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(54) **Liquid crystal display having gray voltages with varying magnitudes and driving method thereof**

Graustufenansteuervorrichtung-verfahren für einen Spannungsgenerator einer Regelungsschaltung einer Flüssigkristallanzeigeeinheit (LCD)

Dispositif et méthode d'alimentation d'écran à cristaux liquides (LCD) délivrant des tensions variables pour l'échelle des gris

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Description**BACKGROUND OF THE INVENTION****(a) Field of the Invention**

[0001] The present invention relates to a liquid crystal display and a driving method thereof, and particularly to a liquid crystal display having a plurality of gray voltages with varying magnitudes and a driving method thereof.

(b) Description of the Related Art

[0002] A typical liquid crystal display ("LCD") includes a pair of panels with field-generating electrodes and a liquid crystal layer with dielectric anisotropy interposed therebetween. The liquid crystal layer is applied with electric field generated by the field-generating electrodes, and the transmittance of light passing through the liquid crystal layer is adjusted by controlling the magnitudes of voltages applied to the field-generating electrodes, thereby obtaining desired images.

[0003] Generally, a dark image of a display is much unclear at a bright place than at a dark place. This is because human eyes hardly recognize the brightness difference between portions of a dark image at a bright place. Since the brightness difference between low grays of a conventional LCD is small, the visibility of LCD images, specifically for a motion picture, is inferior to that of other kinds of displays.

[0004] In order to improve brightness difference between low grays, it is suggested to improve a light source of an LCD such as a backlight unit. For example, the light intensity of lamps of the backlight unit is increased, the number of the lamps is increased, or several various prism sheets are provided in the backlight unit. However, these increase the power consumption, the weight and the cost of the LCD.

[0005] In addition, it is hard to increase the light intensity of the backlight unit twice, three times or more than the normal intensity, and even though the intensity would increase, the visibility is not so much improved in comparison with the increasing rate of the intensity of the backlight unit. Furthermore, a bright screen makes users feel fatigue soon.

[0006] Prior art document EP 1 220 193 generally relates to a brightness offset error reduction system for a display device. In this document, a control circuit varies the luminosity of a backlight device to control brightness. This document does not disclose any system, method, or means for controlling a display device while maintaining a constant backlight luminosity.

SUMMARY OF THE INVENTION

[0007] A liquid crystal display device and its associated driving method are provided as defined in the set of claims 1 to 25.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] The above and other objects and advantages of the present invention will become more apparent by describing in detail preferred embodiments thereof with reference to the accompanying drawings in which:

FIG. 1 is a schematic block diagram of an LCD according to an embodiment of the present invention;

FIG. 2 is a circuit diagram of a gray voltage generator of an LCD according to an embodiment of the present invention;

FIG. 3 illustrates a reference voltage CVDD as function of photocurrent according to an embodiment of the present invention;

FIG. 4 illustrates a conventional gamma curve and an adjusted gamma curve according to an embodiment of the present invention;

FIG. 5 is a circuit diagram of a gray voltage generator of an LCD according to another embodiment of the present invention;

FIG. 6 is a circuit diagram of a gray voltage generator of an LCD according to another embodiment of the present invention;

FIG. 7 is a block diagram of an exemplary screen brightness determining unit according to an embodiment of the present invention;

FIG. 8 is a block diagram of an exemplary square wave generator according to an embodiment of the present invention;

FIG. 9 is a circuit diagram of an exemplary analog converter according to an embodiment of the present invention;

FIG. 10 is a graph showing a voltage across a liquid crystal capacitor as function of time for several duty rates

according to an embodiment of the present invention; and

FIG. 11 shows an adjustment voltage as function of duty rates according to an embodiment of the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0009] The present invention now will be described more fully hereinafter with reference to the accompanying drawings, in which preferred embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein. Like numerals refer to like elements throughout. Then, liquid crystal displays and methods of driving the same according to embodiments of the present invention will be described with reference to the drawings.

[0010] FIG. 1 is a schematic block diagram of an LCD according to an embodiment of the present invention.

[0011] With reference to FIG. 1, an LCD according to an embodiment of the present invention includes a reference voltage generator 100, a common electrode voltage ("common voltage") generator 200, a gray voltage generator 300, a driving voltage generator 400, a gate driver 500, a data driver 600, and an LCD panel assembly 700.

[0012] The panel assembly 700 includes a plurality of gate lines (not shown), a plurality of data lines (not shown), and a plurality of pixels (not shown) arranged in a matrix. Each pixel includes a liquid crystal capacitor (not shown), a switching element such as a thin film transistor ("TFT") (not shown) and preferably a storage capacitor (not shown). Each TFT has a gate connected to one of the gate lines, a source connected to one of the data lines and a drain connected to the liquid crystal capacitor and the storage capacitor. The liquid crystal capacitor is connected between the TFT and a common voltage.

[0013] The driving voltage generator 400 generates a gate-on voltage V_{on} and a gate-off voltage V_{off} to provide for the gate driver 500, and at the same time, to provide the gate-on voltage V_{on} for the reference voltage generator 100.

[0014] The reference voltage generator 100 changes the level of a supply voltage $AVDD$ provided by a DC/DC converter (not shown) based on the gate-on voltage V_{on} from the driving voltage generator 400 and a signal from an external source, to generate a reference voltage $CVDD$ to provide for both the common voltage generator 200 and the gray voltage generator 300.

[0015] Here, the signal 99 from the external source may be a light signal from surroundings of the LCD, a signal generated by a users' manipulation, or a signal varying dependent on brightness of on-screen images.

[0016] The common voltage generator 200 adjusts the level of the reference voltage $CVDD$ to generate and provide a common voltage V_{com} for the liquid crystal capacitors of the panel assembly 700.

[0017] The gray voltage generator 300 generates a plurality of gray voltages with magnitudes depending on the reference voltage $CVDD$ to provide for the data driver 600.

[0018] The gate driver 500 applies the gate-on voltage and the gate-off voltage to the gate lines of the panel assembly 700 according to control signals from a signal controller (not shown) to turn on and off the TFTs.

[0019] The data driver 600 selects the gray voltages based on gray data from the signal controller to provide for the data lines of the panel assembly 700.

[0020] According to an embodiment of the present invention, an LCD increases the brightness of the grays, particularly of the lower grays in a range between the first gray to the sixteenth grays among total sixty four grays, when the brightness of the surrounding of the LCD becomes low, and vice versa. For example, in a normally black mode, the magnitudes of the gray voltages with respect to the common voltage increases when the surroundings of the LCD becomes dark, and vice versa. On the contrary, for a normally white mode LCD, the magnitudes of the gray voltages with respect to the common voltage decreases when the surroundings of the LCD becomes dark, and vice versa.

[0021] Alternatively, a user manipulates to decrease or increase the levels of gray voltages for improving the visibility. Another alternative is to adjust the levels of gray voltages depending on the brightness of on-screen images of the LCD.

[0022] Now, embodiments for adjusting the levels of the gray voltages will be described in detail.

[0023] FIG. 2 is a circuit diagram of an exemplary LCD according to an embodiment of the present invention, which adjusts the levels of gray voltages depending on the brightness level of surroundings of the LCD.

[0024] With reference to FIG. 2, an LCD according to one embodiment of the present invention includes a reference voltage generator 110 automatically sensing the brightness level of surroundings to generate a reference voltage $CVDD$ based on a gate-on voltage V_{on} and a supply voltage $AVDD$, a common voltage generator 200 generating a common voltage V_{com} on the basis of the reference voltage $CVDD$, and a gray voltage generator 300 generating a plurality of gray voltages V_{REF1} - V_{REF10} on the basis of the reference voltage $CVDD$.

[0025] The reference voltage generator 110 includes a photo transistor represented as a photocurrent source $PHOTO_IDC$ and a transistor Q2 with a base connected to the photocurrent source $PHOTO_IDC$, a voltage divider including a pair of resistors R15 and R16 connected in series between a gate-on voltage V_{on} and a collector of the transistor Q2, a resistor R17 connected between an emitter of the transistor Q2 and the voltage divider R15 and R16, and a transistor Q1 with a base connected to the voltage divider R15 and R16, a collector connected to the supply voltage $AVDD$ and an emitter connected to the common voltage generator 200 and the gray voltage generator 300.

[0026] The common voltage generator 200 includes a voltage divider including a pair of resistors R13 and R14 connected in series between the reference voltage CVDD or the output of the reference voltage generator 110 and a predetermined voltage such as a ground voltage. The common voltage, the output voltage of the common voltage generator 200 is the voltage of a node between the resistors R13 and R14.

