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(54) **System and method of providing driving voltages to an RGBW display panel**

System und Verfahren zur Bereitstellung von Ansteuerspannungen für eine RGBW-Anzeigetafel

Système et procédé d'alimentation d'un panneau d'affichage RGBW en tensions de commande

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- **YOJIRO MATSUEDA ET AL: "38.4: 6-bit AMOLED with RGB Adjustable Gamma Compensation LTPS TFT Circuit" 2005 SID INTERNATIONAL SYMPOSIUM. BOSTON, MA, MAY 24 - 27, 2005, SID INTERNATIONAL SYMPOSIUM, SAN JOSE, CA : SID, US, 24 May 2005 (2005-05-24), pages 1352-1355, XP007012301**

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Description

BACKGROUND

[0001] The invention relates to panel displays, and more particularly, to systems and methods for providing driving voltages to RGBW display panels.

[0002] Color image display devices are well known and are based upon a variety of technologies such as cathode ray tubes, liquid crystal modulators and solid-state light emitters such as Organic Light Emitting Diodes (OLEDs). In a common OLED color image display device, a pixel includes red, green and blue colored subpixels. These light emitting colored subpixels define a color gamut, and by additively combining the illumination from each of these three subpixels, i.e. with the integrative capabilities of the human visual system, a wide variety of colors can be achieved. OLEDs may be used to generate color directly using organic materials to emit energy in desired portions of the electromagnetic spectrum, or alternatively, broadband emitting (apparently white) OLEDs may be attenuated with color filters to achieve red, green and blue output.

[0003] Images and data displayed on a color display device are typically stored and/or transmitted in three channels, that is, having these signals corresponding to a standard (e.g. RGB). It is also important to recognize that data typically is sampled to assume a particular spatial arrangement of light emitting elements. In an OLED display device, these light emitting elements are typically arranged side by side on a plane. Therefore, if incoming data is sampled for display on a color display device, the data will also be resampled for display on an OLED display having four subpixels per pixel rather than the three subpixels used in a three channel display device.

[0004] In this regard, Fig. 1A shows a conventional OLED subpixel driving circuit structure, and Fig. 1B shows RGBW subpixel arrangements of a conventional display panel. As shown in Fig. 1A, the subpixel is driven by the current 11 through the driving transistor T1. The driving transistor T1 outputs the current 11 according to the voltage V1.

[0005] Fig. 1C shows a conventional digital signal processing (DSP) structure for driving RGBW subpixels. As shown in Fig. 1C, RGB digital signals are sampled and held and output to a Gamma linear control unit. The Gamma linear control unit adjusts RGB digital signals for Gamma linearity and outputs to the conversion unit. The conversion unit converts the adjusted RGB digital signals to RGBW digital signals and outputs to a Gamma compensation unit. The Gamma compensation unit executes a Gamma compensation of the RGBW digital signals from the conversion unit for Gamma correction and outputs to a RGBW driver. The RGBW driver converts the RGBW digital signals to RGBW analog signals to drive corresponding RGBW subpixels.

[0006] Fig. 2A shows the relationship between the luminance of the OLED subpixel and the current I1. As shown, there is a linear relationship between the luminance of the OLED subpixel and the current I1. Fig. 2B shows the relationship between the current I1 of the driving transistor T1 and the voltage V1 to be non-linear. Fig. 2C shows the relationship between luminance of the OLED subpixel and observable brightness (gamma). Fig. 2D shows the relationship between observable brightness and voltage V1 applied to the driving transistor T1.

[0007] Thus, a gamma correction is required to compensate the non-linear relationship.

[0008] Conventionally, RGB data is converted to RGBW data through digital data processing (DSP). However, due to different optical characteristics (gamma correction) for each RGBW color, DSP typically requires a complicated algorithm to execute such conversion. Further, it may be difficult to obtain a precise analog output corresponding to the gamma correction for each color after using the complicated conversion algorithm.

[0009] For example, Fig. 3 shows a conventional method for converting RGB data to RGBW data. As shown in Fig. 3, the Min(R,G,B) is assumed to be W data, and R'G'B' data (driving the display device) can be obtained by removing the W component from the R,G,B components respectively. Fig. 4 shows another conventional method for converting RGB data to RGBW data. As shown in Fig. 4, the Min(R,G,B) is assumed to be W data, and the W component is converted to W' data in accordance with a characteristic of α*W, where α <1. The R'G'B' data are obtained by removing the W' component from the RGB components respectively. However, these two simple methods typically cannot precisely provide gamma correction for each color because of the non-linear relationship between driving voltage and observable brightness.

[0010] A method and system according to the preamble of the independent claims is described in the article "6-bit AMOLED with RGB Adjustable Gamma Compensation LTPS TFT Circuit" written by Y. Matsueda et al. and published in SID 05 Digest on pages 1352 - 1355. For displaying image the system includes a data driver comprising an average brightness extraction unit. The system further includes a reference voltage generation circuit adapted to provide first to third sets of reference voltages suitable for the red, green and blue sub-pixels, wherein the reference voltage generation circuit at least comprises first, second and third voltage generators. The system also comprises a digital-to-analog (D/A) conversion unit adapted to generate driving voltages to drive the red, green and blue sub-pixels and a display panel comprising the red, green and blue sub-pixels adapted to generate color images according to the driving voltages.

[0011] From EP 1 298 637 A2 a similar system is known, namely a "liquid crystal display" including a reference voltage generator changing the level of a first predetermined voltage based on a first signal to generate a reference voltage. The first signal varies depending on one of the brightness of the surroundings of the liquid crystal display, brightness of the on-screen images of the liquid crystal display and a user's manipulation (see par. [0006]).

[0012] Further methods for providing driving voltages of a system for displaying images are described in EP 0 547 603 A2; US 2004 / 0 113 875 A1 or US 6 593 934 B1.

[0013] From the above mentioned documents RGB based display systems and methods are known which are adapted to select gamma characteristics based on the average image brightness which is extracted from the three color input signals (R. G, B). Thus a conversion of RGB data into RGBW has to be performed, if these known methods shall be applied to RGBW panels. However, in conventional systems the conversion requires DSP processing of a complicated algorithm due to gamma correction. Thus high efforts are needed to achieve an accurately controlled gamma correction for RGBW brightness.

[0014] It is therefore object of the present invention to provide a system and a method which can more easily provide an accurately controlled gamma correction for RGBW brightness.

