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# (54) GATE ELECTRODE DRIVING CIRCUIT, GATE ELECTRODE DRIVING METHOD, AND LIQUID CRYSTAL DISPLAY DEVICE

GATE-ELEKTRODEN-TREIBERSCHALTUNG, GATE-ELEKTRODEN-ANSTEUERVERFAHREN UND FLÜSSIGKRISTALLANZEIGEVORRICHTUNG

CIRCUIT DE COMMANDE D'ÉLECTRODE DE GRILLE, PROCÉDÉ DE COMMANDE D'ÉLECTRODE DE GRILLE ET DISPOSITIF D'AFFICHAGE À CRISTAUX LIQUIDES

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## Description

### TECHNICAL FIELD

**[0001]** The present invention relates to the technical field of gate driving, and in particular relates to a gate driving circuit, a gate driving method and a liquid crystal display (LCD).

### BACKGROUND

**[0002]** The LCD is a commonly-used panel display, wherein the Thin Film Transistor Liquid Crystal Display (TFT-LCD) is the mainstream product in the current liquid crystal displays. With the increasingly fierce competition in the TFT-LCD products, the manufacturers have to reduce the cost of their products by using new techniques, so as to enhance the market competitiveness of the products. Wherein, GOA (Gate on Array) technique refers to integrating a gate driver of TFT-LCD on an array substrate, thereby forming a scan driving of the panel. Compared with the traditional COF (Chip On Flex / Film) process and the COG (Chip On Glass) process, it not only can save cost, but also can achieve a beautiful design of symmetry of both sides, leaving out binding region and fan-out wiring space of a gate integrated circuit (Gate IC), thereby achieving a narrow border design. At the same time, a Gate direction binding process can be saved, which is more favorable for enhancing the productivity and yield.

**[0003]** However, compared to the COF and COG techniques, GOA technique also has some problems. An existing gate driving circuit includes shift registers at a plurality of stages, and Figure 1 is a structure diagram of the shift register at each stage in the existing gate driving circuit. As shown in Figure 1, said shift register at each stage comprises a first TFT switching device M1, a second TFT switching device M2, a third TFT switching device M3, a fourth TFT switching device M4, a pull-down unit PD and a boost device C1; wherein a drain and a gate of M1 is connected to an input terminal (INPUT), and receives an output signal of the shift register at a previous stage; a drain of M2 is connected to a source of M1, a gate of M2 is connected to a reset terminal (RESET) and receives an output signal of the shift register at a next stage, and a source of M2 is connected to a low-voltage signal terminal (VSS) and receives a low-voltage signal; a drain of M3 is connected to a clock signal terminal, a gate of M3 is connected to the source of M1, and a source of M3 serves as a signal output terminal (OUTPUT) of the shift register at the present stage; a drain of M4 is connected to the source of M3, a gate of M4 is connected to the reset terminal (RESET), and a drain of M4 is connected to the low-voltage signal terminal (VSS); one terminal of C1 is connected respectively to the source of M1 and the gate of M3, and the other terminal of C1 is connected to the source of M3; the pull-down unit PD is not only in parallel with C1, but also one terminal thereof is connected to the low-voltage signal terminal (VSS), and another terminal is connected to the drain of M3.

**[0004]** The operational principle of the aforementioned gate driving circuit is: when an input signal at INPUT is at a high level, M1 is turned on, and a node PU is charged; when a clock signal at the clock signal terminal is at the high level, M3 is turned on, the pulse of the clock signal is outputted at OUTPUT, and at the same time the node PU is further pulled up due to bootstrapping of C1; thereafter M2 and M4 are turned on by a reset signal at RESET, so as to discharge the node PU and OUTPUT. Next, the circuit devices of the pull-down unit PD are controlled by the clock signal to discharge the node PU and OUTPUT, ensuring that there will be no noise occurring in the line corresponding to the shift register at the present stage during the non-operating time, the specific timing sequence of respective signals being as shown in Figure 2. In normal circumstances, when the shift register shown in Figure 1 is applied, at the instant of TFT being turned off, the signal at OUTPUT jumps from the high level to a low level, and the voltage jump of the pixel is large, thus affecting the picture quality of LCD.

**[0005]** US 2008/036725 A1, US 2004/189585 A1, and US 2012/044132 A1 respectively discloses a gate driver, in which at the instant of the signal at an output terminal jumping to a low level, the signal at the output terminal directly jumps from the high level to the low level, and the voltage jump of the pixel is very large, thus affecting the picture quality of LCD.

**[0006]** In normal circumstances, it may be considered to add the function of a multi-level gate (MLG) to the gate driving circuit, so as to reduce the voltage jump and improve the picture quality. The generation principle of MLG is to draw a feedback signal from the output terminal to DC/DC IC and subsequently to generate a voltage and output it.

**[0007]** In US 2010/0141570 A1, a pull-in voltage at a pixel electrode is discussed, it is found that the pull-in voltage becomes smaller as a distance between a pixel and an output terminal of a gate driver becomes larger, which renders that an in-plane distribution of potential of the pixel electrodes occurs in a single scanning signal line GL. In consideration of the above defect, a stepwise waveform is proposed to allow the scanning signal to have the approximately same falling waveform in any position in a single scanning signal line GL. However, US 2010/0141570 A1 does not talk about how to generate the stepwise waveform.

**[0008]** Typically, $\alpha$-Si process is adopted in the existing gate driving circuit. Considering the mobility of TFT in the $\alpha$-Si process under a low-temperature condition will drop by about half compared to that under a high-temperature condition, therefore, in order to avoid the situation of failure occurring when the gate driving circuit is in the low-temperature condition, a solution of adding a temperature compensation circuit outside of the gate driving circuit is usually adopted, and particularly a thermo-sensitive de-

vice can be connected in parallel with the feedback circuit generating the gate high level Vgh to cause Vgh to rise with the temperature falling down.

**[0009]** However, once the effectiveness of the gate driving circuit is guaranteed by way of using temperature compensation, the voltage of Vgh may rise to more than 30V, while DC/DC IC cannot withstand such a high voltage, and in this case the function of MLG will be deactivated. Once the function of MLG is deactivated, there will be a large voltage jump at the instant of TFT being turned off, thus affecting the picture quality of TFT panel.

SUMMARY

**[0010]** In view of this, the main object of the present invention is to provide a gate driving circuit, a gate driving method and a display that can realize a gate driving circuit having a MLG function.

**[0011]** The object is achieved by the features of the respective independent claims. Further embodiments are defined in the respective dependent claims.

**[0012]** Accordingly, an embodiment of the present disclosure provides a gate driving circuit, including a plurality of shift registers at a plurality of stages, wherein the shift register at each stage includes a pull-up driving unit, a pull-up unit, a reset unit and a pull-down unit, said shift register further including: a supplementary unit; wherein, said pull-up unit is used for making a clock signal at a first clock terminal an output signal of the shift register at the present stage when being turned on during a phase in which an input node of the pull-up unit is at a high level, the clock signal at the first clock terminal is at its high level and a clock signal at a second clock terminal is at a low level;

said supplementary unit, connected to said pull-up unit, is used for making the clock signal at the second clock terminal the output signal of the shift register at the present stage when being turned on during another phase immediately after said phase in which the input node (PU) of the pull-up unit keeps at the high level, the clock signal at the first clock terminal (CLK1) jumps into a low level and the clock signal at the second clock terminal (CLK2) jumps into its high level, wherein the high level of the clock signal at said second clock terminal is lower than the high level of the clock signal at said first clock terminal.

**[0013]** In one example, said pull-up driving unit, connected to the input node of the pull-up unit, is used for controlling ON and OFF of the pull-up unit.

