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An (43) **Pub. Date: Jun. 15, 2006**(54) **OUTPUT BUFFER OF A SOURCE DRIVER IN A LIQUID CRYSTAL DISPLAY HAVING A HIGH SLEW RATE AND A METHOD OF CONTROLLING THE OUTPUT BUFFER**(52) **U.S. Cl. .... 345/98**(75) **Inventor: Chang-Ho An, Suwon-si (KR)**Correspondence Address:  
**F. CHAU & ASSOCIATES, LLC**  
**130 WOODBURY ROAD**  
**WOODBURY, NY 11797 (US)**(73) **Assignee: Samsung Electronics Co., Ltd.**(21) **Appl. No.: 11/294,080**(22) **Filed: Dec. 5, 2005**(30) **Foreign Application Priority Data**

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**Publication Classification**(51) **Int. Cl.**  
**G09G 3/36 (2006.01)**(57) **ABSTRACT**

Provided is an output buffer for a source driver of an LCD with a high slew rate, and a method of controlling the output buffer. The output buffer, which outputs a source line driving signal for driving a source line of the LCD, includes: an amplifier section amplifying an analog image signal; an output section outputting the source line driving signal in response to a signal amplified by the amplifier section; and a slew rate controller section, setting a capacitance of a capacitor section to a first capacitance, during a first charge sharing period in which the source line is precharged to a first precharge voltage, setting the capacitance of the capacitor section to a second capacitance smaller than the first capacitance during a second charge sharing period in which the source line driving signal is supplied to the source line, and setting the capacitance of the capacitor section to the first capacitance while the source line driving signal is maintained after the second charge sharing period.

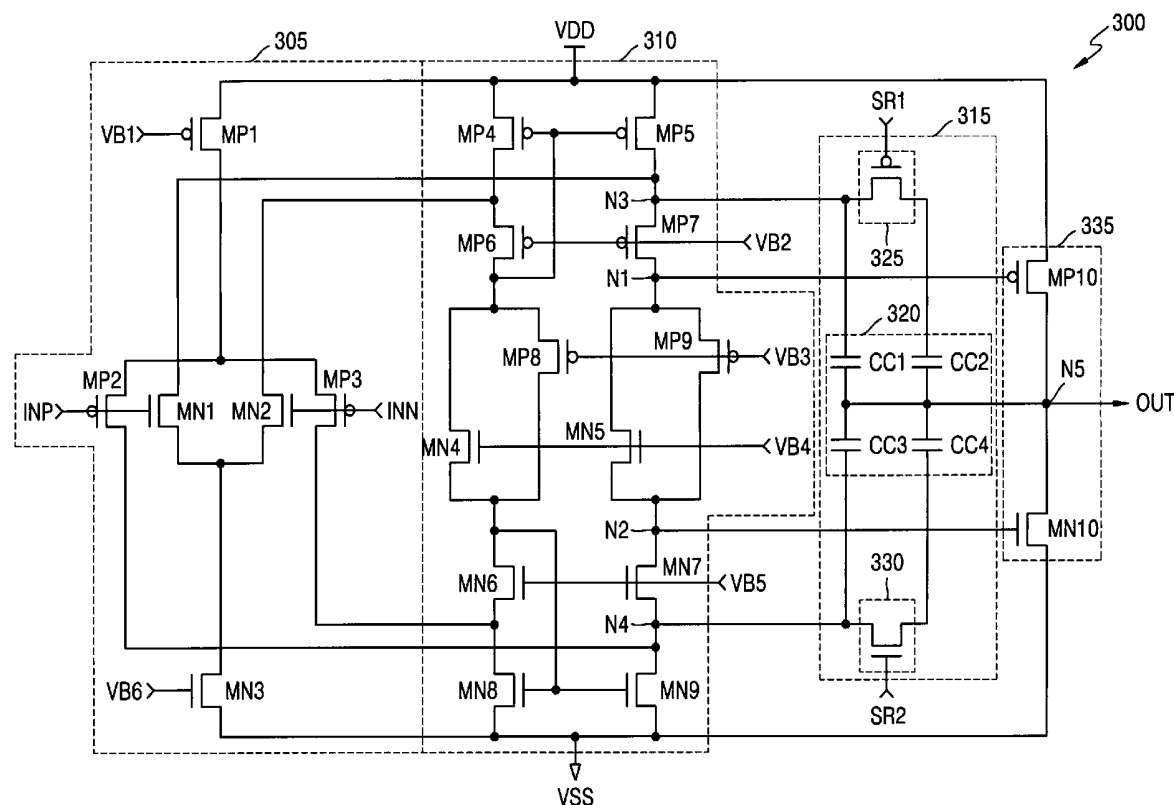


FIG. 1 (PRIOR ART)

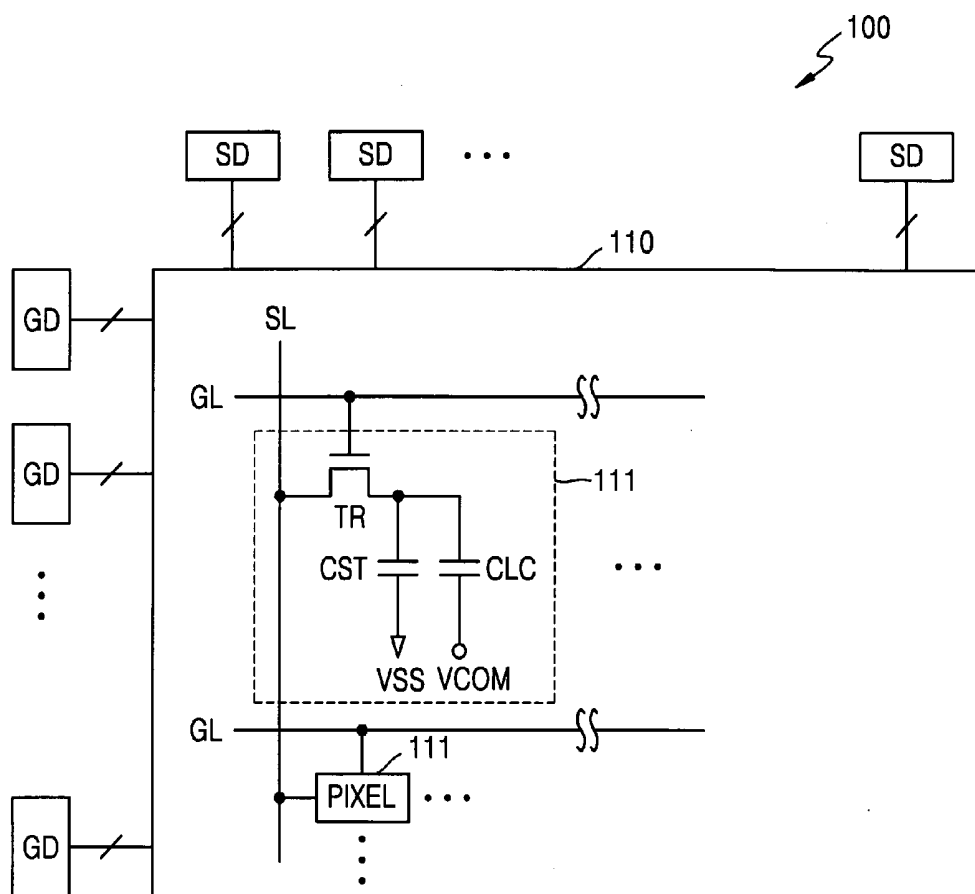


FIG. 2 (PRIOR ART)