[0027] The gray voltage generator 300 includes a positive voltage generator 310 including a series of resistors R1-R6, a negative voltage generator 320 including a series of resistors R7-R12, a pair of diodes D1 and D2 connected in series and forward biased from the positive voltage generator 310 to the negative voltage generator 320, and a capacitor C1 connected between a node between the diodes D1 and D2 and a predetermined voltage such as the ground voltage. The series of resistors R1-R12 connected in series between the output of the reference voltage generator 110 and a predetermined voltage such as the ground voltage. The gray voltages, the outputs VREF1-VREF10 of the positive and the negative voltage generators 310 and 320 are connected to nodes between the resistors R1-R6 and R7-R12, respectively.

[0028] In operation, the photocurrent source PHOTO_IDC generates a photocurrent in response to light of surroundings of the LCD to provide for the base of the transistor Q2. The transistor Q2 varies its collector current proportional to the base current. The voltage divider R15 and R16 reduces the level of the gate-on voltage Von depending on the collector current of the transistor Q2 to provide for the base of the transistor Q1. The transistor Q1 reduces the supply voltage AVDD depending on its base voltage to output through its emitter, and the output voltage of the transistor Q1 is provided as the reference voltage CVDD for the common voltage generator 200 and the gray voltage generator 300.

[0029] The magnitude of the photocurrent from the photocurrent source PHOTO_IDC is proportional to the light intensity of the surroundings of the LCD, and the magnitude of the collector current of the transistor Q2 is proportional to the magnitude of its base current. The magnitude of the output voltage of the voltage divider R15 and R16, i.e., the magnitude of the base voltage of the transistor Q1 is inversely proportional to the collector current of the transistor Q2, and the magnitude of the emitter voltage of the transistor Q1 is approximately proportional to the magnitude of its base voltage. Accordingly, the reference voltage CVDD is approximately inversely proportional to the light intensity of the surroundings of the LCD.

[0030] As a result, the reference voltage CVDD becomes lower as the light intensity of the surroundings becomes stronger, thereby reducing the magnitudes of the gray voltages.

[0031] FIG. 3 is a graph showing a reference voltage CVDD as function of the photocurrent I_PHOTO in an LCD shown in Fig. 2, which was obtained by the simulation using PSPICE.

[0032] It can be understood from the curve shown in Fig. 3 that the reference voltage CVDD is inversely proportional to the photocurrent I_PHOTO. The gradient of the curve shown in Fig. 3 is controlled by adjusting the transmittance of a photo window of the photo transistor.

[0033] FIG. 4 illustrates gamma curves of an LCD according to an embodiment of the present invention for $\gamma=2.2$.

[0034] As shown in FIG. 4, the gamma curve according to an embodiment of the present invention goes toward the curve B as the surroundings become dark, while the gamma curve goes toward the curve A as the surroundings become bright. That is, the brightness for the grays, especially for the lower grays, increases when the surroundings become dark, while the brightness decreases when the surroundings become bright.

[0035] FIG. 5 is a circuit diagram of an exemplary LCD according to another embodiment of the present invention, in which the levels of gray voltages can be adjusted by a user.

[0036] With reference to FIG. 5, an LCD according to another embodiment of the present invention includes a reference voltage generator 120 generating a reference voltage CVDD, a common voltage generator 200 generating a common voltage Vcom on the basis of the reference voltage CVDD, and a gray voltage generator 300 generating a plurality of gray voltages on the basis of the reference voltage CVDD. The elements performing a function similar to those shown FIG. 2 are represented by the same numerals, and the descriptions thereof are omitted.

[0037] The reference voltage generator 120 includes a voltage divider connected between a gate-on voltage Von and a predetermined voltage such as a ground voltage and including a pair of resistors R15 and R17 and a variable resistor R16 connected therebetween, and a transistor Q1 having a base connected to a node between the resistors R15 and R16, a collector connected to a supply voltage AVDD, and an emitter connected to the common voltage generator 200 and the gray voltage generator 300. The resistance of the variable resistor R16 is adjustable by the user's selection.

[0038] In this LCD, the magnitude of the base voltage V_B of the transistor Q1 is determined by Equation 1:

(Equation 1)

$$V_B = \frac{R_{16} + R_{17}}{R_{15} + R_{16} + R_{17}} V_{ON};$$

and the magnitude of a reference voltage CVDD is determined by Equation 2:

(Equation 2)

$$CVDD = V_B - V_{BE} < AVDD,$$

where V_{BE} is a base-emitter voltage of the transistor Q1.

[0039] Accordingly, the magnitude of the reference voltage CVDD is changed by manually adjusting the resistance of the variable resistor R16, thereby varying the magnitudes of the gray voltages.

[0040] FIG. 6 is a circuit diagram of an exemplary LCD according to another embodiment of the present invention, which varies the magnitudes of gray voltages depending on the brightness level of on-screen images.

[0041] With reference to FIG. 6, an LCD according to another embodiment of the present invention includes a screen brightness determining unit 140 determining the brightness level of on-screen images and generating an adjustment voltage VIN depending on the determined brightness level, a reference voltage generator 130 generating a reference voltage CVDD based on the adjustment voltage VIN, a common voltage generator 200 generating a common voltage Vcom on the basis of the reference voltage CVDD, and a gray voltage generator 300 generating a plurality of gray voltages on the basis of the reference voltage CVDD. The elements performing a function similar to those shown FIG. 2 are represented by the same numerals, and the descriptions thereof are omitted.

[0042] Referring to FIG. 6, the reference voltage generator 130 includes an operational amplifier OP with an input resistor RC and a feedback resistor RD, a voltage divider including a pair of resistors R18 and R19 connected in series between a supply voltage AVDD and a predetermined voltage such as a ground voltage, another voltage divider including a pair of resistors R15 and R16 connected in series between a gate-on voltage Von and the output of the amplifier OP, and a transistor Q1 having a base connected to the voltage divider R15 and R16, a collector connected to the supply voltage AVDD, and an emitter connected to the common voltage generator 200 and the gray voltage generator 300.

[0043] The amplifier OP is biased with the supply voltage AVDD and a predetermined voltage such as the ground voltage, and subject to negative feedback. The noninverting input terminal (+) of the amplifier OP is connected to the voltage divider R18 and R19.

[0044] In operation, the voltage divider R18 and R19 drops the magnitude of the supply voltage AVDD to provide for the noninverting terminal (+) of the amplifier OP. The amplifier OP amplifies the difference between the supply voltage AVDD and the adjustment voltage VIN to provide for the voltage divider R15 and R16. The voltage divider R15 and R16 drops the gate-on voltage Von inversely proportional to the magnitude of the output of the amplifier OP to provide for the base of the transistor Q1. The transistor Q1 drops the supply voltage AVDD approximately in proportion to its base voltage to output as the reference voltage CVDD through its emitter.

[0045] As a result, the magnitude of the reference voltage CVDD and thus the magnitudes of the gray voltages vary depending on the magnitude of the adjustment voltage VIN.

[0046] Now, detailed configurations of a screen brightness determining unit of an LCD according to embodiments of the present invention are described in detail.

[0047] According to an embodiment of the present invention, an adjustment voltage VIN is generated by RC filtering a PWM (pulse width modulation) signal with a duty width proportional to a mean value of the gray data for one frame. The adjustment voltage VIN is configured to be either proportional to or inversely proportional to a determined brightness level.

[0048] Fig. 7 is a block diagram illustrating an exemplary screen brightness determining unit of an LCD according to an embodiment of the present invention.

[0049] As shown in Fig. 7, a screen brightness determining unit 140 includes a square wave generator 1410, and an analog converter 1420.

[0050] The square wave generator 1410, provided with gray data R, G and B from a signal source, generates a duty signal Dout with a duty proportional to an average value of the gray data R, G and B for one row of pixels, i.e., for one horizontal time to provide for the analog converter 1420. The square wave generator 1410 may be provided within a signal controller (not shown) controlling the timing of the LCD.

[0051] For example, a 100% duty signal is generated when white gray data are input for one horizontal time, a 50% duty signal is generated when medium gray data are input for one horizontal time, and a 0% duty signal is generated when black gray data are input for one horizontal time. The square wave generator 1410 may be provided at the signal controller, or separated from the signal controller.

[0052] The analog converter 1420 analog-converts the duty signal into an adjustment voltage VIN to provide for the reference voltage generator 130. That is, the analog converter 1420 has a function of a digital-analog converter that receives and converts a square wave with a predetermined duty into an analog adjustment voltage VIN.

[0053] Fig. 8 is a block diagram illustrating an exemplary square wave generator of a brightness determining unit of

an LCD according to an embodiment of the present invention.

[0054] As shown in Fig. 8, a square wave generator 1410 preferably integrated into a signal controller (not shown) includes a pixel data converter 111, an adder 112, a one-line adder 113, a divider 114, a counter 115, and a duty signal generator 116.

[0055] The signal controller provides a load signal LOAD, an adding signal ADDING, a line adding signal LINE ADDING, a dividing signal DIV, and a counting signal COUNTING.