**[0014]** In one example, said pull-up driving unit comprises a first TFT switching device and a second TFT switching device; wherein,

a drain and a gate of the first TFT switching device are connected to an output terminal of the shift register at a previous stage;

a drain of said second TFT switching device is connected to the source of said first TFT switching device, a gate of said second TFT switching device is connected to an output terminal of the shift register at a next stage, and a source of said second TFT switching device is connected to a low level.

**[0015]** In one example, said pull-up unit includes a third TFT switching device and a boost device; Wherein,

a drain of said third TFT switching device is connected to the first clock terminal, a gate of said third TFT switching device is connected to the source of said first TFT switching device, and a source of said third TFT switching device is an output terminal of the shift register at the present stage;

the boost device has a first terminal respectively connected to the source of said first TFT switching device and the gate of said third TFT switching device and a second terminal connected to the source of said third TFT switching device.

**[0016]** In one example, said reset unit includes a fourth TFT switching device; a drain of said fourth TFT switching device is connected to the source of the third TFT switching device, a gate of said fourth TFT switching device is connected to the output terminal of the shift register at the next stage, and a source of said fourth TFT switching device is connected to the low level.

**[0017]** In one example, said supplementary unit includes a fifth TFT switching device and a sixth TFT switching device; wherein,

a drain and a gate of the fifth TFT switching device are connected to the second clock terminal, a drain of the sixth TFT switching device is connected to the source of the fifth TFT switching device, a gate of the sixth TFT switching device is connected to the source of the first TFT switching device of said pull-up driving unit, and a source of the sixth TFT switching device is connected to the output terminal of said pull-up unit and meanwhile serves as the output terminal of the shift register at the present stage.

**[0018]** In one example, said fifth switching device and said sixth TFT switching device are metal-oxide-semiconductor field effect transistors.

**[0019]** In one example, the clock signal at said second clock terminal jumps into its high level at the instant of the clock signal at the first clock terminal becoming the low level.

**[0020]** An embodiment of the invention provides a liquid crystal display comprising the gate driving circuit as described above.

**[0021]** An embodiment of the invention also provides a gate driving method comprising:

during a first phase, turning on the pull-up driving unit and beginning to charge the shift register at the present stage such that an input node (PU) of the pull-up unit is at a high level when the output signal at the output terminal of the shift register at the previous stage is at a high level and both the clock signal at the first clock terminal (CLK1) and the clock signal at the second clock terminal (CLK2) are at a low level;

during a second phase immediately after the first

phase, the output signal at the output terminal (INPUT) of the shift register at the previous stage jumping into the low level, the clock signal at the first clock terminal (CLK1) jumping into its high level, and the clock signal at the second clock terminal (CLK2) keeping at the low level, turning on the pull-up unit by the high level at the input node (PU) of the pull-up unit, and making the clock signal at the first clock terminal the output signal of the shift register at the present stage;

during a third phase immediately after the second phase, the clock signal at said first clock terminal jumping into the low level and the clock signal at said second clock terminal jumping into its high level, turning on the supplementary unit by the clock signal at said second clock terminal (CLK2) and the high level at the input node (PU) of the pull-up unit and making the clock signal at said second clock terminal the output signal of the shift register at the present stage, wherein the high level of the clock signal at said second clock terminal is lower than the high level of the clock signal at said first clock terminal.

**[0022]** In one example, the high level of the clock signal at said second clock terminal is lower than the high level of the clock signal at said first clock terminal.

**[0023]** With the supplementary unit of the shift register at each stage in the gate driving circuit, the present disclosure controls the output of the shift register through turning on the supplementary unit at the instant of the TFT being turned off, which is possible to reduce the voltage jump of the pixel, achieve the MLG function and enhance the picture quality of the LCD.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0024]**

Figure 1 is a schematic structure diagram of a shift register at each stage in the existing gate driving circuit;

Figure 2 is a timing diagram of input and output signals of a shift register in the existing gate driving circuit as shown in Figure 1;

Figure 3 is a schematic diagram of the function structure of a shift register in the gate driving circuit according to an embodiment of the present invention;

Figure 4 is a structure diagram of a specific implementation of a shift register in the gate driving circuit according to an embodiment of the present invention;

Figure 5 is a timing diagram of input and output signals of a shift register in the gate driving circuit according to an embodiment of the present invention;

Figure 6 is a schematic principle diagram of the MLG function being implemented by the gate driving circuit according to an embodiment of the present invention;

Figure 7 is a schematic flowchart of the gate driving method according to an embodiment of the present invention.

**[0025]** Explanation of Symbols: M1-a first TFT switching device; M2-a second TFT switching device; M3-a third TFT switching device; M4-a fourth TFT switching device; M5-a fifth TFT switching device; M6-a sixth TFT switching device; PD-a pull-down unit; C1-a boost device; 31-a GOA circuit unit; 32-a supplementary unit.

## DETAILED DESCRIPTION

**[0026]** In order for those skilled in the art understanding the technical solution sought for protection in the present invention, the gate driving circuit and method and the liquid crystal display provided in the embodiments of the present disclosure will be described with reference to the accompanying drawings. Obviously, the embodiments given in the present application are only some but not all of the embodiments of the present invention, and all other embodiments obtained by those skilled in the art without paying any creative labor shall fall within the protection scope of the present invention which is defined in the claims.

**[0027]** The basic idea of embodiments of the present invention is: said gate driving circuit includes shift registers at a plurality of stages, wherein the shift register at each stage includes a pull-up driving unit, a pull-up unit, a reset unit, a pull-down unit, and further comprises: a supplementary unit; wherein said pull-unit is used for making a clock signal at a first clock terminal an output signal of the shift register at the present stage when being turned on; said supplementary unit is connected to said pull-up unit and is used for making a clock signal at a second clock terminal the output signal of the shift register at the present stage when being turned on.

**[0028]** In order that the object, technical solution and advantages of the present disclosure become clearer, the present disclosure is described in further detail by illustrating the following examples with reference to the accompanying drawings.

**[0029]** Figure 3 illustrates the functional configuration of the shift register of each stage in the gate driving circuit of the present disclosure, and as shown in Figure 3, the shift register comprises a GOA circuit unit 31 and a supplementary unit 32; wherein the GOA circuit unit 31 is connected to an input terminal (INPUT), a reset terminal (RESET), a first clock terminal (CLK1) and a low-voltage signal terminal (VSS), said input terminal (INPUT) receives an output signal of the shift register at a previous stage, said reset terminal (RESET) receives an output signal of the shift register at a next stage, said low signal terminal (VSS) receives a low-voltage signal, and under normal circumstances, a voltage level of said low signal terminal (VSS) is the same as a low level of a clock signal at CLK1; the supplementary unit 32 is connected to a second clock terminal (CLK2) and an output terminal

(OUTPUT) of the GOA circuit unit 31 respectively, and is used for controlling the output of the GOA circuit unit 31.

**[0030]** The specific operating process of the above-mentioned shift register is: when the clock signal at CLK1 is at its high level, the clock signal at CLK2 is at a low level, the output signal at OUTPUT is the pulse signal at CLK1, and the voltage value at that time is referred to as Vgh1; when the clock signal at CLK1 becomes the low level, the clock signal at CLK2 of the supplementary unit 32 turns into its high level, at this time the supplementary unit 32 is turned on, the output signal at OUTPUT is the pulse signal at CLK2, and the voltage value at that time is referred to as Vgh2. In view of the overall situation, the output voltage value at OUTPUT jumps from Vgh1 to Vgh2, which, relative to the shift register of the existing gate driving circuit directly jumping from Vgh1 to 0, greatly reduces the jump voltage of the pixel, thereby achieving the MLG function and enhancing the picture quality.

