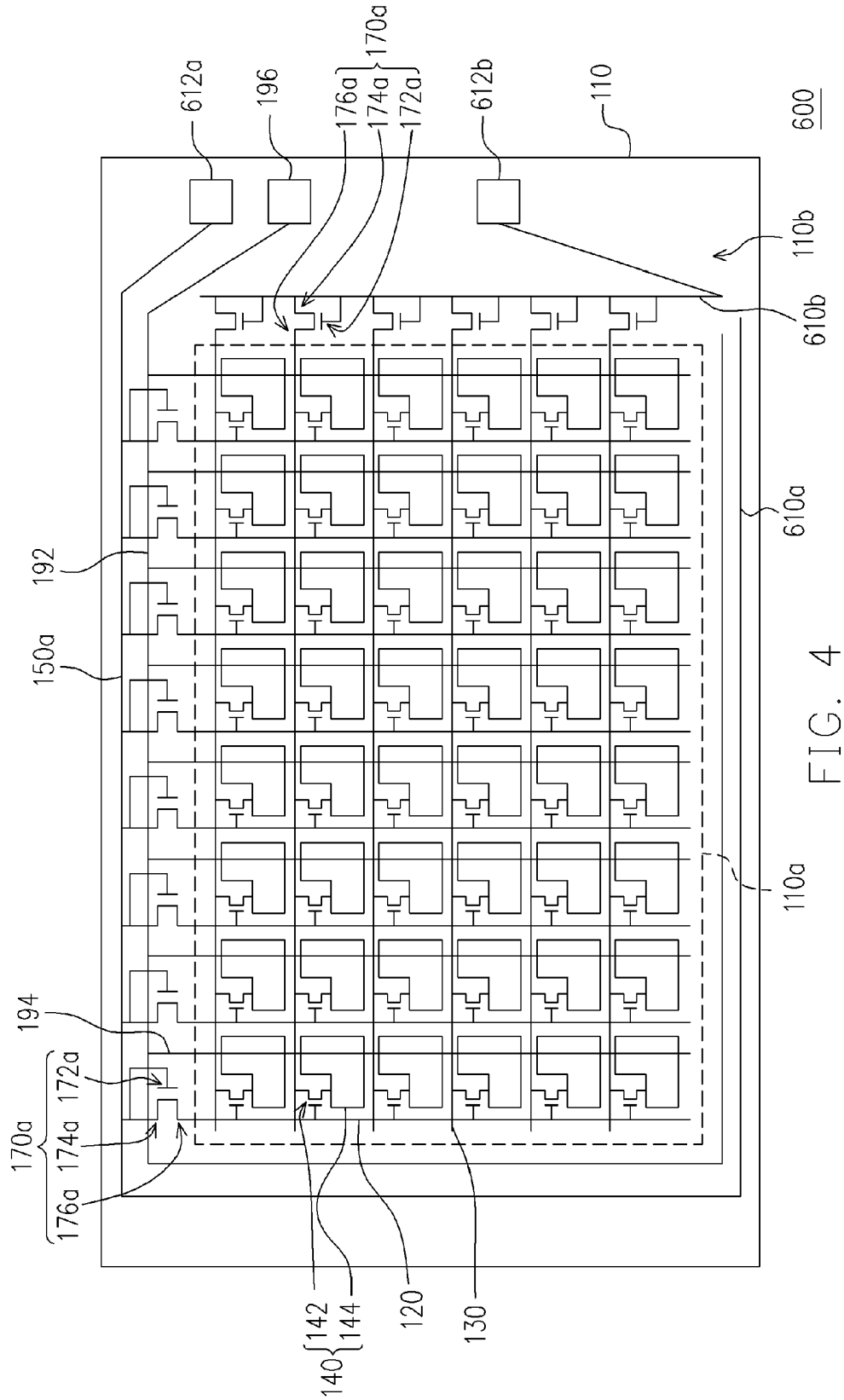
510c
510b
510
510a
182a
184a
186a
180a
142
144
140
120
130

FIG. 3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600
110b
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610a
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172a
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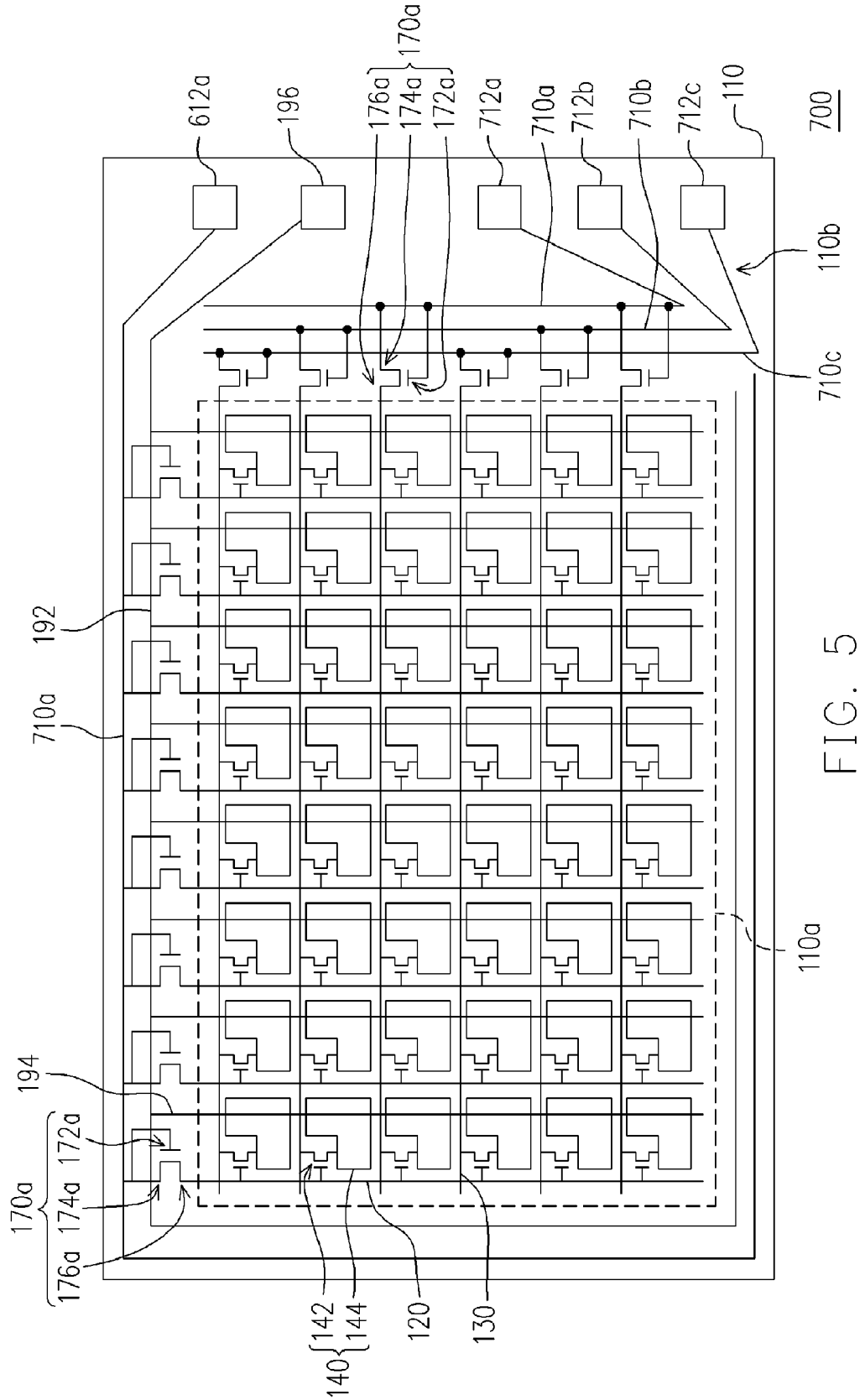
174a
176a
142
144
140
120
130

