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(19) **United States**(12) **Patent Application Publication**  
**Kuo**(10) **Pub. No.: US 2006/0109232 A1**(43) **Pub. Date: May 25, 2006**(54) **LIQUID CRYSTAL DISPLAY AND DRIVING  
CIRCUIT THEREOF****Publication Classification**(76) **Inventor: Mao-Hsiung Kuo, Hsinhua (TW)**(51) **Int. Cl.****G09G 3/36** (2006.01)(52) **U.S. Cl.** ..... **345/100**

Correspondence Address:

**RABIN & Berdo, PC****1101 14TH STREET, NW****SUITE 500****WASHINGTON, DC 20005 (US)**

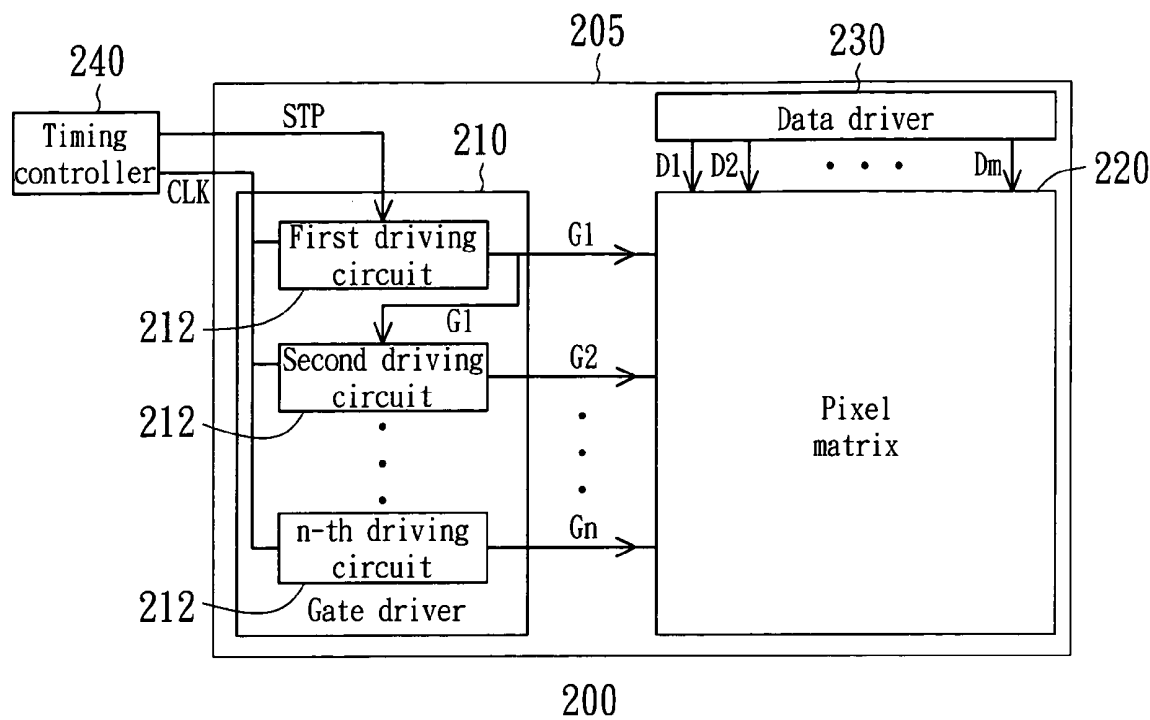
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**ABSTRACT**

A gate driver of a liquid crystal display includes classes of driving circuits coupled to each other for outputting gate pulses. At least one class of driving circuits includes a shift register and a switch. The shift register outputs the gate pulse corresponding to the class of driving circuit according to the gate pulse outputted by a former class of driving circuits. The switch controls the enable of the shift register according to the gate pulse outputted by the former class of driving circuit and the gate pulse outputted by the class of driving circuit.

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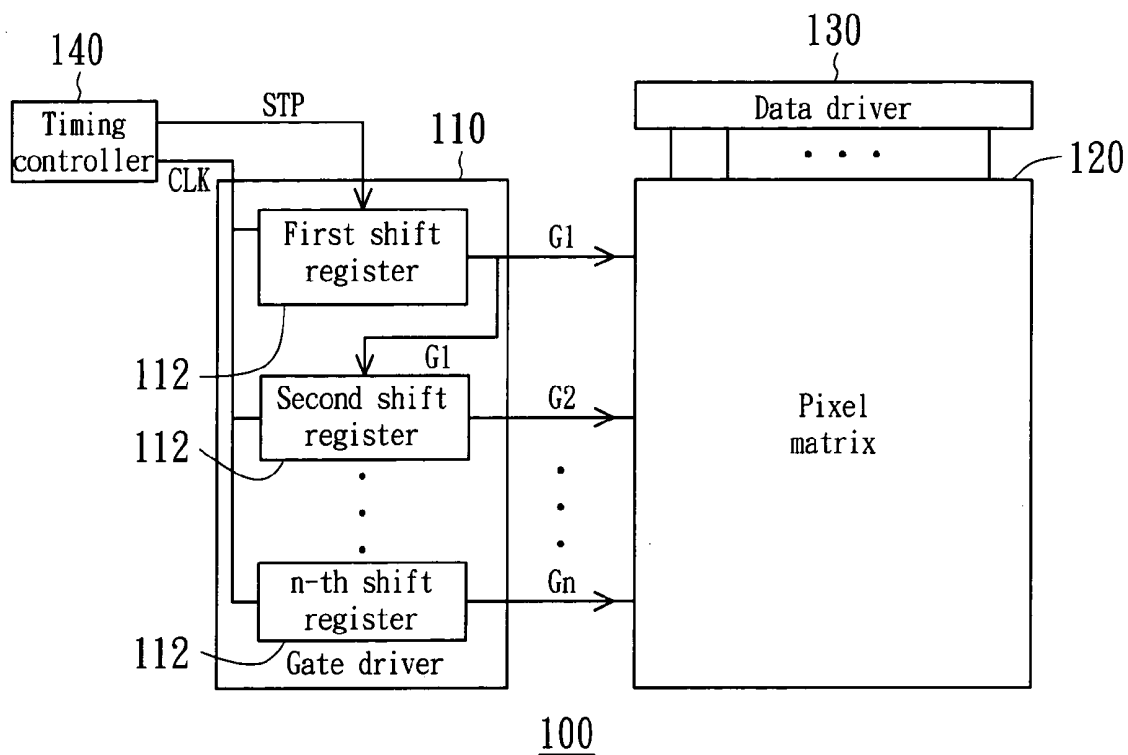