**[0031]** Figure 4 shows a specific implementation structure of the shift register of the gate driving circuit according to an embodiment of the present disclosure, and as shown in Figure 4, the aforesaid GOA circuit unit 31 includes a pull-up driving unit, a pull-up unit, a reset unit, a pull-down unit and a supplementary unit, wherein said pull-unit is used for making the clock signal at a first clock terminal the output signal of the shift register at the present stage when being turned on; said supplementary unit is connected to said pull-up unit and is used for making the clock signal at the second clock terminal the output signal of the shift register at the present stage when being turned on.

**[0032]** Wherein, said pull-up driving unit, connected to an input node of the pull-up unit, is used for controlling ON and OFF of the pull-up unit.

**[0033]** In one example, said pull-up driving unit further comprises a first TFT switching device M1 and a second TFT switching device M2;

said pull-up unit includes a third TFT switching device M3 and a boost device C1;

a drain and a gate of said M1 are connected to the INPUT; a drain of said M2 is connected to a source of said M1, a gate of said M2 is connected to the RESET, and a source of said M2 is connected to the VSS; a drain of said M3 is connected to the CLK1, a gate of said M3 is connected to the source of said M1, and a source of said M3 is the output terminal of said GOA circuit unit 31 and also the output terminal of the shift register at the present stage; said C1 has a first terminal connected to the source of said M1 and the gate of said M3 and a second terminal connected to the source of the M3.

**[0034]** In one example, further, said reset unit specifically includes a fourth TFT switching device M4; a drain of said M4 is connected to the source of the M3, a gate of said M4 is connected to RESET, and a source of said M4 is connected to VSS.

**[0035]** In one example, further, the GOA circuit unit 31 also includes: a pull-down unit PD, connected in parallel with the C1, has a first terminal connected to the VSS and a second terminal connected to the drain of said M3.

**[0036]** In one example, the above-mentioned supplementary unit 32 specifically includes a fifth TFT switching device M5 and a sixth TFT switching devices M6; wherein a drain and a gate of said M5 are connected to CLK2, a drain of the M6 is connected to a source of the M5, a gate of the M6 is connected to the first terminal of C1 in the pull-up driving unit of the GOA circuit unit 31, and a source of the M6 is connected the output terminal of the pull-up unit, i.e. the source of the M3, and also serves as the output terminal of the shift register at the present stage.

**[0037]** Wherein, the above-mentioned M1, M2, M3, M4, M5 and M6 specifically can be metal-oxide-semiconductor (MOS) field effect transistors.

**[0038]** The specific operating process of said gate driving circuit is: when the input signal at INPUT is at its high level, the M1 is turned on and the node PU is charged; when the clock signal at CLK1 is at its high level and the clock signal at CLK2 is a low level, the M3 is turned on, at this time the output signal at OUTPUT is the pulse signal at CLK1, the voltage value at this time is referred to as Vgh1, and meanwhile a first bootstrapping function of C1 pulls up the node PU for the first time. Then, when the clock signal at CLK1 turns into the low level, the clock signal at CLK2 of the supplementary unit 32 turns into its high level and lasts a short time, at this time M5 and M6 are turned on, the output signal at OUTPUT is the pulse signal at CLK2, the voltage value at this time is referred to as Vgh2, a second bootstrapping function of C1 pulls up the node PU once again. In view of the overall situation, the output voltage value at OUTPUT jumps from Vgh1 to Vgh2, which, relative to the shift register of the existing gate driving circuit directly jumping from Vgh1 to 0, greatly reduces the jump voltage of the pixel, thereby achieving the MLG function and enhancing the picture quality. Then, the node PU and OUTPUT are discharged by CLK1 controlling the pull-down unit PD, thereby guaranteeing that the shift register of the gate driving circuit will not produce noise in the non-operating time.

**[0039]** Specifically, during the above process, the timing diagrams of the respective input and output signals can refer to Figure 5. As can be seen from Figure 5, the voltage value of CLK2 Vgh2 is lower that of CLK1 Vgh1. It should be understood that the input signal at the INPUT in Figure 5 is illustrated by the output signal of the shift register at the previous stage of the existing gate driving circuit, and when the gate driving circuit according to the embodiment of the present disclosure is particularly used, the timing diagram of the input signal at the INPUT is the output signal of the shift register at the previous stage of the gate driving circuit according to the embodiment of the present invention.

**[0040]** Figure 6 shows the principle of the MLG function achieved by the gate driving circuit according to the embodiment of the present disclosure. As shown in Figure 6, at the instant of CLK1 turning into a low level, i.e. at the instant of TFT being turned off, OUTPUT will also

turn into the low level, however, since there is an input from CLK2, the value of the output voltage at OUTPUT at this time is Vgh2 and at this time a recharging will occur, thereby achieving an effect of reducing the jump voltage $\Delta$ Vp of pixel, and then enhancing the picture quality; wherein Vp in Figure 6 is the voltage waveform of the pixel, Vcom is the voltage of a common electrode, Vd is the voltage waveform of a data line (Data), and Vgl is the low level of the gate.

**[0041]** Embodiments of the disclosure further provide a liquid crystal display, wherein said liquid crystal display comprises the gate driving circuit as described above.

**[0042]** Embodiments of the present disclosure also provide a gate driving method implemented by taking advantage of the aforesaid gate driving circuit, and the implementation flow of said method can refer to Figure 7, comprising:

Step 701, turning on the pull-up driving unit and beginning to charge the shift register at the present stage when the output signal at the output terminal of the shift register at the previous stage is at a high level;

Step 702, turning on the pull-up unit and making the clock signal at the first clock terminal the output signal of the shift register at the present stage when the clock signal at the first clock terminal is its high level and the clock signal at the second clock terminal is at a low level;

Step 703, the clock signal at said first clock terminal jumping into the low level, the clock signal at said second clock terminal jumping into its high level, turning on the supplementary unit and making the clock signal at said second clock terminal the output signal of the shift register at the present stage.

**[0043]** Wherein, the high level of the clock signal at said second clock terminal is lower than the high level of the clock signal at said first clock terminal. Wherein, the difference between the high level of the clock signal at said second clock terminal and that of the clock signal at said first clock terminal is determined according to the specific situation of the actual application.

## Claims

**1.** A gate driving circuit comprising shift registers at a plurality of stages, wherein the shift register at each stage including a pull-up driving unit, a pull-up unit, a reset unit and a pull-down unit, said shift register further including: a supplementary unit; wherein,
said pull-up unit (M3, C1) is configured for making a clock signal at a first clock terminal (CLK1) an output signal of the shift register at the present stage when being turned on during a phase in which an input node (PU) of the pull-up unit is at a high level, the clock signal at the first clock terminal (CLK1) is at its high level and a clock signal at a second clock terminal (CLK2) is at a low level; **characterized by**
said supplementary unit (32), connected to said pull-up unit, is configured for making the clock signal at the second clock terminal (CLK2) the output signal of the shift register at the present stage when being turned on during another phase immediately after said phase in which the input node (PU) of the pull-up unit keeps at the high level, the clock signal at the first clock terminal (CLK1) jumps into a low level and the clock signal at the second clock terminal (CLK2) jumps into its high level, wherein the high level of the clock signal at said second clock terminal is lower than the high level of the clock signal at said first clock terminal.

**2.** The gate driving circuit according to Claim 1, wherein said pull-up driving unit, connected to the input node (PU) of the pull-up unit, is configured for controlling ON and OFF of the pull-up unit.

**3.** The gate driving circuit according to Claim 2, wherein said pull-up driving unit includes a first TFT switching device (M1) and a second TFT switching device (M2); wherein,
a drain and a gate of the first TFT switching device (M1) are connected to an output terminal (INPUT) of the shift register at a previous stage;
a drain of said second TFT switching device (M2) is connected to the source of said first TFT switching device (M1), a gate of said second TFT switching device (M2) is connected to an output terminal (RESET) of the shift register at a next stage, and a source of said second TFT switching device is connected to a low level.