[0056] The pixel data converter 111 receives R, G and B gray data from an external signal source, and assigns a predetermined weight to at least one of the gray data R, G and B based on the load signal LOAD from the signal controller. The pixel data converter 111 substitutes the remaining gray data (or datum) with the weighted gray datum (or data), and provides the substituted gray data and the weighted gray data for the adder 112 as converted gray data R', G' and B'. For example, if the R and B gray data are six bit data of '000000', the G gray datum is six bit datum of '111111' and weighted, the R', G' and B' gray data are '111111'. The assignment of weight may be omitted.

[0057] The adder 112 adds the converted gray data R', G' and B' based on the adding signal ADDING, and provides the sum SUM of the gray data R', G' and B' for the one line adder 113. For the above example, the sum SUM of the gray data R', G' and B' is '10111101.'

[0058] The one line adder 113 adds the sums SUM of the gray data R', G' and B' for one row of pixels based on the line adding signal LINE ADDING, and provides the one line sum TSUM of the sums SUM of the gray data R', G' and B' for the divider 114. For the above example with an XGA resolution with 1024 RGB pixels, the one line sum TSUM is an 18 bit datum of '101111010000000000.'

[0059] The divider 114 divides the one line sum TSUM by three based on the dividing signal DIV, and extracts top six bits (MSB) from the one line sum TSUM divided by three to provide for the counter 115. For the above example, the one line sum TSUM divided by three is '1111110000000000,' and the extracted six bit datum is '111111.'

[0060] The counter 115 provides a predetermined counted number for the duty signal generator 116 based on the extracted six-bit datum. The counter 115 includes a duty register (not shown) and a down counter (not shown). The duty register stores the extracted six-bit datum from the divider 114 upon receipt of the load signal LOAD. The down counter sequentially down-counts bits of the stored six bit datum on the basis of the counting signal COUNTING, and provides the down-counted number for the duty signal generator 116.

[0061] The duty signal generator 116 generates a duty signal Dout based on the down-counted number, and provides for the analog converter 1420.

[0062] Fig. 9 is an exemplary circuit diagram of an analog converter according to an embodiment of the present invention.

[0063] As shown in Fig. 9, an analogue converter according to an embodiment of the present invention includes a voltage divider having a plurality of resistors R12-R15, a transistor Q11 having a base with an input resistor R11 connected to the duty signal Dout, an emitter connected to a predetermined voltage such as a ground voltage and a collector connected to the supply voltage AVDD via the resistor R12, and a capacitor C1 connected between the resistor R15 and a predetermined voltage such as the ground voltage. The resistors R14 and R15 are connected in parallel to the resistor R13, which in turn is connected to the collector of the transistor Q11, and the resistor R14 is connected to a predetermined voltage such as the ground voltage. The output VIN of the analogue converter 1420 is connected to a node between the capacitor C1 and the resistor R15.

[0064] When the duty signal Dout is in the low level, the transistor Q11 is turned off so that the capacitor is charged.

At this time, the voltage across the capacitor C1 is given by $AVDD \cdot \frac{R14}{R12 + R13 + R14}$. On the contrary, when

the duty signal Dout is in the high level, the first transistor Q11 is turned on so that the capacitor C1 is discharged.

[0065] The adjustment voltage VIN is determined by the time constant of the resistor R15 and the capacitor C1. That is, the adjustment voltage VIN is in proportion to the duty of the duty signal Dout and the number of pulses thereof.

[0066] Fig. 10 illustrates the adjustment voltage VIN as a function of time for several duty ratios of the duty signal Dout, where R11=20 ∇ , R12=1 ∇ , R13=1 ∇ , R14=1 ∇ , R15=20 ∇ , C1=0.1 μ F, and AVDD=9V. The result was obtained by using PSPICE and the curves are obtained for 0%, 10%, 30%, 50%, 70% and 90% duty ratios.

[0067] As shown in Fig. 10, the adjustment voltage VIN reaches its maximum value after one frame period of about 16.6 ms. The time period for reaching the maximum value may be changed by adjusting the time constant, i.e., the values of R15 and C1 shown in Fig. 9.

[0068] Fig. 11 shows the adjustment voltage VIN as function of the duty ratio of the duty signal. The linear proportionality of the adjustment voltage VIN to the duty ratio of the duty signal Dout means that the analogue converter 1420 performs a function of a D/A converter converting the average gray data for a display screen into an analog voltage.

[0069] Although preferred embodiments of the present invention have been described in detail hereinabove, it should be clearly understood that said present invention, is defined in the appended claims.

[0070] Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly, such reference signs do not have any limiting effect on the scope of each element identified by way of example by such reference signs.

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Claims

1. A liquid crystal display LCD comprising:

10 a reference voltage generator (100, 110, 120, 130) for changing the level of a first predetermined voltage (AVDD) based on a first signal (99, VIN) to generate a reference voltage (CVDD) from said first predetermined voltage (AVDD) and depending on a brightness level of surroundings of the LCD, said first signal (99) varying depending on one of brightness of surroundings of the liquid crystal display, brightness of on-screen images of the liquid crystal display, and a user's manipulation; and said liquid crystal display being **characterised in that** it further
15 comprises
a gray voltage generator (300) for generating a plurality of gray voltages with magnitudes depending on a magnitude of the reference voltage (CVDD) and a second predetermined voltage such as a ground voltage, wherein the plurality of gray voltages are transmitted to a plurality of pixels, the plurality of pixels included in the liquid crystal display.

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2. The liquid crystal display of claim 1, further comprising:

a plurality of data lines, a plurality of gate lines and the plurality of pixels connected to the data lines and the gate lines; and
25 a first driver (600) selecting the gray voltages based on gray data from an external source to supply to the plurality of pixels via the data lines.

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3. The liquid crystal display of claim 2, further comprising a second driver (500) supplying gate signals to the gate lines, each pixel including a switching element connected to one of the data lines and one of the gate lines and transmitting the gray voltages to the pixels under the control of the gate signals.

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4. The liquid crystal display of claim 3, wherein the reference voltage generator (110, 120, 130) comprises a first voltage divider (R15, R16) dropping level of a third predetermined voltage (Von) for turning on a transistor (Q1) with a base connected to the voltage divider (R15, R16) to generate the reference voltage (CVDD).

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5. The liquid crystal display of claim 4, wherein the reference voltage generator (110) further comprises a light sensor sensing the brightness of the surroundings of the liquid crystal display and generating a photocurrent signal depending on the sensed brightness (R15, R16), and the level drop of the third predetermined voltage (Von) is performed based on the photocurrent signal.

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6. The liquid crystal display of claim 4, wherein the first voltage divider (R15, R16, R17) comprises a variable resistor (R16) with resistance adjustable by a user.

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7. The liquid crystal display of claim 4, further comprising a signal generator (140) determining the brightness of the on-screen images of the liquid crystal display and generating a third signal (VIN) depending on the brightness and the level drop of the third predetermined voltage (Von) is performed based on the third signal (VIN).

8. The liquid crystal display of claim 7, wherein the reference voltage generator (130) further comprises an amplifier (OP) amplifying the third signal.

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9. The liquid crystal display of claim 8, wherein the reference voltage generator (130) further comprises a second voltage divider (R18, R19) reducing level of the first predetermined voltage (AVDD), and the amplification of the third signal (VIN) is performed based on the level-reduced first predetermined voltage.

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10. The liquid crystal display of claim 2, further comprising a common voltage generator (200) generating a common voltage (Vcom) to be applied to the pixels, based on the reference voltage (CVDD).

11. The liquid crystal display of claim 1, wherein the gray voltage generator (300) comprises a voltage divider (R1-R12)

connected between the reference voltage (CVDD) and the second predetermined voltage.

- 5 12. The liquid crystal display of claim 11, wherein the voltage divider (R1-R12) comprises first (R1-R6) and second (R7-R12) series of resistors connected in series, and the first series of resistors (R1-R6) is connected to the reference voltage (CVDD) while the second series of resistors (R7-R12) is connected to the second predetermined voltage, the magnitudes of the gray voltages being determined by magnitudes of the reference voltage (CVDD) and the second predetermined voltage and by resistances of the first and the second series of resistors (R1-R12).
- 10 13. The liquid crystal display of claim 12, wherein the reference voltage generator (110) comprises a transistor (Q1) having a first terminal coupled to the first signal (99), a second terminal coupled to the first predetermined voltage (AVDD), and a third terminal outputting the reference voltage (CVDD).
- 15 14. The liquid crystal display of claim 1, wherein the reference voltage generator (110) comprises a light sensor sensing the brightness level of the surroundings to generate the first signal (99) depending on the sensed brightness level.
- 15 15. The liquid crystal display of claim 1, wherein the reference voltage generator (120) comprises a variable resistor (R16) with resistance adjustable by a user.
- 20 16. The liquid crystal display of claim 1, further comprising a signal generator (140) determining the brightness of the on-screen images of the liquid crystal display to generate the first signal (VIN) depending on the brightness.
17. The liquid crystal display of claim 16, wherein the reference voltage generator (130) comprises an amplifier (OP) amplifying the first signal (VIN).
- 25 18. The liquid crystal display of claim 17, wherein the reference voltage generator (13) further comprises a voltage divider (R18, R19), connected between the first predetermined voltage (AVDD) and the second predetermined voltage, reducing level of the first predetermined voltage (AVDD) to provide for the amplifier, the amplification of the first signal (VIN) is performed based on the level-reduced first predetermined voltage.
- 30 19. The liquid crystal display of claim 16, wherein the signal generator (140) comprises:

a square wave generator (1410) calculating an average value of gray data from an external source for a horizontal period and generating a duty signal (Dout) depending on the average value of the gray data; and
an analog converter (1420) analogue-converting the duty signal (Dout) from the square wave generator (1410)
35 into the first signal (VIN).
20. The liquid crystal display of claim 19, wherein the square wave generator (1410) comprises:

a data converter (111) assigning a weight to at least one gray datum in each group of the gray data;
40 a first adder (112) adding the gray data in each group of the gray data to output as first sums;
a second adder (113) adding the first sums for one horizontal period to output as a second sum;
a divider (114) dividing the second sum by the number of the gray data in each group of the gray data and extracting top bits from the second sum divided by the number of the gray data in each group of the gray data to output as first data;
45 a counter (115) down-counting the first data; and
a duty signal generator (116) generating a square wave having a duty on the basis of the down-counted number of the first data.
21. The liquid crystal display of claim 19, wherein the analogue converter (1420) comprises:
50 a transistor (Q11) turned on and off in response to the duty signal (Dout); and
a voltage control unit (R12-R15, C1) generating the first signal (VIN) analogue-converted in response to analogue voltages leveled up and down depending on the turning on and off of the transistor (Q11).
- 55 22. The liquid crystal display of claim 21, wherein the first signal (VIN) is determined by time constant of the voltage control unit (R12-R15, C1), and is proportional to duty and pulse count of the duty signal (Dout).
23. A method of driving a liquid crystal display having a plurality of gate lines, a plurality of data lines, and a plurality of

pixels including switching elements connected to the gate lines and the data lines, the method comprising the steps of:

determining the brightness level of on-screen images of the liquid crystal display based on gray data from an external source to generate a first signal (99, VIN);

changing the level of a predetermined voltage (AVDD) to generate a reference voltage (CVDD) on the basis of the first signal (99, VIN); said method **characterised in that** it comprises the steps of:

generating a plurality of gray voltages (VREF1-VREF10) with values varying depending on the reference voltage (CVDD);

providing scan signals for the gate lines to turn on the switching elements; and

converting the gray data into corresponding gray voltages to provide the corresponding gray voltages to the pixels via the data lines and the switching elements.

24. The method of claim 23, wherein the determination comprises:

calculating an average value of the gray data for a horizontal period;

generating a duty signal (Dout) depending on the average value of the gray data; and

analogue-converting the duty signal into the first signal (VIN).

25. The method of claim 24, wherein the calculation of the average value comprises:

adding the gray data in respective groups of the gray data to output as first sums;

adding the first sums for one horizontal period to output as a second sum; dividing the second sum by the number of the gray data in each group of the gray data;

extracting top bits from the second sum divided by the number of the gray data in each group of the gray data to output as first data;

down-counting the first data; and generating a square wave having a duty on the basis of the down-counted number of the first data.

Patentansprüche

1. Eine Flüssigkristallanzeige LCD, die Folgendes umfasst:

einen Bezugsspannungsgenerator (100, 110, 120, 130) zum Ändern des Niveaus einer ersten vordefinierten Spannung (AVDD) auf der Grundlage eines ersten Signals (99, VIN), um eine Bezugsspannung (CVDD) aus der ersten vordefinierten Spannung (AVDD) und abhängig von einem Helligkeitsgrad der Umgebung der LCD zu erzeugen, wobei das erste Signal (99) abhängig von einem der folgenden Faktoren variiert: Helligkeit der Umgebung der Flüssigkristallanzeige, Helligkeit von Bildern auf dem Flüssigkristallanzeigen-Bildschirm und Einstellungen durch einen Benutzer; und wobei die Flüssigkristallanzeige **dadurch gekennzeichnet ist, dass** sie weiter Folgendes umfasst:

einen Grauwert-Spannungsgenerator (300) zur Erzeugung einer Vielzahl von Grauwert-Spannungen mit Größen, die abhängig sind von einer Größe der Bezugsspannung (CVDD) und einer zweiten vordefinierten Spannung, wie zum Beispiel einer Erdspannung, wobei die Vielzahl von Grauwert-Spannungen an eine Vielzahl von Pixeln gesendet wird und die Vielzahl von Pixeln in der Flüssigkristallanzeige eingeschlossen ist.

2. Die Flüssigkristallanzeige gemäß Anspruch 1, die weiter Folgendes umfasst:

eine Vielzahl von Daten-Leitungen, eine Vielzahl von Gate-Leitungen und die Vielzahl von Pixeln, die mit den Daten-Leitungen und den Gate-Leitungen verbunden sind, und

einen ersten Treiber (600), der die Grauwert-Spannungen anhand von Grauwert-Daten von einer externen Quelle auswählt, um sie der Vielzahl von Pixeln über die Daten-Leitungen zuzuführen.

3. Die Flüssigkristallanzeige gemäß Anspruch 2, die weiter einen zweiten Treiber (500) umfasst, welcher den Gate-Leitungen Gate-Signale zuführt, wobei jeder Pixel ein Schaltelement einschließt, das mit einer der Daten-Leitungen und einer der Gate-Leitungen verbunden ist und die Grauwert-Spannungen unter der Steuerung der Gate-Signale

an die Pixel sendet.

4. Die Flüssigkristallanzeige gemäß Anspruch 3, wobei der Bezugsspannungsgenerator (110, 120, 130) einen ersten Spannungsteiler (R15, R16) umfasst, welcher das Niveau einer dritten vordefinierten Spannung (Von) senkt, um einen Transistor (Q1) mit einer Basis, die mit dem Spannungsteiler (R15, R16) verbunden ist, einzuschalten, um die Bezugsspannung (CVDD) zu erzeugen.
5. Die Flüssigkristallanzeige gemäß Anspruch 4, wobei der Bezugsspannungsgenerator (110) weiter einen Lichtsensor umfasst, der die Helligkeit der Umgebung der Flüssigkristallanzeige erfasst und abhängig von der erfassten Helligkeit (R15, R16) ein Fotostromsignal erzeugt; und die Senkung des Niveaus der dritten vordefinierten Spannung (Von) auf der Grundlage des Fotostromsignals durchgeführt wird.
6. Die Flüssigkristallanzeige gemäß Anspruch 4, wobei der erste Spannungsteiler (R15, R16, R17) einen variablen Widerstand (R16) mit einem Widerstand umfasst, der von einem Benutzer eingestellt werden kann.
7. Die Flüssigkristallanzeige gemäß Anspruch 4, die weiter einen Signalgenerator (140) umfasst, der die Helligkeit der Bilder auf dem Flüssigkristallanzeigen-Bildschirm bestimmt und abhängig von der Helligkeit ein drittes Signal (VIN) erzeugt, und die Senkung des Niveaus der dritten vordefinierten Spannung (Von) wird auf der Grundlage des dritten Signals (VIN) durchgeführt.
8. Die Flüssigkristallanzeige gemäß Anspruch 7, wobei der Bezugsspannungsgenerator (130) weiter einen Verstärker (OP) umfasst, der das dritte Signal verstärkt.
9. Der Flüssigkristallanzeige gemäß Anspruch 8, wobei der Bezugsspannungsgenerator (130) weiter einen zweiten Spannungsteiler (R18, R19) umfasst, welcher das Niveau der ersten vordefinierten Spannung (AVDD) senkt, und die Verstärkung des dritten Signals (VIN) auf der Grundlage der ersten vordefinierten Spannung mit reduziertem Niveau durchgeführt wird.
10. Die Flüssigkristallanzeige gemäß Anspruch 2, die weiter einen Spannungsgenerator (200) für eine gemeinsame Elektrode umfasst, der auf der Grundlage der Bezugsspannung (CVDD) eine Spannung (Vcom) für die gemeinsame Elektrode erzeugt, die an die Pixel anzulegen ist.
11. Die Flüssigkristallanzeige gemäß Anspruch 1, wobei der Grauwert-Spannungsgenerator (300) einen Spannungsteiler (R1-R12) umfasst, der zwischen der Bezugsspannung (CVDD) und der zweiten vordefinierten Spannung angeschlossen ist.
12. Die Flüssigkristallanzeige gemäß Anspruch 11, wobei der Spannungsteiler (R1-R12) erste (R1-R6) und zweite (R7-R12) Reihen von Widerständen umfasst, die in Reihe geschaltet sind, und die erste Reihe von Widerständen (R1-R6) an die Bezugsspannung (CVDD) angeschlossen ist, während die zweite Reihe von Widerständen (R7-R12) an die zweite vordefinierte Spannung angeschlossen ist, wobei die Größen der Grauwert-Spannungen von Größen der Bezugsspannung (CVDD) und der zweiten vordefinierten Spannung und von Widerständen der ersten und der zweiten Reihe von Widerständen (R1-R12) bestimmt werden.
13. Die Flüssigkristallanzeige gemäß Anspruch 12, wobei der Bezugsspannungsgenerator (110) einen Transistor (Q1) umfasst, welcher eine erste Klemme hat, die an das erste Signal (99) gekoppelt ist, eine zweite Klemme, die an die erste vordefinierte Spannung (AVDD) gekoppelt ist, und eine dritte Klemme, welche die Bezugsspannung (CVDD) ausgibt.
14. Die Flüssigkristallanzeige gemäß Anspruch 1, wobei der Bezugsspannungsgenerator (110) einen Lichtsensor umfasst, der den Helligkeitsgrad der Umgebung erfasst, um abhängig vom erfassten Helligkeitsgrad das erste Signal (99) zu erzeugen.
15. Die Flüssigkristallanzeige gemäß Anspruch 1, wobei der Bezugsspannungsgenerator (120) einen variablen Widerstand (R16) mit einem Widerstand umfasst, der von einem Benutzer eingestellt werden kann.
16. Die Flüssigkristallanzeige gemäß Anspruch 1, die weiter einen Signalgenerator (140) umfasst, welcher die Helligkeit der Bilder auf dem Flüssigkristallanzeigen-Bildschirm ermittelt, um abhängig von der Helligkeit das erste Signal (VIN) zu erzeugen.

