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(54) **Liquid crystal display device and driving method of the same**

Flüssigkristalldisplay-Vorrichtung und Steuerungsverfahren dafür

Dispositif d'affichage à cristaux liquides et procédé de commande de celui-ci

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Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a liquid crystal display device, and more particularly, to a liquid crystal display device and a driving method of the same.

Discussion of the Related Art

[0002] With rapid development of information technologies, display devices processing and displaying a large amount of information have been rapidly developed. Recently, flat panel display (FPD) devices such as a liquid crystal display (LCD) device, a plasma display panel (PDP) device and an organic light emitting diode (OLED) device have been suggested.

[0003] Among the various FPD devices, the LCD device has been widely used for its superiorities of small size, light-weight, thin profile and low power consumption. Meanwhile, active matrix type liquid crystal display devices, which include pixels arranged in a matrix form and thin film transistors to control on/off the respective pixels, have been widely used because of their high resolution, color rendering capability and superiority in displaying moving images.

[0004] Recently, in an LCD device for mobile devices, an image data of a black level of a gray scale has been widely used, and its displaying time has been increased. Thus, there is a problem of an afterimage at the black level in addition to afterimages at middle levels or low levels.

[0005] The afterimage at the black level will be explained with reference to Table 1. Table 1 shows a driving voltage at each level of a gray scale in a normally black mode.

[0006] In Table 1, the driving voltage of the black level Gray0, which is a zeroth gray level, is 0.222V, and this is for a gray scale inversion. More particularly, brightness at the levels of the gray scale should be gradually increased. At this time, the driving voltage of the black level Gray0 is lower than a voltage at which a gray inversion occurs, and the driving voltage of a first gray level Gray1 is higher than the voltage at which the gray inversion occurs. The driving voltages of second and third gray levels Gray2 and Gray3 are gradually increased. Here, the gray inversion may occur at about 0.3V, and the driving voltage of the first gray level Gray1 may be about 0.4V.

[Table 1]

Gray	driving voltage (V)
0	0.222
1	0.367
2	0.421
3	0.476
4	0.512
5	0.555
6	0.599
7	0.642
8	0.686
9	0.729
10	0.791

[0007] However, as stated above, when the driving voltage of the black level Gray0 is about 0.2V and the image data of the black level Gray0 is displayed for a long time, liquid crystal is affected by 0.2V. Therefore, the image data of the black level displayed at a current frame remains at a next frame, and there is an afterimage.

[0008] US 2002/0060656 A1 discloses a liquid crystal display device having a liquid crystal panel, a gray scale power circuit establishing a gamma voltage corresponding to each gray level according to a predetermined T-V curve, and a data signal output circuit changing digital image data into analog image data using the gamma voltage and outputting the analog image data to the liquid crystal panel. The gray scale power circuit comprises a gray scale voltage supplying source which provides gray scale voltages derived from a reference voltage such that the reference voltage is divided by 255. Thus, the difference between two successive gray scale voltages V_i and V_{i+1} is $V_{ref}/255$. Here, the gray scale voltage for the black level is 0V.

[0009] EP 1 465 147 A2 discloses a liquid crystal display a driving circuit of which comprises a gradation voltage generation circuit arranged to generate a plurality of voltages using a resistor string circuit to fit to the gamma characteristics of the display unit, and a data driving unit changing digital image data into analog image data using the gamma voltage and outputting the analog image data to the liquid crystal panel. The gamma voltage VR1 corresponding to a black level 0 is set to 0 V. With regard to the positive polarity the voltage VR2 of the next gray level 1 is 0,330 V.

Summary of the invention

[0010] The object of the present invention is to provide a liquid crystal display device and a driving method of the same that improve an afterimage problem reduce power consumption and volt gray inversion at low grey levels.

[0011] This object is achieved by the liquid crystal display device and the control method according to the respective independent claims.

[0012] A liquid crystal display device includes a liquid crystal panel; a gamma voltage supplying unit establishing a gamma voltage corresponding to each gray level according to a predetermined T-V curve; and a data driving unit changing digital image data into analog image data using the gamma voltage and outputting the analog image data to the liquid crystal panel, wherein the gamma voltage corresponding to a black level is configured to have a value within a range of 0 V to 0.005 V.

[0013] A driving method of a liquid crystal display device includes changing digital image data into analog image data; and outputting the analog image data to a liquid crystal panel, wherein outputting the analog image data to the liquid crystal panel includes using a gamma voltage established according to a predetermined T-V curve, wherein the gamma voltage corresponding to a black level is configured to have a value within a range of 0 V to 0.005 V.

[0014] It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and together with the description serve to explain the principles of the invention.

[0016] FIG. 1 is a schematic view of illustrating a liquid crystal display device according to an exemplary embodiment of the present invention.

[0017] FIG. 2 is a graph of illustrating a gamma curve of a normally black mode liquid crystal display device according to the present invention.

[0018] FIG. 3 is a view of illustrating a gamma voltage supplying unit according to an embodiment of the present invention.

[0019] FIG. 4 is a graph of illustrating transmittance-voltage characteristics of a liquid crystal display device according to the present invention.

DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENTS

[0020] Reference will now be made in detail to embodiments of the present invention, examples of which are illustrated in the accompanying drawings.

[0021] FIG. 1 is a schematic view of illustrating a liquid crystal display device according to an exemplary embodiment of the present invention.

[0022] In FIG. 1, a liquid crystal display device 100 of the present invention includes a liquid crystal panel 200, a backlight 800 and a driving circuit portion.

[0023] The liquid crystal panel 200 includes gate lines GL extending along a row line direction and data lines DL along a column line direction in the context of the figure. The gate lines GL and the data lines DL cross each other to define subpixels SP arranged in a matrix form.

[0024] The subpixels SP, for example, may include R subpixels for red, G subpixels for green, and B subpixels for blue. R, G and B image data are inputted to R, G and B subpixels, respectively. Here, adjacent three R, G and B subpixels SP form a pixel.