**4.** The gate driving circuit according to Claim 3, wherein said pull-up unit includes a third TFT switching device (M3) and a boost device (C1); wherein,
a drain of said third TFT switching device (M3) is connected to the first clock terminal (CLK1), a gate of said third TFT switching device (M3) is connected to the source of said first TFT switching device (M1), and a source of said third TFT switching device (M3) is an output terminal (OUTPUT) of the shift register at the present stage;
said boost device (C1) has a first terminal respectively connected to the source of said first TFT switching device (M1) and the gate of said third TFT switching device (M3) and a second terminal connected to the source of said third TFT switching device (M3).

**5.** The gate driving circuit according to Claim 4, wherein said reset unit includes a fourth TFT switching device (M4); a drain of said fourth TFT switching device (M4) is connected to the source of the third TFT switching device (M3), a gate of said fourth TFT switching de-

vice (M4) is connected to the output terminal (RESET) of the shift register at the next stage, and a source of said fourth TFT switching device (M4) is connected to a low level.

**6.** The gate driving circuit according to Claim 5, wherein said supplementary unit includes a fifth TFT switching device (M5) and a sixth TFT switching device (M6); wherein,
a drain and a gate of the fifth TFT switching device (M5) are connected to the second clock terminal (CLK2), a drain of the sixth TFT switching device (M6) is connected to a source of the fifth TFT switching device (M5), a gate of the sixth TFT switching device (M6) is connected to the source of the first TFT switching device (M1) of said pull-up driving unit, and a source of the sixth TFT switching device (M6) is connected to the output terminal of said pull-up unit and also serves as the output terminal (OUTPUT) of the shift register at the present stage.

**7.** The gate driving circuit according to Claim 6, wherein said fifth switching device (M5) and said sixth TFT switching device (M6) are metal-oxide-semiconductor field effect transistors.

**8.** The gate driving circuit according to Claim 6, wherein the clock signal at said second clock terminal (CLK2) jumps into its high level at the instant of the clock signal at the first clock terminal (CLK1) becoming the low level.

**9.** A liquid crystal display comprising the gate driving circuit according to any of Claims 1-8.

**10.** A gate driving method for the gate driving circuit according to any of Claims 1-8, comprising:

during a first phase, turning on the pull-up driving unit and beginning to charge the shift register at the present stage such that an input node (PU) of the pull-up unit is at a high level when the output signal at the output terminal (INPUT) of the shift register at a previous stage is at a high level and both the clock signal at the first clock terminal (CLK1) and the clock signal at the second clock terminal (CLK2) are at a low level;
during a second phase immediately after the first phase, the output signal at the output terminal (INPUT) of the shift register at the previous stage jumping into the low level, the clock signal at the first clock terminal (CLK1) jumping into its high level, and the clock signal at the second clock terminal (CLK2) keeping at the low level, turning on the pull-up unit by the high level at the input node (PU) of the pull-up unit, and making the clock signal at the first clock terminal (CLK1) the output signal of the shift register at the present stage;
during a third phase immediately after the second phase, the clock signal at said first clock terminal (CLK1) jumping into the low level, the clock signal at said second clock terminal (CLK2) jumping into its high level, turning on the supplementary unit by the clock signal at said second clock terminal (CLK2) and the high level at the input node (PU) of the pull-up unit and making the clock signal at said second clock terminal the output signal of the shift register at the present stage, wherein the high level of the clock signal at said second clock terminal is lower than the high level of the clock signal at said first clock terminal.

**Patentansprüche**

**1.** Gate-Ansteuerschaltung mit Schieberegistern an einer Vielzahl von Stufen, wobei die Schieberegister an jeder Stufe eine Pull-Up-Ansteuereinheit, eine Pull-Up-Einheit, eine Reset-Einheit und eine Pull-Down-Einheit, wobei das Schieberegister weiter aufweist: eine Zusatzeinheit aufweisen; wobei
die Pull-Up-Einheit (M3, C1) konfiguriert ist zum Bilden eines Taktsignals an einem ersten Taktanschluss (CLK1) als ein Ausgabesignal des Schieberegisters an der vorliegenden Stufe, wenn es während einer Phase eingeschaltet wird, in der ein Eingangsknoten (PU) der Pull-Up-Einheit sich auf einem H-Pegel befindet, das Taktsignal an dem ersten Taktanschluss (CLK1) sich an seinem H-Pegel befindet und ein Taktsignal an einem zweiten Taktanschluss (CLK2) sich an einem L-Pegel befindet; **gekennzeichnet dadurch, dass**
die Zusatzeinheit (32), welche mit der Pull-Up-Einheit verbunden ist, konfiguriert ist zum Bilden des Taktsignals an dem zweiten Taktanschluss (CLK2) als das Ausgangssignal des Schieberegisters an der vorliegenden Stufe, wenn es während einer anderen Phase eingeschaltet wird, unmittelbar nach der Phase, in der der Eingangsknoten (PU) der Pull-Up-Einheit auf dem H-Pegel verbleibt, das Taktsignal an dem ersten Taktanschluss (CLK1) auf einen L-Pegel springt und das Taktsignal an dem zweiten Taktanschluss (CLK2) auf seinen H-Pegel springt, wobei der H-Pegel des Taktsignals an dem zweiten Taktanschluss niedriger als der H-Pegel des Taktsignals an dem ersten Taktanschluss ist.

**2.** Gate-Ansteuerschaltung gemäß Anspruch 1, wobei die Pull-Up-Ansteuereinheit, die mit dem Eingangsknoten (PU) der Pull-Up-Einheit verbunden ist, zum Steuern des EIN und AUS der Pull-Up-Einheit konfiguriert ist.

**3.** Gate-Ansteuerschaltung gemäß Anspruch 2, wobei

die Pull-Up-Ansteuereinheit eine erste TFT-Schaltvorrichtung (M1) und eine zweite TFT-Schaltvorrichtung (M2) aufweist; wobei,
ein Drain und ein Gate der ersten TFT-Schaltvorrichtung (M1) verbunden sind mit einem Ausgangsanschluss (INPUT) des Schieberegisters an einer vorhergehenden Stufe;
ein Drain der zweiten TFT-Schaltvorrichtung (M2) mit der Source der ersten TFT-Schaltvorrichtung (M1) verbunden ist, ein Gate der zweiten TFT-Schaltvorrichtung (M2) mit einem Ausgangsanschluss (RESET) des Schieberegisters an einer nächsten Stufe verbunden ist, und eine Source der zweiten TFT-Schaltvorrichtung mit einem L-Pegel verbunden ist.

**4.** Gate-Ansteuerschaltung gemäß Anspruch 3, wobei die Pull-Up-Einheit eine dritte TFT-Schaltvorrichtung (M3) und eine Verstärkervorrichtung (C1) aufweist; wobei
ein Drain der dritten TFT-Schaltvorrichtung (M3) mit dem ersten Taktanschluss (CLK1) verbunden ist, ein Gate der dritten TFT-Schaltvorrichtung (M3) mit der Source der ersten TFT-Schaltvorrichtung (M1) verbunden ist, und eine Source der dritten TFT-Schaltvorrichtung (M3) mit einem Ausgangsanschluss (OUTPUT) des Schieberegisters an der vorliegenden Stufe verbunden ist;
die Verstärkervorrichtung (C1) einen ersten Anschluss aufweist, der jeweils mit der Source der ersten TFT-Schaltvorrichtung (M1) und dem Gate der dritten TFT-Schaltvorrichtung (M3) verbunden ist und ein zweiter Anschluss mit der Source der dritten TFT-Schaltvorrichtung (M3) verbunden ist.