[0015] The object is solved by a system having the features of claim 1 and by a method having the features of independent claim 10.

[0016] Accordingly the invention proposes to execute an AND logic operation to red, green and blue input signals controlling brightness of the red, green and blue subpixels respectively to extract the white component signal; to generate first to fourth sets of reference voltages suitable for the red, green, blue and white sub-pixels, wherein the first to third sets of reference voltages suitable for the red, green and blue sub-pixels are generated according to the white component signal; and to generate the driving voltages to drive the red, green, blue and white sub-pixels according to the first to fourth sets of reference voltages, the red, green and blue input signals and the white component signal. The system of the invention shall comprise a white component extraction unit which is adapted to execute an AND logic operation to the red, green and blue input signals controlling brightness of the red, green and blue sub-pixels respectively, to extract the white component signal. The reference voltage generation circuit shall be adapted to provide first to fourth sets of reference voltages suitable for the red, green, blue and white sub-pixels, wherein the first to third sets of reference voltages suitable for the red, green and blue subpixels are generated according to the white component signal, wherein the first, second and third voltage generators each comprise: first and second resistor strings connected to each other in series, each comprising a plurality of resistors and nodes. The first, second and third voltage generators shall further comprise a first demultiplexer adapted to selectively make connections between a first power voltage and one of the nodes of the first resistor string according to the white component signal; and a second de-multiplexer adapter to selectively make connections between a second power voltage and one of the nodes of the second resistor string according to the white component signal. Finally the digital-to-analog (D/A) conversion unit shall be adapted to generate the driving voltages to drive the red, green, blue and white sub-pixels according to the first to fourth sets of reference voltages, the red, green and blue input signals and the white component signal.

[0017] In summary the invention discloses a system and a method for providing driving voltages of RGBW display panels.

[0018] An exemplary embodiment of such a system comprises a data driver with a reference voltage generation circuit providing reference voltages according to a white component signal (W) extracted from three color input signals (R,G,B), and a digital-to-analog (D/A) conversion unit to generate driving voltages according to the reference voltages, the three color input signals and the white component signal.

[0019] An exemplary embodiment of a method for providing driving voltages of a RGBW display panel, comprises generating reference voltages according to a white component signal (W) extracted from three color input signals (R,G,B); and generating driving voltages according to the reference voltages, the three color input signals and the white component signal.

DESCRIPTION OF THE DRAWINGS

[0020] The invention can be more fully understood by the subsequent detailed description and examples with reference made to the accompanying drawings, wherein:

Fig. 1A shows a conventional OLED subpixel driving circuit structure;

Fig. 1B shows RGBW pixel arrangements of conventional display panel;

Fig. 1C shows a conventional digital signal processing (DSP) structure for driving RGBW pixels;

Fig. 2A shows the relationship between the luminance of OLED and current;

Fig. 2B shows the relationship between current through the control transistor and driving voltage thereof;

Fig. 2C shows the relationship between luminance of the OLED and observable brightness;

Fig. 2D shows the relationship between observable brightness and driving voltage of driving transistor;

Fig. 3 shows a conventional method for converting RGB data to RGBW data;

Fig. 4 shows another conventional method for converting RGB data to RGBW data;

Fig. 5 shows an embodiment of a data driver;

Figs. 6A-6D show embodiments of a voltage generator;

Fig. 7 shows another embodiment of a data driver;

Figs. 8-1 and 8-2 show another embodiment of a data driver;

Fig. 9 is a schematic diagram of an embodiment of a display; and

Fig. 10 is a schematic diagram of an embodiment of an electronic device employing the display panel shown in Fig. 9.

DETAILED DESCRIPTION

[0021] Systems for providing driving voltages to display panels will now be described with reference to several exemplary embodiments. In this regard, an embodiment of a system providing driving voltages to an RGBW display panel is depicted in Fig. 5. As shown in Fig. 5, data driver 100A comprises a white component extraction unit 10, an analog reference voltage generation circuit 20 and N digital-to-analog (D/A) conversion units 30_1A~30_NA.

[0022] The white component extraction unit 10 extracts a white component signal Wi from three color input signals Ri, Gi and Bi. For example, three color input signals Ri, Gi and Bi can be 6 bit digital data. If color input signals R1, G1 and B1 are 110111, 010111 and 000111 respectively, the white component signal W1 can be 000111. Alternately, white component extraction unit 10 can output a suppressed white component signal W1 of 000011 according to the color input signal R1, G1 and B1.

[0023] The white component signal Wi can be obtained by executing an AND logic operation to the three color input signals Ri, Gi and Bi. For example, when the color input signals R1, G1 and B1 are 110111, 010111 and 000111 respectively, the white component signal W1 can be 000111.

[0024] Conversely, the white component signal Wi can be obtained by executing an AND logic operation to M bits of the three color input signals Ri, Gi, Bi, and $0 < M < 6$. For example, when M=2, a suppressed white component signal W1 of 000011 can be obtained according to the color input signal R1, G1 and B1.

[0025] The analog reference voltage generation circuit 20 generates four sets of reference voltages $V0_R$~$V63_R$, $V0_G$~$V63_G$, $V0_B$~$V63_B$ and $V0_W$~$V63_W$ for color input signal Ri, Gi and Bi and the white component signal Wi respectively, the reference voltages $V0_R$~$V63_R$, $V0_G$~$V63_G$ and $V0_B$~$V63_B$ are generated according to the white component signal Wi.

[0026] The D/A conversion units 30_1A~30_NA receive the reference voltages VO_R~$V63_R$, $V0_G$~$V63_G$, $V0_B$~$V63_B$ and $V0_W$~$V63_W$ from the analog reference voltage generation circuit 20 to generate corresponding driving voltages $VA1_R$~VAN_R, $VA1_G$~VAN_G, $VA1_B$~VAN_B and $VA1_W$~VAN_W according to the three color input signals Ri, Gi and Bi and the white component signal Wi. For example, the D/A conversion unit 30_1A receives the reference voltages $V0_R$~$V63_R$, $V0_G$~$V63_G$, $V0_B$~$V63_B$ and $V0_W$~$V63_W$ and generates corresponding driving voltages $VA1_R$, $VA1_G$, $VA1_B$ and $VA1_W$ according to the three color input signals R1, G1 and B1 and the white component signal W1 during a first period. The D/A conversion unit 30_2A receives the reference voltages $V0_R$~$V63_R$, $V0_G$~$V63_G$, $V0_B$~$V63_B$ and $V0_W$~$V63_W$ and generates corresponding driving voltages, $VA2_R$, $VA2_G$, $VA2_B$ and $VA2_W$ according to the three color input signals R2, G2 and B2 and the white component signal W2 during a second period, and so on. Namely, all D/A conversion units 30_1A~30_NA employ the same type of analog reference voltage circuit which can generate different reference voltages $V0_R$~$V63_R$, $V0_G$~$V63_G$, $V0_B$~$V63_B$ and $V0_W$~$V63_W$ according to different white component signals Wi during different periods.