FIG. 4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176a
174a
172a
170a
712a
710a
712b
710b
712c
110
700
110b
710c
192
710a
194
172a
170a
174a
176a
142
144
140
120
130
110a

FIG. 5

LIQUID CRYSTAL DISPLAY PANEL, THIN FILM TRANSISTOR ARRAY SUBSTRATE AND DETECTION METHODS THEREFOR

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention generally relates to a display panel, an active device array substrate and detection methods thereof. More particularly, the present invention relates to a liquid crystal display panel, a thin film transistor array substrate and detection methods thereof.

[0003] 2. Description of Related Art

[0004] Since the demand of displays is drastically increasing, the industry has devoted full efforts to develop display devices and their associated products. Among these display devices, a cathode ray tube (CRT) had occupied the market for a long time because it had excellent display quality and technology maturity. However, the larger power consumption and the higher radiation features of the CRT contradict to the green environment concept. In addition, to further minimize the occupied space of a CRT is limited. As a result, the CRT can not meet the market trend of a lightweight, thin, short, compact, appealing and low-power consumption product. Accordingly, a thin film transistor liquid crystal display (TFT-LCD) having the features of high image quality, optimal space efficiency and low power consumption has become a mainstream in the market.

[0005] The TFT-LCD module mainly comprises a liquid crystal display panel and a backlight module. The liquid crystal display panel generally comprises a thin film transistor array substrate, a color filter substrate and a liquid crystal layer sandwiched between them. The backlight module is to providing a surface light source for the liquid crystal display panel, to achieve the display effect.

[0006] The thin film transistor array substrate comprises a display region and a peripheral circuit region. A plurality of pixel units arranged in an array are formed on the display region. Each pixel unit comprises a thin film transistor and a pixel electrode connected thereto. Besides, a plurality of scan lines and data lines are arranged on the peripheral circuit region and the display region. The thin film transistor of each pixel unit is controlled by the corresponding scan line and data line.

[0007] After the fabrication process of the thin film transistor array substrate, an electrical test is usually performed on the pixel unit of the thin film transistor array substrate, to determine whether the pixel unit is normal or not. If the pixel unit is abnormal, it needs to repair the abnormal device (such as thin film transistor or pixel electrode . . . etc.) or circuit. However, a detection circuit should be formed on the peripheral circuit region of the thin film transistor array substrate in order to perform the electrical test. It should be noted that the detection circuit is complex, and the layout region of the panel would narrow down because of the detection circuit. Besides, after the electrical test is performed, the detection circuit would be disabled by laser cutting technology, to avoid affecting the display quality of the liquid crystal display panel.

[0008] Furthermore, the external factors such as manual transportation or changes in the environment may lead to the static charges accumulation in the liquid crystal display panel. When the static charges exceed a definite amount, an electrostatic discharge may occur and this would damage the lines or the thin film transistor on the thin film transistor array substrate. Therefore, an electrostatic discharge (ESD) protection circuit is formed on the peripheral circuit region, to avoid the damages resulted from electrostatic discharge.

[0009] However, to achieve the above mentioned electrical test and ESD protection functions, the detection circuit and the ESD protection circuit should be fabricated on the peripheral circuit region of the thin film transistor array substrate simultaneously. So, it will make the layout of the peripheral circuit region more complex and the space for the layout may not be enough. And this doesn't help simplify the fabrication process and promote the productivity efficiency.

SUMMARY OF THE INVENTION

[0010] Accordingly, the present invention is directed to a thin film transistor array substrate with a simpler layout.

[0011] The present invention is also directed to providing a liquid crystal display panel with a simpler detection circuit.

[0012] The present invention is directed to providing a detection method for detecting whether a short circuit occurs between the lines of the thin film transistor array substrate or not.

[0013] The present invention is also directed to providing a detection method for detecting whether the display of the liquid crystal display panel is normal or not.

[0014] To achieve the above and other objects, the present invention provides a thin film transistor array substrate comprising a substrate, a plurality of pixel units, a plurality of scan lines, a plurality of data lines, a plurality of inner anti-static rings, a plurality of first and second thin film transistors. The substrate comprises a display region and a peripheral circuit region around the display region. The pixel units are arranged on the display region. The scan lines and data lines are arranged on the substrate, and the pixel units are controlled by the scan lines and data lines. The inner anti-static rings are arranged on the peripheral circuit region, and the first and second thin film transistors are also arranged on the peripheral circuit region. Each first thin film transistor comprises a gate, a source and a drain. The gates and the sources are connected to one part of the inner anti-static rings, and the drains are connected to the scan lines respectively. Each second thin film transistor comprises a gate, a source and a drain. The gates and the sources are connected to the other part of the inner anti-static rings, and the drains are connected to the data lines respectively.