**5.** Gate-Ansteuerschaltung gemäß Anspruch 4, wobei die Reset-Einheit eine vierte TFT-Schaltvorrichtung (M4) aufweist; wobei ein Drain der vierten TFT-Schaltvorrichtung (M4) mit der Source der dritten TFT-Schaltvorrichtung (M3) verbunden ist, ein Gate der vierten TFT-Schaltvorrichtung (M4) mit dem Ausgangsanschluss (RESET) des Schieberegisters an der nächsten Stufe verbunden ist, und eine Source der vierten TFT-Schaltvorrichtung (M4) mit einem L-Pegel verbunden ist.

**6.** Gate-Ansteuerschaltung gemäß Anspruch 5, wobei die Zusatzeinheit eine fünfte TFT-Schaltvorrichtung (M5) und eine sechste TFT-Schaltvorrichtung (M6) aufweist; wobei
ein Drain und ein Gate der fünften TFT-Schaltvorrichtung (M5) verbunden sind mit dem zweiten Taktanschluss (CLK2), ein Drain der sechsten TFT-Schaltvorrichtung (M6) verbunden ist mit einer Source der fünften TFT-Schaltvorrichtung (M5), ein Gate der sechsten TFT-Schaltvorrichtung (M6) verbunden ist mit der Source der ersten TFT-Schaltvorrichtung (M1) der Pull-Up-Ansteuereinheit, und eine Source der sechsten TFT-Schaltvorrichtung (M6) verbunden ist mit dem Ausgangsanschluss der Pull-Up-Einheit und auch als der Ausgangsanschluss (OUTPUT) des Schieberegisters an der vorliegenden Stufe dient.

**7.** Gate-Ansteuerschaltung gemäß Anspruch 6, wobei die fünfte Schaltvorrichtung (M5) und die sechste TFT-Schaltvorrichtung (M6) Metalloxyd-Halbleiter-Feldeffekttransistoren sind.

**8.** Gate-Ansteuerschaltung gemäß Anspruch 6, wobei das Taktsignal an dem zweiten Taktanschluss (CLK2) in dem Augenblick auf seinen H-Pegel springt, in dem das Taktsignal an dem ersten Taktanschluss (CLK1) den L-Pegel einnimmt.

**9.** Flüssigkristallanzeige mit der Gate-Ansteuerschaltung gemäß einem der Ansprüche 1 bis 8.

**10.** Gate-Ansteuerverfahren für die Gate-Ansteuerschaltung gemäß einem der Ansprüche 1 bis 8, aufweisend:

während einer ersten Phase, Einschalten der Pull-Up-Ansteuereinheit und Beginnen das Schieberegister an der vorliegenden Stufe derart zu laden, dass ein Eingangsknoten (PU) der Pull-Up-Einheit sich an einem H-Pegel befindet, wenn das Ausgangssignal an dem Ausgangsanschluss (INPUT) des Schieberegisters an einer vorhergehenden Stufe sich auf einem H-Pegel befindet und sowohl das Taktsignal an dem ersten Taktanschluss (CLK1) als auch das Taktsignal an dem zweiten Taktanschluss (CLK2) sich auf einem L-Pegel befinden;
während einer zweiten Phase unmittelbar nach der ersten Phase, das Ausgangssignal an dem Ausgangsanschluss (INPUT) des Schieberegisters an der vorhergehenden Stufe auf den L-Pegel springt, das Taktsignal an dem ersten Taktanschluss (CLK1) auf seinen H-Pegel springt, und das Taktsignal an dem zweiten Taktanschluss (CLK2) auf seinem L-Pegel verbleibt, Einschalten der Pull-Up-Einheit durch den H-Pegel an dem Eingangsknoten (PU) der Pull-Up-Einheit und Bilden des Taktsignals an dem ersten Taktanschluss (CLK1) als das Ausgangssignal des Schieberegisters an der vorliegenden Stufe;
während einer dritten Phase, unmittelbar nach der zweiten Phase, Springen des Taktsignals an dem ersten Taktanschluss (CLK1) auf den L-Pegel, Springen des Taktsignals an dem zweiten Taktanschluss (CLK2) auf seinen H-Pegel, Einschalten der Zusatzeinheit durch das Taktsignal an dem zweiten Taktanschluss (CLK2) und des H-Pegels an dem Eingangsknoten (PU)

der Pull-Up-Einheit, und Bilden des Taktsignals an dem zweiten Taktanschluss als das Ausgangssignal des Schieberegisters an der vorliegenden Stufe, wobei H-Pegel des Taktsignals an dem zweiten Taktanschluss niedriger als der H-Pegel des Taktsignals an dem ersten Taktanschluss ist.

**Revendications**

**1.** Circuit de commande de grille, comprenant des registres à décalage sur une pluralité d'étages, dans lequel le registre à décalage à chaque étage inclut une unité de commande de forçage au niveau haut, une unité de forçage au niveau haut, une unité de réinitialisation et une unité de commande de forçage au niveau bas, ledit registre à décalage incluant en outre une unité supplémentaire ; dans lequel
ladite unité de forçage au niveau haut (M3, C1) est configurée pour faire d'un signal d'horloge sur une première borne d'horloge (CLK1) un signal de sortie du registre à décalage sur l'étage actuel lorsqu'elle est mise sous tension durant une phase au cours de laquelle un noeud d'entrée (PU) de l'unité de forçage au niveau haut est sur un niveau haut, le signal d'horloge sur la première borne d'horloge (CLK1) est sur son niveau haut, et un signal d'horloge sur une seconde borne d'horloge (CLK2) est sur un niveau bas, **caractérisé par le fait que**
ladite unité supplémentaire (32), connectée à ladite unité de forçage au niveau haut, est configurée pour faire du signal d'horloge sur la seconde borne d'horloge (CLK2) le signal de sortie du registre à décalage sur l'étage actuel lorsqu'elle est mise sous tension durant une autre phase immédiatement après ladite phase au cours de laquelle le noeud d'entrée (PU) de l'unité de forçage au niveau haut reste sur le niveau haut, le signal d'horloge sur la première borne d'horloge (CLK1) saute sur un niveau bas et le signal d'horloge sur la seconde borne d'horloge (CLK2) saute sur son niveau haut, dans lequel le niveau haut du signal d'horloge sur ladite seconde borne d'horloge est inférieur au niveau haut du signal d'horloge sur ladite première borne d'horloge.

**2.** Circuit de commande de grille selon la revendication 1, dans lequel ladite unité de commande de forçage au niveau haut, connectée au noeud d'entrée (PU) de l'unité de forçage au niveau haut, est configurée pour la commande sous tension et hors tension de l'unité de forçage au niveau haut.

**3.** Circuit de commande de grille selon la revendication 2, dans lequel ladite unité de commande de forçage au niveau haut inclut un premier dispositif de commutation TFT (transistor à couches minces) (M1) et un deuxième dispositif de commutation TFT (M2), dans lequel
un drain et une grille du premier dispositif de commutation TFT (M1) sont connectés à une borne de sortie (INPUT) du registre à décalage sur un étage précédent ;
un drain dudit deuxième dispositif de commutation TFT (M2) est connecté à la source dudit premier dispositif de commutation TFT (M1), une grille dudit deuxième dispositif de commutation TFT (M2) est connectée à une borne de sortie (RESET) du registre à décalage sur un étage suivant, et une source dudit deuxième dispositif de commutation TFT est connectée à un niveau bas.