[0025] Each subpixel includes a thin film transistor T, a liquid crystal capacitor Clc, and a storage capacitor Cst. The liquid crystal capacitor Clc comprises a pixel electrode and a common electrode. The thin film transistor T is formed at each crossing portion of the gate lines GL and the data lines DL and is connected to the pixel electrode.

[0026] A data voltage is applied to the pixel electrode, and a common electrode is applied to the common electrode. An electric field is generated between the pixel electrode and the common electrode, and liquid crystal molecules are driven by the electric field. The pixel electrode, the common electrode, and the liquid crystal molecules therebetween constitute the liquid crystal capacitor Clc.

[0027] In the meantime, the storage capacitor Cst in each subpixel SP stores the data voltage applied to the pixel electrode until a next frame.

[0028] The backlight 800 provides light to the liquid crystal panel 200. The backlight 800 may include a cold cathode fluorescent lamp (CCFL), an external electrode fluorescent lamp (EEFL) or a light emitting diode (LED) lamp as a light source.

[0029] The driving circuit portion includes a timing control unit 300, a gate driving unit 400, a data driving unit 500, a source voltage supplying unit 600, and a gamma voltage supplying unit 700.

[0030] The timing control unit 300 receives digital image data RGB and control signals TCS such as a vertical sync signal, a horizontal sync signal, a clock signal, a data enable signal from an outer system such as a TV system or a graphic card. Although not shown in the figure, the signals may be inputted through an interface constructed in the timing control unit 300.

[0031] The timing control unit 300 generates gate control signals GCS for controlling the gate driving unit 400 and data control signals DCS for controlling the data driving unit 500 by using the inputted control signals TCS. The gate control signals GCS include a gate start pulse (GSP), a gate shift clock (GSC), and a gate output enable (GOE). The data control signals include a source start pulse (SSP), a source sampling clock (SSC), a source output enable (SOE), and a polarity (POL).

[0032] The gate start pulse is a signal of indicating a start line of the liquid crystal panel 200 in a vertical period. The gate shift clock is a signal of determining on/off time of a gate of the thin film transistor. The gate output enable is a signal of controlling output of the gate driving unit 400.

[0033] The source sampling clock is used as sampling clock for latching data in the data driving unit 500 and determines a driving frequency of the data driving unit 500. The source output enable transmits the data latched by the source sampling clock to the liquid crystal panel 200. The source start pulse is a signal of indicating start of data latch or sampling in a horizontal period. The polarity is a signal of indicating a polarity for an inversion operation of liquid crystal.

[0034] The timing control unit 300 arranges the inputted digital image data RGB and provides them to the data driving unit 500.

[0035] The gate driving unit 400 scans the gate lines GL in order, corresponding to the gate control signals GCS provided by the timing control unit 300. For example, the gate driving unit 400 sequentially selects the gate lines GL during each frame and outputs a gate voltage to the selected gate line GL. The thin film transistors T of a corresponding row line are turned on by the gate voltage. Then, a turn-off voltage is applied to the gate line GL, and the thin film transistors T maintain a turn-off state.

[0036] The data driving unit 500 changes the digital image data RGB into analog image data RGB, corresponding to the data control signal DCS and the digital image data RGB provided by the timing control unit 300 and provide the analog image data RGB to the data lines DL. That is, the data driving unit 500 generates a data voltages corresponding to the digital image data RGB by using a gamma voltage Vgamma and outputs the data voltages to the data lines DL.

[0037] The source voltage supplying unit 600 receives reference voltages from the outer system and generates and provides voltages for elements of the liquid crystal panel 200 and the driving circuit portion. For example, the source voltage supplying unit 600 generates a power voltage supplied to the timing control unit 300, the gate driving unit 400 and the data driving unit 500 and also generates a gate high voltage and a gate low voltage supplied to the gate driving unit 400.

[0038] The gamma voltage supplying unit 700 generates a gamma voltage Vgamma for changing the digital image data RGB into the analog image data RGB and provides the gamma voltage Vgamma to the data driving unit 500.

[0039] The gamma voltage driving unit 700 will be explained in more detail with reference to accompanying drawings.

[0040] The gamma voltage Vgamma is supplied to the pixel electrode of the liquid crystal display device 100 and is applied to the liquid crystal layer. The transmittance of the liquid crystal display device 100 changes depending on the gamma voltage Vgamma, and the gray scale is produced.

[0041] The gamma is a slope of showing a relation between input and output of a converter. The gamma shows the relation between transmittances of the digital image data RGB and the analog image data RGB in the liquid crystal display device 100. It is known that optimum viewing angle and brightness properties can be achieved at the gamma of about 2.2 when the visibility of the viewer is considered.

[0042] Meanwhile, the gamma voltage can be expressed by a gamma curve, which shows the relation between the digital image data RGB and the analog image data RGB.

[0043] FIG. 2 is a graph of illustrating a gamma curve of a normally black mode liquid crystal display device according to the present invention. FIG. 2 shows a change of the gamma voltage Vgamma depending on the digital image data RGB.

[0044] In FIG. 2, when the digital image data RGB is 8-bit data, which is expressed by hexadecimal (base 16) code HEX, for example, the gamma voltage Vgamma for the analog image data can be divided into 256 gray levels. Namely, the data driving unit 500 of the liquid crystal display device 100 decodes the digital image data RGB and selects and provides the gamma voltage Vgamma corresponding to the decoded information to the pixel electrode, thereby displaying an image of 256 gray levels.

[0045] Here, the gamma voltage Vgamma has a value between a high potential source voltage VDD and a low potential source voltage VSS, and some of the gamma voltage Vgamma corresponds to a plurality of gamma reference voltages GMA1 to GMA18.

[0046] The gamma voltage Vgamma is generated due to voltage division, in which the high potential source voltage VDD and the low potential source voltage VSS are connected a plurality of resistors in series therebetween and a voltage between the high potential source voltage VDD and the low potential source voltage VSS is divided by the resistors. This will be explained hereinafter with reference to FIG. 3.

[0047] FIG. 3 is a view of illustrating a gamma voltage supplying unit according to an embodiment of the present invention.