17. Die Flüssigkristallanzeige gemäß Anspruch 16, wobei der Bezugsspannungsgenerator (130) einen Verstärker (OP) umfasst, welcher das erste Signal (VIN) verstärkt.

18. Die Flüssigkristallanzeige gemäß Anspruch 17, wobei der Bezugsspannungsgenerator (13) weiter einen Spannungsteiler (R18, R19), angeschlossen zwischen der ersten vordefinierten Spannung (AVDD) und der zweiten vordefinierten Spannung, umfasst, welcher das Niveau der ersten vordefinierten Spannung (AVDD) senkt, um den Verstärker zu beliefern; die Verstärkung des ersten Signals (VIN) wird auf der Grundlage der ersten vordefinierten Spannung mit reduziertem Niveau durchgeführt.

19. Die Flüssigkristallanzeige gemäß Anspruch 16, wobei der Signalgenerator (140) Folgendes umfasst:

einen Rechteckwellen-Generator (1410), der für eine horizontale Periode einen Durchschnittswert von Grauwert-Daten aus einer externen Quelle berechnet und abhängig vom Durchschnittswert der Grauwert-Daten ein Lastsignal (Dout) erzeugt, und
einen Analogwandler (1420), der das Lastsignal (Dout) vom Rechteckwellen-Generator (1410) analog in das erste Signal (VIN) umwandelt.

20. Die Flüssigkristallanzeige gemäß Anspruch 19, wobei der Rechteckwellen-Generator (1410) Folgendes umfasst:

einen Datenwandler (111), der mindestens einem Grauwert-Datum in jeder Gruppe der Grauwert-Daten eine Wichtung zuweist,
einen ersten Addierer (112), der die Grauwert-Daten in jeder Gruppe der Grauwert-Daten addiert, um sie als erste Summen auszugeben,
einen zweiten Addierer (113), der die ersten Summen für eine horizontale Periode addiert, um sie als zweite Summe auszugeben,
einen Dividierer (114), der die zweite Summe durch die Anzahl der Grauwert-Daten in jeder Gruppe der Grauwert-Daten teilt und obere Bits aus der zweiten Summe, geteilt durch die Anzahl der Grauwert-Daten in jeder Gruppe der Grauwert-Daten, extrahiert, um sie als erste Daten auszugeben,
einen Zähler (115), der die ersten Daten rückwärts zählt, und
einen Lastsignalgenerator (116), der eine Rechteckwelle mit einer Last auf der Grundlage der rückwärts gezählten Anzahl der ersten Daten erzeugt.

21. Die Flüssigkristallanzeige gemäß Anspruch 19, wobei der Analogwandler (1420) Folgendes umfasst:

einen Transistor (Q11), der abhängig vom Lastsignal (Dout) an- und ausgeschaltet wird, und
eine Spannungs-Steuereinheit (R12-R15, C1), die das erste Signal (VIN), analog gewandelt als Reaktion auf Analogspannungen, erzeugt, welche abhängig vom Ein- und Ausschalten des Transistors (Q11) erhöht und erniedrigt werden.

22. Die Flüssigkristallanzeige gemäß Anspruch 21, wobei das erste Signal (VIN) durch die Zeitkonstante der Spannungs-Steuereinheit (R12-R15, C1) bestimmt wird und proportional zur Last- und Impulsanzahl des Lastsignals (Dout) ist.

23. Ein Verfahren zum Ansteuern einer Flüssigkristallanzeige mit einer Vielzahl von Gate-Leitungen, einer Vielzahl von Daten-Leitungen und einer Vielzahl von Pixeln, die Schaltelemente einschließen, welche mit den Gate-Leitungen und den Daten-Leitungen verbunden sind, wobei das Verfahren folgende Schritte umfasst:

Bestimmung des Helligkeitsgrads von Bildern auf dem Flüssigkristallanzeigen-Bildschirm anhand von Grauwert-Daten aus einer externen Quelle zur Erzeugung eines ersten Signals (99, VIN),
Änderung des Niveaus einer vordefinierten Spannung (AVDD) zur Erzeugung einer Bezugsspannung (CVDD) auf der Grundlage des ersten Signals (99, VIN), wobei das Verfahren **dadurch gekennzeichnet ist, dass** es folgende Schritte umfasst:

Erzeugung einer Vielzahl von Grauwert-Spannungen (VREF1-VREF10) mit Werten, die abhängig von der Bezugsspannung (CVDD) variieren,
Lieferung von Scansignalen an die Gate-Leitungen zum Einschalten der Schaltelemente und
Umwandlung der Grauwert-Daten in entsprechende Grauwert-Spannungen, um die entsprechenden Grauwert-Spannungen an die Pixel über die Daten-Leitungen und an die Schaltelemente zu liefern.

24. Das Verfahren gemäß Anspruch 23, wobei die Bestimmung Folgendes umfasst:

Berechnung eines Durchschnittswerts der Grauwert-Daten für eine horizontale Periode,
Erzeugung eines Lastsignals (Dout) abhängig vom Durchschnittswert der Grauwert-Daten, und
Analog-Umwandlung des Lastsignals in das erste Signal (VIN).

25. Das Verfahren gemäß Anspruch 24, wobei die Berechnung des Durchschnittswerts Folgendes umfasst:

Addieren der Grauwert-Daten in entsprechenden Gruppen der Grauwert-Daten, um sie als erste Summen auszugeben,
Addieren der ersten Summen für eine horizontale Periode, um sie als zweite Summe auszugeben,
Dividieren der zweiten Summe durch die Anzahl der Grauwert-Daten in jeder Gruppe der Grauwert-Daten,
Extrahieren oberer Bits aus der zweiten Summe, geteilt durch die Anzahl der Grauwert-Daten in jeder Gruppe der Grauwert-Daten, um sie als erste Daten auszugeben,
Rückwärtszählen der ersten Daten, und
Erzeugen einer Rechteckwelle mit einer Last auf der Grundlage der rückwärts gezählten Anzahl der ersten Daten.

Revendications

1. Écran à cristaux liquides LCD comprenant :

un générateur de tension de référence (100, 110, 120, 130) pour changer le niveau d'une première tension prédéterminée (AVDD) sur la base d'un premier signal (99, VIN) pour générer une tension de référence (CVDD) à partir de ladite première tension prédéterminée (AVDD) et suivant un niveau de luminosité du milieu extérieur environnant du LCD, ledit premier signal (99) variant suivant une parmi la luminosité du milieu extérieur environnant de l'écran à cristaux liquides, la luminosité d'images sur écran de l'écran à cristaux liquides, et la manipulation d'un utilisateur ; et ledit écran à cristaux liquides étant **caractérisé en ce qu'il** comprend en outre :

un générateur de tension de gris (300) pour générer une pluralité de tensions de gris avec des amplitudes suivant une amplitude de la tension de référence (CVDD) et une deuxième tension prédéterminée, telle qu'une tension de terre, dans lequel la pluralité de tensions de gris sont transmises à une pluralité de pixels, la pluralité de pixels étant incluse dans l'écran à cristaux liquides.