[0027] The D/A conversion units 30_1A~30_NA each comprise four sampling latches $S1_R$~$S1_W$, four holding latches $H1_R$~$H1_W$, four D/A converters DAC_R~DAC_W and four analog buffers AB_R~AB_W. The sampling latches $S1_R$~$S1_W$ sample the color input signals Ri, Gi and Bi and the white component signal Wi at one time. The holding latches $H1_R$~$H1_W$ hold the color input signals Ri, Gi and Bi and the white component signal Wi sampled by the sampling latches $S1_R$~$S1_W$. The D/A converters DAC_R~DAC_W convert the held color input signals Ri, Gi and Bi and the held white component signal Wi to corresponding analog voltages $VA1_R$~$VA1_W$ according to the reference voltages $V0_R$~$V63_R$, $V0_G$~$V63_G$, $V0_B$~$V63_B$ and $V0_W$~$V63_W$, and output the corresponding driving voltages $VA1_R$~$VA1_W$ through the analog buffers AB_R~AB_W. Operation and structure of the D/A conversion units 30_2A~30_NA are similar to those of the D/A conversion unit 30_1A. In this embodiment, the data diver 100A can output four corresponding voltages to drive four data lines at one time.

[0028] The analog reference voltage generation circuit 20 comprises four voltage generators 22R, 22G, 22B and 22W shown in Figs. 6A~6D to generate reference voltages $V0_R$~$V63_R$, $V0_G$~$V63_G$, $V0_B$~$V63_B$ and $V0_W$~$V63_W$. As shown in Fig. 6A, the voltage generator 22R generates the reference voltages $V0_R$~$V63_R$ to D/A converters DAC_R of the D/A conversion units 30_1A~30_NA according to the white component signal Wi. The voltage generator 22R comprises two de-multiplexers 211 and 212 and two series-connected resistor strings 231 and 232. The resistor string 231 comprises resistors $R0_{R''}$~$R62_{R''}$ connected in series, and the resistor string 232 comprises resistors $R0_R$~$R64_R$ for red color grey level gamma correction. The de-multiplexer 211 selectively outputs a first power voltage VerfH to one node of the resistor string 231 according to the white component signals Wi, and the de-multiplexer 212 selectively outputs a second power voltage VrefL to one node of the resistor string 232 according to the white component signals Wi. The first power voltage VrefH exceeds the second power voltage VrefL, the resistors $R0_{R''}$ and $R0_R$ are the same, the resistors $R1_{R''}$ and $R1_R$ are the same, the resistors $R2_{R''}$ and $R2_R$ are the same, and so on.

[0029] For example, if the white component signal Wi extracted from the three color input signals Ri, Gi and Bi is 000000, the power voltage VrefL is forced to the node N0 of the resistor string 232, and the power voltage VrefH is forced to the node N3 of the resistor string 231. Alternately, if the white component signal Wi extracted from the three color input signals Ri, Gi and Bi is 000001, the power voltage VrefL is forced to the node N1 of the resistor string 232, and the power voltage VrefH is forced to the node N4 of the resistor string 231. Accordingly, the voltage level of the reference voltage $V0_R$~$V63_R$ for the red input signal Ri can be lowered by a first voltage drop.

[0030] Alternately, if the white component signal Wi extracted from the three color input signals Ri, Gi and Bi is 000010, the power voltage VrefL is forced to the node N2 of the resistor string 232, and the power voltage VrefH is forced to the node N5 of the resistor string 231. Accordingly, the voltage level of the reference voltage $V0_R$~$V63_R$ for the red input signal Ri can be lowered by a second voltage drop exceeding the first voltage drop. Thus, the voltage level of the reference voltage $V0_R$~$V63_R$ for the red input signal Ri can be adjusted based on the white component signal Wi.

[0031] As shown in Fig. 6B, the voltage generator 22G generates the reference voltages $V0_G$~$V63_G$ to D/A converters DAC_G of the D/A conversion units 30_1A~30_NA according to the white component signal Wi. The voltage generator 22R comprises two de-multiplexers 213 and 214 and two series-connected resistor strings 233 and 234. The resistor string 233 comprises resistors $R0_{G''}$~$R62_{G''}$ connected in series, and the resistor string 234 comprises resistors $R0_G$~$R64_G$ for green color grey level gamma correction. The de-multiplexer 213 selectively outputs the first power voltage VrefH to one node of the resistor string 233, and the de-multiplexer 214 selectively outputs the second power voltage VrefL to one node of the resistor string 234. The resistors $R0_{G''}$ and $R0_G$ are the same, the resistors $R1_{G''}$ and $R1_G$ are the same, the resistors $R2_{G''}$ and $R2_G$ are the same, and so on.

[0032] As shown in Fig. 6C, the voltage generator 22B generates the reference voltages $V0_B$~$V63_B$ to D/A converters DAC_B of the D/A conversion units 30_1A~30_NA according to the white component signal Wi. The voltage generator 22B comprises two de-multiplexers 215 and 216 and two series-connected resistor strings 235 and 236. The resistor string 235 comprises resistors $R0_{B''}$~$R62_{B''}$ connected in series, and the resistor string 236 comprises resistors $R0_B$~$R64_B$ for blue color grey level gamma correction. The de-multiplexer 215 selectively outputs the first power voltage VrefH to one node of the resistor string 235, and the de-multiplexer 216 selectively outputs the second power voltage VrefL to one node of the resistor string 236. The resistors $R0_{B''}$ and $R0_B$ are the same, the resistors $R1_{B''}$ and $R1_B$ are the same, the resistors $R2_{B''}$ and $R2_B$ are the same, and so on. Operation of the voltage generator 22G and 22B is similar to that of the voltage generator 22R., . The resistors $R0_R$~$R64_R$, $R0_G$~$R64_G$ and $R0_B$~$R62_B$ can be different from others, depending on design.