[0015] According to an embodiment of the present invention, the thin film transistor array substrate may further comprise a plurality of detection pads arranged on the peripheral circuit region. One end of each inner anti-static ring is connected to one of the detection pad.

[0016] According to an embodiment of the present invention, each pixel unit comprises an active device and a pixel electrode. The active device is connected to one of the scan lines and data lines, and the pixel electrode is connected to the active device.

[0017] According to an embodiment of the present invention, the thin film transistor array substrate may further

comprise a plurality of common lines and a detection trace connected to one end of the common lines. The common lines are arranged on the substrate and the detection trace is arranged on the peripheral circuit region.

[0018] To achieve the above and other objects, the present invention provides a liquid crystal display panel comprising a thin film transistor array substrate, a color filter substrate and a liquid crystal layer sandwiched between them. The thin film transistor array substrate comprises a substrate, a plurality of pixel units, a plurality of scan lines, a plurality of data lines, a plurality of inner anti-static rings, a plurality of first and second thin film transistors. The substrate comprises a display region and a peripheral circuit region around the display region. The pixel units are arranged on the display region. The scan lines and data lines are arranged on the substrate, and the pixel units are controlled by the scan lines and data lines. The inner anti-static rings are arranged on the peripheral circuit region, and the first and second thin film transistors are also arranged on the peripheral circuit region. Each first thin film transistor comprises a gate, a source and a drain. The gates and the sources are connected to one part of the inner anti-static rings, and the drains are connected to the scan lines respectively. Each second thin film transistor comprises a gate, a source and a drain. The gates and the sources are connected to the other part of the inner anti-static rings, and the drains are connected to the data lines respectively.

[0019] According to an embodiment of the present invention, the thin film transistor array substrate may further comprise a plurality of detection pads arranged on the peripheral circuit region. One end of each inner anti-static ring is connected to the corresponding detection pad.

[0020] According to an embodiment of the present invention, each pixel unit comprises an active device and a pixel electrode. The active device is connected to one of the scan lines and data lines, and the pixel electrode is connected to the active device.

[0021] According to an embodiment of the present invention, the thin film transistor array substrate may further comprise a plurality of common lines and a detection trace connected to one end of the common lines. The common lines are arranged on the substrate and the detection trace is arranged on the peripheral circuit region.

[0022] To achieve the above and other objects, the present invention provides a detection method suitable for the above mentioned liquid crystal display panel. The detection method comprises the following steps. First, a light source is provided and the liquid crystal display panel is arranged on the light source. A scan signal is transmitted to the scan lines through the inner anti-static rings. A data signal is transmitted to the data lines through the inner anti-static rings for displaying images on the liquid crystal display panel.

[0023] According to an embodiment of the present invention, after the scan signal and the data signal are transmitted, the liquid crystal display panel displays a black screen, a white screen or a gray level screen.

[0024] According to an embodiment of the present invention, after the scan signal and the data signal are transmitted, the liquid crystal display panel displays a red screen, a green screen or a blue screen.

[0025] To achieve the above and other objects, the present invention provides a thin film transistor array substrate comprising a substrate, a plurality of pixel units, a plurality of first lines, a plurality of second lines, an inner anti-static ring, a circuit, a plurality of first and second thin film transistors. The substrate comprises a display region and a peripheral circuit region around the display region. The pixel units are arranged on the display region. The first and second lines are arranged on the substrate, and the pixel units are controlled by the first lines and second lines. The inner anti-static ring, the circuit, the first and second thin film transistors are arranged on the peripheral circuit region. Each first thin film transistor comprises a gate, a source and a drain. The gates and the sources are connected to the inner anti-static ring, and the drains are connected to the first lines respectively. Each second thin film transistor comprises a gate, a source and a drain. The gates are connected to the inner anti-static ring, the sources are connected to the circuit, and the drains are connected to the second lines respectively.

[0026] According to an embodiment of the present invention, the above mentioned first lines may be scan lines and the second lines may be data lines.

[0027] According to an embodiment of the present invention, the above mentioned first lines may be data lines and the second lines may be scan lines.

[0028] According to an embodiment of the present invention, the circuit may comprise a plurality of lines, and the sources of the second thin film transistors are connected to the lines respectively.

[0029] According to an embodiment of the present invention, the thin film transistor array substrate may further comprise a plurality of detection pads arranged on the peripheral circuit region, and one end of the inner anti-static ring and the circuit are connected to one of the detection pads respectively.

[0030] According to an embodiment of the present invention, each pixel unit may comprise an active device and a pixel electrode. The active device is connected to one of the first lines and second lines, and the pixel electrode is connected to the active device.

[0031] According to an embodiment of the present invention, the thin film transistor array substrate may further comprise a plurality of common lines and a detection trace connected to one end of the common lines. The common lines are arranged on the substrate and the detection trace is arranged on the peripheral circuit region.

[0032] To achieve the above and other objects, the present invention provides a detection method suitable for the above mentioned thin film transistor array substrate. The detection method comprises the following steps. A current signal is transmitted to the first lines through the inner anti-static ring. Then, detection is performed on the circuit. If the current signal is detected, a short circuit occurs between the first lines and the second lines.

[0033] To achieve the above and other objects, the present invention provides a detection method suitable for the above mentioned thin film transistor array substrate. The detection method comprises the following steps. A current signal is transmitted to the first lines through the inner anti-static ring. Then, detection is performed on the lines. If the current

signal is detected from the line, a short circuit occurs between the first lines and the second lines corresponding to the line.

[0034] To achieve the above and other objects, the present invention provides a detection method suitable for the above mentioned thin film transistor array substrate. The detection method comprises the following steps. A current signal is transmitted to the first lines through the inner anti-static ring. Then, detection is performed on the detection trace. If the current signal is detected, it means that a short circuit occurs between the first lines and the common lines.

[0035] According to an embodiment of the present invention, the mentioned first lines may be scan lines and the second lines may be data lines.

[0036] According to an embodiment of the present invention, the mentioned first lines may be data lines and the second lines may be scan lines.