**4.** Circuit de commande de grille selon la revendication 3, dans lequel ladite unité de forçage au niveau haut inclut un troisième dispositif de commutation TFT (M3) et un dispositif de suralimentation (C1), dans lequel
un drain dudit troisième dispositif de commutation TFT (M3) est connecté à la première borne d'horloge (CLK1), une grille dudit troisième dispositif de commutation TFT (M3) est connectée à la source dudit premier dispositif de commutation TFT (M1), et une source dudit troisième dispositif de commutation TFT (M3) est une borne de sortie (OUTPUT) du registre à décalage sur l'étage présent ;
ledit dispositif de suralimentation (C1) présente une première borne connectée respectivement à la source dudit premier dispositif de commutation TFT (M1) et à la grille dudit troisième dispositif de commutation TFT (M3) et une seconde borne connectée à la source dudit troisième dispositif de commutation TFT (M3).

**5.** Circuit de commande de grille selon la revendication 4, dans lequel ladite unité de réinitialisation inclut un quatrième dispositif de commutation TFT (M4) ; un drain dudit quatrième dispositif de commutation TFT (M4) est connecté à la source du troisième dispositif de commutation TFT (M3), une grille dudit quatrième dispositif de commutation TFT (M4) est connectée à la borne de sortie (RESET) du registre de décalage sur l'étage suivant, et une source dudit quatrième dispositif de commutation TFT (M4) est connectée à un niveau bas.

**6.** Circuit de commande de grille selon la revendication 5, dans lequel ladite unité supplémentaire inclut un cinquième dispositif de commutation TFT (M5) et un sixième dispositif de commutation TFT (M6), dans lequel
un drain et une grille du cinquième dispositif de commutation TFT (M5) sont connectés à la seconde borne d'horloge (CLK2), un drain du sixième dispositif de commutation TFT (M6) est connecté à une source du cinquième dispositif de commutation TFT (M5), une grille du sixième dispositif de commutation TFT

(M6) est connectée à la source du premier dispositif de commutation TFT (M1) de ladite unité de commande de forçage au niveau haut, et une source du sixième dispositif de commutation TFT (M6) est connectée à la borne de sortie de ladite unité de forçage au niveau haut et sert également de borne de sortie (OUTPUT) du registre à décalage sur l'étage actuel.

**7.** Circuit de commande de grille selon la revendication 6, dans lequel ledit cinquième dispositif de commutation TFT (M5) et ledit sixième dispositif de commutation TFT (M6) sont des transistors à effet de champ à semi-conducteur à oxyde métallique.

**8.** Circuit de commande de grille selon la revendication 6, dans lequel le signal d'horloge sur ladite seconde borne d'horloge (CLK2) saute à son niveau haut à l'instant où le signal d'horloge sur la première borne d'horloge (CLK1) passe au niveau bas.

**9.** Affichage à cristaux liquides comprenant le circuit de commande de grille selon l'une quelconque des revendications 1 à 8.

**10.** Procédé de commande de grille pour le circuit de commande de grille selon l'une quelconque des revendications 1 à 8, comprenant :

durant une première phase, la mise sous tension de l'unité de commande de forçage au niveau haut et le début de charge du registre à décalage sur l'étage présent, de telle sorte qu'un noeud d'entrée (PU) de l'unité de forçage au niveau haut est sur un niveau haut lorsque le signal de sortie sur la borne de sortie (INPUT) du registre à décalage sur un étage précédent est sur un niveau haut, et le signal d'horloge sur la première borne d'horloge (CLK1) et le signal d'horloge sur la seconde borne d'horloge (CLK2) sont tous deux sur un niveau bas ;
durant une deuxième phase immédiatement après la première phase, le signal de sortie sur la borne de sortie (INPUT) du registre à décalage sur l'étage précédent sautant sur le niveau bas, le signal d'horloge sur la première borne d'horloge (CLK1) sautant sur son niveau haut, et le signal d'horloge sur la seconde borne d'horloge (CLK2) restant sur le niveau bas, mettant sous tension l'unité de forçage au niveau haut par le niveau haut sur le noeud d'entrée (PU) de l'unité de forçage au niveau haut, et faisant du signal d'horloge sur la première borne d'horloge (CLK1) le signal de sortie du registre à décalage sur l'étage présent ;
durant une troisième phase immédiatement après la deuxième phase, le signal d'horloge sur ladite première borne d'horloge (CLK1) sautant sur le niveau bas, le signal d'horloge sur la seconde borne d'horloge (CLK2) sautant sur son niveau haut, mettant sous tension l'unité supplémentaire par le signal d'horloge sur ladite seconde borne d'horloge (CLK2) et le niveau haut sur le noeud d'entrée (PU) de l'unité de forçage au niveau haut, et faisant du signal d'horloge sur ladite seconde borne d'horloge le signal de sortie du registre à décalage sur l'étage présent, dans lequel le niveau haut du signal d'horloge sur ladite seconde borne d'horloge est inférieur au niveau haut du signal d'horloge sur ladite première borne d'horloge.

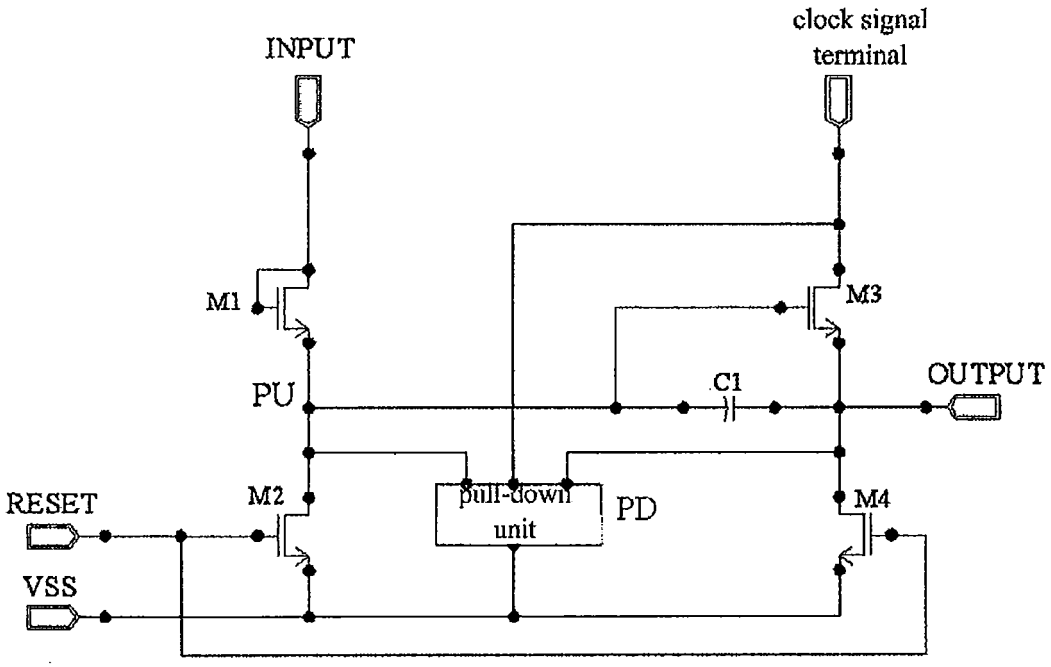
INPUT
clock signal terminal
M1
M3
PU
C1
OUTPUT
RESET
M2
pull-down unit
PD
M4
VSS