[0033] As shown in Fig. 6D, the voltage generator 22W comprises a resistor string 237 comprising a plurality of resistors $R0_W$~$R63_W$ connected in series for white color grey level gamma correction. The power voltages VrefH and VrefL are forced to two ends of the resistor string 237, such that the reference voltages $V0_W$~$V63_W$ are generated according to difference resistances of the resistors $R0_W$~$R63_W$.

[0034] In this embodiment , the voltage level of the reference voltages V0R~V63R, V0G~V63G and V0B~V63B for three color input signals Ri, Gi and Bi can be adjusted based on the white component signal Wi. The lower voltage level of the reference voltages $V0_R$~$V63_R$, $V0_G$~$V63_G$ and $V0_B$~$V63_B$, the lower driving voltage $VA1_R$~VAN_R, $VA1_G$~VAN_G and $VA1_B$~VAN_B generated by D/A conversion units 30_1A~30_NA. Namely, the voltage level of the driving voltages $VA1_R$~VAN_R, $VA1_G$~VAN_G and $VA1_B$~VAN_B generated by D/A conversion units 30_1A~30_NA can be adjusted according to the extracted white component signal Wi. When N-type transistors are used as driving devices of pixels, the RGB brightness of the subpixels on a display device is lowered as the driving voltage decreases based on the white component signal Wi. In some embodiments, when P-type transistors are used as driving devices of pixels, the RGB brightness of the pixels on a display device is lowered as the driving voltage increases based on the white component signal Wi. Thus, gamma correction for RGBW brightness can be accurately controlled.

[0035] Alternately, in some embodiments, the de-multiplexers 211, 213 and 215 selectively output the second power voltage VrefL to one node of the resistor string 231, 233 and 235, and the de-multiplexer 212, 214 and 216 selectively output the first power voltage VrefH to one node of the resistor string 232, 234 and 236.

[0036] Fig. 7 shows another embodiment of a data driver. As shown, the data driver 100B is similar to the data driver 100A shown in Fig. 5, with the exception of analog sampling and holding latches ASH_R~ASH_W coupled between the analog buffers AB_R~AB_W and the D/A converters DAC_R~DAC_W in each D/A conversion unit 30_1B~30_NB. Description of the same structure shown in Fig. 5 is omitted for simplification. In the data driver 100B, the driving voltages $VA1_R$~VAN_R, $VA1_G$~VAN_G, $VA1_B$~VAN_B and $VA1_W$~VAN_W generated by the D/A conversion units 30_1B~30_NB during different periods can be sampled and held by the analog sampling and holding latches ASH_R~ASH_W. Thus, the data driver 100B can output the corresponding voltages to drive one row of data lines in one time.

[0037] Figs. 8-1 and 8-2 show another embodiment of a data driver. As shown, the data driver 100C is similar to the data driver 100A shown in Fig. 5, with the exception of N analog reference voltage generation circuits 20_1~20_N coupled to the D/A conversion units 30_1C~30_NC. Description of the same structure shown in Fig. 7 is omitted for simplification. In the data driver 100C, the N analog reference voltage generation circuits 20_1~20_N each correspond to one of the D/A conversion units 30_1C~30_NC. For example, the analog reference voltage generation circuit 20_1 corresponds to the D/A conversion unit 30_1C, the analog reference voltage generation circuit 20_2 corresponds to the D/A conversion unit 30_2C, and so on. The color input signals Ri, Gi, Bi and the extracted white component signal Wi are sampled by the sampling latches $S1_R$~$S1_W$ and held by the holding latches $H1_R$~$H1_W$ in the D/A conversion units 30_1C~30_NC during each period. For example, the color input signals R1, G1, B1 and the extracted white component signal W1 are sampled and held in the D/A conversion units 30_1C during a first period, the color input signals R2, G2, B2 and the extracted white component signal W2 are sampled and held in the D/A conversion units 30_2C during a second period, and so on.

[0038] All held color input signals Ri, Gi, Bi and the white component signal Wi can be output to the corresponding D/A converters DAC_R~DAC_W and the corresponding analog reference voltage circuit at one time. For example, the white component signal W1 is output to analog reference voltage generation circuit 20_1, such that the reference voltages $V0_R$~$V63_R$, $V0_G$~$V63_G$, $V0_B$~$V63_B$ and $V0_W$~$V63_W$ are output to the D/A converters DAC_R~DAC_W. Accordingly, the D/A converters DAC_R~DAC_W receive the reference voltages $V0_R$~$V63_R$, $V0_G$~$V63_G$, $V0_B$~$V63_B$ and $V0_W$~$V63_W$ and generate the driving voltage $VA1_R$~$VA1_W$ according to the three color input signals R1, G1, B1 and W1. Similarly, the D/A conversion units 30_2C~30_NC generate the driving voltages $VA2_R$~VAN_R, $VA2_G$~VAN_G and $VA2_B$~VAN_B at the same time. Namely, the data driver 100C can output the corresponding voltages to drive one row of data lines in one time.

[0039] Fig. 9 is a schematic diagram of another embodiment of a system, in this case a display panel, for providing driving voltages. As shown in Fig. 9, the display device 300 comprises a data driver such as data drvier100A/100B/100C, a pixel array 200 and a gate driver 210. The pixel array 200 comprises RGBW color pixels arranged in matrix, a plurality of data lines and a plurality of scan lines. The data driver generates analog driving voltages to the pixel array 200, and the gate driver 210 provides scan signals to the pixel array 200 such that the scan lines are asserted or de-asserted. The pixel array 200 generates color images according to the analog driving voltages from the data driver. While the display panel can be an organic light emitting panel, an electroluminescent panel or a liquid crystal display panel for example, various other technologies can be used in other embodiments.

[0040] Fig. 10 schematically shows an embodiment of yet another system, in this case an electronic device for providing driving voltages. In particular, electronic device 600 employs a display panel such as display panel 600 shown in Fig. 9. The electronic device 600 may be a device such as a PDA, notebook computer, digital camera, tablet computer, cellular phone or a display monitor device, for example.

[0041] Generally, the electronic device 600 comprises a housing 500, a display panel 300 and a DC/DC converter 400, although it is to be understood that various other components can be included, such components not shown or described here for ease of illustration and description. In operation, the DC/DC converter 400 powers the display panel 300 so that the display panel 300 can display color images.