[0048] In FIG. 3, the gamma voltage supplying unit 700 includes a gamma reference voltage supplying part 710, a positive gamma voltage generating part 720, and a negative gamma voltage generating part 730.

[0049] The gamma reference voltage supplying part 710 generates a plurality of gamma reference voltages GMA1 to GMA18 and provides them to nodes between resistors R0 to R254 of each of the positive gamma voltage generating part 720 and the negative gamma voltage generating part 730.

[0050] When the gamma voltage Vgamma is generated simply due to the voltage division using the resistors R0 to R254, there may be current leakage along with the outputted gamma voltage Vgamma, and currents flowing through the resistors R0 to R254 may be decreased. Therefore, the gamma voltage Vgamma may not be correctly outputted as designed. At this time, using the gamma reference voltages GMA1 to GMA18, decreases in the currents may be compensated, and a predetermined gamma voltage Vgamma may be outputted. That is, the gamma reference voltages GMA1 to GMA18 function as a sort of a current source.

[0051] The positive gamma voltage generating part 720 includes the plurality of resistors R0 to R254 in series between the high potential source voltage VDD and a half voltage VDD/2 of the high potential source voltage VDD. The positive gamma voltage generating part 720 divides a voltage between both ends of the plurality of resistors R0 to R254 due to a voltage division rule and generates and outputs positive gamma voltage values VGMP0 to VGMP255. Here, the high potential source voltage VDD may be a fixed voltage that is generated in the source voltage supplying unit 600 of the liquid crystal display device 100. A resistance of each of the resistors R0 and R254 may be 3% of a total resistance of the resistors R1 to R253. For example, each of the resistors R0 and R254 may have a resistance of about 420 ohms when the total resistance of the resistors R1 to R253 may be about 14K ohms.

[0052] Similarly, the negative gamma voltage generating part 730 includes the plurality of resistors R0 to R254 in series between the half voltage VDD/2 of the high potential source voltage VDD and the low potential source voltage VSS. The negative gamma voltage generating part 730 divides a voltage between both ends of the plurality of resistors R0 to R254 due to the voltage division rule and generates and outputs negative gamma voltage values VGMN0 to VGMN255.

[0053] The positive gamma voltage values VGMP0 to VGMP255 and the negative gamma voltage values VGMN0 to VGMN255 are determined depending to the resistances of the resistors R0 to R254 and are designed considering transmittance-voltage (T-V) characteristics of the liquid crystal display device 100 and the visibility of the viewer.

[0054] The gamma voltage Vgamma outputted from the gamma voltage supplying unit 700 is applied to the pixel electrode of the liquid crystal display device 100, thereby displaying an image. The transmittance-voltage characteristics of the liquid crystal display device 100 may be changed depending on its designs or deviations in manufacturing processes. That is, the liquid crystal display device 100 may be designed to have different transmittance-voltage characteristics for its usage or model from others. In addition, even in the same model, the liquid crystal display device 100 may have different transmittance-voltage characteristics from others due to deviations in photolithography processes for patterns such as the pixel electrode in manufacturing processes or deviations in a cell gap.

[0055] A design of the gamma voltage considering transmittance-voltage characteristics will be explained hereinafter with reference to FIG. 4.

[0056] FIG. 4 is a graph of illustrating transmittance-voltage characteristics of a liquid crystal display device according to the present invention. FIG. 4 shows variations of luminance versus voltage, which is applied to the pixel electrode of the normally black mode liquid crystal display device 100 and is referred to as a pixel voltage Vpixel. For convenience of explanation, the graph of FIG. 4 will be referred to as a T-V curve.

[0057] The T-V curve of FIG. 4 shows the variations of luminance when the pixel voltage Vpixel is less than 1 V. Namely, the T-V curve corresponds to low gray levels.

[0058] In FIG. 4, when the pixel voltage Vpixel is less than about 0.35 V, the luminance hardly changes and has a substantially constant value.

[0059] When the pixel voltage Vpixel is more than 0.45 V, the luminance increases. More particularly, an instant variation of the luminance to the pixel voltage Vpixel gradually increases, and the luminance rapidly increases. This is to consider that human beings easily distinguish a brightness difference in a dart image but hardly distinguish a brightness difference in a bright image.

[0060] When the pixel voltage Vpixel is more than about 0.35 V and less than about 0.45 V, there is a gray inversion that the luminance increases and then decreases. This is why upper and lower sections of the liquid crystal panel have asymmetric arrangements due to movements of the liquid crystal molecules when a voltage is applied to the liquid crystal layer. Namely, according to the voltage applied to the liquid crystal layer, the luminance does not increase because of different phase retardation effects due to properties of the liquid crystal molecules and temporarily decreases.

[0061] Hereinafter, a driving voltage corresponding to a zeroth gray level Gray0 of the present invention will be described with reference to Table 2.

[0062] Table 2 shows gray levels corresponding to the T-V curve of FIG. 4 and corresponding driving voltages. Here, a black level is the zeroth gray level Gray0, and a white level is a 255th gray level Gray255.

[Table 2]

Gray	driving voltage (V)
0	0.005
1	0.483
2	0.523
3	0.602
4	0.642
5	0.667
6	0.692
7	0.717
8	0.742
9	0.766
10	0.791

[0063] In the present invention, the driving voltage corresponding to the black level Gray0, that is, the value of the gamma voltage Vgamma, is designed to have a value of about 0 V. For example, as shown in Table 2, the driving voltage of the black level Gray0 may be 0.005 V or may be less than or more than 0.005 V. Therefore, the driving voltage of the black level Gray0 may be with a range 0 V to 0.005 V.

[0064] Namely, the driving voltage of the black level Gray0 has a value within a range in which an afterimage of the image data of the black level does not exist after the image data of the black level is displayed in the liquid crystal panel 200. As stated above, this will be flexibly determined considering the characteristics of the T-V curve.

[0065] The driving voltage corresponding to the first gray level Gray1, that is, the value of the gamma voltage Vgamma, is designed to have a value as largely different as possible from the driving voltage corresponding to the black level Gray0. In addition, the driving voltage of the first gray level Gray1 may have a value within a range in which the luminance gradually increases after the gray inversion occurs.