2. Écran à cristaux liquides selon la revendication 1, comprenant en outre:

une pluralité de lignes de données, une pluralité de lignes de porte et la pluralité de pixels connectée aux lignes de données et aux lignes de porte ; et
un premier pilote (600) sélectionnant les tensions de gris sur la base de données de gris à partir d'une source externe, à fournir à la pluralité de pixels par l'intermédiaire des lignes de données.

3. Écran à cristaux liquides selon la revendication 2, comprenant en outre un second pilote (500) fournissant des signaux de porte aux lignes de porte, chaque pixel comprenant un élément de commutation connecté à une des lignes de données et une des lignes de porte, et transmettant les tensions de gris aux pixels sous le contrôle des signaux de porte.

4. Écran à cristaux liquides selon la revendication 3, dans lequel le générateur de tension de référence (110, 120, 130) comprend un premier diviseur de tension (R15, R16) réduisant le niveau d'une troisième tension prédéterminée (Von) pour allumer un transistor (Q1) avec une base connectée au diviseur de tension (R15, R16), pour générer la tension de référence (CVDD).

5. Écran à cristaux liquides selon la revendication 4, dans lequel le générateur de tension de référence (110) comprend en outre un capteur de luminosité détectant la luminosité du milieu extérieur environnant de l'écran à cristaux liquides et générant un signal de photo-courant suivant la luminosité détectée (R15, R16), et la réduction de niveau de la troisième tension prédéterminée (Von) est exécutée sur la base du signal de photo-courant.

6. Écran à cristaux liquides selon la revendication 4, dans lequel le premier diviseur de tension (R15, R16, R17)

comprend une résistance variable (R16) avec une résistance réglable par un utilisateur.

- 5 7. Écran à cristaux liquides selon la revendication 4, comprenant en outre un générateur de signal (140) déterminant la luminosité des images sur écran de l'écran à cristaux liquides et générant un troisième signal (VIN) suivant la luminosité et la réduction de niveau de la troisième tension prédéterminée (Von) est exécutée sur la base du troisième signal (VIN).
- 10 8. Écran à cristaux liquides selon la revendication 7, dans lequel le générateur de tension de référence (130) comprend en outre un amplificateur (OP) amplifiant le troisième signal.
- 15 9. Écran à cristaux liquides selon la revendication 8, dans lequel le générateur de tension de référence (130) comprend en outre un second diviseur de tension (R18, R19) réduisant le niveau de la première tension prédéterminée (AVDD), et l'amplification du troisième signal (VIN) est exécutée sur la base de la première tension prédéterminée à niveau réduit.
- 20 10. Écran à cristaux liquides selon la revendication 2, comprenant en outre un générateur de tension commun (200) générant une tension commune (Vcom) destinée à être appliquée sur les pixels, sur la base de la tension de référence (CVDD).
- 25 11. Écran à cristaux liquides selon la revendication 1, dans lequel le générateur de tension de gris (300) comprend un diviseur de tension (R1-R12) connecté entre la tension de référence (CVDD) et la deuxième tension prédéterminée.
- 30 12. Écran à cristaux liquides selon la revendication 11, dans lequel le diviseur de tension (R1-R12) comprend des première (R1-R6) et seconde (R7-R12) séries de résistances connectées en série, et la première série de résistances (R1-R6) est connectée à la tension de référence (CVDD) alors que la seconde série de résistances (R7-R12) est connectée à la deuxième tension prédéterminée, les amplitudes des tensions de gris étant déterminée par des amplitudes de la tension de référence (CVDD) et de la deuxième tension prédéterminée et par des résistances des première et seconde séries de résistances (R1-R12).
- 35 13. Écran à cristaux liquides selon la revendication 12, dans lequel le générateur de tension de référence (110) comprend un transistor (Q1) possédant une première borne couplée au premier signal (99), une deuxième borne couplée à la première tension prédéterminée (AVDD), et une troisième borne faisant sortir la tension de référence (CVDD).
- 40 14. Écran à cristaux liquides selon la revendication 1, dans lequel le générateur de tension de référence (110) comprend un capteur de luminosité détectant le niveau de luminosité du milieu extérieur environnant pour générer le premier signal (99) suivant le niveau de luminosité détecté.
- 45 15. Écran à cristaux liquides selon la revendication 1, dans lequel le générateur de tension de référence (120) comprend une résistance variable (R16) avec une résistance réglable par un utilisateur.
- 50 16. Écran à cristaux liquides selon la revendication 1, comprenant en outre un générateur de signal (140) déterminant la luminosité des images sur écran de l'écran à cristaux liquides pour générer le premier signal (VIN) suivant la luminosité.
- 55 17. Écran à cristaux liquides selon la revendication 16, dans lequel le générateur de tension de référence (130) comprend un amplificateur (OP) amplifiant le premier signal (VIN).
18. Écran à cristaux liquides selon la revendication 17, dans lequel le générateur de tension de référence (13) comprend en outre un diviseur de tension (R18, R19), connecté entre la première tension prédéterminée (AVDD) et la deuxième tension prédéterminée, réduisant le niveau de la première tension prédéterminée (AVDD) à fournir pour l'amplificateur, l'amplification du premier signal (VIN) est exécutée sur la base de la première tension prédéterminée à niveau réduit.
19. Écran à cristaux liquides selon la revendication 16, dans lequel le générateur de signal (140) comprend :
un générateur d'onde carrée (1410) calculant une valeur moyenne de données de gris à partir d'une source externe pour une période horizontale et générant un signal de service (Dout) suivant la valeur moyenne des données de gris ; et

un convertisseur analogique (1420) réalisant une conversion analogique du signal de service (Dout) à partir du générateur d'onde carrée (1410) en premier signal (VIN).

20. Écran à cristaux liquides selon la revendication 19, dans lequel le générateur d'onde carrée (1410) comprend :

un convertisseur de données (111) attribuant un poids à au moins une donnée de gris dans chaque groupe des données de gris ;
un first additionneur (112) additionnant les données de gris dans chaque groupe des données de gris pour produire des premières sommes ;
un second additionneur (113) additionnant les premières sommes pour une période horizontale pour produire une seconde somme ;
un diviseur (114) divisant la seconde somme par le nombre des données de gris dans chaque groupe des données de gris et extrayant des bits supérieurs à partir de la seconde somme divisée par le nombre des données de gris dans chaque groupe des données de gris pour produire des premières données ;
un compteur (115) comptant régressivement les premières données ; et
un générateur de signal de service (116) générant une onde carrée possédant un cycle de service sur la base du nombre compté régressivement des premières données.

21. Écran à cristaux liquides selon la revendication 19, dans lequel le convertisseur analogique (1420) comprend :

un transistor (Q11) allumé et éteint en réponse au signal de service (Dout) ; et
une unité de réglage de tension (R12-R15, C1) générant le premier signal (VIN) ayant subi une conversion analogique en réponse à des tensions analogiques dont le niveau a été augmenté et réduite suivant que le transistor (Q11) est allumé ou éteint.

22. Écran à cristaux liquides selon la revendication 21, dans lequel le premier signal (VIN) est déterminé par constante de temps de l'unité de réglage de tension (R12-R15, C1), et est proportionnel à un compte de services et d'impulsions du signal de service (Dout).

23. Procédé de pilotage d'écran à cristaux liquides possédant une pluralité de lignes de porte, une pluralité de lignes de données, et une pluralité de pixels comprenant des éléments de commutation connectés aux lignes de porte et aux lignes de données, le procédé comprenant les étapes consistant à :

déterminer le niveau de luminosité d'images sur écran de l'écran à cristaux liquides sur la base de données de gris à partir d'une source externe pour générer un premier signal (99, VIN) ;
changer le niveau d'une tension prédéterminée (AVDD) pour générer une tension de référence (CVDD) sur la base du premier signal (99, VIN) ; ledit procédé étant **caractérisé en ce qu'il** comprend les étapes consistant à :

générer une pluralité de tensions de gris (VREF1-VREF10) avec des valeurs variant suivant la tension de référence (CVDD) ;
fournir des signaux de balayage pour que les lignes de porte allument les éléments de commutation ; et
convertir les données de gris en tensions de gris correspondantes pour fournir les tensions de gris correspondantes aux pixels par l'intermédiaire des lignes de données et les éléments de commutation.

24. Procédé selon la revendication 23, dans lequel la détermination comprend les étapes consistant à :

calculer une valeur moyenne des données de gris pour une période horizontale ;
générer un signal de service (Dout) suivant la valeur moyenne des données de gris ; et
réaliser une conversion analogique du signal de service en premier signal (VIN).

25. Procédé selon la revendication 24, dans lequel le calcul de la valeur moyenne comprend les étapes consistant à :

additionner les données de gris dans des groupes respectifs des données de gris pour produire des premières sommes ;
additionner les premières sommes pour une période horizontale pour produire une seconde somme ;
diviser la seconde somme par le nombre des données de gris dans chaque groupe des données de gris ;
extraire des bits supérieurs à partir de la seconde somme divisée par le nombre des données de gris dans chaque groupe des données de gris pour produire des premières données ;

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compter régressivement les premières données ; et
générer une onde carrée possédant un cycle de service sur la base du nombre compté régressivement des
premières données.