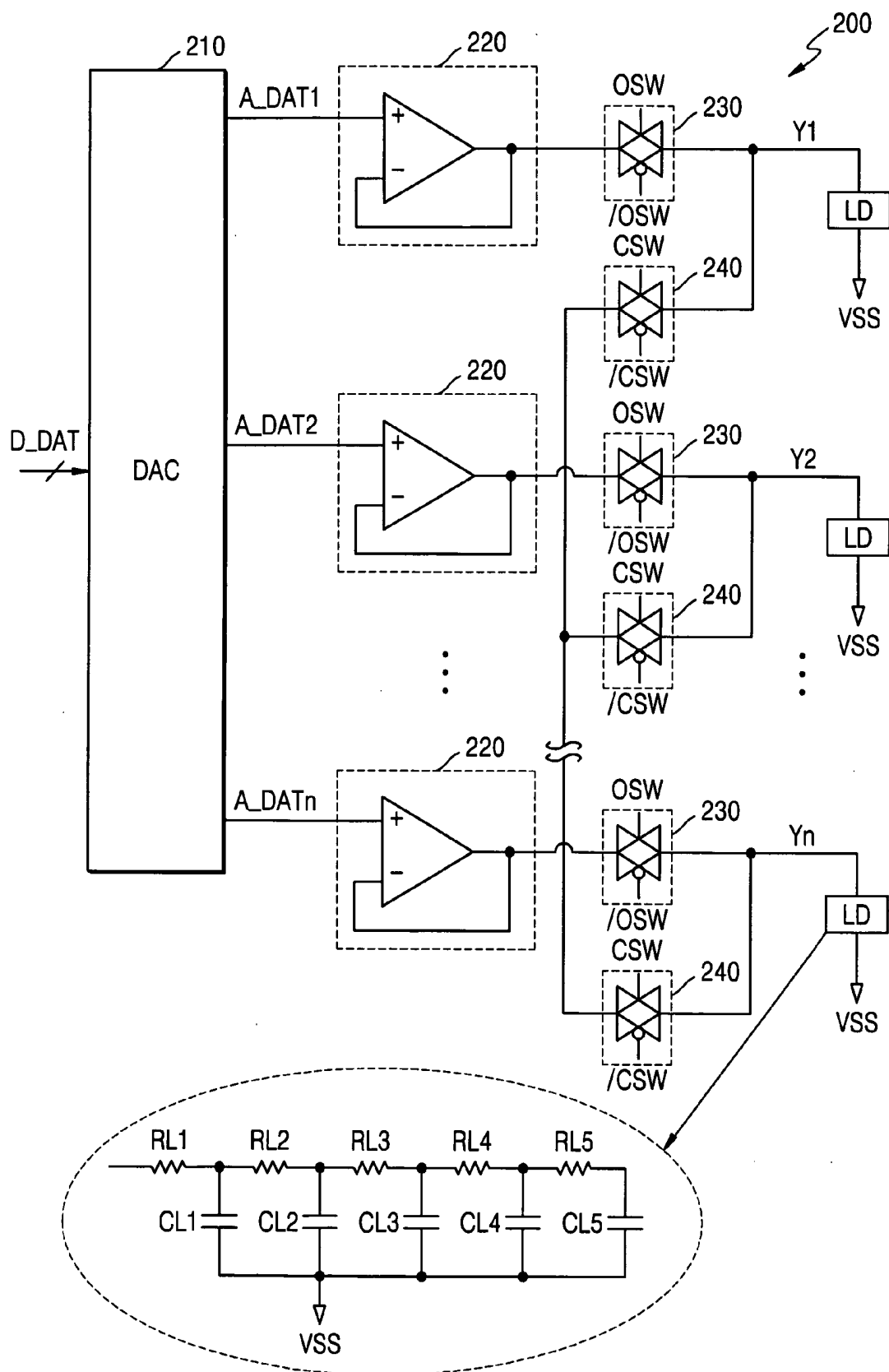


FIG. 3 (PRIOR ART)