[0037] To achieve the above and other objects, the present invention provides a liquid crystal display panel comprising a thin film transistor array substrate, a color filter substrate and a liquid crystal layer sandwiched between them. The thin film transistor array substrate comprises a substrate, a plurality of pixel units, a plurality of first lines and second lines, an inner anti-static ring, a circuit, a plurality of first and second thin film transistors. The substrate comprises a display region and a peripheral circuit region around the display region. The pixel units are arranged on the display region, and the first and second lines are arranged on the substrate. The pixel units are controlled by the first lines and second lines. The inner anti-static ring, the circuit, the first and second thin film transistors are arranged on the peripheral circuit region. Each first thin film transistor comprises a gate, a source and a drain. The gates and the sources are connected to the inner anti-static ring, and the drains are connected to the first lines respectively. Each second thin film transistor comprises a gate, a source and a drain. The gates are connected to the inner anti-static ring, the sources are connected to the circuit, and the drains are connected to the second lines respectively.

[0038] According to an embodiment of the present invention, the above mentioned first lines may be scan lines and the second lines may be data lines.

[0039] According to an embodiment of the present invention, the above mentioned first lines may be data lines and the second lines may be scan lines.

[0040] According to an embodiment of the present invention, the circuit comprises a plurality of lines. The sources of the second thin film transistors are connected to the lines respectively.

[0041] According to an embodiment of the present invention, the thin film transistor array substrate further comprises a plurality of detection pads arranged on the peripheral circuit region, and one end of the inner anti-static ring and the circuit are connected to one of the detection pads respectively.

[0042] According to an embodiment of the present invention, each pixel unit comprises an active device and a pixel electrode. The active device is connected to one of the first lines and second lines, and the pixel electrode is connected to the active device.

[0043] According to an embodiment of the present invention, the above mentioned thin film transistor array substrate further comprises a plurality of common lines and a detection trace connected to one end of the common lines. The common lines are arranged on the substrate and the detection trace is arranged on the peripheral circuit region.

[0044] To achieve the above and other objects, the present invention provides a detection method suitable for the above mentioned liquid crystal display panel. The detection method comprises the following steps. First, a light source is provided and the liquid crystal display panel is arranged on the light source. A first signal is transmitted to the first lines through the inner anti-static ring. A second signal is transmitted to the second lines through the circuit, to make the liquid crystal display panel display a black screen, a white screen or a gray level screen.

[0045] To achieve the above and other objects, the present invention provides a detection method suitable for the above mentioned liquid crystal display panel. The detection method comprises the following steps. First, a light source is provided and the liquid crystal display panel is arranged on the light source. A first signal is transmitted to the first lines through the inner anti-static ring. A second signal is transmitted to the second lines through the lines, to make the liquid crystal display panel display a red screen, a green screen or a blue level screen.

[0046] According to an embodiment of the present invention, the above mentioned first lines may be scan lines and the second lines may be data lines.

[0047] According to an embodiment of the present invention, the above mentioned first lines may be data lines and the second lines may be scan lines.

[0048] In summary, the invention takes the inner anti-static ring as a part or whole of the detection circuit, so the detection circuit and the ESD protection circuit can be integrated together. Besides, compared with the prior art, the invention has less detection pads and a simpler layout.

BRIEF DESCRIPTION OF THE DRAWINGS

[0049] 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.

[0050] FIGS. **1**A and **1**B are schematic views showing a thin film transistor array substrate according to the first embodiment of the present invention.

[0051] FIG. **2** is a cross-sectional view showing a thin film transistor array substrate according to the first embodiment of the present invention.

[0052] FIG. **3** is a schematic view showing a thin film transistor array substrate according to the second embodiment of the present invention.

[0053] FIG. **4** is a schematic view showing a thin film transistor array substrate according to the third embodiment of the present invention.

[0054] FIG. **5** is a schematic view showing a thin film transistor array substrate according to the fourth embodiment of the present invention.

DESCRIPTION OF THE EMBODIMENTS

[0055] Reference will now be made in detail to the present embodiments of the invention, examples of which are illustrated in the accompanying drawings. Wherever possible, the same reference numbers are used in the drawings and the description to refer to the same or like parts.

First Embodiment

[0056] FIGS. 1A and 1B are schematic views showing a thin film transistor array substrate according to the first embodiment of the present invention. First, please refer to FIG. 1A, the thin film transistor array substrate **100***a* comprises a substrate **110**, a plurality of scan lines **120**, a plurality of data lines **130**, a plurality of pixel units **140**, an inner anti-static ring **150***a*, a circuit **160***a*, a plurality of first thin film transistors **170***a* and a plurality of second thin film transistors **180***a*. The substrate **110** comprises a display region **110***a* and a peripheral circuit region **110***b*. The substrate **110** may comprise a quartz substrate, a glass substrate or other transparent substrate.

[0057] The scan lines **120** and data lines **130** are arranged on the substrate **110**, and the pixel units **140** are arranged on the display region **110***a*. Besides, each pixel unit **140** is controlled by the corresponding scan line **120** and data line **130**. Further, each pixel unit **140** comprises an active device **142** and a pixel electrode **144**. The active device **142** is connected to the corresponding scan line **120** and data line **130**, and the pixel electrode **144** is connected to the active device **142**. In this embodiment, the active device **142** is a thin film transistor. However, it can be a low temperature poly silicon thin film transistor (LTPS-TFT) or other active device.

[0058] The inner anti-static ring **150***a*, the circuit **160***a*, the first thin film transistors **170***a* and the second thin film transistors **180***a* are arranged on the peripheral circuit region **110***b*. The first thin film transistors **170***a* comprises a gate **172***a*, a source **174***a* and a drain **176***a*. The gate **172***a* and the source **174***a* are connected to the inner anti-static ring **150***a*, and the drain **176***a* is connected to the corresponding scan line **120**. Besides, the second thin film transistor **180***a* comprises a gate **182***a*, a source **184***a* and a drain **186***a*. The gate **182***a* is connected to the inner anti-static ring **150***a*, the source **184***a* is connected to the circuit **160***a*, and the drain **186***a* is connected to the corresponding data line **130**.

[0059] In this embodiment, the thin film transistor array substrate **100***a* may further comprise a detection trace **192** and a plurality of common lines **194**. These common lines **194** are arranged on the substrate **110** and the detection trace **192** is arranged on the peripheral circuit region **110***b*. Besides, one end of each common line **194** is connected to the detection trace **192**. In addition, the detection pads **152** and **162** can also be arranged at one end of the inner anti-static ring **150***a* and circuit **160***a* respectively. Similarly, the detection pad **196** can also be arranged at one end of the detection trace **192**.