Claims

1. A system for displaying images according to a red (Ri), green (Gi) and blue (Bi) input signal, the system comprising:

   a display panel (300) comprising red, green and blue sub-pixels adapted to generate color images according to driving voltages;
   the display panel further comprising a data driver (100) comprising:

      a reference voltage generation circuit (20) adapted to provide sets of reference voltages suitable for the sub-pixels, wherein the reference voltage generation circuit (20) at least comprises first, second and third voltage generators (22R, 22G, 22B); and
      a digital-to-analog (D/A) conversion unit (30_1A) adapted to generate the driving voltages to drive the sub-pixels according to the input signals (Ri, Gi, Bi) and the sets of reference voltages;
      characterized in that
      the display panel further comprises white sub-pixels;
      the data driver further comprises a white component extraction unit (10) adapted to execute an AND logic operation to the red, green and blue input signals (Ri, Gi, Bi) controlling brightness of the red, green and blue sub-pixels respectively, to extract a white component signal (Wi) controlling brightness of a white sub-pixel;
      the reference voltage generation circuit (20) is adapted to provide first to third sets of reference voltages ($V0_R$ - $V63_R$, $V0_G$ - $V63_G$, $V0_B$ - $V63_B$) respectively suitable for the red, green blue and sub-pixels according to the white component signal (Wi), wherein the first, second and third voltage generators (22R, 22G, 22B), respectively providing the first to third sets of reference voltages, each comprise:
      first and second resistor strings (231, 232; 233, 234; 235, 236) connected to each other in series, each comprising a plurality of resistors (R0R - R62R; R0G - R62G; ROB - R62B) and nodes (N4 - N5; N0 - N3);

a first de-multiplexer (211; 213; 215) adapted to selectively make connections between a first power voltage (V_{refH}) and one of the nodes of the first resistor string (231; 233; 235) according to the white component signal; and

a second de-multiplexer (212; 214; 216) adapted to selectively make connections between a second power voltage (V_{refL}) and one of the nodes of the second resistor string (232; 234; 236) according to the white component signal;

wherein the digital-to-analog (D/A) conversion unit (30) is adapted to generate the driving voltages (VAN_R, VAN_G, VAN_B, VAN_W) to drive the red, green, blue and white sub-pixels according to the first to fourth sets of reference voltages, the red, green and blue input signals and the white component signal; and

wherein the reference voltage generation circuit (20) further comprises a fourth voltage generator (22W) that is adapted to generate the fourth set of reference voltages suitable for the white sub-pixels.

2. The system as claimed in claim 1, wherein the driving voltages at least comprise a red driving voltage (VAN_R), a green driving voltage (VAN_G), a blue driving voltage (VAN_B) and a white driving voltage (VAN_W), and the digital-to-analog conversion unit (30_1) comprises:

a first digital-to-analog converter (DAC_R) adapted to generate the red driving voltage according to the first set of reference voltages and the red input signal;

a second digital-to-analog converter (DAC_G) adapted to generate the green driving voltage according to the second set of reference voltages and the green input signal;

a third digital-to-analog converter (DAC_B) adapted to generate the blue driving voltage according to the third set of reference voltages and the blue input signal, and

a fourth digital-to-analog converter (DAC_W) adapted to generate the white driving voltage according to the fourth set of reference voltages and the white component signal.

3. The system as claimed in claim 2, wherein the digital-to-analog conversion unit (30_1) further comprises a plurality of digital holding units (H/L) connected to the inputs of the digital-to-analog converters (DAC_R - DAC_W) and adapted to hold the red, green and blue input signals and the white component signal.

4. The system as claimed in claim 2, wherein the digital-to-analog conversion unit (30_1) further comprises a plurality of analog holding units (S/H) adapted to hold the red, green, blue and white driving voltages output by the digital-to-analog converters (DAC_R - DAC_W).

5. The system as claimed in claim 1, wherein the fourth voltage generator (22W) comprises a third resistor string (237) connected between the first power voltage and the second power voltage.

6. The system as claimed in claim 1, wherein the display panel (300) is a liquid crystal display panel.

7. The system as claimed in claim 1, wherein the display panel (300) is an electroluminescent panel.

8. The system as claimed in claim 1, wherein the display panel (300) is an organic light emitting panel.

9. The system as claimed in claim 1, wherein the system is implemented as a PDA, a display monitor, a digital camera, a notebook computer, a tablet computer or a cellular phone.

10. A method of displaying images according to a red (Ri), green (Gi) and blue (Bi) input signal, comprising:

generating first to third sets of reference voltages suitable for red, green and blue sub-pixels, respectively;

generating driving voltages to drive the red, green, and blue sub-pixel according to the input signals (Ri, Gi, Bi) and the sets of reference voltages; and

displaying color images by driving the sub-pixels according to the driving voltages;

characterized by the steps of:

extracting a white component (Wi) controlling brightness of a white sub-pixel by executing an AND logic operation to the red, green and blue input signals (Ri, Gi, Bi) controlling brightness of the red, green and blue sub-pixels respectively ;

generating the first to third sets of reference voltages ($V0_R$ - $V63_R$, $V0_G$ - $V63_G$, $V0_B$-$V63_B$) respectively suitable for the red, green and blue sub-pixels according to the white component signal (Wi);

generating a fourth set of reference voltages ($V0_W$ - $V63_W$) suitable for the white sub-pixels; and

generating the driving voltages (VAN_R. VAN_G , VAN_B , VAN_W) to drive the red, green, blue and white sub-pixels according to the first to fourth sets of reference voltages, the red, green and blue input signals and the white component signal.

11. The method as claimed in claim 10, wherein the driving voltages at least comprise a red driving voltage generated according to the first set of reference voltages and the red input signal, a green driving voltage generated according to the second set of reference voltages and the green input signal, a blue driving voltage generated according to the third set of reference voltages and the blue input signal and a white driving voltage generated according to the fourth set of reference voltages and the white component signal.

12. The method as claimed in claim 10, further comprising holding the white component signal (Wi) and the red, green and blue input signals (Ri, Gi, Bi) before generating the driving voltages.

13. The method as claimed in claim 10, wherein the white component signal (Wi) and the red, green and blue input signals (Ri, Gi, Bi) each is a digital data comprising N bits.