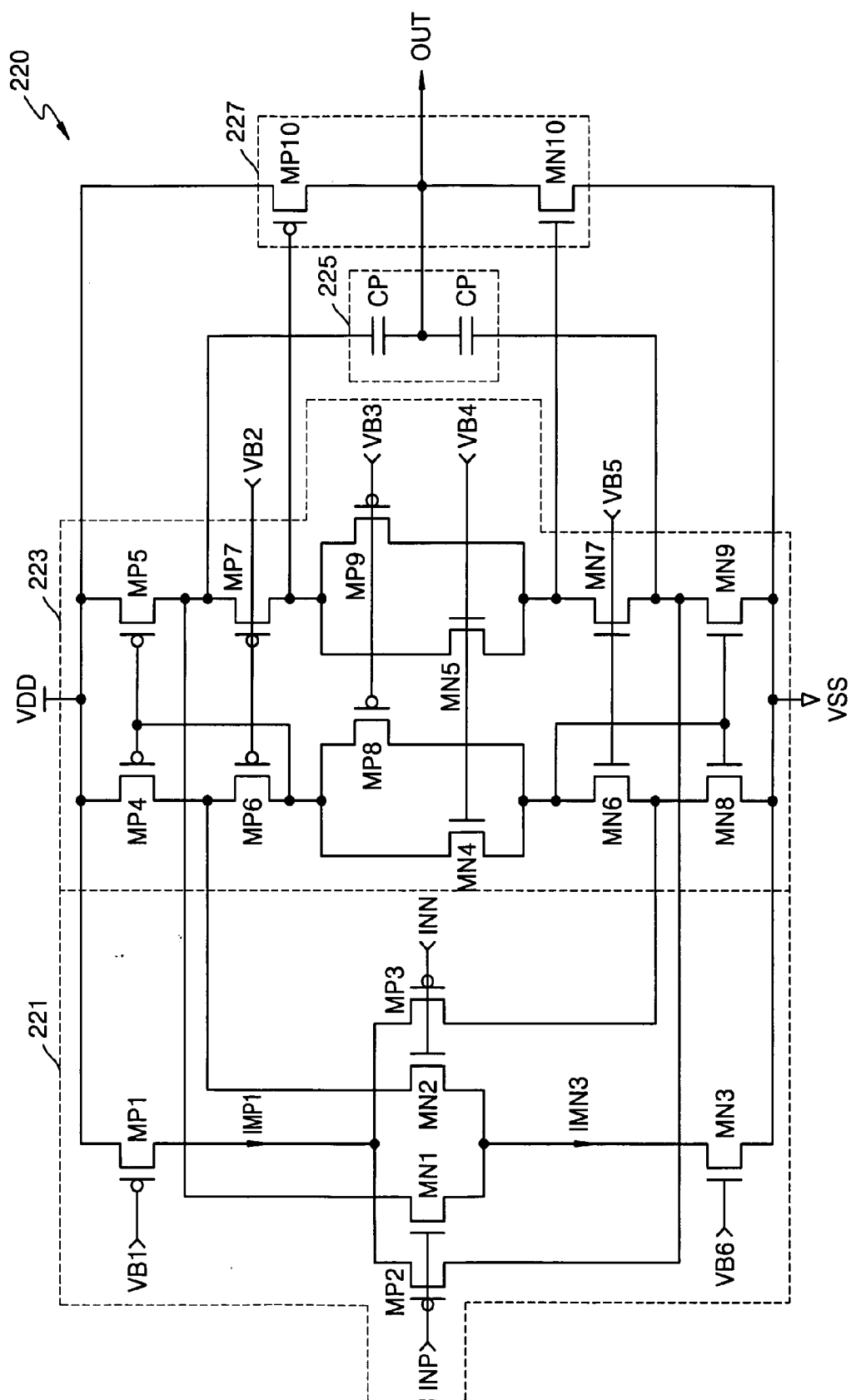


FIG. 4

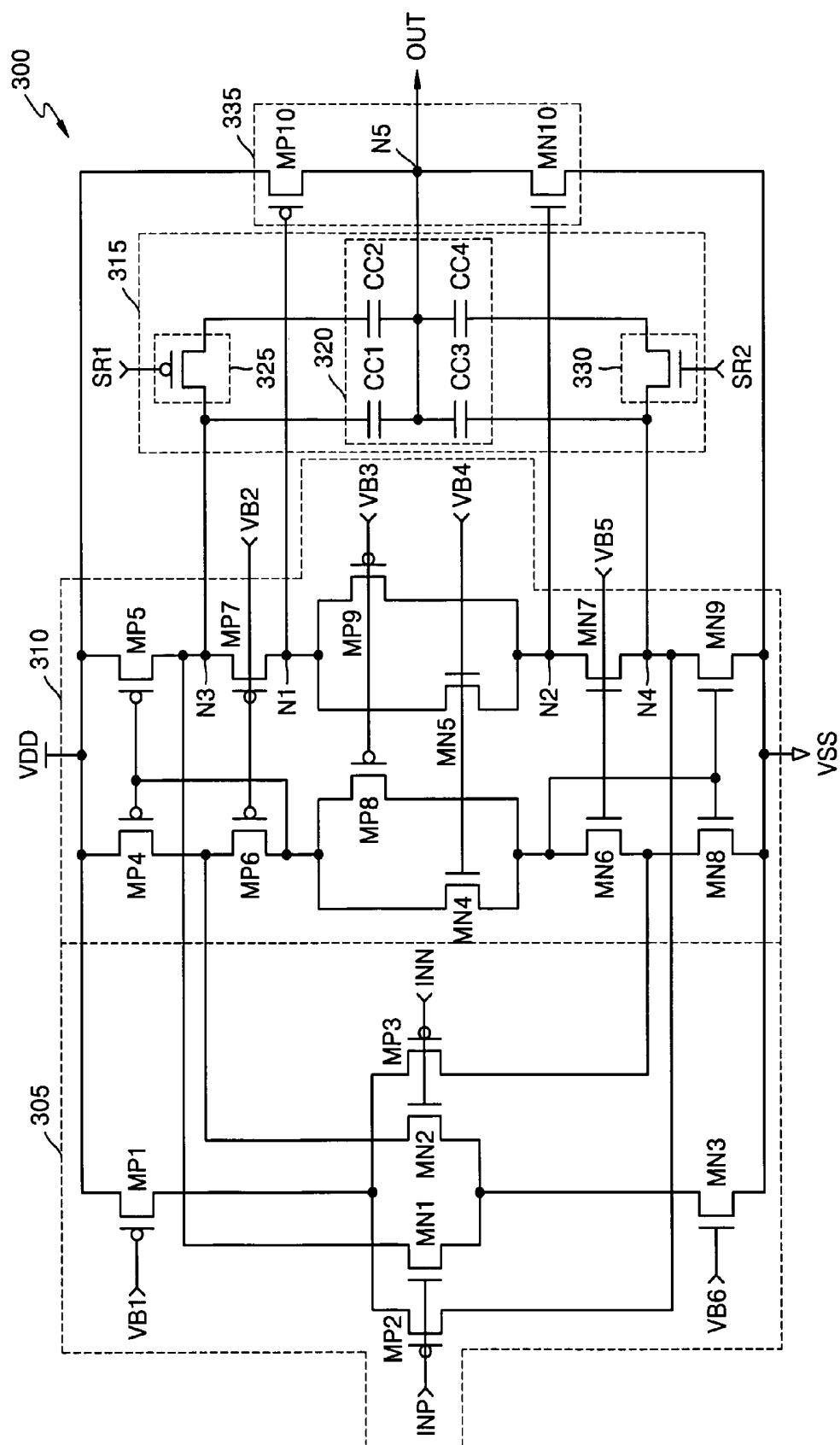


FIG. 5

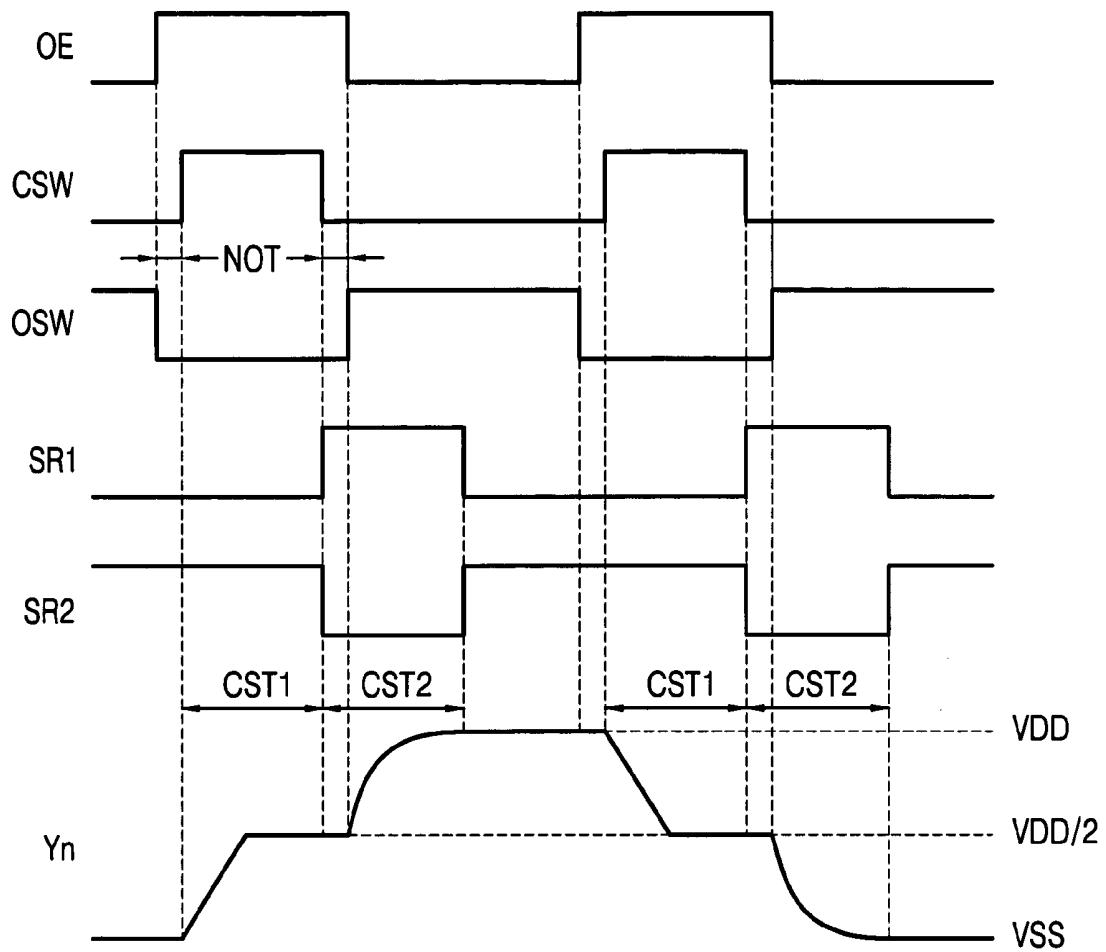


FIG. 6

VDD [V]	SETTLING TIME						IDD		
	CONVENTIONAL BUFFER			BUFFER OF THE PRESENT INVENTION			CONVENTIONAL BUFFER	BUFFER OF THE PRESENT INVENTION	
	Tr		Tf	Tr		Tf			
	RISING PERIOD [μs]	FALLING PERIOD [μs]	RISING PERIOD [μs]	FALLING PERIOD [μs]					
	Tr1	Tr2	Tf1	Tf2	Tr1	Tr2	Tf1	Tf2	
13.5	1.486	8.385	1.305	9.130	0.899	8.059	0.813	8.021	
							61.64	23.67	61.19
							1 CHANNEL	1 CHANNEL	384 CHANNEL
							μA	mA	μA
							OPERATION CURRENT		

# **OUTPUT BUFFER OF A SOURCE DRIVER IN A LIQUID CRYSTAL DISPLAY HAVING A HIGH SLEW RATE AND A METHOD OF CONTROLLING THE OUTPUT BUFFER**

## CROSS-REFERENCE TO RELATED PATENT APPLICATION

[0001] This application claims priority to Korean Patent Application No. 10-2004-0103629, filed on Dec. 9, 2004, in the Korean Intellectual Property Office, the disclosure of which is incorporated by reference herein in its entirety.

## BACKGROUND OF THE INVENTION

### [0002] 1. Technical Field

[0003] The present invention relates to a Liquid Crystal Display (LCD), and more particularly, to an output buffer of a source driver included in an LCD having a high slew rate and a method of controlling the output buffer.

### [0004] 2. Discussion of the Related Art

[0005] An LCD is one of the most widely used flat panel displays because of its small-size, thinness and low power consumption. For example, an LCD is commonly found in a variety of electronic devices such as flat screen televisions, notebook computers, cell phones and digital cameras.

[0006] There are two main types of LCDs used in the market; they are passive matrix and active matrix. Because active matrix type LCDs use thin-film transistors as their switching devices, which enable products to be developed that have very good image quality, wide color gamut, and response time, they are increasingly becoming the choice of notebook computer and flat screen television manufacturers.