FIG. 1A(PRIOR ART)

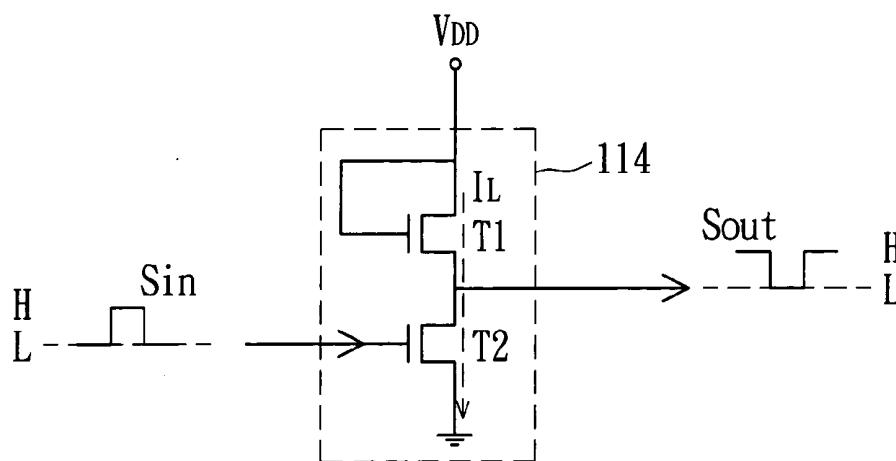


FIG. 1B(PRIOR ART)