14. The method as claimed in claim 10, wherein the white component signal (Wi) and the red, green and blue input signals (Ri, Gi, Bi) each is a digital data comprising N bits, and the white component signal (Wi) is obtained by executing the AND logic operation to M bits of the red, green and blue input signals (Ri, Gi, Bi), and 0 < M < N.

15. The method as claimed in claim 10, further comprising holding the generated driving voltages.

16. The method as claimed in claim 10, wherein the system comprises a display device and the display device is an organic light emitting device, a liquid crystal display device or an electroluminescent device.

Patentansprüche

1. System zur Anzeige von Bildern gemäß einem roten (Ri), grünen (Gi) und blauen (Bi) Eingaugs-Signal, wobei das System aufweist:

eine Anzeige-Tafel (300) umfassend rote, grüne und blaue Sub-Pixel, die beschaffen sind, Farb-Bilder gemäß Treiber-Spannungen zu erzeugen;
wobei die Anzeige-Tafel ferner einen Daten-Treiber (100) aufweist, der umfasst:

eine Referenz-Spannungs-Erzeugungs-Schaltung (20), die beschaffen ist, Sätze von Referenz-Spannungen passend für die Sub-Pixel bereitzustellen, wobei die Referenz- Spannungs- Erzeugungs- Schaltung (20) mindestens erste, zweite und dritte Spannungs-Erzeuger (22R, 22G, 22B) aufweist; und
eine Digital-Analog (D/A) Wandler-Einheit (30_1A), die beschaffen ist, die Treiber-Spannungen zu erzeugen, um die Sub-Pixel gemäß der Eingangs-Signale (Ri, Gi, Bi) und der Sätze von Referenz-Spannungen anzutreiben;
dadurch gekennzeichnet, dass
die Anzeige-Tafel ferner weiße Sub-Pixel aufweist;
der Daten-Treiber ferner eine Weiß-Komponenten-Extraktions-Einheit (10) aufweist, die beschaffen ist, eine logische UND-Verknüpfung an den roten, grünen und blauen Eingangs-Signalen (Ri, Gi, Bi) durchzuführen, die die Helligkeit der roten, grünen und blauen Sub-Pixel steuern, um ein Weiß-Komponenten-Signal (Wi) zu extrahieren, das die Helligkeit eines weißen Sub-Pixels steuert;
wobei Referenz-Spannung-Erzeugungs-Schaltung (20) beschaffen ist, erste bis dritte Sätze von Referenz-Spannungen ($V0_A$ - $V63_R$, $V0_G$- $V63_G$, $V0_B$ - $V63_B$, $V0_W$ - $V63_W$) jeweils passend für die roten, grünen, blauen und weißen Sub-Pixel gemäß dem Weiß-Komponenten-Signal (Wi) bereitzustellen, wobei die ersten, zweiten und dritten Spannungs-Erzeuger (22R, 22G, 22B) jeweils die ersten, zweiten und dritten Sätze von Referenz-Spannungen bereitstellen, wobei jeder aufweist:

erste und zweite Widerstands-Reihen (231, 232, 233, 234; 235, 236), die miteinander in Reihe geschaltet sind, wobei jede eine Vielzahl von Widerständen (R0R - R62R; R0G - R62G; R0B - R62B) und Knoten (N4 - N5 ; N0 - N3) aufweist;
einen ersten Demultiplexer (211; 213; 215), der beschaffen ist, selektiv Verbindungen zwischen einer ersten Versorgungs-Spannung (V_{refH}) und einem der Knoten der ersten Widerstands-Reihe (231; 233; 235) gemäß dem Weiß-Komponenten-Signal herzustellen, und
einen zweiten Demultiplexer (212; 214; 216), der beschaffen ist, selektiv Verbindungen zwischen einer zweiten Versorgungs-Spannung (V_{refL}) und einem der Knoten der zweiten Widerstands-Reihe (232; 234; 236) gemäß dem Weiß-Komponenten-Signal herzustellen;
wobei die Digital-Analog (D/A) Wandler-Einheit (30) beschaffen ist, die Treiber-Spannungen (VAN_R, VAN_G, VAN_B, VAN_W) zu erzeugen, um die roten, grünen, blauen und weißen Sub-Pixel gemäß den ersten bis vierten Sätzen von Refe-

renz-Spannungen, den roten, grünen und blauen Eingangs-Signalen und dem weißen Komponenten-Signal anzutreiben; und
wobei die Referenz-Spannung-Erzeugungs-Schaltung (20) ferner einen vierten Spannungs-Erzeuger (22W) aufweist, der beschaffen ist, den vierten Satz von Referenz-Spannungen passend für die weißen Sub-Pixel zu erzeugen.

2. System nach Anspruch 1, **dadurch gekennzeichnet, dass** die Treiber-Spannungen mindestens eine rote Treiber-Spannung (VAN_R), eine grüne Treiber-Spannung (VAN_G), eine blauen Treiber-Spannung (VAN_B) und eine weiße Treiber-Spannung (VAN_W) umfassen, und wobei die Digital-zu-Analog-Wandler Einheit (30_1) umfasst:

einen ersten Digital-Analog-Wandler (DAC_R), der beschaffen ist, die rote Treiber-Spannung gemäß dem ersten Satz von Referenz-Spannungen und dem roten Eingangs-Signal zu erzeugen;
einen zweiten Digital-Analog-Wandler (DAC_G), der beschaffen ist, die grüne Treiber-Spannung gemäß dem zweiten Satz von Referenz-Spannungen und dem grünen Eingangs-Signal zu erzeugen;
einen dritten Digital-Analog-Wandler (DAC_B), der beschaffen ist, die blaue Treiber-Spannung gemäß dem dritten Satz von Referenz-Spannungen und dem blauen Eingangs-Signal zu erzeugen, und
einen vierten Digital-Analog-Wandler (DAC_W), der beschaffen ist, die weiße Treiber-Spannung gemäß dem vierten Satz von Referenz-Spannungen und dem Weiß-Komponenten-Signal zu erzeugen.

3. System nach Anspruch 2, wobei die Digital-Analog-Wandler-Einheit (30_1) ferner eine Vielzahl von digitalen Halte-Einheiten (H/L) aufweist, die mit den Eingängen der Digital-Analog-Wandler (DAC_R - DAC_W) verbunden sind und beschaffen sind, die roten, grünen, blauen Eingangs-Signale und das Weiß-Komponenten-Signal zu halten.