[0060] The gate **172***a* and the source **174***a* of the first thin film transistor **170***a* are connected to the inner anti-static ring **150***a*, and the gate **182***a* of the second thin film transistor **180***a* is connected to the inner anti-static ring **150***a*. So, when the electrostatic charges are conducted to the inner anti-static ring **150***a*, the first thin film transistor **170***a* and the second thin film transistor **180***a* can be turned on, and the electrostatic charges can be conducted to each scan line **120** through each first thin film transistor **170***a*. In other words, the inner anti-static ring **150***a* may conduct the electrostatic charges to the whole thin film transistor array substrate **100***a*, to avoid damaging the circuit resulted from the electrostatic charges. So, the first thin film transistor **170***a*, the second thin film transistor **180***a* and the inner anti-static ring **150***a* can be called the ESD protection circuit of the thin film transistor array substrate **100***a*. Besides, the first thin film transistor **170***a* and the second thin film transistor **180***a* can be called the ESD protection devices. It should be noted that the first thin film transistor **170***a*, the second thin film transistor **180***a* and the inner anti-static ring **150***a* can not also be the ESD protection circuit but also a detection circuit of the thin film transistor array substrate **100***a*.

[0061] The detection method suitable for the thin film transistor array substrate **100***a* comprises the following steps. First, a probe (not shown) touches the detection pad **152** to let a current signal be conducted to these scan lines **120** through the inner anti-static ring **150***a*. The voltage level of the current signal is the VGH for the first thin film transistor **170***a* and the second thin film transistor **180***a*. So, the current signal can travel through each first thin film transistor **170***a* to each scan lines **120**. Then, let the probe touch the detection pad **162** in order to measure the circuit **160***a*. If a short circuit occurs between the scan lines **120** and the data lines **130**, the current signal would be conducted to the drain **186***a* of the second thin film transistor **180***a* through the scan line **120** and data line **130**. At this time, because the second thin film transistor **180***a* is turned on, the current signal would be conducted to the detection pad **162** through the circuit **160***a*. In other words, if the current signal is detected from the detection pad **162**, it means that a short circuit occurs between the scan lines **120** and data lines **130**.

[0062] Similarly, the above mentioned method is also suitable for detecting whether a short circuit occurs between the scan line **120** and the common line **194** or not. In brief, let the current signal be conducted to the scan lines **120** through the detection pad **152** and the inner anti-static ring **150***a*. If a short circuit occurs between the scan line **120** and the common line **194**, the current signal would be conducted to the detection pad **196** through the scan line **120**, the common line **192** and the detection trace **192** sequentially. So, the inspector may determine whether a short circuit occurs between the scan lines **120** and the common lines **194** according to the measurement of the current signal.

[0063] Because the inner anti-static ring **150***a*, the first thin film transistor **170***a* and the second thin film transistor **180***a* can be a part of the detection circuit, the thin film transistor array substrate **100***a* has more areas for the layout compared with the prior art. Besides, the circuit for detecting the thin film transistor array substrate **100***a* can be simplified and the detection time is shorter, to improve the production efficiency. Further, the number of the detection pads can be reduced. It should be noted that the above mentioned first thin film transistor **170***a* is connected to the scan line **120** and the second thin film transistor **180***a* is connected to the data line **130**, but the connection manner can be reversed as the following.

[0064] Please refer to FIG. 1B, in the thin film transistor array substrate **100***b*, the gate **172***b* and the source **174***b* of

the first thin film transistor **170***b* are connected to the inner anti-static ring **150***b*, and the drain **176***b* of the first thin film transistor **170***b* is connected to the data line **130**. Besides, the gate **182***b* of the second thin film transistor **180***b* is also connected to the inner anti-static ring **150***b*, and the source **184***b* of the second thin film transistor **180***b* is also connected to the circuit **160***b*. In addition, the drain **186***b* of the second thin film transistor **180***b* is connected to the scan line **120**.

[**0065**] Similarly, the detection method suitable for the thin film transistor array substrate **100***b* comprises the following steps. First, a current signal is transmitted to the data lines **130** through the detection pad **152** and the inner anti-static ring **150***b*. Because the voltage level of the current signal is the VGH for the first thin film transistor **170***b* and the second thin film transistor **180***b*. So, the current signal can travel through each first thin film transistor **170***b* to each data lines **130**. If a short circuit occurs between the data lines **130** and the scan lines **120**, the current signal would be conducted to the detection pad **162** through the data line **130**, scan line **120** and the circuit **160***b*. However, the same method can also apply to determine whether a short circuit occurs between the data line **130** and the common line **194** or not. In brief, a current signal is transmitted to the detection pad **152**, then, the detection pad **196** is detected to see if the current signal is detected therefrom in order to determine whether a short circuit occurs between the data line **130** and the common line **194** or not. It should be noted that after the panel is fabricated, a testing should also be performed on the panel, and the testing taken the above mentioned thin film transistor array substrate **100***a* as an example is interpreted in the following.

[**0066**] FIG. **2** is a cross-sectional view showing a thin film transistor array substrate according to the first embodiment of the present invention. FIG. **2** only shows the necessary elements in order to simplify the drawing. Please refer to FIG. **1**A and FIG. **2**, the liquid crystal display panel **10** comprises a thin film transistor array substrate **100***a*, a liquid crystal layer **200** and a color filter substrate **300**. The color filter substrate **300** attaches the thin film transistor array substrate **100***a* by a sealant **400**. Besides, the liquid crystal layer **200** is arranged in a closed space constructed by the color filter substrate **300**, the thin film transistor array substrate **100***a* and the sealant **400**. Besides, the color filter substrate **300** comprises a substrate **310**, a color filter layer **320** and a common electrode layer **330**. The color filter layer **320** is sandwiched between the substrate **310** and the common electrode layer **330**, and the common electrode layer **330** faces the thin film transistor array substrate **100***a*.