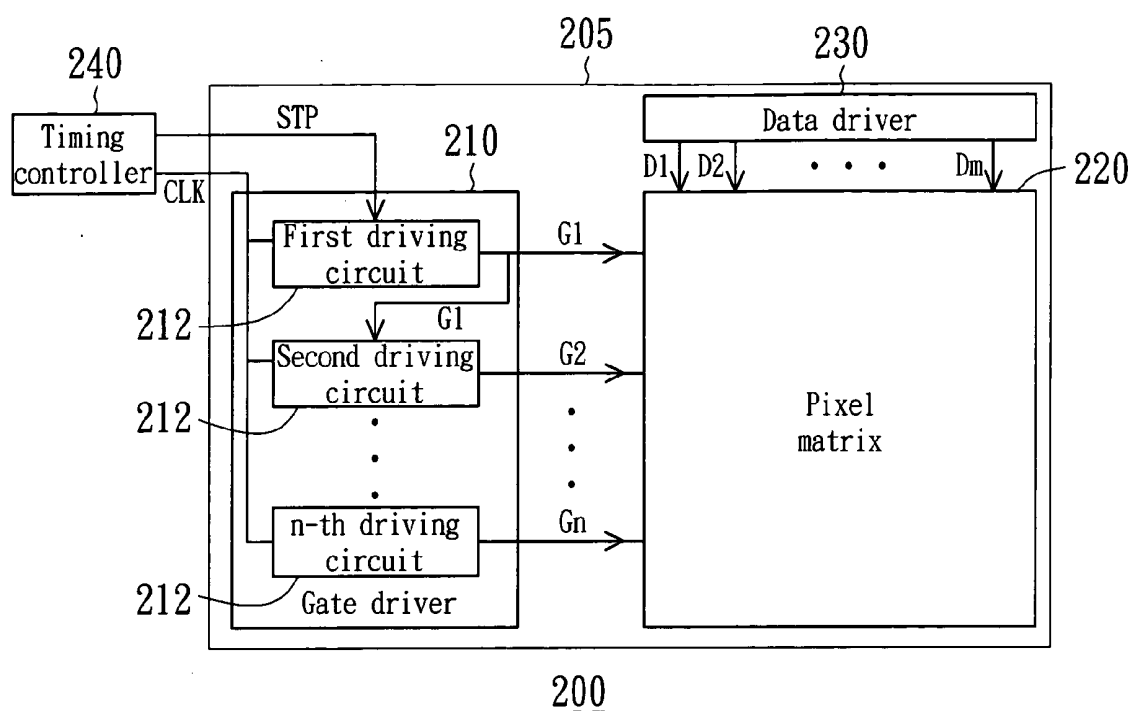


FIG. 2A

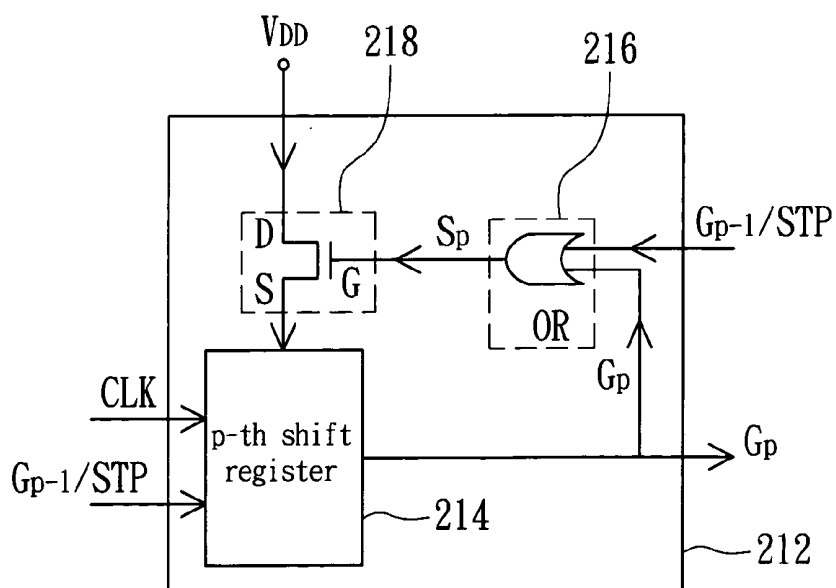


FIG. 2B

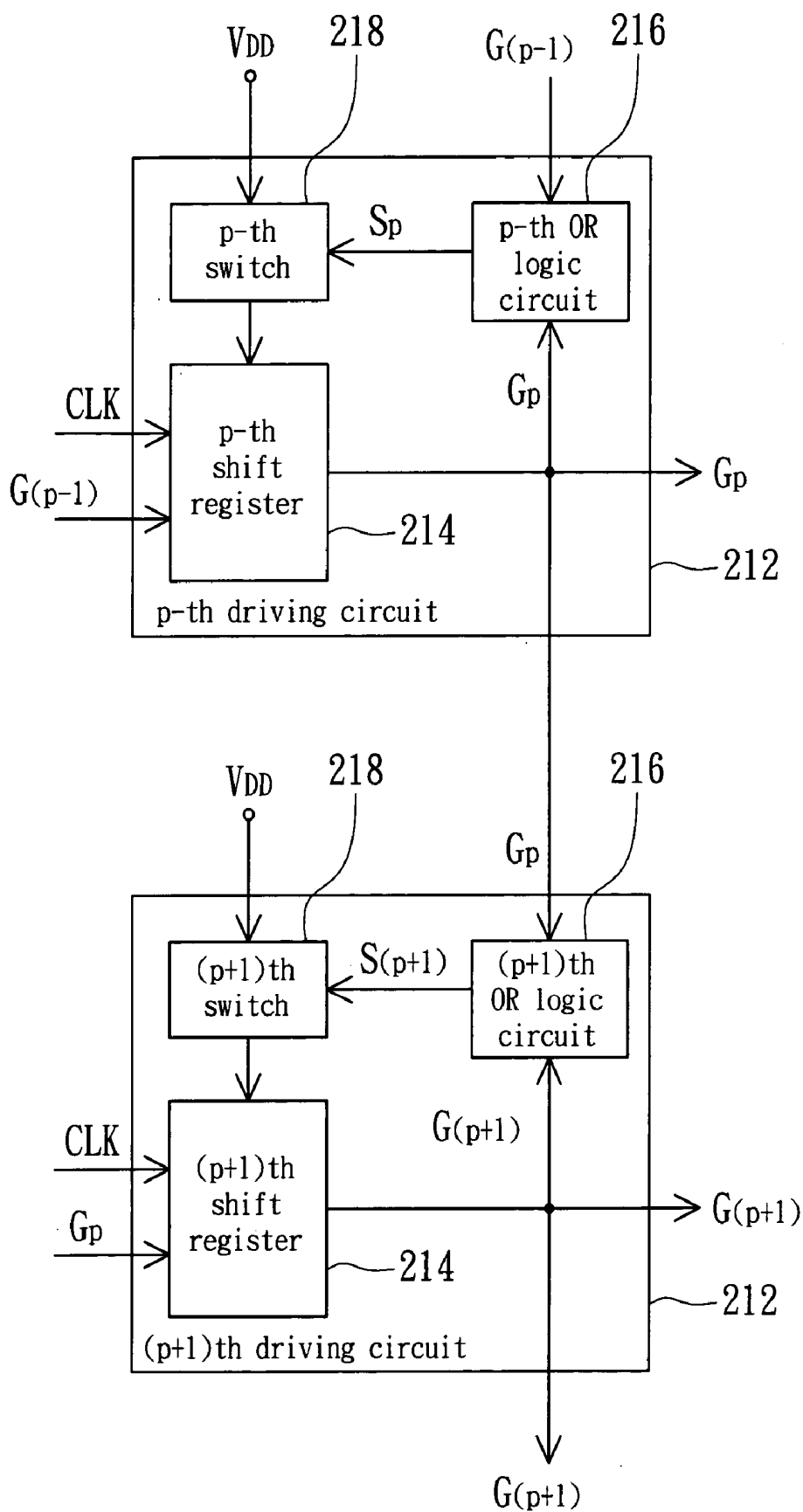


FIG. 2C

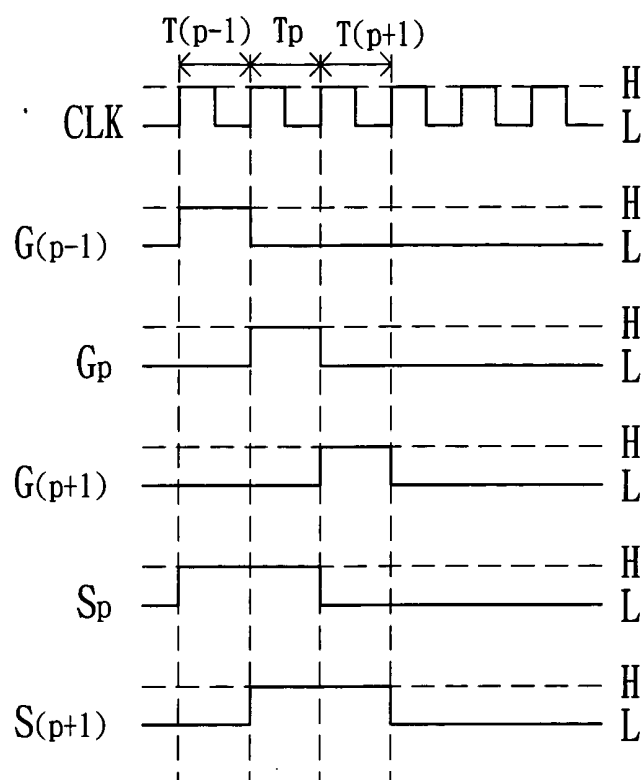


FIG. 2D

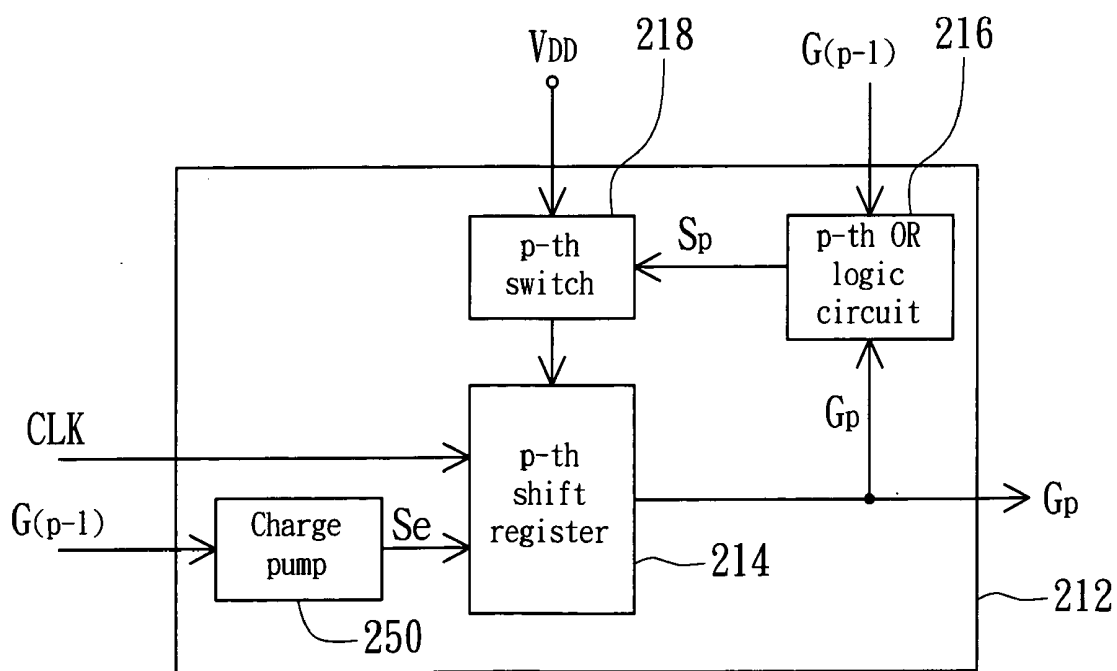


FIG. 2E

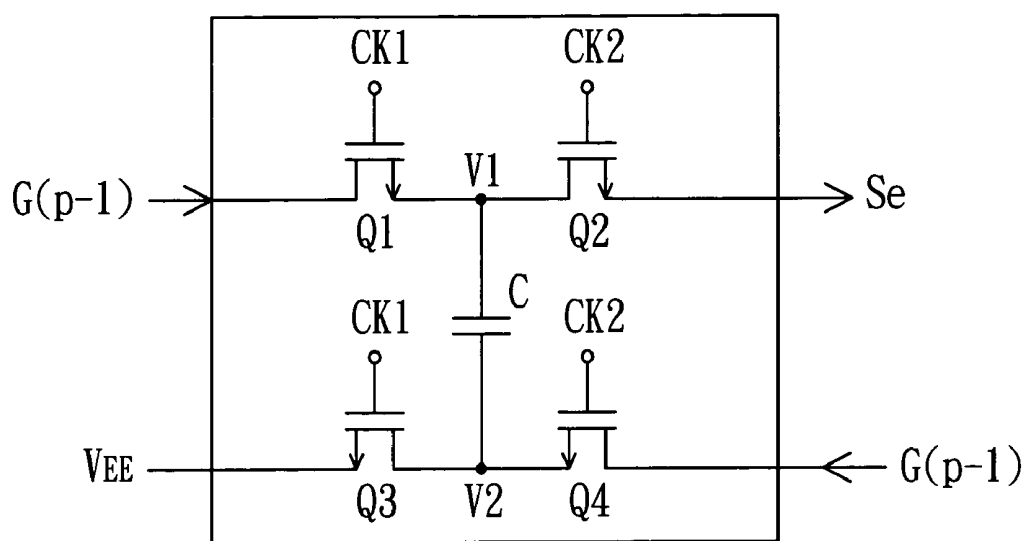


FIG. 3A

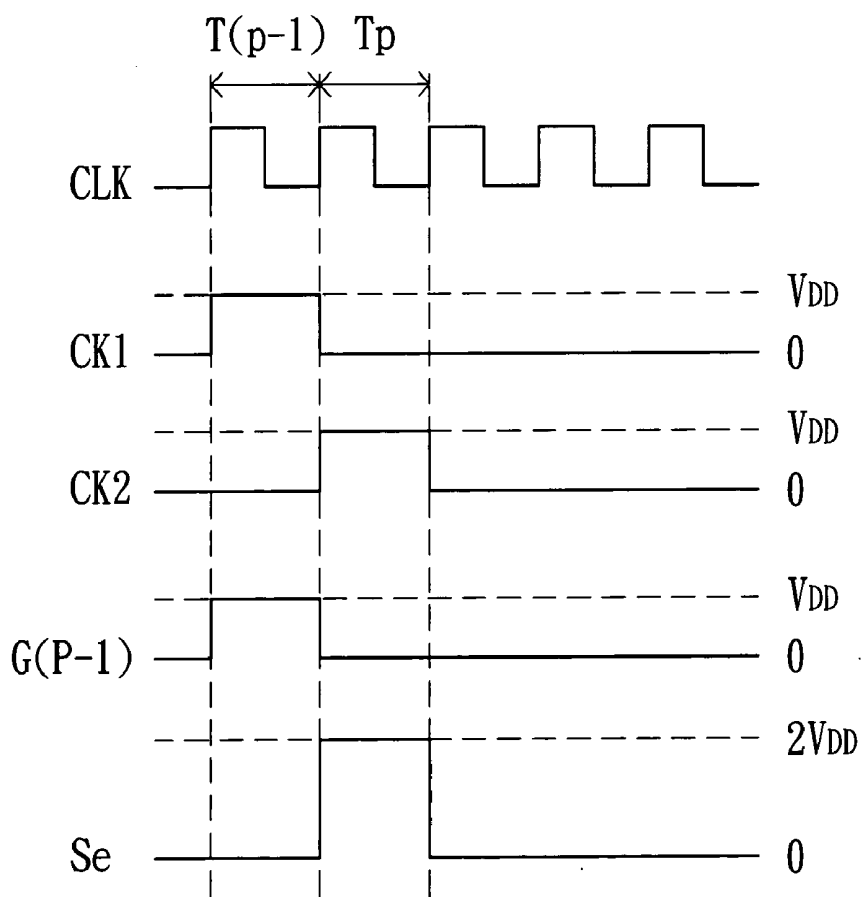


FIG. 3B

## LIQUID CRYSTAL DISPLAY AND DRIVING CIRCUIT THEREOF

[0001] This application claims the benefit of Taiwan application Serial No. 93135769, filed Nov. 19, 2004, the subject matter of which is incorporated herein by reference.

### BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The invention relates in general to a liquid crystal display and driving circuit thereof, and more particularly to a liquid crystal display, in which a shift register in a class of driving circuit is controlled to enable according to an output signal of a former class of driving circuit and an output signal of the class of driving circuit in a gate driver, and driving circuit.