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FIG. 1

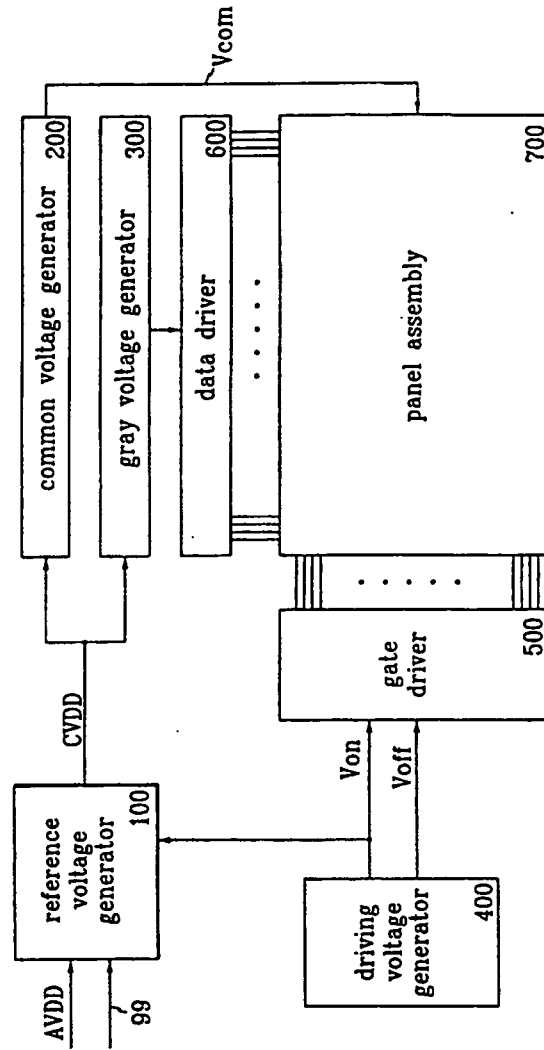


FIG. 2

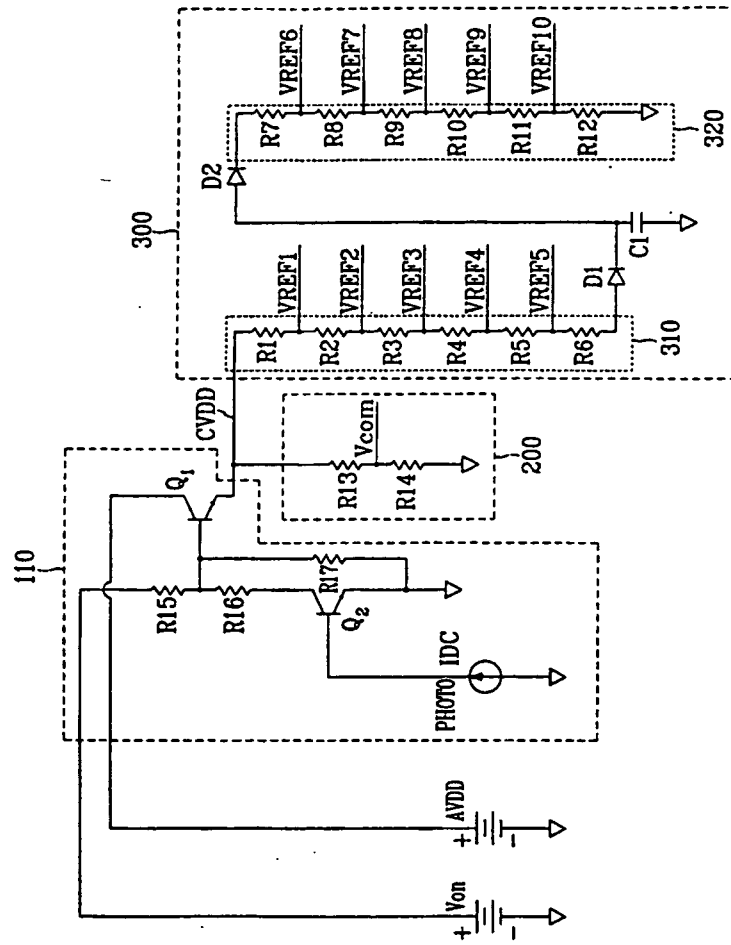


FIG. 3

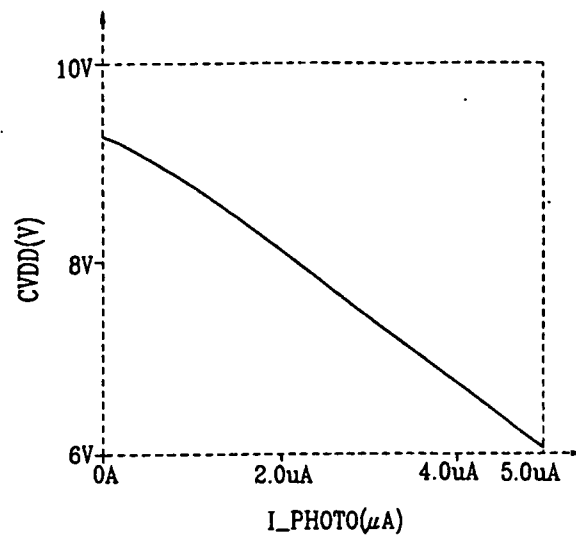


FIG. 4

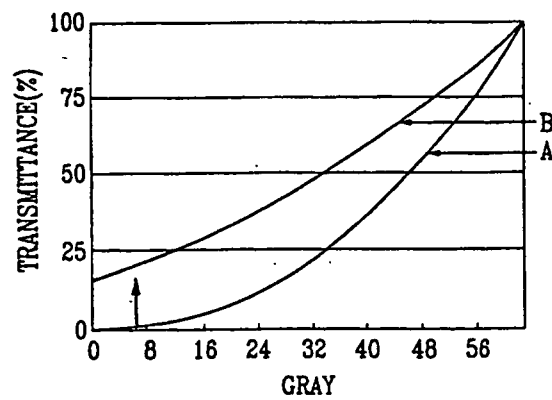


FIG. 5

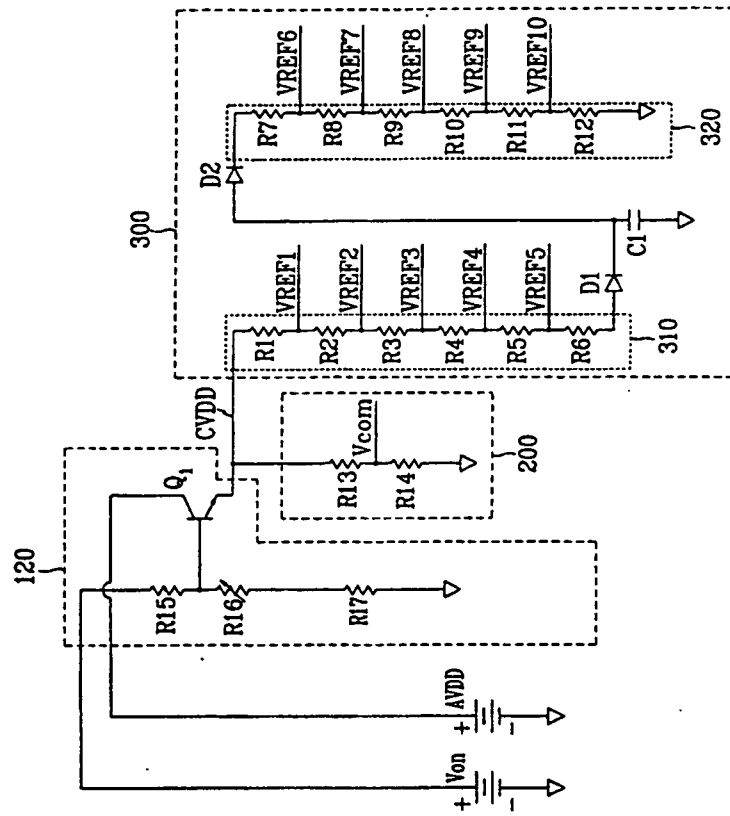


FIG. 6

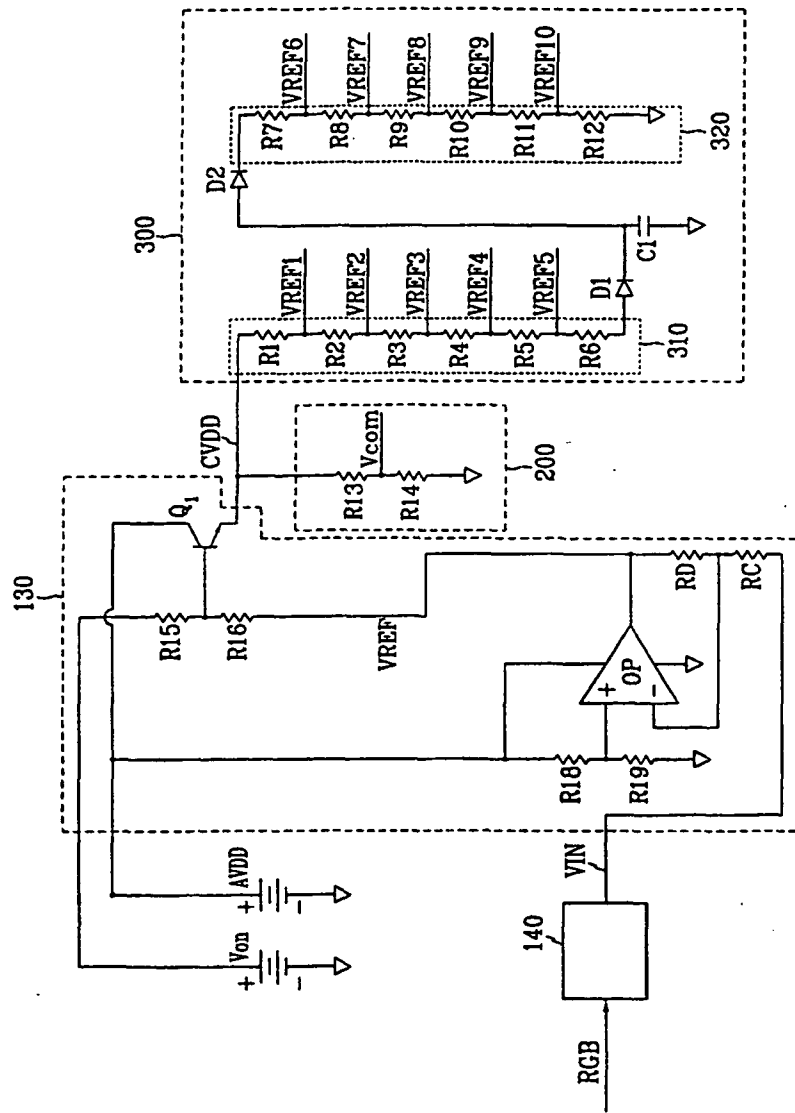


FIG. 7

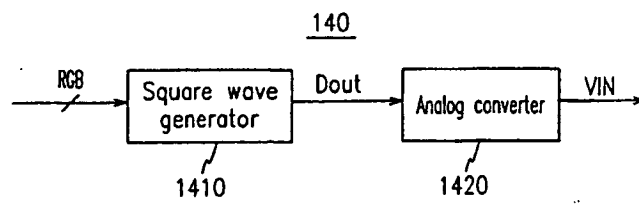


FIG. 8

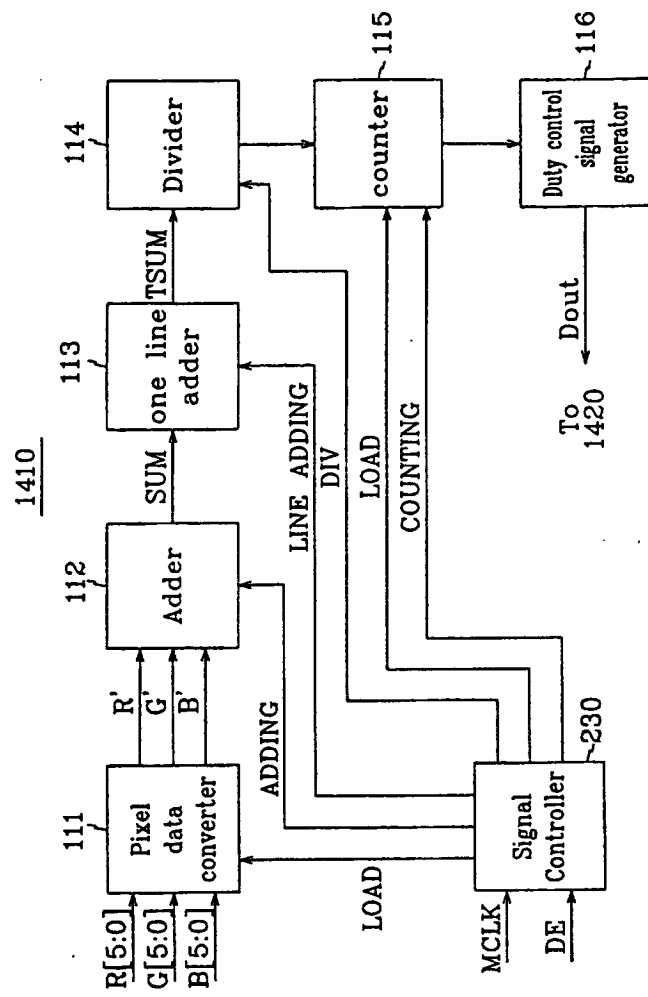


FIG. 9

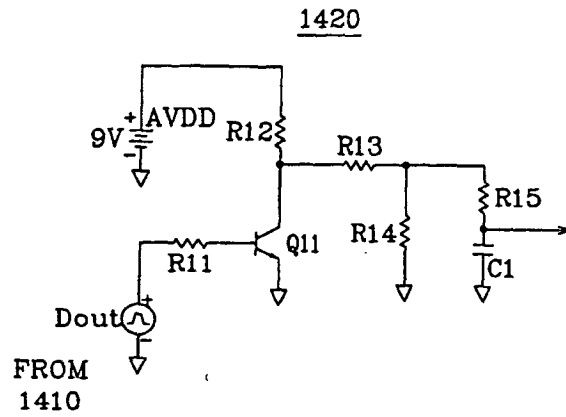


FIG. 10

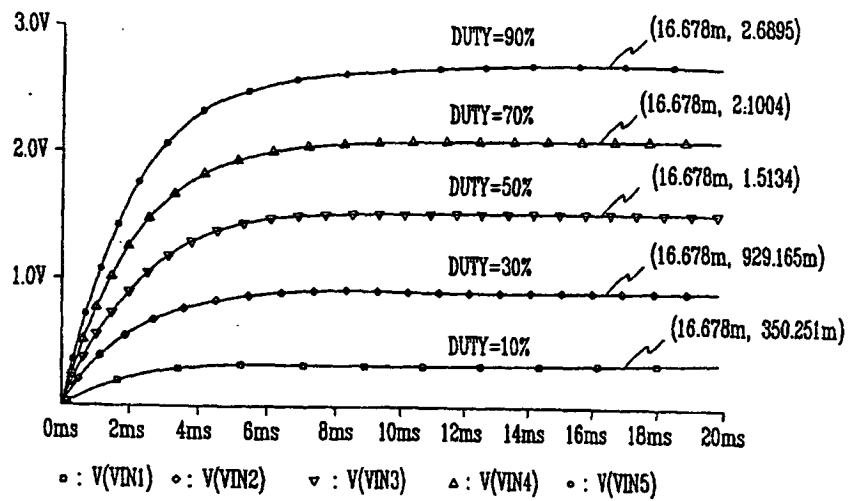
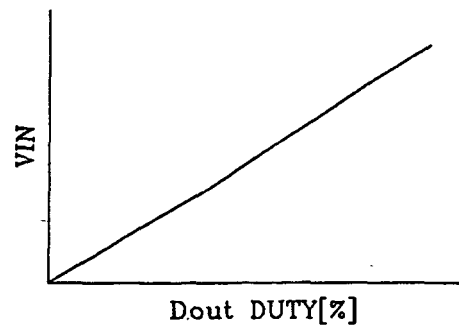


FIG. 11



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 1220193 A [0006]

专利名称(译)	具有变化幅度的灰度电压的液晶显示器及其驱动方法		
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优先权	1020010059868 2001-09-27 KR		
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外部链接	Espacenet		

摘要(译)

一种具有多个具有变化幅度的灰度电压的液晶显示器 (“LCD”) 及其驱动方法。LCD包括参考电压发生器，其基于第一信号改变电源电压的电平以产生参考电压。第一信号根据LCD的周围亮度，LCD的屏幕图像的亮度和用户的操纵而变化。LCD还包括灰度电压发生器，其产生具有根据参考电压的幅度和诸如接地电压的预定电压而变化的幅度的多个灰度电压。LCD还包括传输多个栅极信号的多条栅极线，传输灰度电压的多条数据线和多个像素。每个像素具有连接到栅极线之一和数据线之一的开关元件，并且在栅极信号的控制下将灰度电压传输到像素。LCD包括向栅极线提供栅极信号的栅极驱动器和基于来自外部源的灰度数据选择灰度电压以经由数据线提供给像素的数据驱动器。

(Equation 1)

$$V_d = \frac{R_{16} + R_{17}}{R_{15} + R_{16} + R_{17}} V_{ONi}$$