[0066] More particularly, the driving voltage of the first gray level Gray1 may be more than about 0.4V, at which the gray inversion does not occur. Moreover, the driving voltage of the first gray level Gray1 may be more than about 0.45V, where the luminance gradually increases. For example, the driving voltage of the first gray level Gray1 may be 0.483 V as shown in Table 2 or may be more or less than this.

[0067] Namely, as mentioned above, since the gray inversion occurs from about 0.35 V to about 0.45 V, the driving voltage of the first gray level Gray1 may be determined more than a voltage at which the gray inversion does not occur. Additionally, the driving voltage of the first gray level Gray1 may be determined more than a voltage from which the luminance increases, for example, 0.45 V such than the luminance at each level is gradually raised.

[0068] When the driving voltage of the black level Gray0 is about 0 V, there is no afterimage after the image data of the black level is displayed in the liquid crystal panel. This is because the liquid crystal layer is not affected by the driving voltage of the black level Gray0. Thus, clearer quality of images can be displayed. Moreover, since the driving voltage of the black level Gray is relatively low, there is an effect of reducing power consumption. Furthermore, when the driving voltage of the first gray level Gray1 is designed as stated above, the gray inversion does not occur.

[0069] Therefore, the gray inversion can be prevented, and the afterimage of the black level can be improved.

[0070] Meanwhile, as mentioned above, the T-V curve can be changed due to the design of the liquid crystal display device 100 or the deviations in the manufacturing processes. That is, the liquid crystal display device 100 can be designed to have different T-V characteristics from others depending on its model or usage. Thus, the driving voltages of the black level Gray0 and the first gray level Gray1 can be changed depending on the corresponding T-V curve.

[0071] In the liquid crystal display device of the present invention, the afterimage of the image data of the black level is improved. Since the driving voltage of the black level is about 0 V, the power consumption is improved.

[0072] It will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without departing from the scope of the invention. Thus, it is intended that the present invention cover the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

Claims

1. A normally black mode liquid crystal display device (100) displaying an image of (256) gray levels, comprising:

    - a liquid crystal panel (200);
    - a gamma voltage supplying unit (700) establishing a gamma voltage corresponding to each gray level according to a predetermined T-V curve, which is a graph of transmittance-voltage characteristics of the normally black mode liquid crystal display device and shows variations of luminance versus voltage applied to a pixel electrode of the liquid crystal panel; and
    - a data driving unit (500) changing digital image data into analog image data using the gamma voltage and outputting the analog image data to the liquid crystal panel (200),
    - wherein the gamma voltage corresponding to a black level for the normally black mode liquid crystal display device is configured to have a value within a range of 0V to 0.005V, **characterized in that**
    - the gamma voltage corresponding to a first gray level is configured to have a value within a range in which the luminance increases after a range in which gray inversion, in which the luminance increases and then decreases in the predetermined T-V curve as the voltage increases, occurs, wherein the gray inversion occurs in a voltage range from about 0.35V to about 0.45V.

2. The device according to claim 1, wherein the gamma voltage supplying unit (700) includes:

    - a positive gamma voltage generating part (720) connected to a high potential source voltage VDD and a half voltage VDD/2 of the high potential source voltage and outputting positive gamma voltage values; and
    - a negative gamma voltage generating part

(730) connected to the half voltage VDD/2 of the high potential source voltage and a low potential source voltage VSS and outputting negative gamma voltage values.

3. The device according to claim 2, wherein each of the positive and negative gamma voltage generating parts (720, 730) includes a plurality of resistors (R0 ~ R254) in series.

4. The device according to claim 1, further comprising:

- a gate driving unit (400) scanning gate lines (GL) of the liquid crystal panel (200); and
- a timing control unit (300) providing the digital image data (RGB) and data control signals (DCS) to the data driving unit (500) and providing gate control signals (GCS) to the gate driving unit (400).

5. A driving method of a normally black mode liquid crystal display device (100) displaying an image of 256 gray levels, comprising:

- changing digital image data into analog image data; and
- outputting the analog image data to a liquid crystal panel (200),
- wherein outputting the analog image data to the liquid crystal panel includes using a gamma voltage established according to a predetermined T-V curve, which is a graph of transmittance-voltage characteristics of the normally black mode liquid crystal display device and shows variations of luminance versus voltage applied to a pixel electrode of the liquid crystal panel,
- wherein the gamma voltage corresponding to a black level for the normally black mode liquid crystal display device is configured to have a value within a range of 0V to 0.005V, **characterized in that**
- the gamma voltage corresponding to a first gray level is configured to have a value within a range in which the luminance increases after a range in which gray inversion, in which the luminance increases and then decreases in the predetermined T-V curve as the voltage increases, occurs, wherein the gray inversion occurs in a voltage range from about 0.35V to about 0.45V.

Patentansprüche

1. Flüssigkustallanzeigevoruchtung (100) mit normalerweise schwarzer Betriebsart, die ein Bild mit (256) Graustufen anzeigt und Folgendes umfasst:

- eine Flüssigkristalltafel (200);
- eine Gammaspannungs-Versorgungseinheit (700), die eine Gammaspannung, die jeder einzelnen Graustufe entspricht, in Übereinstimmung mit einer vorgegebenen T-V-Kurve aufbaut, die ein Graph einer Durchlassgrad/Spannungs-Kennlinie der Flüssigkristallanzeigevorrichtung mit normalerweise schwarzer Betriebsart ist und Veränderungen der Luminanz gegenüber der an eine Pixelelektrode der Flüssigkristalltafel angelegten Spannung zeigt; und
- eine Datenansteuereinheit (500), die digitale Bilddaten in analoge Bilddaten unter Verwendung der Gammaspannung ändert und die analogen Bilddaten an die Flüssigkristalltafel (200) ausgibt,
- wobei die Gammaspannung, die einem Schwarzpegel für die Flüssigkristallanzeigevorrichtung mit normalerweise schwarzer Betriebsart entspricht, so konfiguriert ist, dass sie einen Wert im Bereich von 0 V bis 0,005 V hat,

dadurch gekennzeichnet, dass

- die Gammaspannung, die einer ersten Graustufe entspricht, so konfiguriert ist, dass sie einen Wert in einem Bereich hat, in dem die Luminanz nach einem Bereich, in dem eine Grauumkehrung, in der die Luminanz in der vorgegebenen T-V-Kurve zunimmt und dann abnimmt, wenn die Spannung zunimmt, auftritt, wobei die Grauumkehrung in einem Spannungsbereich von etwa 0,35 V bis etwa 0,45 V auftritt, zunimmt.