[0007] FIG. 1 is a block diagram illustrating a conventional active matrix type LCD 100. Referring to FIG. 1, the LCD 100 includes a liquid crystal panel 110, source drivers SD for driving a plurality of source lines SL, and gate drivers GD for driving a plurality of gate lines GL. It is noted that the source lines SL may also be referred to as data lines or channels.

[0008] The liquid crystal panel 110 includes a plurality of pixels 111. Each of the pixels 111 includes a switch transistor TR, a storage capacitor CST for reducing current leakage from a liquid crystal, and a liquid crystal capacitor CLC.

[0009] As shown in FIG. 1, the switch transistor TR is turned on/off in response to a signal received at a first terminal of the switch transistor TR for driving a gate line GL. A second terminal of the switch transistor TR is connected to a source line SL. The storage capacitor CST is connected between a third terminal of the switch transistor TR and a ground voltage VSS. The liquid capacitor CLC is connected between the third terminal of the switch transistor TR and a common voltage VCOM. Here, the common voltage VCOM may be half the value of a power supply voltage VDD.

[0010] FIG. 2 is a circuit diagram of a source driver (SD) 200 illustrated in FIG. 1. Referring to FIG. 2, the source driver 200 includes a digital-to-analog converter (DAC) 210, output buffers 220, output switches 230, and charge sharing switches 240.

[0011] The DAC 210 receives and converts a digital image signal D\_DAT into analog image signals A\_DAT1, A\_DAT2, . . . , A\_DATn. Each of the analog image signals A\_DAT1, A\_DAT2, . . . , A\_DATn has a gray level voltage.