[0004] 2. Description of the Related Art

[0005] **FIG. 1A** is a block diagram showing a conventional structure of a liquid crystal display. Referring to **FIG. 1A**, the liquid crystal display **100** includes a gate driver **110**, a pixel matrix **120**, a data driver **130** and a timing controller **140**. The gate driver **110** includes a first shift register **112**, a second shift register **112**, . . . , and an n-th shift register **112**, wherein n is a positive integer greater than 1. The p-th ( $1 \leq p \leq n$ ) shift register **112** outputs a gate pulse  $G_p$  according to a clock signal CLK and a start pulse STP ( $p=1$ ) outputted by the timing controller **140** or a gate pulse  $G_{(p-1)}$  ( $p \neq 1$ ), so as to turn on a p-th row of pixels (not shown) of the pixel matrix **120** to receive pixel data signals outputted by the data driver **130**.

[0006] **FIG. 1B** is a diagram showing partial circuits of the shift register of **FIG. 1A**. Referring to **FIG. 1B**, the typical shift register **112** includes a logic device such as an inverter **114**. The inverter **114** includes two N-type metal oxide semiconductor (NMOS) transistors **T1** and **T2**. When the input signal  $S_{in}$  is at a high level, the transistor **T2** is turned on such that the output signal  $S_{out}$  has a low level. When the input signal  $S_{in}$  is at a low level, the transistor **T2** is turned off. At this time, because the gate of the transistor **T1** is coupled to the drain of the transistor **T1** to form an equivalent resistor, the operation voltage VDD of the shift register **112** boosts the output signal  $S_{out}$  to a high level, and the effect of signal inverting is thus generated.

[0007] However, the transistors **T1** and **T2** are a single type of NMOS design but not the complementary metal oxide semiconductor (CMOS) architecture. Thus, even if the transistor **T2** is turned off, the transistor **T2** still has a leakage current  $I_L$  outputted by the operation voltage VDD. Because the gate driver **110** has the leakage current phenomenon in each class of shift register **112** during the operation, the power consumption of the liquid crystal display **100** is thus increased.

### SUMMARY OF THE INVENTION

[0008] It is therefore an object of the invention to provide a liquid crystal display and driving circuit thereof. An operation voltage of one class of driving circuit is inputted to a shift register according to a gate pulse outputted by a former class of driving circuit and a gate pulse outputted by the class of driving circuit in a gate driver. Thus, the leakage

current in each class of driving circuit can be reduced, and the power-saving effect of the liquid crystal display may be achieved.

[0009] The invention achieves the above-identified object by providing a driving circuit used in a gate driver. The driving circuit includes a shift register, a logic circuit and a switch. The shift register outputs a gate pulse according to a starting signal. The OR logic circuit outputs a control signal according to the starting signal and the gate pulse. The switch controls the enable of the shift register according to the control signal.

[0010] The invention also achieves the above-identified object by providing a gate driver including a first driving circuit and a second driving circuit. The first driving circuit includes a first shift register, a first logic circuit and a first switch. The first shift register outputs a first gate pulse according to a starting signal. The first logic circuit outputs a first control signal according to the starting signal and the first gate pulse. The first switch controls the enable of the first shift register according to the first control signal. In addition, the second driving circuit coupled to the first driving circuit includes a second shift register, a second logic circuit and a second switch. The second shift register outputs a second gate pulse according to the first gate pulse. The second logic circuit outputs a second control signal according to the first gate pulse and the second gate pulse. The second switch controls the enable of the second shift register according to the second control signal.

[0011] The invention also achieves the above-identified object by providing a gate driver including a first shift register and a first switch. The first shift register outputs a first gate pulse according to a starting signal. The first switch controls the enable of the first shift register according to the starting signal and the first gate pulse.

[0012] The invention also achieves the above-identified object by providing a liquid crystal display including a substrate, a gate driver, a pixel matrix and a data driver. The pixel matrix includes a plurality of pixels on the substrate. The data driver outputs a plurality of pixel data signals to the pixel matrix. The gate driver includes classes of driving circuits coupled to each other and outputs a plurality of gate pulses to sequentially drive the pixels. At least one of the classes of driving circuits includes a shift register and a switch. The shift register outputs the gate pulse corresponding to the class of driving circuit according to the gate pulse outputted by a former class of driving circuit. The switch controls the enable of the shift register according to the gate pulse outputted by the former class of driving circuit and the gate pulse outputted by the class of driving circuit.

[0013] Other objects, features, and advantages of the invention will become apparent from the following detailed description of the preferred but non-limiting embodiments. The following description is made with reference to the accompanying drawings.

### BRIEF DESCRIPTION OF THE DRAWINGS

[0014] **FIG. 1A** is a block diagram showing a conventional structure of a liquid crystal display.

[0015] **FIG. 1B** is a diagram showing partial circuits of the shift register of **FIG. 1A**.

[0016] FIG. 2A is a block diagram showing circuits of a liquid crystal display according to a preferred embodiment of the invention.

[0017] FIG. 2B is a block diagram showing circuits of the p-th driving circuit in FIG. 2A.

[0018] FIG. 2C is a block diagram showing circuits of the p-th driving circuit 212 and the (p+1)th driving circuit 212 coupled to each other in FIG. 2A.

[0019] FIG. 2D is a timing chart showing the timings of the clock signal CLK, the gate pulses G(p-1), Gp and G(p+1), and the control signals Sp and S(p+1) in the liquid crystal display of FIG. 2A.

[0020] FIG. 2E is a block diagram showing circuits of the driving circuit with a charge pump according to the preferred embodiment of the invention.

[0021] FIG. 3A is a diagram showing a circuit structure of the charge pump of FIG. 2E.

[0022] FIG. 3B is a timing chart showing the timings of the gate pulse G(p-1), the voltage amplifying signal Se, and the clock signals CLK, CK1 and CK2.

#### DETAILED DESCRIPTION OF THE INVENTION

[0023] FIG. 2A is a block diagram showing circuits of a liquid crystal display according to a preferred embodiment of the invention. Referring to FIG. 2A, the liquid crystal display 200 includes a substrate 205, a gate driver 210, a pixel matrix 220, a data driver 230 and a timing controller 240. The pixel matrix 220 is disposed on the substrate 205. The gate driver 210 includes n classes of driving circuits 212 coupled to each other. The classes of driving circuits 212 sequentially output n gate pulses G1 to Gn for driving each row of pixels (not shown) of the pixel matrix 220 to receive pixel data signals D1 to Dm outputted by the data driver 230, wherein m and n are positive integers greater than 1. The p-th driving circuit 212 outputs a gate pulse Gp to the pixel matrix 220 according to a clock signal CLK and a start pulse STP (p=1) outputted by the timing controller 240 or a gate pulse G(p-1) (p≠1) outputted by the (p-1)th driving circuit 212, wherein  $1 \leq p \leq n$ , and p is a positive integer.