4. System nach Anspruch 2, wobei die Digital-Analog-Wandlung Einheit (30_1) ferner eine Vielzahl von analogen Halte-Einheiten (S/H) aufweist, die beschaffen sind, die roten, grünen, blauen und weißen Treiber-Spannungen zu halten, die von den Digital-zu-Analog-Wandlern (DAC_R - DAC_W) ausgegeben werden.

5. System nach Anspruch 1, wobei der vierte Spannungs-Erzeuger (22W) eine dritte Widerstands-Reihe (237) aufweist, die zwischen der ersten Versorgungs-Spannung und der zweiten Versorgungs-Spannung geschaltet ist.

6. System nach Anspruch 1, wobei die Anzeige-Tafel (300) eine Flüssigkristall-Anzeige-Tafel ist.

7. System nach Anspruch 1, wobei die Anzeige-Tafel (300) eine Elektrolumineszenz-Tafel ist.

8. System nach Anspruch 1, wobei die Anzeige-Tafel (300) eine Organische Licht-emittierende Tafel ist.

9. System nach Anspruch 1, wobei das System als ein PDA, ein Anzeige-Monitor, eine Digital-Kamera, ein Notebook, ein Tablet-Computer oder ein Mobiltelefon ausgebildet ist.

10. Verfahren zur Anzeige von Bildern gemäß einem roten (Ri), grünen (Gi) und blauen (Bi) Eingangs-Signal, umfassend:

Erzeugen erster bis dritter Sätze von Referenz-Spannungen jeweils für rote, grüne und blaue Sub-Pixel;
Erzeugen von Treiber-Spannungen, um die roten, grünen und blauen Sub-Pixel gemäß den Eingangs-Signalen (Ri, Gi, Bi) und den Sätzen von Referenz-Spannungen anzutreiben; und
Anzeigen von Farb-Bildern durch Antreiben der Sub-Pixel gemäß den Treiber-Spannungen;
gekennzeichnet durch die Schritte:
Extrahieren einer Weiß-Komponente (Wi), die die Helligkeit eines weißen Sub-Pixels steuert **durch** das Ausführen einer logischen UND-Verknüpfung an den roten, grünen und blauen Eingangs-Signalen (Ri, Gi, Bi), die jeweils die Helligkeit der roten, grünen und blauen Sub-Pixel steuern;
Erzeugen der ersten bis dritten Sätze von Referenz-Spannungen (VO_R - $V63_R$, $V0_G$ - $V63_G$, $V0_B$ - $V63_B$) jeweils passend für die roten, grünen und blauen Sub-Pixel gemäß dem Weiß-Komponenten-Signal (Wi);
Erzeugen eines vierten Satzes von Referenz-Spannungen ($V0_W$ - $V63_W$) passend für die weißen Sub-Pixel, und
Erzeugen der Treiber-Spannungen (VAN_R, VAN_G, VAN_B, VAN_W), um die roten, grünen, blauen und weißen Sub-Pixel gemäß den ersten bis vierten Sätzen von Referenz-Spannungen, den roten, grünen und blauen Eingangs-Signale und dem Weiß-Komponenten-Signal anzutreiben.

11. Verfahren nach Anspruch 10, wobei die Treiber-Spannungen zumindest eine rote Treiber-Spannung umfassen, die gemäß dem ersten Satz von Referenz-Spannungen und dem roten Eingangs-Signal erzeugt wird, eine grüne Treiber-Spannung umfas-

sen, die gemäß dem zweiten Satz von Referenz-Spannungen und dem grünen Eingangs-Signal erzeugt wird, eine blaue Treiber-Spannung umfassen, die gemäß dem dritten Satz von Referenz-Spannungen und dem blauen Eingangs-Signal erzeugt wird, und eine weiße Treiber-Spannung umfassen, die gemäß dem vierten Satz von Referenz-Spannungen und dem Weiß-Komponenten-Signal erzeugt wird.

12. Verfahren nach Anspruch 10 ferner aufweisend ein Halten der Weiß-Komponenten-Signals (Wi) und der roten, grünen und blauen Eingangs-Signale (Ri, Gi, Bi) vor dem Erzeugen der Treiber-Spannungen.

13. Verfahren nach Anspruch 10, wobei das Weiß-Komponenten-Signal (Wi) und die roten, grünen und blauen Eingangs-Signale (Ri, Gi, Bi) jeweils einem digitalen Datenwert mit N Bit entsprechen.

14. Verfahren nach Anspruch 10, wobei das Weiß-Komponenten-Signal (Wi) und die roten, grünen und blauen Eingangs-Signale (Ri, Gi, Bi) jeweils einem digitalen Datenwert mit N Bits entsprechen, und wobei das Weiß-Komponenten-Signal (Wi) gewonnen wird durch die Durchführung der UND- Verknüpfung an M Bits der roten, grünen und blauen Eingangs-Signale (Ri, Gi, Bi), und 0 <M <N ist.

15. Verfahren nach Anspruch 10 ferner aufweisend ein Halten der erzeugten Treiber-Spannungen.

16. Verfahren nach Anspruch 10, wobei das System eine Anzeige-Vorrichtung aufweist, und die Anzeige-Vorrichtung eine Organische Licht-emittierende Vorrichtung, eine Flüssigkristall-Anzeige-Tafel-Vorrichtung oder ein Elektrolumineszenz-Vorrichtung ist.