[0012] Each of the output buffers 220 amplifies a corresponding analog image signal A\_DAT1, A\_DAT2, . . . , A\_DATn and outputs the amplified analog image signal to a corresponding output switch 230. The output switch 230 outputs the amplified analog image signal as one of a plurality of source line driving signals Y1, Y2, . . . , Yn in response to the activation of output switch control signals OSW and /OSW. Each of the source line driving signals Y1, Y2, . . . , Yn is supplied to a load LD connected to a source line SL.

[0013] As shown in FIG. 2, one of the loads LD is modeled by parasitic resistors RL1 through RL5 and parasitic capacitors CL1 through CL5, interconnected in the form of a ladder circuit.

[0014] Referring still to FIG. 2, the charge sharing switches 240 share charges stored in loads LD connected to the source lines SL in response to the activation of sharing switch control signals CSW and /CSW, thus precharging the source line driving signals Y1, Y2, . . . , Yn to a predetermined precharge voltage. If the voltage polarities of the source line driving signals Y1, Y2, . . . , Yn applied to neighboring source lines SL are opposite to each other, the precharge voltage may be VDD/2. For example, if a voltage of a first source line driving signal Y1 has a positive polarity voltage between VDD and VDD/2 and a voltage of a second source line driving signal Y2 has a negative polarity voltage between VDD/2 and VSS (e.g., a ground voltage), the precharge voltage may be VDD/2.

[0015] The charge sharing switches 240 control the voltages of each of the source line driving signals Y1, Y2, . . . , Yn to be VDD/2 during a charge sharing period before the output switches 230 are turned on. In other words, the voltage of each of the source line driving signals Y1, Y2, . . . , Yn is precharged to VDD/2, and the output switches 230 are turned on to supply the driving signals amplified by the output buffers 220 to their corresponding loads LD.

[0016] FIG. 3 is a circuit diagram of the conventional output buffer 220 shown in FIG. 2. Referring to FIG. 3, the output buffer 220 is implemented by a rail-to-rail operational amplifier.

[0017] The output buffer 220 includes an input section 221, an amplifier section 223, a capacitor section 225, and an output section 227. Here, the output buffer 220 has a voltage follower configuration in which an output signal OUT is fed back as a second input signal INN. A first input signal INP is an analog image signal and the second input signal INN is a source line driving signal.

[0018] The input section 221 includes first through third PMOS transistors MP1 through MP3 and first through third NMOS transistors MN1 through MN3, and receives the first input signal INP and the second input signal INN, which are complementary signals. A first bias voltage VB1 is applied to the gate of the first PMOS transistor MP1 and a sixth bias voltage VB6 is applied to the gate of the third NMOS transistor MN3.

[0019] The amplifier section 223, which is a folded cascode section, includes fourth through ninth PMOS transis-

tors MP4 through MP9, and fourth through ninth NMOS transistors MN4 through MN9, and receives output signals of the input section 221 to amplify the input signals INP and INN. A second bias voltage VB2 is applied to the gates of the sixth and seventh PMOS transistors MP6 and MP7 and a third bias voltage VB3 is applied to the gates of the eighth and ninth PMOS transistors MP8 and MP9. A fourth bias voltage VB4 is applied to the gates of the fourth and fifth NMOS transistors MN4 and MN5 and a fifth bias voltage VB5 is applied to the gates of the sixth and seventh NMOS transistors MN6 and MN7.

[0020] The capacitor section 225 includes two capacitors Cp and stabilizes the frequency characteristics of the output signal OUT. The capacitor section 225 controls the output signal OUT of the output buffer 220 so that it does not oscillate. The capacitor section 225 is also called a 'Miller compensation capacitor'.

[0021] The output section 227 includes a PMOS transistor MP10 and an NMOS transistor MN10, receives output signals of the amplifier section 223 and generates the output signal OUT of the output buffer 220. The output signal OUT is a source line driving signal.

[0022] A slew rate SR of the output voltage of the conventional output buffer 220 can be calculated using Equation 1 shown below.

$$SR = dV_{out}/dt = (IMP1 + IMN3) / 2C_{tm} \quad (1)$$

[0023] where,  $V_{out}$  is the output voltage of the output buffer 220, IMP1 is an amount of current flowing through the first PMOS transistor MP1, IMN3 is an amount of current flowing through the third NMOS transistor MN3, and C is the total capacitance of the capacitor Cp included in the capacitor section 225.

[0024] Since the conventional output buffer 220 has the constant capacitance C, the slew rate SR of the output voltage cannot be easily enhanced. For this reason, a source driver using the conventional output buffer 220 is unsuitable for a large-sized liquid crystal panel having source lines with large loads. Accordingly, there is a need for an output buffer for use with a source driver in an LCD that is capable of obtaining an enhanced slew rate.

#### SUMMARY OF THE INVENTION

[0025] According to an aspect of the present invention, there is provided an output buffer for a source driver of an LCD, comprising: an amplifier section amplifying an analog image signal; an output section outputting a source line driving signal for driving a source line of the LCD in response to a signal amplified by the amplifier section; and a slew rate controller section, setting a capacitance of a capacitor section to a first capacitance, during a first charge sharing period in which the source line is precharged to a first precharge voltage, setting the capacitance of the capacitor section to a second capacitance smaller than the first capacitance during a second charge sharing period in which the source line driving signal is supplied to the source line, and setting the capacitance of the capacitor section to the first capacitance while the source line driving signal is maintained after the second charge sharing period.

[0026] The first charge sharing period has the same length as the second charge sharing period. The first precharge voltage is half a power supply voltage. The second capacitance is zero.

[0027] The output buffer further comprises an input section for receiving the analog image signal and the source line driving signal. The output buffer is implemented by a rail-to-rail operational amplifier or by two operational amplifiers.

[0028] The first capacitance is set by activating first and second slew rate control signals and the second capacitance is set by deactivating the first and second slew rate control signals, and the first slew rate control signal is a signal obtained by delaying a sharing switch control signal for controlling the source line to be precharged to the precharge voltage and the second slew rate control signal is an inverted signal of the first slew rate control signal. The first slew rate control signal may also be a signal obtained by delaying the sharing switch control signal by the first charge sharing period through a D flip flop.

[0029] The slew rate controller section further comprises first and second switches for controlling the capacitance of the capacitor section to switch between the first capacitance and the second capacitance, in response to the first and second slew rate control signals. The first switch is a PMOS transistor and the second switch is an NMOS transistor.