[0024] When the pixel matrix 220 of the liquid crystal display 200 is composed of N-type transistors and the gate driver 210 and the pixel matrix 220 are to be integrated on the same substrate 205, it is an optimum condition that both of the gate driver 210 and the pixel matrix 220 are N-type transistors so as to reduce the number of manufacturing steps and cost. On the contrary, both of the gate driver 210 and the pixel matrix 220 are P-type transistors.

[0025] FIG. 2B is a block diagram showing circuits of the p-th driving circuit 212 in FIG. 2A. Referring to FIG. 2B, the p-th driving circuit 212 includes a p-th shift register 214, a p-th OR logic circuit 216 and a p-th switch 218. The p-th shift register 214 outputs a gate pulse Gp according to the clock signal CLK and a gate signal G(p-1) (p≠1) or the start pulse STP (p=1). The p-th OR logic circuit 216 outputs a control signal Sp according to the gate pulse Gp and the gate signal G(p-1) (p≠1) or the start pulse STP (p=1). The p-th switch 218 controls an operation voltage VDD to be inputted to the p-th shift register 214 according to the control signal Sp. The p-th switch 218 may be, for example a NMOS

transistor having a gate G for receiving the control signal Sp, a drain D coupled to the operation voltage VDD, and a source S coupled to the p-th shift register 214. The p-th switch 218 controls the enable of the p-th shift register 214. That is, the p-th switch 218 and the pixel matrix 220 in this case are composed of N-type transistors.

[0026] FIG. 2C is a block diagram showing circuits of the p-th driving circuit 212 and the (p+1)th driving circuit 212 coupled to each other in FIG. 2A. FIG. 2D is a timing chart showing the timings of the clock signal CLK, the gate pulses G(p-1), Gp and G(p+1), and the control signals Sp and S(p+1) in the liquid crystal display of FIG. 2A. Two arbitrary driving circuits such as the p-th (p≥2) driving circuit 212 and the (p+1)th driving circuit 212 coupled to each other will be illustrated as an example. According to the clock signal CLK outputted by the timing controller 240, the gate pulse G(p-1) outputs a high voltage level H (~VDD) and the p-th driving circuit 212 and the (p+1)th driving circuit 212 have no signal output in the timing period T(p-1). That is, the gate pulses Gp and G(p+1) are at low voltage levels L (=0). At this time, the p-th OR logic circuit 216 in the p-th driving circuit 212 outputs the control signal Sp with the high voltage level H according to the gate pulses G(p-1) (H) and Gp(L), such that the p-th switch 218 is turned on and the p-th shift register 214 is thus enabled. Thus, the p-th shift register 214 is powered on by the operation voltage VDD, and continues outputting the gate pulse Gp with the low voltage level L according to the clock signal CLK and the gate signal G(p-1) (L).

[0027] Meanwhile, the (p+1)th OR logic circuit 216 in the (p+1)th driving circuit 212 outputs a control signal S(p+1) with the low voltage level L according to the gate pulses Gp(L) and G(p+1) (L), such that the (p+1)th switch 218 is turned off. Because the operation voltage VDD cannot be inputted to the (p+1)th shift register 214, the gate pulse G(p+1) continues outputting the low voltage level L.

[0028] Next, in the timing period Tp, the p-th switch 218 is turned on and the operation voltage VDD may be inputted to the p-th shift register 214. Because the gate pulse G(p-1) still has the high voltage level H and is not lowered to the low level L at the moment as the clock signal CLK is boosted from the low level L to the high level H, the p-th shift register 214 detects the gate pulse G(p-1) with the high level H and outputs the gate pulse Gp with the high voltage level H. The p-th OR logic circuit 216 in the p-th driving circuit 212 continues outputting the control signal Sp with the high voltage level H according to the gate pulses G(p-1) (L) and Gp(H), such that the p-th switch is kept ON and the p-th shift register 214 is kept at the enabled state. At this time, the (p+1)th driving circuit 212 still has no signal output yet. That is, the gate pulse G(p+1) still has the low voltage level L. Thus, the (p+1)th OR logic circuit 216 in the (p+1)th driving circuit 212 outputs the control signal S(p+1) with the high voltage level H according to the gate pulses Gp(H) and G(p+1) (L), such that the (p+1)th switch 218 is turned on. Consequently, the (p+1)th shift register 214 is powered on by the operation voltage VDD and continues outputting the gate pulse G(p+1) with the low voltage level L according to the clock signal CLK and the gate signal Gp.

[0029] Next, in the timing period T(p+1), the gate pulse G(p-1) continues outputting the low voltage level L. The p-th shift register 214 in the p-th driving circuit 212 outputs



the gate pulse  $G_p$  with the low voltage level  $L$  according to the clock signal  $CLK$  and the gate signal  $G(p-1)$  ( $L$ ). The  $p$ -th OR logic circuit **216** outputs the control signal  $S_p$  with the low voltage level  $L$  according to the gate pulses  $G(p-1)$  ( $L$ ) and  $G_p(L)$ , such that the  $p$ -th switch **218** is turned off and the  $p$ -th shift register **214** is disabled. At this time, the  $(p+1)$ th switch **218** is still ON. Because the gate pulse  $G_p$  still has the high voltage level  $H$  and is not lowered to the low level  $L$  yet at the moment as the clock signal  $CLK$  is boosted from the low level  $L$  to the high level  $H$ , the  $(p+1)$ th shift register **214** detects the gate pulse  $G_p$  with the high level  $H$  and outputs the gate pulse  $G(p+1)$  with the high voltage level  $H$ . Thus, the  $(p+1)$ th OR logic circuit **216** in the  $(p+1)$ th driving circuit **212** outputs the control signal  $S(p+1)$  with the high voltage level  $H$  according to the gate pulses  $G_p(L)$  and  $G(p+1)$  ( $H$ ), such that the  $(p+1)$ th switch **218** is still kept ON and the  $(p+1)$ th shift register **214** is still kept enabled.