[**0067**] The detection method apply to the above mentioned liquid crystal display panel **10** comprises the following steps. First, the liquid crystal display panel **10** is arranged on a light source (not shown). A scan signal is transmitted to the scan lines **120** through the detection pad **152**, the inner anti-static ring **150***a* and the first transistors **170***a*. A data signal is transmitted to the data lines **130** through the detection pad **152**, the circuit **160***a* and the second transistors **180***a* for displaying a black screen, a white screen or a gray level screen on the liquid crystal display panel **10**. Besides, the above mentioned scan signal and data signal can be separately transmitted to the scan lines **120** and data lines **130** at the same time. It should be noted that when the liquid crystal display panel **10** operates, a turn-off voltage level of the first transistors **170***a* and the second transistors **180***a* can be transmitted to the inner anti-static ring **150***a* in order to avoid signal interference.

[**0068**] Similarly, the above mentioned method can also apply to the thin film transistor array substrate **100***b* as a part of the liquid crystal display panel **10**. In details, a data signal is transmitted to the data lines **130** through the detection pad **152**, the inner anti-static ring **150***b* and the first transistors **170***a*. A scan signal is transmitted to the scan lines **130** through the detection pad **162**, the circuit **160***b* and the second transistors **180***b* for displaying a black screen, a white screen or a gray level screen on the liquid crystal display panel **10**. It should be noted that the data signal should overlap the scan signal.

Second Embodiment

[**0069**] FIG. **3** is a schematic view showing a thin film transistor array substrate according to the second embodiment of the present invention. Please refer to FIG. **3**, the content of FIG. **3** is similar to that of FIG. **1**, the difference is that the circuit **510** of the thin film transistor array substrate **500** comprises lines **510***a*, **510***b* and **510***c*. Besides, the detection pad **512***a*, **512***b* and **512***c* can be arranged at one end of the lines **510***a*, **510***b* and **510***c* in order to input signals or measure signals.

[**0070**] For a short circuit detection, the detection method for the thin film transistor array substrate **500** comprises the step of transmitting current signals to the scan lines **120** through the detection pad **152**, the inner anti-static ring **150***a* and the first transistors **170***a*. Then, each detection pad **512***a*, **512***b* and **512***c* is measured respectively in order to determine that a short circuit occurs between the scan lines **120** and data lines **130** connected to the detection pad **512***a*, **512***b* and **512***c*. For example, if a current signal is measured from the detection pad **512***a*, it means that a short circuit occurs between the scan line **120** and data line **130** connected to the detection pad **512***a*. Similarly, the above mentioned method can also apply to determine that if a short circuit occurs between the common line **194** and the data line **130** connected to each detection pad **512***a*, **512***b* and **52***c*.

[**0071**] If the thin film transistor array substrate **500** has been fabricated to become a panel (similar to FIG. **2**), the detection method may comprise the step of transmitting a scan signal to the scan lines **120** through the detection pad **152**, the inner anti-static ring **150***a* and the first transistors **170***a*. The data signals indicating red, green and blue are transmitted to the data lines **130** through the corresponding lines **510***a*, **510***b* and **510***c*. In order words, compared to FIG. **2**, the embodiment can detect red, green or blue screen respectively.

[**0072**] Similarly, the circuit **160***b* shown in FIG. **1**B can be divided into two kinds of lines connected to the odd and even scan lines **120**, to determine that if a short circuit occurs between the data line **130** and the odd or even scan lines **120**. Similarly, the above mentioned detection method can also apply to determine that if a short circuit occurs between the common line **194** and the odd or even scan lines **120**. Besides, the above mentioned detection method can also apply to the liquid crystal display panel comprising this type of thin film transistor array substrate.

Third Embodiment

[**0073**] FIG. **4** is a schematic view showing a thin film transistor array substrate according to the third embodiment

of the present invention. Please refer to FIG. **4**, the content of FIG. **4** is similar to that of FIG. **1**, the difference is that a portion of the first transistors **170***a* of the thin film transistor array substrate **600** are connected to the inner anti-static ring **610***a* and the scan line **120** respectively and the other portion of the first transistors **170***a* are connected to the inner anti-static ring **610***b* and the data line **130**. In other words, the thin film transistor array substrate **600** doesn't comprise a circuit similar to the circuit **160***a* shown in FIG. **1**A. Besides, the detection pads **612***a* and **612***b* can also be arranged at one end of the inner anti-static rings **610***a* and **610***b*.

[**0074**] Similarly, the above mentioned detection method can also apply to determine that if a short circuit occurs between the common line **194** and the scan line **120**. In brief, a current signal is transmitted to the scan line **120** through the detection pad **612***a*, the inner anti-static rings **610***a* and the first transistor **170***a*. Then, the detection pad **196** is detected. If the input current signal is measured, it means that a short circuit occurs between the scan line **120** and the common line **194**. Similarly, the same method can also apply to detect if a short circuit occurs between the common line **194** and the data line **130**.

[**0075**] If the thin film transistor array substrate **600** has been fabricated to become a panel (similar to FIG. **2**), the detection method may comprise the step of transmitting the scan signal and the data signal to the scan lines **120** and data lines **130** through the inner anti-static ring **610***a* and **610***b*, to perform the white screen, black screen or gray level screen detection.

Fourth Embodiment

[**0076**] FIG. **5** is a schematic view showing a thin film transistor array substrate according to the fourth embodiment of the present invention. Please refer to FIG. **5**, the content of FIG. **4** is similar to that of FIG. **1**, the difference is that the data line **120** corresponding to red, green and blue are connected to the inner anti-static ring **710***a*, **710***b* and **710***c* respectively. Besides, the detection pads **712***a*, **712***b* and **712***c* are arranged at one end of the inner anti-static ring **710***a*, **710***b* and **710***c* respectively.

[**0077**] For the short circuit detection, it can detect that if a short circuit occurs between the data lines **120** corresponding to red, green and blue and the common line **192**. Similarly, it can also detect that if a short circuit occurs between the common line **192** and the scan line **120**.

[**0078**] If the thin film transistor array substrate **700** has been fabricated to become a panel (similar to FIG. **2**), the detection method may comprise the step of transmitting the scan signal to the scan lines **120** through the inner anti-static ring **610***a*, then the data signal is transmitted to the data lines **130** through the inner anti-static rings **710***a*, **710***b* and **710***c*, to perform the red screen, green screen or blue screen detection.