[0030] According to another aspect of the present invention, there is provided an output buffer for a source driver of an LCD, comprising: an amplifier section amplifying an analog image signal and including a first current mirror circuit and a second current mirror circuit; an output section outputting a source line driving signal for driving a source line of the LCD through an output node in response to a signal amplified by the amplifier section; and a slew rate controller section, wherein the slew rate controller section comprises: a first capacitor connected between the output node of the output section and an output node of a first current mirror circuit; a second capacitor connected in parallel with the first capacitor and disconnected from the first capacitor when the source line driving signal supplied to the source line is initially activated; a third capacitor connected between the output node of the output section and an output node of the second current mirror circuit; and a fourth capacitor connected in parallel with the third capacitor and disconnected from the third capacitor when the source line driving signal supplied to the source line is initially activated.

[0031] The first and third capacitors have the same capacitance, and the second and fourth capacitors have the same capacitance. The capacitances of the first and third capacitors are zero.

[0032] According to another aspect of the present invention, there is provided a method for controlling an output buffer in a source driver of an LCD, comprising: setting the capacitance of a capacitor section in the output buffer to a first capacitance, during a first charge sharing period, in which the source line is precharged to a first precharge voltage; setting the capacitance of the capacitor section to a second capacitance smaller than the first capacitance, during a second charge sharing period, in which the source line driving signal supplied to the source line is initially activated; and setting the capacitance of the capacitor section to the first capacitance while the source line driving signal is maintained after the second charge sharing period.

## BRIEF DESCRIPTION OF THE DRAWINGS

[0033] The above and other features of the present invention will become more apparent by describing in detail exemplary embodiments thereof with reference to the attached drawings in which:

[0034] **FIG. 1** is a block diagram illustrating a conventional LCD;

[0035] **FIG. 2** is a circuit diagram of a source driver shown in **FIG. 1**;

[0036] **FIG. 3** is a circuit diagram of a conventional output buffer shown in **FIG. 2**;

[0037] **FIG. 4** is a circuit diagram of an output buffer according to an exemplary embodiment of the present invention;

[0038] **FIG. 5** is a timing diagram for explaining an operation of the source driver shown in **FIG. 2** when the output buffer shown in **FIG. 4** is used as an output buffer of the source driver; and

[0039] **FIG. 6** is a table showing simulation results obtained by using an output buffer according to an exemplary embodiment of the present invention in a source driver of an LCD and a conventional output buffer in a source driver of an LCD.

## DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0040] Hereinafter, embodiments of the present invention will be described in detail with reference to the appended drawings. Like reference numbers refer to like components throughout the drawings.

[0041] **FIG. 4** is a circuit diagram of an output buffer 300 according to an embodiment of the present invention. Referring to **FIG. 4**, the output buffer 300, which is implemented by a rail-to-rail operational amplifier, may be used in place of the output buffer 220 in the source driver 200 shown in **FIG. 2**.

[0042] The output buffer 300 includes an input section 305, an amplifier section 310, a slew rate controller section 315, and an output section 335. The output buffer 300 has a voltage follower configuration in which an output signal OUT is fed back as a second input signal INN. A first input signal INP is an analog image signal and the second input signal INN is a source line driving signal.

[0043] The input section 305 includes first through third PMOS transistors MP1 through MP3 and first through third NMOS transistors MN1 through MN3, and receives the first and second input signals INP and INN, which are complementary signals. A first bias voltage VB1 is applied to the gate of the first PMOS transistor MP1, and a sixth bias voltage VB6 is applied to the gate of the third NMOS transistor MN3.

[0044] The amplifier section 310, which is a folded cascode section, includes fourth through ninth PMOS transistors MP4 through MP9 and fourth through ninth NMOS transistors MN4 through MN9, and receives output signals of the input section 305 to amplify the input signals INP and INN.

[0045] A second bias voltage VB2 is applied to the gates of the sixth and seventh PMOS transistors MP6 and MP7, and a third bias voltage VB3 is applied to the gates of the eighth and ninth PMOS transistors MP8 and MP9. A fourth bias voltage VB4 is applied to the gates of the fourth and fifth NMOS transistors MN4 and MN5, and a fifth bias voltage VB5 is applied to the gates of the sixth and seventh NMOS transistors MN6 and MN7.

[0046] The fourth through seventh PMOS transistors MP4 through MP7 constitute a first current mirror circuit and the sixth through ninth NMOS transistors MN6 through MN9 constitute a second current mirror circuit. The eighth and ninth PMOS transistors MP8 and MP9 and the fourth and fifth NMOS transistors MN4 and MN5 control the amount of current flowing through a tenth PMOS transistor MP10 of the output section 335 and/or the amount of current flowing through a tenth NMOS transistor MN10 of the output section 335.

[0047] The output section 335 includes the PMOS transistor MP10 and the NMOS transistor MN10, and receives signals via output nodes N1 and N2 of the amplifier section 310 to generate the output signal OUT of the output buffer 300 through an output node N5. The output signal OUT is a source line driving signal for driving one of the source lines SL shown in **FIG. 2**.

[0048] The slew rate controller section 315 includes a capacitor section 320 such as a Miller compensation capacitor, a first switch 325, and a second switch 330. The capacitor section 320 includes first through fourth capacitors CC1, CC2, CC3, and CC4. The first capacitor CC1 is connected between an output node N3 of the first current mirror circuit in the amplifier section 310 and the output node N5 of the output section 335. The second capacitor CC2 is disconnected from the first capacitor CC1 when a source line driving signal applied to the source lines SL is initially activated. The third capacitor CC3 is connected between an output node N4 of the second current mirror circuit in the amplifier section 310 and the output node N5 of the output section 335. The fourth capacitor CC4 is disconnected from the third capacitor CC3 when a source line driving signal applied to the source lines SL is initially activated.

[0049] Preferably, the capacitances of the first and third capacitors CC1 and CC3 are equal and the capacitances of the second and fourth capacitors CC2 and CC4 are equal. Each of the first and third capacitors CC1 and CC3 has a minimum capacitance of zero. In addition, the parallel capacitance of the first capacitor CC1 and the second capacitor CC2 should be equal to the capacitance of one of the capacitors Cp shown in **FIG. 3**.

[0050] As further shown in **FIG. 4**, the first switch 325 may be a PMOS transistor and the second switch 330 may be an NMOS transistor. The first switch 325 connects/disconnects the first capacitor CC1 to/from the second capacitor CC2 in response to a first slew rate control signal SR1. The second switch 330 connects/disconnects the third capacitor CC3 to/from the fourth capacitor CC4 in response to a second slew rate control signal SR2.