2. Vorrichtung nach Anspruch 1, wobei die Gammaspannungs-Versorgungseinheit (700) umfasst:

- einen Erzeugungsabschnitt (720) für positive Gammaspannung, der mit einer Quellenspannung VDD mit hohem Potential und einer halben Spannung VDD/2 der Quellenspannung mit hohem Potential verbunden ist und positive Gammaspannungswerte ausgibt; und
- einen Erzeugungsabschnitt (730) für negative Gammaspannung, der mit der halben Spannung VDD/2 der Quellenspannung mit hohem Potential und mit einer Quellenspannung VSS mit niedrigem Potential verbunden ist und negative Gammaspannungswerte ausgibt.

3. Vorrichtung nach Anspruch 2, wobei die beiden Erzeugungsabschnitte (720, 730) für positive bzw. negative Gammaspannung mehrere in Reihe geschaltete Widerstände (R0~R254) enthalten.

4. Vorrichtung nach Anspruch 1, die ferner umfasst:

- eine Gate-Ansteuereinheit (400), die Gate-Leitungen (GL) der Flüssigkristalltafel (200) abtastet; und

- eine Zeitvorgabe-Steuereinheit (300), die die digitalen Bilddaten (RGB) und Datensteuersignale (DCS) für die Datenansteuereinheit (500) bereitstellen und Gate-Steuersignale (GCS) für die Gate-Ansteuereinheit (400) bereitstellt.

5. Ansteuerverfahren für eine Flüssigkristallanzeigevorrichtung (100) mit normalerweise schwarzer Betriebsart, die ein Bild mit 256 Graustufen anzeigt, das umfasst:

- Ändern digitaler Bilddaten in analoge Bilddaten; und
- Ausgeben der analogen Bilddaten an eine Flüssigkristalltafel (200),
- wobei das Ausgeben der analogen Bilddaten an die Flüssigkristalltafel das Verwenden einer Gammaspannung, die in Übereinstimmung mit einer vorgegebenen T-V-Kurve aufgebaut wird, die ein Graph einer Durchlassgrad/Spannungs-Kennlinie der Flüssigkristallanzeigevorrichtung mit normalerweise schwarzer Betriebsart ist und Veränderungen der Luminanz gegenüber der an eine Pixelelektrode der Flüssigkristalltafel angelegten Spannung zeigt, umfasst,
- wobei die Gammaspannung, die einem Schwarzpegel für die Flüssigkristallanzeigevorrichtung mit normalerweise schwarzer Betriebsart entspricht, so konfiguriert ist, dass sie einen Wert in einem Bereich von 0 V bis 0,005 V hat,

dadurch gekennzeichnet, dass

- die Gammaspannung, die einer ersten Graustufe entspricht, so konfiguriert ist, dass sie einen Wert in einem Bereich hat, in dem die Luminanz nach einem Bereich, in dem eine Grauumkehrung, in der in der vorgegebenen T-V-Kurve die Luminanz zunimmt und dann abnimmt, wenn die Spannung zunimmt, auftritt, wobei die Grauumkehrung in einem Spannungsbereich von etwa 0,35 V bis etwa 0,45 V auftritt, zunimmt.

Revendications

1. Dispositif d'affichage à cristaux liquides en mode normalement noir (100) affichant une image à (256) niveaux de gris, comprenant :

- un panneau à cristaux liquides (200) ;
- une unité d'alimentation de tension gamma (700) établissant une tension gamma correspondant à chaque niveau de gris en fonction d'une courbe T-V prédéterminée, qui est un graphique de caractéristiques de transmittance-tension du dispositif d'affichage à cristaux liquides en mode normalement noir et représente des variations de luminance par rapport à la tension appliquée à une électrode de pixel du panneau à cristaux liquides ; et
- une unité de commande de données (500) changeant des données d'image numériques en données d'image analogiques en utilisant la tension gamma et délivrant les données d'image analogiques au panneau à cristaux liquides (200),
- dans lequel la tension gamma correspondant à un niveau de noir pour le dispositif d'affichage à cristaux liquides en mode normalement noir est configurée pour avoir une valeur dans une plage de 0 V à 0,005 V,

caractérisé en ce que

- la tension gamma correspondant à un premier niveau de gris est configurée pour avoir une valeur dans une plage dans laquelle la luminance augmente après une plage dans laquelle une inversion de gris, dans laquelle la luminance augmente puis diminue dans la courbe T-V prédéterminée au fur et à mesure de l'augmentation de la tension, se produit, dans lequel l'inversion de gris se produit dans une plage de tension d'environ 0,35 V à environ 0,45 V.

2. Dispositif selon la revendication 1, dans lequel l'unité d'alimentation de tension gamma (700) comprend

- une partie de génération de tension gamma positive (720) reliée à une tension de source de potentiel haut, VDD, et une demi-tension, VDD/2, de la tension de source de potentiel haut et délivrant des valeurs de tension gamma positive ; et
- une partie de génération de tension gamma négative (730) reliée à la demi-tension, VDD/2, de la tension de source de potentiel haut et une tension de source de potentiel bas, VSS, et délivrant des valeurs de tension gamma négative.

3. Dispositif selon la revendication 2, dans lequel chacune des parties de génération de tension gamma positive et négative (720, 730) comprend une pluralité de résistances (R0 ~ R254) en série.