Fig.1

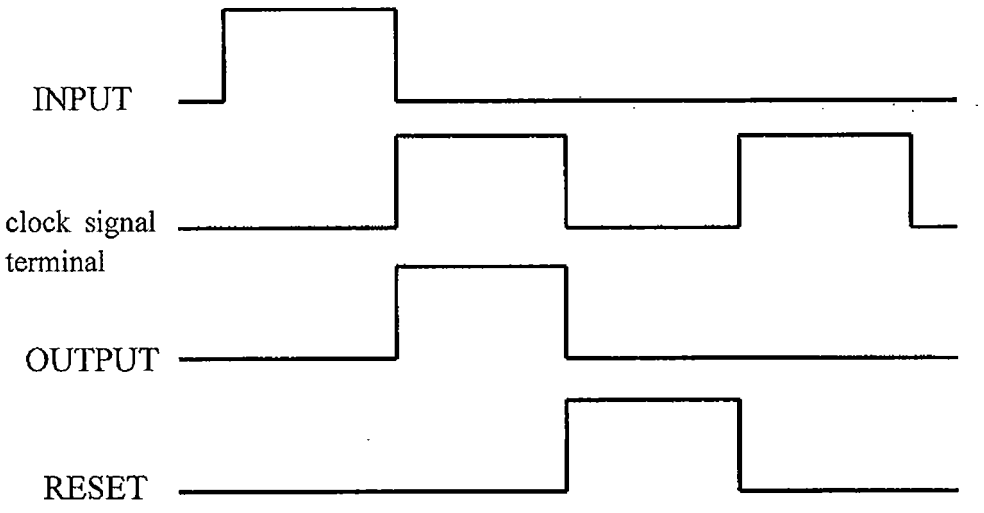
INPUT
clock signal terminal
OUTPUT
RESET

Fig.2

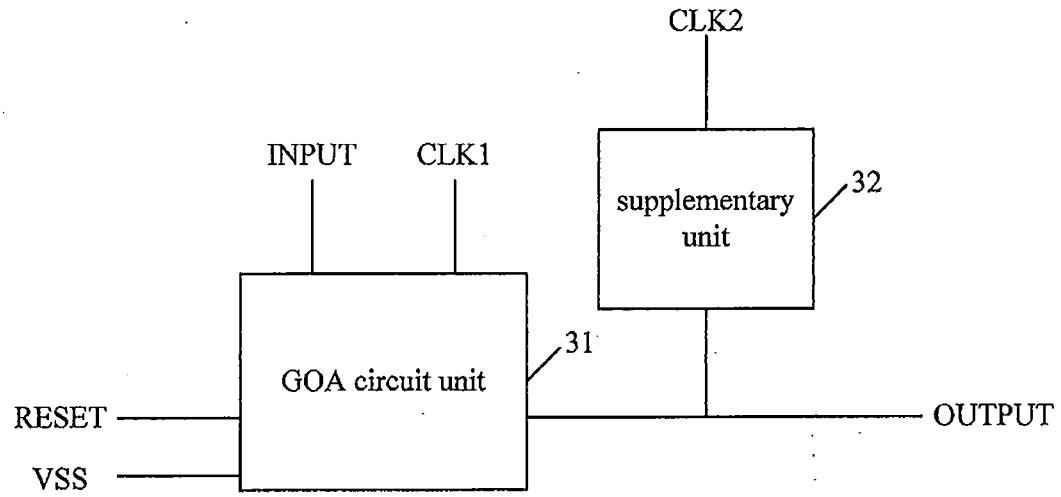
CLK2
INPUT
CLK1
supplementary unit
32
GOA circuit unit
31
RESET
VSS
OUTPUT

Fig.3

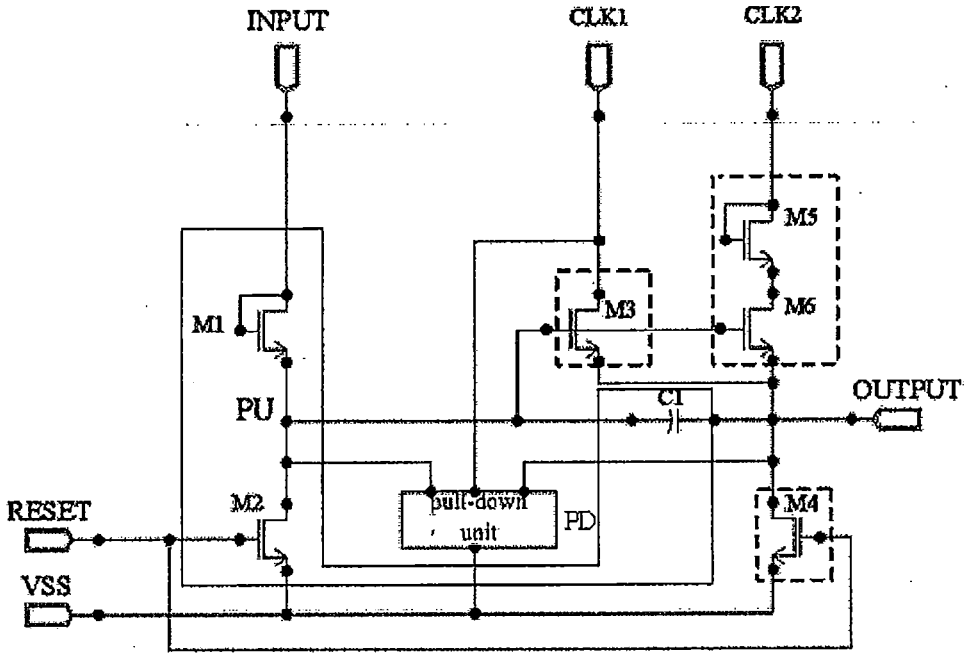
INPUT
CLK1
CLK2
M5
M1
M3
M6
PU
C1
OUTPUT
RESET
M2
pull-down unit
PD
M4
VSS

Fig.4

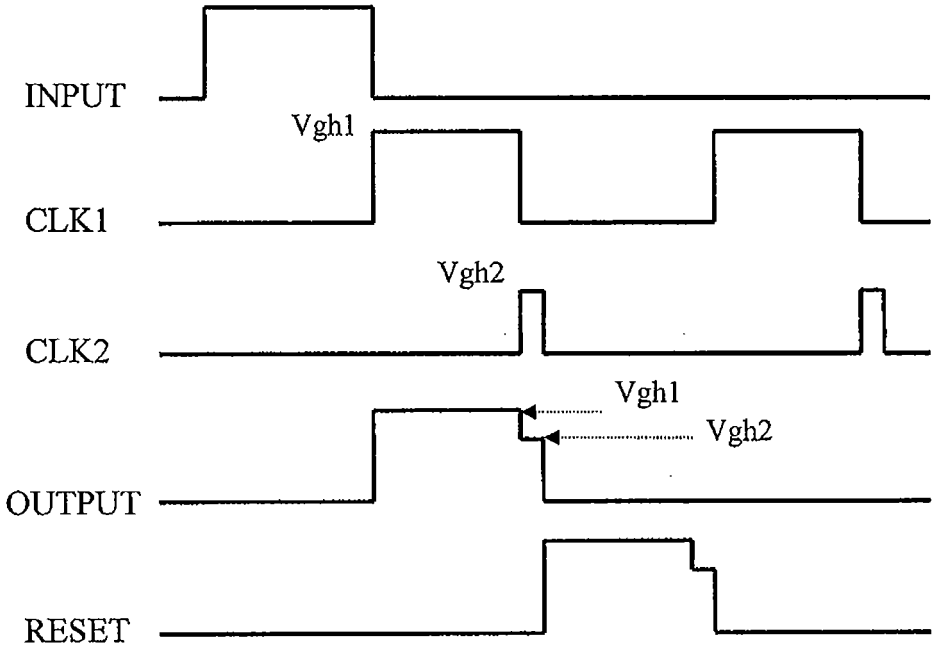
INPUT
Vgh1
CLK1
Vgh2
CLK2
Vgh1
Vgh2
OUTPUT
RESET