[0051] The first slew rate control signal SR1 is a delayed signal of a sharing switch control signal such as CSW of **FIG. 2** for controlling the source lines SL to be precharged

to a predetermined precharge voltage. The second slew rate control signal SR2 is an inverted signal of the first slew rate control signal SR1. The precharge voltage is half the value of a power supply voltage (e.g.,  $VDD/2$ ). The first slew rate control signal SR1 may also be a signal obtained from delaying the sharing switch control signal CSW by a first charge sharing period during which the source lines SL are precharged to the precharge voltage through a D flop-flop.

[0052] The slew rate controller section 315 sets the capacitance of the capacitor section 320 to a first capacitance (e.g., a capacitance formed by the parallel connections between the capacitors CC1 and CC2 and between the capacitors CC3 and CC4) to stabilize the frequency characteristics of the source line driving signal, during the first charge sharing period. The slew rate controller section 315 sets the capacitance of the capacitor section 320 to a second capacitance (e.g., the capacitance formed by the capacitors CC1 and CC3 connected in series) smaller than the first capacitance, during a second charge sharing period following the first charge sharing period, in which a source line driving signal applied to the source lines SL is initially activated.

[0053] The slew rate controller section 315 sets the capacitance of the capacitor section 320 to the first capacitance while the source line driving signal is continuously supplied after the second charge sharing period. The first capacitance is set by activating the first and second slew rate control signals SR1 and SR2. The second capacitance is set by deactivating the first and second slew rate control signals SR1 and SR2. The first charge sharing period may be set to be equal to the second charge sharing period.

[0054] In summary, the slew rate controller section 315 controls the capacitance of the capacitor section 320 to switch between the first capacitance and the second capacitance, in response to the first and second slew rate control signals SR1 and SR2. Accordingly, the slew rate controller section 315 stabilizes the frequency characteristics of the source line driving signal OUT and enhances a slew rate of the voltage of the source line driving signal OUT. Therefore, the output buffer 300 according to an embodiment of the present invention can output a source line driving signal OUT with a high slew rate by adjusting the capacitance of the capacitor section 320 as expressed by Equation 1.

[0055] It is to be understood by one of ordinary skill in the art that although the output buffer 300 according to an embodiment of the present invention has been described as being implemented by a rail-to-rail operational amplifier, the output buffer 300 can be implemented by two operational amplifiers each having an input section with a structure different from the input section of the rail-to-rail operational amplifier.

[0056] FIG. 5 is a timing diagram for explaining the operation of the source driver 200 shown in FIG. 2 when the output buffer 300 shown in FIG. 4 is used as an output buffer of the source driver 200.

[0057] Referring to FIG. 5, a sharing switch control signal CSW and an output switch control signal OSW are generated in response to an output enable signal OE. The output enable signal OE is generated from a timing controller for controlling the source driver 200.

[0058] While the sharing switch control signal CSW is high (e.g., in an activation state), during a first charge

sharing period CST1, a source line driving signal  $Y_n$  ( $n$  is a natural number) rises from a ground voltage VSS to a precharge voltage  $VDD/2$ . The first charge sharing period CST1 may be, for example, 0.5  $\mu s$  through 1.0  $\mu s$ . During the first charge sharing period CST1, the first slew rate control signal SR1 is activated to a low level and the second slew rate control signal SR2 is activated to a high level. Accordingly, the capacitance of the capacitor section 320 illustrated in FIG. 4 is set to the first capacitance (e.g., the capacitance formed by the parallel connections between the capacitors CC1 and CC2 and between the capacitors CC3 and CC4).

[0059] During the second charge sharing period CST2, which has the same length as the first charge sharing period CST1, and follows the first charge sharing period CST1, since the output switch control signal OSW remains high after a non-overlapping time NOT, a positive polarity voltage (e.g., a power supply voltage VDD) of the source line driving signal  $Y_n$  begins to be supplied to the source line. The non-overlapping time NOT is used to prevent excessive current from flowing through the source lines SL. The non-overlapping time NOT may be 5 ns.

[0060] Also during the second charge sharing period CST2, the first slew rate control signal SR1 is deactivated to a high level and the second slew rate control signal SR2 is deactivated to a low level. Accordingly, the capacitance of a capacitor section such as the capacitor section 320 of FIG. 4 is set to the second capacitance (e.g., the capacitance of the capacitors CC1 and CC3). As a result, the source line driving signal  $Y_n$  rises sharply toward VDD. In other words, during the second charge sharing period CST2, a high slew rate is obtained.

[0061] After the second charge sharing period CST2, the first slew rate control signal SR1 is again activated to a low level and the second slew rate control signal SR2 is activated to a high level, so that the capacitance of the capacitor section 320 of FIG. 4 is set to the first capacitance. As a result, the frequency characteristics of the source line driving signal  $Y_n$  are stabilized. At this time, since the output switch control signal OSW remains high, the source line driving signal  $Y_n$  has the voltage VDD.

[0062] When the voltage of the source line driving signal  $Y_n$  has a negative polarity (e.g., VSS), its frequency characteristics are stabilized in the same fashion as described above for when the source line driving signal  $Y_n$  has a positive polarity voltage (e.g., VDD).

[0063] FIG. 6 is a table showing simulation results obtained by using an output buffer according to an embodiment of the present invention in a source driver of an LCD and a conventional output buffer in a source driver of an LCD.

[0064] The table of FIG. 6 lists a settling time and operation currents IDD flowing through a source line of the source drivers, when a power supply voltage VDD is 13.5 V. The settling time is divided into a rising period and a falling period. In addition, the rising period is divided into a first rising period Tr1 and a second rising period Tr2, and the falling period is divided into a first falling period Tf1 and a second falling period Tf2.

[0065] The first rising period Tr1 is a period during which the source line driving signal  $Y_n$  rises from 10% of a target voltage to 90% of the target voltage. The second rising

period Tr2 is a period during which the source line driving signal Yn rises from 10% of the target voltage to 99.5% of the target voltage. The first falling period Tf1 is a period during which the source line driving signal Yn falls from 90% of the target voltage to 10% of the target voltage. The second falling period Tf2 is a period during which the source line driving signal Yn falls from 99.5% of the target voltage to 10% of the target voltage.

[0066] Referring to the table of FIG. 6, according to an embodiment of the output buffer of the present invention, the rising and falling periods of a source line driving signal can be reduced, thereby enhancing a slew rate of the source line driving signal. In addition, a current flowing through a channel (or, e.g., a source line or a data line), can be reduced.

[0067] While the present invention has been particularly shown and described with reference to exemplary embodiments thereof, it will be understood by those of ordinary skill in the art that various changes in form and details may be made therein without departing from the spirit and scope of the present invention as defined by the following claims.