4. Dispositif selon la revendication 1, comprenant en outre :

- une unité de commande de grille (400) balayant des lignes de grille (GL) du panneau à cristaux liquides (200) ; et
- une unité de commande de synchronisation (300) fournissant les données d'image numériques (RVB) et les signaux de commande de données (DCS) à l'unité de commande de données (500) et fournissant des signaux de commande de grille (GCS) à l'unité de commande

de grille (400).

5. Procédé de commande d'un dispositif d'affichage à cristaux liquides en mode normalement noir (100) affichant une image à 256 niveaux de gris, comprenant

- le changement de données d'image numériques en données d'image analogiques ; et
- la délivrance des données d'image analogiques à un panneau à cristaux liquides (200),
- dans lequel la délivrance des données d'image analogiques au panneau à cristaux liquides comprend l'utilisation d'une tension gamma établie en fonction d'une courbe T-V prédéterminée, qui est un graphique de caractéristiques de transmittance-tension du dispositif d'affichage à cristaux liquides en mode normalement noir et représente des variations de luminance par rapport à la tension appliquée à une électrode de pixel du panneau à cristaux liquides,
- dans lequel la tension gamma correspondant à un niveau de noir pour le dispositif d'affichage à cristaux liquides en mode normalement noir est configurée pour avoir une valeur dans une plage de 0 V à 0,005 V,

caractérisé en ce que

- la tension gamma correspondant à un premier niveau de gris est configurée pour avoir une valeur dans une plage dans laquelle la luminance augmente après une plage dans laquelle une inversion de gris, dans laquelle la luminance augmente puis diminue dans la courbe T-V prédéterminée au fur et à mesure de l'augmentation de la tension, se produit, dans lequel l'inversion de gris se produit dans une plage de tension d'environ 0,35 V à environ 0,45 V.

FIG. 1

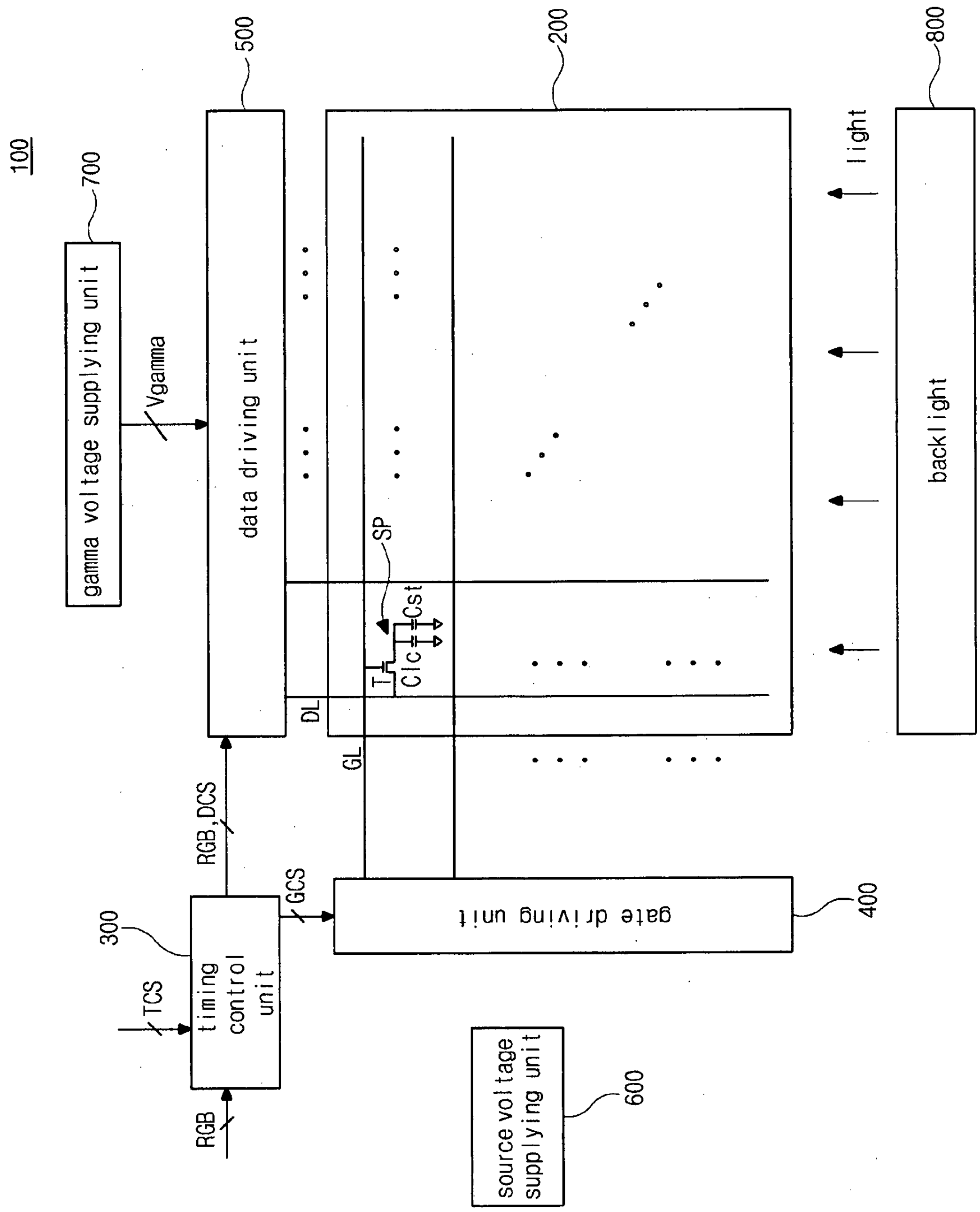

100
700
gamma voltage supplying unit
Vgamma
500
data driving unit
200
800
light
backlight
SP
Cst
Clc
T
DL
GL
RGB,DCS
GCS
300
timing control unit
TCS
RGB
gate driving unit
400
source voltage supplying unit
600