Fig.5

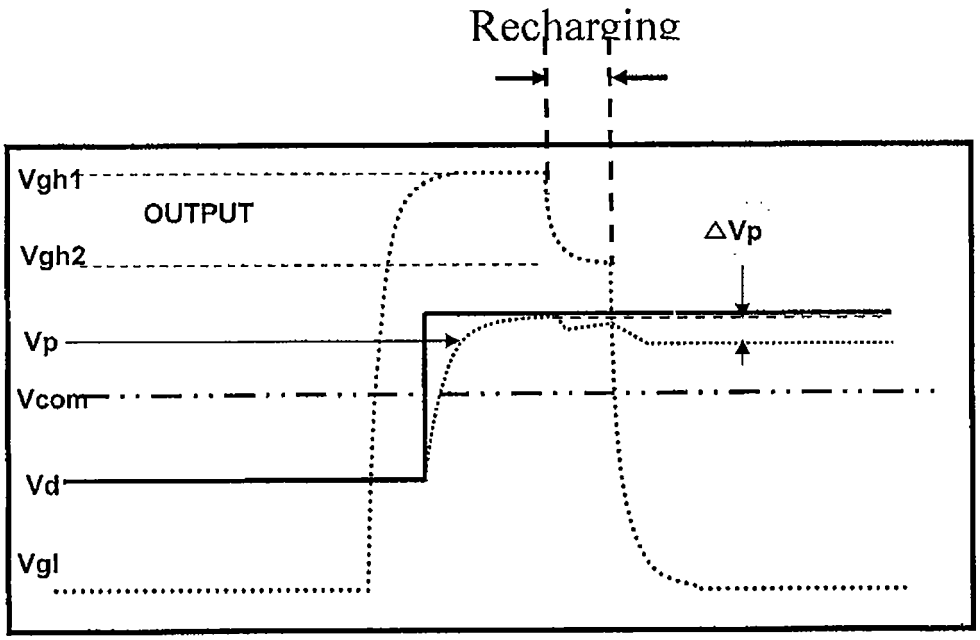
Recharging
Vgh1
OUTPUT
Vgh2
ΔVp
Vp
Vcom
Vd
Vgl

Fig.6

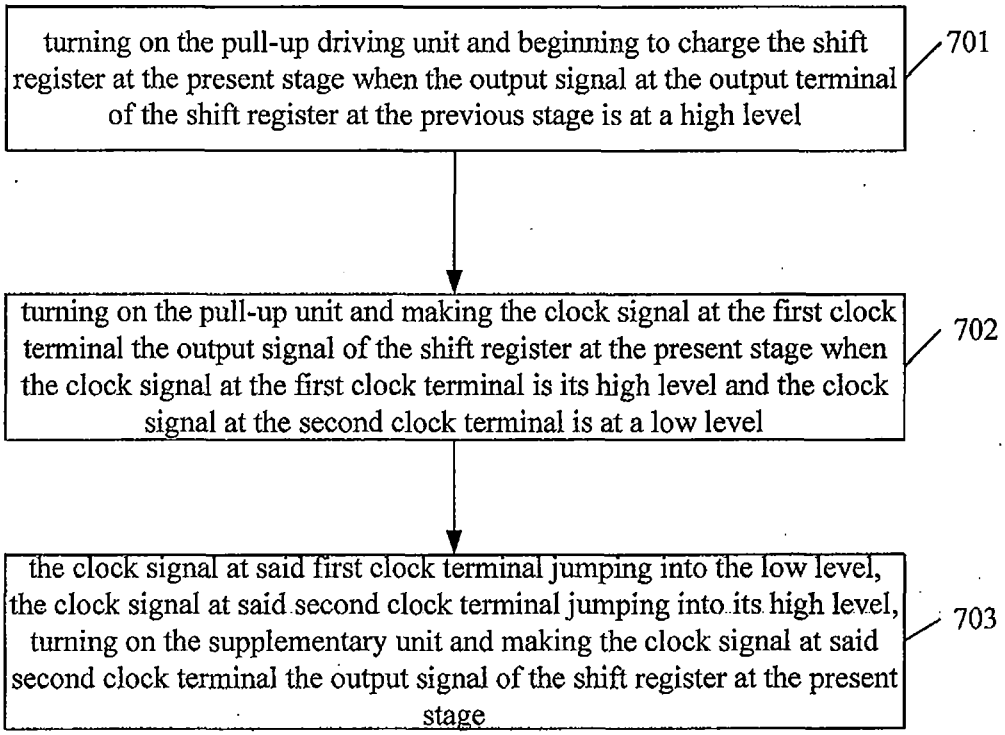
turning on the pull-up driving unit and beginning to charge the shift register at the present stage when the output signal at the output terminal of the shift register at the previous stage is at a high level
701
turning on the pull-up unit and making the clock signal at the first clock terminal the output signal of the shift register at the present stage when the clock signal at the first clock terminal is its high level and the clock signal at the second clock terminal is at a low level
702
the clock signal at said first clock terminal jumping into the low level, the clock signal at said second clock terminal jumping into its high level, turning on the supplementary unit and making the clock signal at said second clock terminal the output signal of the shift register at the present stage
703

Fig.7

## REFERENCES CITED IN THE DESCRIPTION

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- US 2004189585 A1 **[0005]**
- US 2012044132 A1 **[0005]**
- US 20100141570 A1 **[0007]**

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|---|---|---|---|
| 专利名称(译) | 栅电极驱动电路，栅电极驱动方法和液晶显示装置 | | |
| 公开(公告)号 | EP2667376B1 | 公开(公告)日 | 2017-07-19 |
| 申请号 | EP2012842680 | 申请日 | 2012-11-23 |
| [标]申请(专利权)人(译) | 北京京东方光电科技有限公司 | | |
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| 当前申请(专利权)人(译) | 北京京东方光电科技有限公司. | | |
| [标]发明人 | CHEN XI<br>CUI WENHAI | | |
| 发明人 | CHEN, XI<br>CUI, WENHAI | | |
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| 优先权 | 201210089393.9 2012-03-29 CN | | |
| 其他公开文献 | EP2667376A1<br>EP2667376A4 | | |
| 外部链接 | Espacenet | | |


摘要(译)

本发明提供一种栅极驱动电路，栅极驱动方法和液晶显示器。所述栅极驱动电路包括多级移位寄存器，其中每级的移位寄存器包括上拉驱动单元，上拉单元，复位单元，下拉单元和辅助单元;所述上拉单元用于在第一时钟端子处产生时钟信号，当接通时，在当前阶段产生移位寄存器的输出信号;所述辅助单元，连接到所述上拉单元，用于在接通时在当前阶段在第二时钟端子处产生移位寄存器的输出信号的时钟信号。利用栅极驱动电路中每个级的移位寄存器的辅助单元，本发明通过在TFT关闭的瞬间接通辅助单元来控制移位寄存器的输出，这可以减少电压跳变。像素，实现MLG功能，提升LCD的画质。


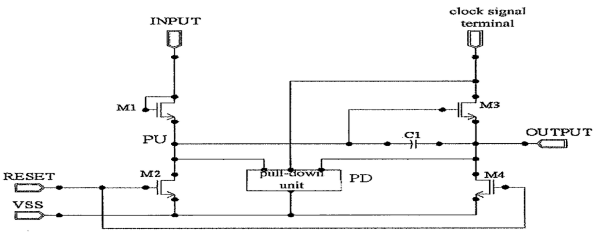


Fig.1

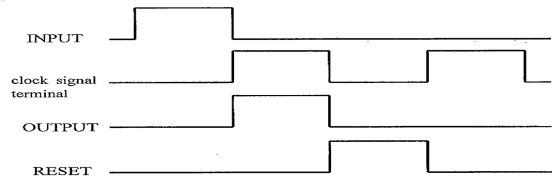


Fig.2