What is claimed is:

1. An output buffer for a source driver of an LCD, comprising:

an amplifier section amplifying an analog image signal;

an output section outputting a source line driving signal for driving a source line of the LCD in response to a signal amplified by the amplifier section; and

a slew rate controller section, setting a capacitance of a capacitor section to a first capacitance, during a first charge sharing period in which the source line is precharged to a first precharge voltage, setting the capacitance of the capacitor section to a second capacitance smaller than the first capacitance during a second charge sharing period in which the source line driving signal is supplied to the source line, and setting the capacitance of the capacitor section to the first capacitance while the source line driving signal is maintained after the second charge sharing period.

2. The output buffer of claim 1, wherein the first charge sharing period has the same length as the second charge sharing period.

3. The output buffer of claim 1, wherein the first precharge voltage is half a power supply voltage.

4. The output buffer of claim 1, wherein the second capacitance is zero.

5. The output buffer of claim 1, further comprising:

an input section for receiving the analog image signal and the source line driving signal.

6. The output buffer of claim 5, wherein the output buffer is implemented by a rail-to-rail operational amplifier or by two operational amplifiers.

7. The output buffer of claim 5, wherein the first capacitance is set by activating first and second slew rate control signals and the second capacitance is set by deactivating the first and second slew rate control signals, and

the first slew rate control signal is a signal obtained by delaying a sharing switch control signal for controlling the source line to be precharged to the precharge voltage or the first slew rate control signal is a signal obtained by delaying the sharing switch control signal

by the first charge sharing period through a D flip flop, and the second slew rate control signal is an inverted signal of the first slew rate control signal.

8. The output buffer of claim 7, wherein the slew rate controller section further comprises:

first and second switches for controlling the capacitance of the capacitor section to switch between the first capacitance and the second capacitance, in response to the first and second slew rate control signals.

9. The output buffer of claim 8, wherein the first switch is a PMOS transistor and the second switch is an NMOS transistor.

10. An output buffer for a source driver of an LCD, comprising:

an amplifier section amplifying an analog image signal and including a first current mirror circuit and a second current mirror circuit;

an output section outputting a source line driving signal for driving a source line of the LCD through an output node in response to a signal amplified by the amplifier section; and

a slew rate controller section, wherein the slew rate controller section comprises:

a first capacitor connected between the output node of the output section and an output node of a first current mirror circuit;

a second capacitor connected in parallel with the first capacitor and disconnected from the first capacitor when the source line driving signal supplied to the source line is initially activated;

a third capacitor connected between the output node of the output section and an output node of the second current mirror circuit; and

a fourth capacitor connected in parallel with the third capacitor and disconnected from the third capacitor when the source line driving signal supplied to the source line is initially activated.

11. The output buffer of claim 10, wherein the slew rate controller section further comprises:

a first switch connecting the first capacitor to the second capacitor in response to a first slew rate control signal or disconnecting the first capacitor from the second capacitor in response to the first slew rate control signal; and

a second switch connecting the third capacitor to the fourth capacitor in response to a second slew rate control signal or disconnecting the third capacitor from the fourth capacitor in response to the second slew rate control signal.

12. The output buffer of claim 11, wherein the first switch is a PMOS transistor and the second switch is an NMOS transistor.

13. The output buffer of claim 10, wherein the first and third capacitors have the same capacitance, and the second and fourth capacitors have the same capacitance.

14. The output buffer of claim 13, wherein the capacitances of the first and third capacitors are zero.

15. The output buffer of claim 11, further comprising:

an input section for receiving the analog image signal and the source line driving signal.

16. The output buffer of claim 15, wherein the output buffer is implemented by a rail-to-rail operational amplifier or by two operational amplifiers.

17. The output buffer of claim 11, wherein the first slew rate control signal is a signal obtained by delaying a sharing switch control signal to control the source line being precharged to a first precharge voltage or the first slew rate control signal is a signal obtained by delaying the sharing switch control signal by a charge sharing period during which the source line is precharged to the first precharge voltage through a D flip flop, and the second slew rate control signal is an inverted signal of the first slew rate control signal.

18. The output buffer of claim 17, wherein the first precharge voltage is half a power supply voltage.

19. A method for controlling an output buffer in a source driver of an LCD, comprising:

setting a capacitance of a capacitor section in the output buffer to a first capacitance, during a first charge sharing period, in which a source line of the LCD is precharged to a first precharge voltage;

setting the capacitance of the capacitor section to a second capacitance smaller than the first capacitance, during a

second charge sharing period, in which the source line driving signal supplied to the source line is initially activated; and

setting the capacitance of the capacitor section to the first capacitance while the source line driving signal is maintained after the second charge sharing period.

20. The method of claim 19, wherein the first charge sharing period is equal to the second charge sharing period.

21. The method of claim 19, wherein the precharge voltage is half a power supply voltage.

22. The method of claim 19, wherein the second capacitance is zero.

23. The method of claim 19, wherein the first capacitance is set by activating first and second slew rate control signals and the second capacitance is set by deactivating the first and second slew rate control signals, and

the first slew rate control signal is a signal obtained by delaying a sharing switch control signal for controlling the source line to be precharged to the precharge voltage or the first slew rate control signal is a signal obtained by delaying the sharing switch control signal by the first charge sharing period through a D flip flop, and the second slew rate control signal is an inverted signal of the first slew rate control signal.

\* \* \* \* \*

专利名称(译)	具有高压摆率的液晶显示器中的源极驱动器的输出缓冲器和控制输出缓冲器的方法		
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申请(专利权)人(译)	SAMSUNG ELECTRONICS CO., LTD.		
当前申请(专利权)人(译)	SAMSUNG ELECTRONICS CO., LTD.		
[标]发明人	AN CHANG HO		
发明人	AN, CHANG-HO		
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#### 摘要(译)

提供了一种用于具有高压摆率的LCD的源极驱动器的输出缓冲器，以及一种控制输出缓冲器的方法。输出缓冲器，其输出用于驱动LCD的源极线的源极线驱动信号，包括：放大器部分，用于放大模拟图像信号；输出部分响应由放大器部分放大的信号输出源极线驱动信号；以及转换速率控制器部分，在第一电荷共享时段期间将电容器部分的电容设置为第一电容，其中源极线被预充电到第一预充电电压，将电容器部分的电容设置为更小的第二电容源极线驱动信号提供给源极线的第二电荷共享周期期间的第一电容，并且将电容器部分的电容设置为第一电容，而在第二电荷共享周期之后保持源极线驱动信号。