FIG. 2

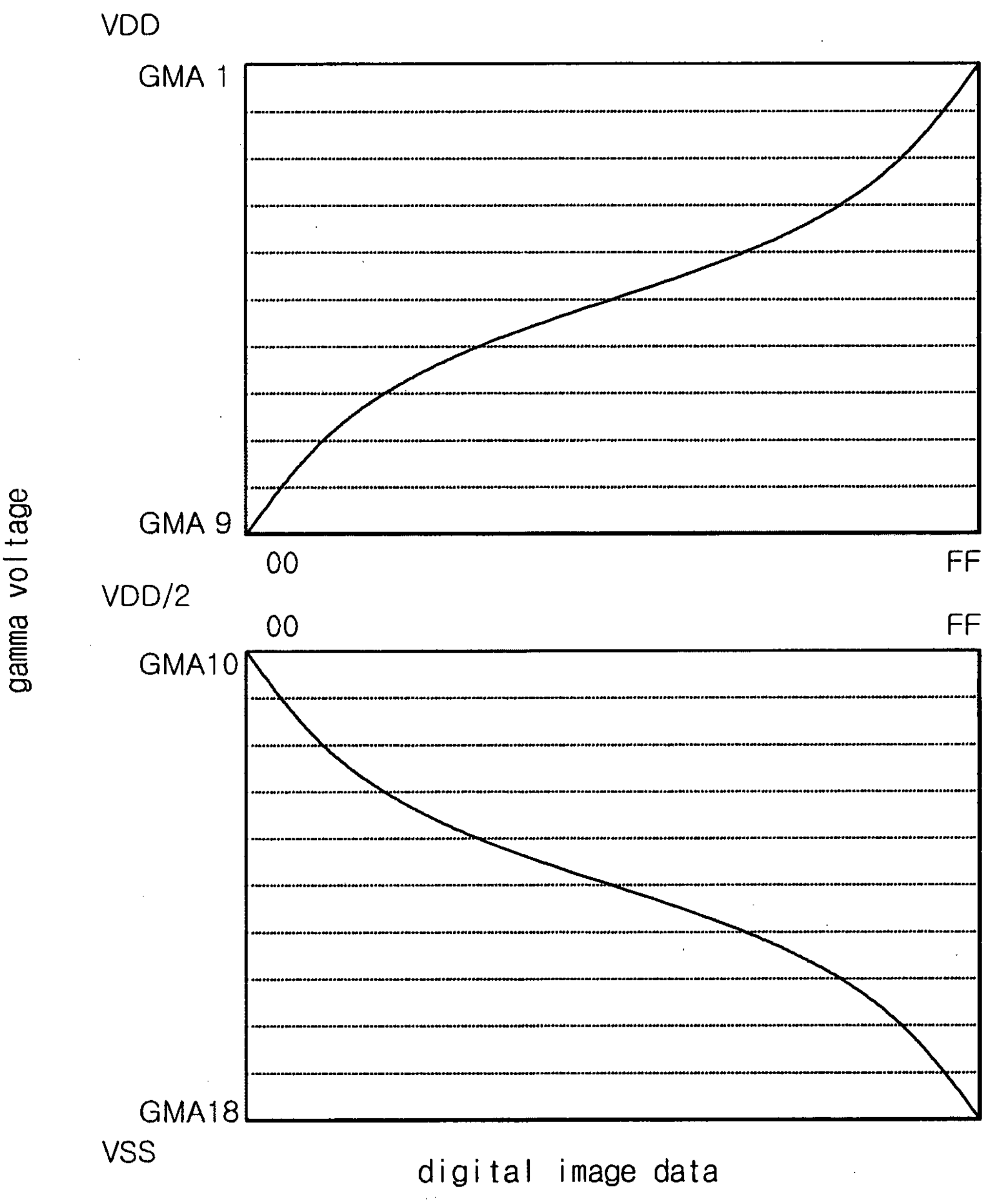

VDD
GMA 1
GMA 9
00
FF
VDD/2
00
FF
GMA10
GMA18
VSS
gamma voltage
digital image data