[**0079**] Similarly, the scan lines **120** can be divided into the odd and even scan lines **120**, and the odd and even scan lines **120** are connected to the inner anti-static rings (not shown) which are electrical isolated with each other. Besides, in this arrangement, a short circuit occurs between the odd scan lines **120** and the common lines **192** can also be detected. Alternatively, a short circuit occurs between the even scan lines **120** and the common lines **192** can also be detected. The white screen, black screen or gray level screen detection can also be performed on the liquid crystal display panel having the thin film transistor array substrate. Alternatively, the red screen, green screen or blue screen detection can also be performed on the liquid crystal display panel.

[**0080**] In summary, the invention has the following advantages:

[**0081**] 1. Compared with the prior art, the invention takes the inner anti-static ring as a part of the detection circuit or whole circuit so the layout area of the substrate increases and the complexity of the layout is lower. In other words, the invention integrates the detection circuit with the ESD protection circuit.

[**0082**] 2. After the panel operates, the turn-off voltage level for transistor can be transmitted to the inner anti-static ring, to avoid signal interference.

[**0083**] 3. With different arrangement of the inner anti-static ring, the invention can detect that if a short circuit occurs between the scan line and the common line, the data line and the common line or the scan line and the data line.

[**0084**] 4. After the panel is fabricated, the black screen, the white screen or the gray level screen detection can be performed on the panel. Alternatively, the red screen, the green screen or the blue screen detection can be performed on the panel.

[**0085**] 5. Compared with the prior art, the detection time of the present invention is shorter.

[**0086**] It will be apparent to those skilled in the art that various modifications and variations may be made to the structure of the present invention without departing from the scope or spirit of the invention. In view of the foregoing, it is intended that the present invention cover modifications and variations of this invention provided they fall within the scope of the following claims and their equivalents.

What is claimed is:

1. A thin film transistor array substrate, comprising:

a substrate comprising a display region and a peripheral circuit region around the display region;

a plurality of pixel units arranged on the display region;

a plurality of scan lines arranged on the substrate;

a plurality of data lines arranged on the substrate, wherein the pixel units are controlled by the scan line and data line;

a plurality of inner anti-static rings arranged on the peripheral circuit region;

a plurality of first thin film transistors arranged on the peripheral circuit region, each first thin film transistor comprising a gate, a source and a drain, wherein the gates and the sources are connected to one part of the inner anti-static rings, and the drains are connected to the scan lines respectively; and

a plurality of second thin film transistors arranged on the peripheral circuit region, each second thin film transistor comprising a gate, a source and a drain, wherein the gates and the sources are connected to the other part of

the inner anti-static rings, and the drains are connected to the data lines respectively.

2. The thin film transistor array substrate according to claim 1, further comprising a plurality of detection pads arranged on the peripheral circuit region, wherein one end of each inner anti-static ring is connected to one of the detection pad.

3. The thin film transistor array substrate according to claim 1, wherein each pixel unit comprises:

an active device connected to one of the scan lines and data lines; and

a pixel electrode connected to the active device.

4. The thin film transistor array substrate according to claim 1, further comprising a plurality of common lines and a detection trace connected to one end of each common lines, wherein the common lines are arranged on the substrate and the detection trace is arranged on the peripheral circuit region.

5. A liquid crystal display panel, comprising: a thin film transistor array substrate comprising:

a substrate comprising a display region and a peripheral circuit region around the display region;

a plurality of pixel units arranged on the display region;

a plurality of scan lines arranged on the substrate;

a plurality of data lines arranged on the substrate, wherein the pixel units are controlled by the scan lines and data lines;

a plurality of inner anti-static rings arranged on the peripheral circuit region;

a plurality of first thin film transistors arranged on the peripheral circuit region, each first thin film transistor comprising a gate, a source and a drain, wherein the gates and the sources are connected to one part of the inner anti-static rings, and the drains are connected to the corresponding scan lines respectively; and

a plurality of second thin film transistors arranged on the peripheral circuit region, each second thin film transistor comprising a gate, a source and a drain, wherein the gates and the sources are connected to the other part of the inner anti-static rings, and the drains are connected to the data lines respectively;

a color filter substrate; and

a liquid crystal layer sandwiched between the color filter substrate and the thin film transistor array substrate.

6. The liquid crystal display panel according to claim 5, wherein the thin film transistor array substrate further comprises a plurality of detection pads arranged on the peripheral circuit region, and one end of each inner anti-static ring is connected to one of the detection pads.

7. The liquid crystal display panel according to claim 5, wherein each pixel unit comprises:

an active device connected to one of the scan lines and data lines; and

a pixel electrode connected to the active device.

8. The liquid crystal display panel according to claim 5, wherein the thin film transistor array substrate further comprises a plurality of common lines and a detection trace connected to one end of the common lines, wherein the common lines are arranged on the substrate and the detection trace is arranged on the peripheral circuit region.

9. A detection method for the liquid crystal display panel as recited in claim 5, the detection method comprising the following steps:

providing a light source and arranging the liquid crystal display panel on the light source;

transmitting a scan signal to the scan lines through the inner anti-static rings; and

transmitting a data signal to the data lines through the inner anti-static rings for displaying images on the liquid crystal display panel.

10. The detection method according to claim 9, wherein after the scan signal and the data signal are transmitted, the liquid crystal display panel displays a black screen, a white screen or a gray level screen.

11. The detection method according to claim 9, wherein after the scan signal and the data signal are transmitted, the liquid crystal display panel displays a red screen, a green screen or a blue screen.

12. A thin film transistor array substrate, comprising:

a substrate comprising a display region and a peripheral circuit region around the display region;

a plurality of pixel units arranged on the display region;

a plurality of first lines arranged on the substrate;

a plurality of second lines arranged on the substrate, wherein the pixel units are controlled by the first lines and second lines;

an inner anti-static ring arranged on the peripheral circuit region;

a circuit arranged on the peripheral circuit region;

a plurality of first thin film transistors arranged on the peripheral circuit region, each first thin film transistor comprising a gate, a source and a drain, wherein the gates and the sources are connected to the inner anti-static ring, and the drains are connected to the first lines respectively; and

a plurality of second thin film transistors arranged on the peripheral circuit region, each second thin film transistor comprising a gate, a source and a drain, wherein the gates are connected to the inner anti-static ring, the sources are connected to the circuit, and the drains are connected to the second lines respectively.

13. The thin film transistor array substrate according to claim 12, wherein the first lines are scan lines and the second lines are data lines.