[0030] Analogically, it can be known that the switch **218** (the  $p$ -th switch **218**) in each class of driving circuit **212** is ON in only two timing periods ( $T(p-1)$  and  $T_p$ ), and OFF in other timing periods. Alternatively, only the switches **218** (the  $p$ -th and  $(p+1)$ th switches) of two driving circuits **212** are ON and the switches **218** of other driving circuits **212** are OFF in the same timing period ( $T_p$ ). Thus, the operation voltage  $VDD$  cannot be inputted to the shift register **214** of each class of driving circuit **212** in the timing period when the corresponding switch **218** is OFF. So, it can reduce the leakage current generated by the shift register, and effectively reduce the power consumption of the liquid crystal display **200**.

[0031] FIG. 2E is a block diagram showing circuits of the driving circuit **212** with a charge pump according to the preferred embodiment of the invention. The  $p$  ( $1 \leq p \leq n$ ) driving circuit **212** further includes a charge pump **250**, which is coupled to the  $p$ -th shift register **214**, for outputting a voltage amplifying signal  $Se$  according to the gate pulse  $G(p-1)$  ( $p \neq 1$ ) or the start pulse  $STP$  ( $p=1$ ). The  $p$ -th shift register **214** outputs the gate pulse  $G_p$  according to the clock signal  $CLK$  and the voltage amplifying signal  $Se$ . The high voltage level of the gate pulse  $G_p$  outputted by each conventional shift register **214** is  $(VDD - p \times V_t)$ , wherein  $V_t$  is the threshold voltage of the transistor in the shift register **214**. That is, the output level of the gate pulse  $G_p$  descends from class to class.

[0032] FIG. 3A is a diagram showing a circuit structure of the charge pump **250** of FIG. 2E. Referring to FIG. 3A, the charge pump **250** includes four NMOS transistors  $Q1$ ,  $Q2$ ,  $Q3$  and  $Q4$  and a capacitor  $C$ . A clock signal  $CK1$  is inputted to gates of the transistors  $Q1$  and  $Q3$ , and a clock signal  $CK2$  is inputted to gates of the transistors  $Q2$  and  $Q4$ . In addition, the gate pulse  $G(p-1)$  is inputted to drains of the transistors  $Q1$  and  $Q4$ , and a voltage  $VEE$  is inputted to a source of the transistor  $Q3$ . Hereinafter, the voltage  $VEE=0$  will be illustrated as an example.

[0033] FIG. 3B is a timing chart showing timings of the gate pulse  $G(p-1)$ , the voltage amplifying signal  $Se$ , and the clock signals  $CLK$ ,  $CK1$  and  $CK2$ . In the timing period  $T(p-1)$ , the gate pulse  $G(p-1)$  outputs a high level ( $VDD$ ) voltage. At this time, the clock signal  $CK1$  outputs a high-level voltage ( $VDD$ ) and the clock signal  $CK2$  outputs a low-level voltage ( $0$ ) such that the transistors  $Q1$  and  $Q3$

are turned on and the transistors  $Q2$  and  $Q4$  are turned off. Thus, the signal  $Se$  outputs the low level ( $0$ ), and the terminal voltage  $V1=VDD$  and the terminal voltage  $V2=VEE=0$ . So, the capacitor  $C$  stores a voltage drop of  $VDD$ .

[0034] Next, in the timing period  $T_p$ , the clock signal  $CK1$  outputs the low level ( $0$ ) and the clock signal  $CK2$  outputs the high level ( $VDD$ ), such that the transistors  $Q1$  and  $Q3$  are turned off and the transistors  $Q2$  and  $Q4$  are turned on. At this time, the terminal voltage  $V2=VDD$ , and the terminal voltage  $V1$  is boosted to  $2 VDD$  due to the  $VDD$  voltage previously stored in the capacitor  $C$ . Thus, the signal  $Se$  outputs the  $2 VDD$  voltage. However, because the turned on transistors  $Q1$  to  $Q4$  has a voltage drop, the output level of the signal  $Se$  is actually smaller than  $2 VDD$  and equal to about  $1.5 VDD$ . So, using the design of the charge pump **250** can boost the output of the signal  $Se$  to  $1.5 VDD$ , such that the shift register **214** can output the gate pulse  $G_p$  approximating the high level  $VDD$  according to the clock signal  $CLK$  and the voltage amplifying signal  $Se$ , and the problem of the output level descending of the gate pulse  $G_p$  from class to class can be avoided. That is, the charge pump **250** and the pixel matrix **220** are both composed of  $N$ -type transistors.

[0035] The advantage of the liquid crystal display disclosed in the embodiment of the invention will be described in the following. Each class of driving circuit controls the turn on or turn off of the shift register according to the output signal of the former class of driving circuit and the output signal of this class of driving circuit, such that the shift register in the same driving circuit is turned on in only two timing periods, or the shift registers in only two driving circuits are turned on in the same timing period. Thus, it can reduce the leakage current generated in each class of shift register, and the power-saving effect of the liquid crystal display may be achieved.

[0036] The  $p$ -th switch **218** of FIG. 2B may also be replaced by a PMOS transistor. In this case, the  $p$ -th OR logic circuit **216** is replaced by a NOR logic circuit, and the  $p$ -th switch **218** and the pixel matrix **220** are composed of  $P$ -type transistors. In addition, it is also possible to move the  $p$ -th switch ( $N$ -type transistor) **218** of FIG. 2B to the position between the  $p$ -th shift register and the ground, and the operation principle is the same as that shown in FIG. 2B. When the  $p$ -th switch **218** is moved to the position between the  $p$ -th shift register and the ground, it may also be replaced by a  $P$ -type transistor. At this time, the  $p$ -th OR logic circuit **216** is replaced by a NOR logic circuit.

[0037] While the invention has been described by way of example and in terms of a preferred embodiment, it is to be understood that the invention is not limited thereto. On the contrary, it is intended to cover various modifications and similar arrangements and procedures, and the scope of the appended claims therefore should be accorded the broadest interpretation so as to encompass all such modifications and similar arrangements and procedures.