FIG. 3

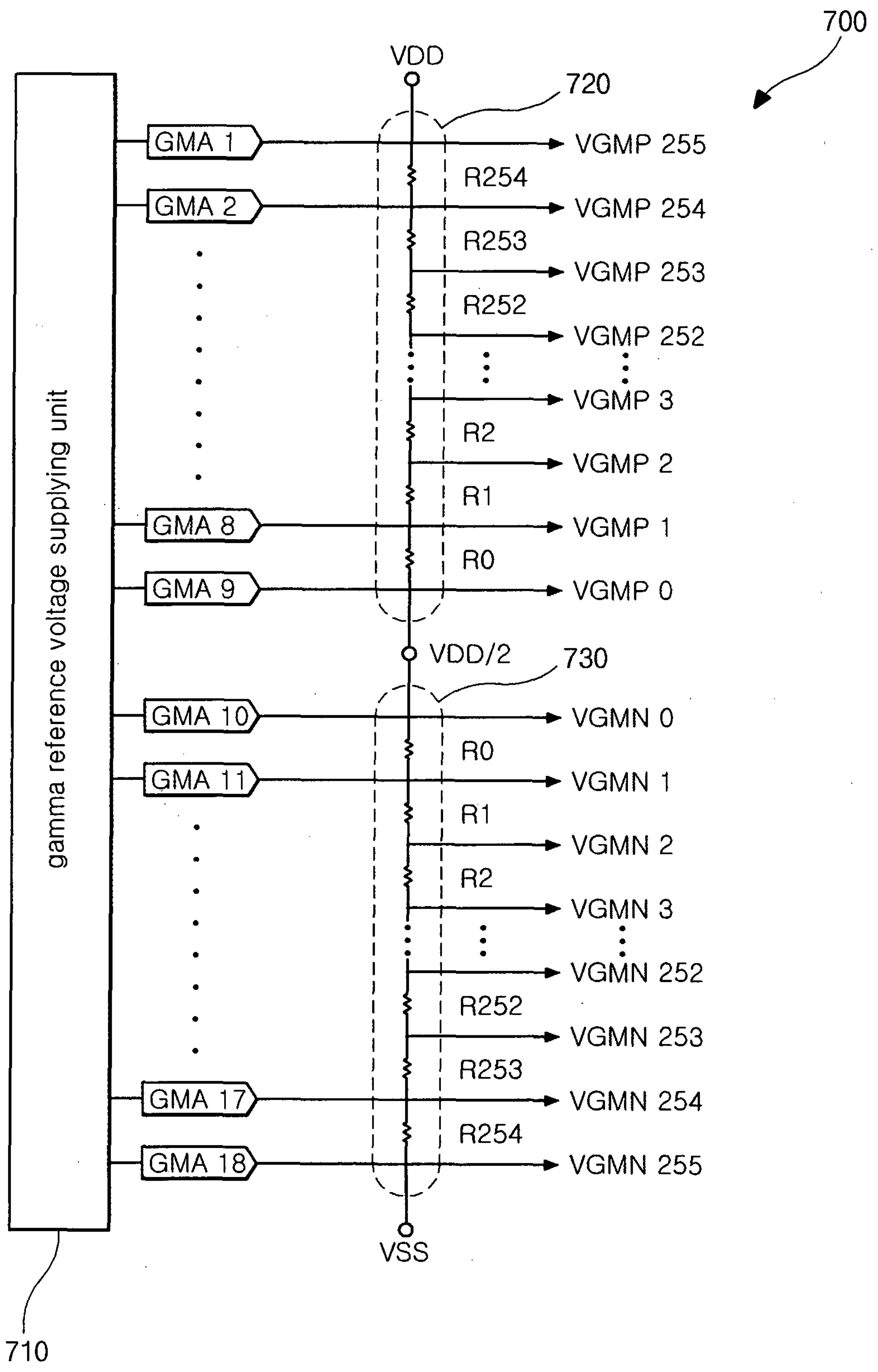
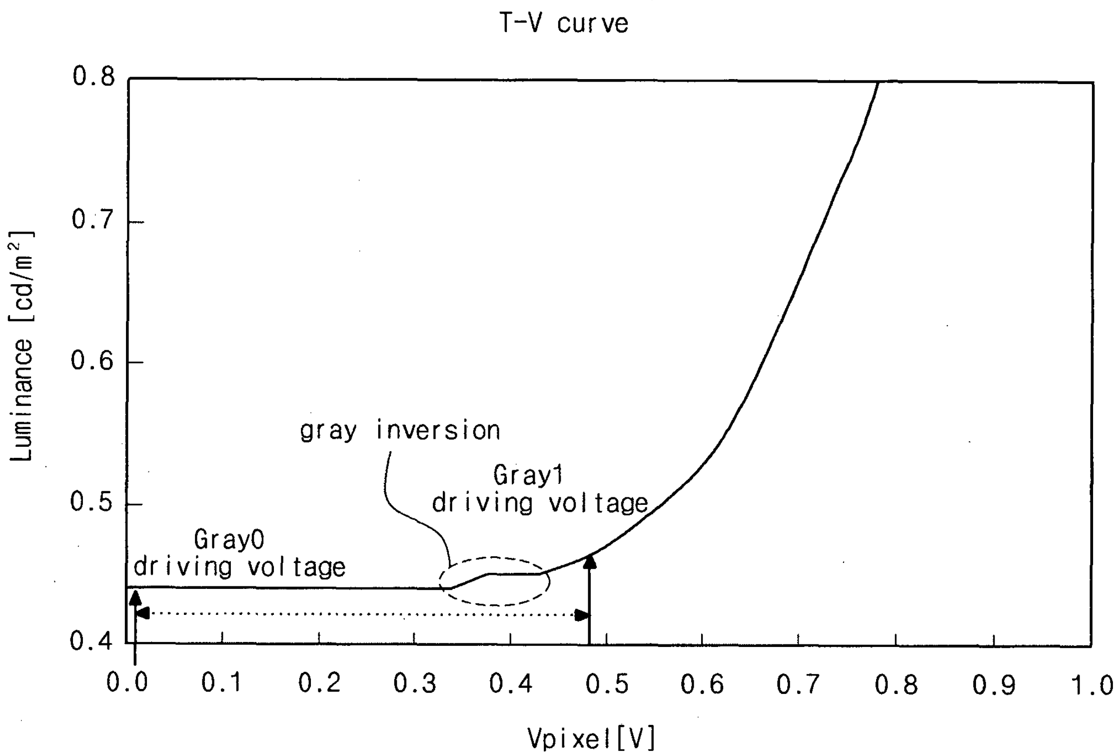

700
710
gamma reference voltage supplying unit
GMA 1
GMA 2
GMA 8
GMA 9
GMA 10
GMA 11
GMA 17
GMA 18
VDD
720
R254
R253
R252
R2
R1
R0
VGMP 255
VGMP 254
VGMP 253
VGMP 252
VGMP 3
VGMP 2
VGMP 1
VGMP 0
VDD/2
730
R0
R1
R2
R252
R253
R254
VGMN 0
VGMN 1
VGMN 2
VGMN 3
VGMN 252
VGMN 253
VGMN 254
VGMN 255
VSS

FIG. 4


T-V curve
Luminance [cd/m2]
0.8
0.7
0.6
0.5
0.4
gray inversion
Gray1
driving voltage
Gray0
driving voltage
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Vpixel[V]

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 20020060656 A1 **[0008]**
- EP 1465147 A2 **[0009]**

专利名称(译)	液晶显示装置及其驱动方法		
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[标]申请(专利权)人(译)	乐金显示有限公司		
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发明人	YOON, JOON-SHIK		
IPC分类号	G09G3/36 G09G3/20		
CPC分类号	G09G3/2007 G09G3/3685 G09G3/3696 G09G2320/0238 G09G2320/0257 G09G2320/046		
优先权	1020100104675 2010-10-26 KR		
其他公开文献	EP2447936A1		
外部链接	[Espacenet](#)		

摘要(译)

液晶显示装置包括液晶面板;伽马电压提供单元根据预定的T-V曲线建立对应于每个灰度级的伽马电压;数据驱动单元，使用伽马电压将数字图像数据变换为模拟图像数据，并将模拟图像数据输出到液晶面板，其中，对应于黑电平的伽马电压被配置为具有0V范围内的值。至0.005 V.

FIG. 1