14. The thin film transistor array substrate according to claim 12, wherein the first lines are data lines and the second lines are scan lines.

15. The thin film transistor array substrate according to claim 12, wherein the circuit comprises a plurality of lines, and the sources of the second thin film transistors are connected to the lines respectively.

16. The thin film transistor array substrate according to claim 12, further comprising a plurality of detection pads arranged on the peripheral circuit region, one end of the inner anti-static ring and the circuit being connected to one of the detection pads respectively.

17. The thin film transistor array substrate according to claim 12, wherein each pixel unit comprises:

an active device connected to one of the first lines and second lines; and

a pixel electrode connected to the active device.

18. The thin film transistor array substrate according to claim 12, further comprising a plurality of common lines and a detection trace connected to one end of the common lines, wherein the common lines are arranged on the substrate and the detection trace is arranged on the peripheral circuit region.

19. A detection method for the thin film transistor array substrate as recited in claim 12, the detection method comprising the following steps:

transmitting a current signal to the first lines through the inner anti-static ring; and

detecting the circuit, if the current signal is detected, a short circuit occurs between the first lines and the second lines.

20. The detection method according to claim 19, wherein the first lines are scan lines and the second lines are data lines.

21. The detection method according to claim 19, wherein the first lines are data lines and the second lines are scan lines.

22. A detection method for the thin film transistor array substrate as recited in claim 15, the detection method comprising the following steps:

transmitting a current signal to the first lines through the inner anti-static ring; and

detecting the lines, if the current signal is detected from the line, a short circuit occurs between the first lines and the second lines corresponding to the line.

23. The detection method according to claim 22, wherein the first lines are scan lines and the second lines are data lines.

24. The detection method according to claim 22, wherein the first lines are data lines and the second lines are scan lines.

25. A detection method for the thin film transistor array substrate as recited in claim 18, the detection method comprising the following steps: transmitting a current signal to the first lines through the inner anti-static ring; and detecting the detection trace, if the current signal is detected, a short circuit occurs between the first lines and the common lines.

26. The detection method according to claim 25, wherein the first lines are scan lines and the second lines are data lines.

27. The detection method according to claim 25, wherein the first lines are data lines and the second lines are scan lines.

28. A liquid crystal display panel, comprising:

a thin film transistor array substrate comprising:

a substrate comprising a display region and a peripheral circuit region around the display region;

a plurality of pixel units arranged on the display region;

a plurality of first lines arranged on the substrate;

a plurality of second lines arranged on the substrate, wherein the pixel units are controlled by the first lines and second lines;

an inner anti-static ring arranged on the peripheral circuit region;

a circuit arranged on the peripheral circuit region;

a plurality of first thin film transistors arranged on the peripheral circuit region, each first thin film transistor comprising a gate, a source and a drain, wherein the gates and the sources are connected to the inner anti-static ring, and the drains are connected to the first lines respectively; and

a plurality of second thin film transistors arranged on the peripheral circuit region, each second thin film transistor comprising a gate, a source and a drain, wherein the gates are connected to the inner anti-static ring, the sources are connected to the circuit, and the drains are connected to the second lines respectively;

a color filter substrate; and

a liquid crystal layer sandwiched between the color filter substrate and the thin film transistor array substrate.

29. The liquid crystal display panel according to claim 28, wherein the first lines are scan lines and the second lines are data lines.

30. The liquid crystal display panel according to claim 28, wherein the first lines are data lines and the second lines are scan lines.

31. The liquid crystal display panel according to claim 28, wherein the circuit comprises a plurality of lines and the sources of the second thin film transistors are connected to the lines respectively.

32. The liquid crystal display panel according to claim 28, wherein the thin film transistor array substrate further comprises a plurality of detection pads arranged on the peripheral circuit region, and one end of the inner anti-static ring and the circuit are connected to one of the detection pads respectively.

33. The liquid crystal display panel according to claim 28, wherein each pixel unit comprises:

an active device connected to one of the first lines and second lines; and

a pixel electrode connected to the active device.

34. The liquid crystal display panel according to claim 28, wherein the thin film transistor array substrate further comprises a plurality of common lines and a detection trace connected to one end of the common lines, the common lines are arranged on the substrate and the detection trace is arranged on the peripheral circuit region.

35. A detection method for the liquid crystal display panel as recited in claim 28, the detection method comprising the following steps:

providing a light source and arranging the liquid crystal display panel on the light source;

transmitting a first signal to the first lines through the inner anti-static ring; and

transmitting a second signal to the second lines through the circuit to make the liquid crystal display panel display a black screen, a white screen or a gray level screen.

36. The detection method according to claim 35, wherein the first lines are scan lines and the second lines are data lines.

37. The detection method according to claim 35, wherein the first lines are data lines and the second lines are scan lines.

38. A detection method for the liquid crystal display panel as recited in claim 31, the detection method comprising the following steps:

providing a light source and arranging the liquid crystal display panel on the light source;

transmitting a first signal to the first lines through the inner anti-static ring; and

transmitting a second signal to the second lines through the lines to make the liquid crystal display panel display a red screen, a green screen or a blue screen.

39. The detection method according to claim 38, wherein the first lines are scan lines and the second lines are data lines.

40. The detection method according to claim 38, wherein the first lines are data lines and the second lines are scan lines.

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[标]申请(专利权)人(译)	林匡翔 常袁浩		
申请(专利权)人(译)	林匡襄 昌源浩		
当前申请(专利权)人(译)	中华映管股份有限公司.		
[标]发明人	LIN KUANG HSIANG CHANG YUAN HAO		
发明人	LIN, KUANG-HSIANG CHANG, YUAN-HAO		
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摘要(译)

提供一种薄膜晶体管（TFT）阵列基板，包括基板，像素单元，扫描和数据线，内部抗静电环，第一和第二薄膜晶体管。像素单元布置在基板的显示区域上，扫描线和数据线布置在基板上。每个像素单元由相应的扫描和数据线控制。内部抗静电环，第一和第二TFT布置在显示区域周围的基板的外围电路区域上。每个第一TFT的栅极和源极连接到内部抗静电环的一部分，并且每个第一TFT的漏极分别连接到扫描线。每个第二TFT的栅极和源极连接到内部抗静电环的另一部分，每个第二TFT的漏极分别连接到数据线。