What is claimed is:

1. A driving circuit used in a gate driver, the driving circuit comprising:

a shift register for outputting a gate pulse according to a starting signal;

- a logic circuit for outputting a control signal according to the starting signal and the gate pulse; and
- a switch for controlling enable of the shift register according to the control signal.
- 2. The driving circuit according to claim 1, wherein the starting signal is another gate pulse outputted by the gate driver or a start pulse outputted by a timing controller.
- 3. The driving circuit according to claim 1, wherein in a first timing period, the starting signal outputs a high voltage level, the gate pulse outputs a low voltage level, and the control signal enables the shift register.
- 4. The driving circuit according to claim 3, wherein in a second timing period, the starting signal outputs the low voltage level, the gate pulse outputs the high voltage level, and the control signal enables the shift register.
- 5. The driving circuit according to claim 4, wherein in a third timing period, the starting signal and the gate pulse simultaneously output the low voltage level, and the shift register is disabled.
- 6. The driving circuit according to claim 1, further comprising a charge pump, which is coupled to the shift register, for outputting a voltage amplifying signal according to the starting signal, wherein the shift register outputs the gate pulse according to the voltage amplifying signal.
- 7. A gate driver, comprising:
  - a first driving circuit, comprising:
    - a first shift register for outputting a first gate pulse according to an starting signal;
    - a first logic circuit for outputting a first control signal according to the starting signal and the first gate pulse; and
    - a first switch for controlling enable of the first shift register according to the first control signal; and
  - a second driving circuit, coupled to the first driving circuit, the second driving circuit comprising:
    - a second shift register for outputting a second gate pulse according to the first gate pulse;
    - a second logic circuit for outputting a second control signal according to the first gate pulse and the second gate pulse; and
    - a second switch for controlling enable of the second shift register according to the second control signal.
- 8. The gate driver according to claim 7, wherein the starting signal is a third gate pulse outputted by the gate driver, or a start pulse outputted by a timing controller.
- 9. The gate driver according to claim 7, wherein in a first timing period, the starting signal outputs a high voltage level, the first gate pulse and the second gate pulse output a low voltage level, the first control signal enables the first shift register, and the second shift register is disabled.
- 10. The gate driver according to claim 9, wherein in a second timing period, the starting signal outputs the low voltage level, the first gate pulse outputs the high voltage level, the second gate pulse outputs the low voltage level, the first control signal and the second control signal enable the first shift register and the second shift register, respectively.
- 11. The gate driver according to claim 10, wherein in a third timing period, the starting signal and the first gate pulse output the low voltage level, the second gate pulse outputs

the high voltage level to disable the first shift register, and the second control signal enables the second shift register.

12. The gate driver according to claim 7, wherein:

the first driving circuit and the second driving circuit respectively comprise a first charge pump coupled to the first shift register, and a second charge pump coupled to the second shift register;

the first charge pump and the second charge pump respectively output a first voltage amplifying signal and a second voltage amplifying signal according to the starting signal and the first gate pulse; and

the first shift register and the second shift register respectively output the first gate pulse and the second gate pulse according to the first voltage amplifying signal and the second voltage amplifying signal.

13. A gate driver, comprising:

a first shift register for outputting a first gate pulse according to a starting signal; and

a first switch for controlling enable of the first shift register according to the starting signal and the first gate pulse.

14. The gate driver according to claim 13, further comprising:

a second shift register for outputting a second gate pulse according to the first gate pulse;

a second switch for controlling enable of the second shift register according to the first gate pulse and the second gate pulse.

15. The gate driver according to claim 13, wherein the starting signal is a third gate pulse outputted by the gate driver.

16. The gate driver according to claim 14, wherein in a first timing period, the starting signal outputs a high voltage level, and the first gate pulse and the second gate pulse output a low voltage level such that the first shift register is enabled and the second shift register is disabled.

17. The gate driver according to claim 16, wherein in a second timing period, the starting signal outputs the low voltage level, the first gate pulse outputs the high voltage level, and the second gate pulse outputs the low voltage level such that the first shift register and the second shift register are enabled.

18. The gate driver according to claim 17, wherein in a third timing period, the starting signal and the first gate pulse outputs the low voltage level, the second gate pulse outputs the high voltage level, such that the first shift register is disabled and the second shift register is enabled.

19. A liquid crystal display, comprising:

a substrate;

a pixel matrix comprising a plurality of pixels on the substrate;

a data driver for outputting a plurality of pixel data signals to the pixels; and

a gate driver, comprising classes of driving circuits coupled to each other, for outputting a plurality of gate pulses to sequentially drive the pixels, at least one of the classes of driving circuits comprising:

a shift register for outputting the gate pulse corresponding to the class of driving circuit according to the gate pulse outputted by a former class of driving circuit;

a switch for controlling enable of the shift register according to the gate pulse outputted by the former class of driving circuit and the gate pulse outputted by the class of driving circuit.

**20.** The liquid crystal display according to claim 19, wherein the liquid crystal display comprises a timing controller coupled to the gate driver, the shift register in a first class of driving circuit outputs the corresponding gate pulse according to a start pulse outputted by the timing controller.

**21.** The liquid crystal display according to claim 19, wherein the at least one of the driving circuits further

comprises a charge pump, coupled to the corresponding shift register, for outputting a voltage amplifying signal according to the gate pulse outputted by the former class of driving circuit, and the corresponding shift register outputs the gate pulse corresponding to the of the class of driving circuit according to the voltage amplifying signal.

**22.** The liquid crystal display according to claim 19, wherein the switches and the pixels are disposed on the substrate.

**23.** The liquid crystal display according to claim 22, wherein the switches and the pixels are all N-type transistors or P-type transistors.

\* \* \* \* \*

|                |                                                 |         |            |
|----------------|-------------------------------------------------|---------|------------|
| 专利名称(译)        | 液晶显示器及其驱动电路                                     |         |            |
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| [标]申请(专利权)人(译) | KUO MAO HSIUNG                                  |         |            |
| 申请(专利权)人(译)    | KUO MAO-HSIUNG                                  |         |            |
| 当前申请(专利权)人(译)  | HIMAX TECHNOLOGIES LIMITED                      |         |            |
| [标]发明人         | KUO MAO HSIUNG                                  |         |            |
| 发明人            | KUO, MAO-HSIUNG                                 |         |            |
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| 其他公开文献         | US8018421                                       |         |            |
| 外部链接           | <a href="#">Espacenet</a> <a href="#">USPTO</a> |         |            |

#### 摘要(译)

液晶显示器的栅极驱动器包括彼此耦合的各类驱动电路，用于输出栅极脉冲。至少一类驱动电路包括移位寄存器和开关。移位寄存器根据前一类驱动电路输出的栅极脉冲输出对应于驱动电路类别的栅极脉冲。开关根据前一类驱动电路输出的栅极脉冲和一类驱动电路输出的栅极脉冲控制移位寄存器的使能。