Revendications

1. Un système pour l'affichage d'images suivant un signal d'entrée rouge (Ri), vert (Gi) et bleu (Bi), le système comprenant:

un panneau d'affichage (300) comportant des sous-pixels rouges, verts et bleus adaptés à la génération d'images en couleur en fonction de tensions de commande ;
le panneau d'affichage comportant en outre un pilote de données (100) comprenant :

un circuit de génération de tensions de référence (20) adapté pour générer des jeux de tensions de référence convenant aux sous-pixels, dans lequel le circuit de génération de tensions de référence (20) comporte au moins un premier, un second et un troisième générateurs de tension (22R, 22G, 22B); et
une unité (30_1A) de conversion numérique-analogique (D/A) adaptée à la génération de tensions de commande pour la commande des sous-pixels en fonction des signaux d'entrée (Ri, Gi, Bi) et des jeux de tension de référence ;

caractérisé en ce que
le panneau d'affichage comporte en outre des sous-pixels blancs;
le pilote de donnée comporte en outre une unité d'extraction de composante blanche (10) adaptée pour l'exécution d'une opération logique ET aux signaux d'entrée rouge, vert et bleu (Ri, Gi, Bi) commandant la luminosité des sous-pixels rouges, verts et bleus respectivement, pour l'extraction d'un signal de composante blanche (Wi) commandant la luminosité d'un sous-pixel blanc ;
le circuit de génération de tension de référence (20) est adapté pour la génération des premier au troisième jeux de tension de référence ($V0_R$-$V63_R$, $V0_G$-$V63_G$, $V0_B$-$V63_B$) respectivement adaptés aux sous-pixels rouges, verts et bleus en fonction du signal de composante blanche (Wi), dans lequel les premier, second et troisième générateurs de tension (22R, 22G, 22B) génèrent respectivement les premier, second et troisième jeux de tension de référence, chacun comportant :

des premières et secondes chaînes de résistances (231, 232 ; 233, 234 ; 235, 236) connectées en série les unes aux autres, chacune comportant une pluralité de résistances (R0R-R62R ; R0G-R62G ; ROB-R62B) et des noeuds (N4-N5 ; N0-N3) un premier dé-multiplexeur (211 ; 213 ; 215) adapté pour des connexions sélectives entre une première tension d'alimentation (VrefH) et l'un des noeuds de la première chaîne de résistance (231 ; 233 ; 235) en fonction du signal de composante blanche ; et
un second dé-multiplexeur (212 ; 214 ; 216) adapté pour des connexions sélectives entre une seconde tension d'alimentation (VrefL) et l'un des noeuds de la seconde chaîne de résistance (232 ; 234 ; 236) en fonction du signal de composante blanche ;
dans lequel l'unité (30) de conversion numérique-analogique (D/A) est adaptée à la génération des tensions de commande (VAN_R, VAN_G, VAN_B, VAN_W) pour commander les sous-pixels rouges, verts , bleus et blancs en fonction des premier au quatrième jeux de tension de référence, des

signaux d'entrée rouge, vert et bleu et du signal de composante blanche ; et
dans lequel le circuit de génération de tension de référence (20) comporte en outre un quatrième générateur de tension (22W) adapté à la génération du quatrième jeu de tension de référence convenant aux sous-pixels blancs.

2. Le système tel que revendiqué dans la revendication 1, dans lequel les tensions de commande comportent au moins une tension de commande pour le rouge (VAN_R), une tension de commande pour le vert (VAN_G), une tension de commande pour le bleu (VAN_B) et une tension de commande pour le blanc (VAN_W), et l'unité (30_1A) de conversion numérique-analogique comporte :

un premier convertisseur numérique analogique (DAC_R) adapté pour la génération de la tension de commande pour le rouge en fonction du premier jeu de tensions de référence et du signal d'entrée rouge ;
un second convertisseur numérique analogique (DAC_G) adapté pour la génération de la tension de commande pour le vert en fonction du second jeu de tensions de référence et du signal d'entrée vert ;
un troisième convertisseur numérique analogique (DAC_B) adapté pour la génération de la tension de commande pour le bleu en fonction du troisième jeu de tensions de référence et du signal d'entrée bleu;
un quatrième convertisseur numérique analogique (DAC_W) adapté pour la génération de la tension de commande pour le blanc en fonction du quatrième jeu de tensions de référence et du signal de composante blanche.

3. Le système tel que revendiqué dans la revendication 2, dans lequel l'unité (30_1A) de conversion numérique-analogique comporte en outre une pluralité d'unités d'échantillonnage numériques (H/L) connectées aux entrées des convertisseurs numériques-analogiques (DAC_R - DAC_W) et adaptées à l'échantillonnage des signaux d'entrées rouge, vert et bleu et du signal de composante blanche.

4. Le système tel que revendiqué dans la revendication 2, dans lequel l'unité (30_1A) de conversion numérique-analogique comporte en outre une pluralité d'unités d'échantillonnage analogiques (S/H) et adaptées pour l'échantillonnage des tensions de commande pour le rouge, le vert, le bleu et le blanc générés par les convertisseurs numériques-analogiques (DAC_R - DAC_W).

5. Le système tel que revendiqué dans la revendication 1, dans lequel le quatrième générateur de tension (22W) comporte une troisième chaîne de résistance (237) connectée entre la première tension d'alimentation et la seconde tension d'alimentation.

6. Le système tel que revendiqué dans la revendication 1, dans lequel le panneau d'affichage (300) est un panneau d'affichage à cristaux liquides.

7. Le système tel que revendiqué dans la revendication 1, dans lequel le panneau d'affichage (300) est un panneau électroluminescent.

8. Le système tel que revendiqué dans la revendication 1, dans lequel le panneau d'affichage (300) est un panneau électroluminescent organique.

9. Le système tel que revendiqué dans la revendication 1, dans lequel le système est implémenté sous la forme d'un assistant numérique portable (PDA), d'un moniteur d'affichage, d'un appareil photographique numérique, d'un ordinateur portable, d'une tablette numérique ; ou d'un téléphone cellulaire.

10. Une méthode d'affichage d'images suivant un signal d'entrée rouge (Ri), vert (Gi) et bleu (Bi), comprenant :

la génération d'une première, seconde et troisième tensions de référence adaptés aux sous-pixels rouges, verts et bleus, respectivement ;
la génération de tensions de commande pour la commande des sous-pixels rouges, verts, et bleus en fonction des signaux d'entrée (Ri, Gi, Bi) et des jeux de tensions de référence ; et
l'affichage d'images en couleur par la commande de sous-pixels en fonction des tensions de commande ;
caractérisée par les étapes :

l'extraction d'une composante blanche (Wi) commandant la luminosité d'un sous-pixel blanc au moyen de l'exécution d'une opération ET logique sur les signaux d'entrées rouge, vert et bleu (Ri, Gi, Bi) commandant la luminosité des sous-pixels rouge, vert et bleu respectivement ;
la génération des premier, second et troisième jeux de tensions de référence ($V0_R$-$V63_R$, $V0_G$-$V63_G$, VG_B-$V63_B$) respectivement adaptés aux sous-pixels rouge, vert et bleu en fonction du signal de composante blanche (Wi) ;
la génération d'un quatrième jeu de tensions de référence ($V0_W$-$V63_W$) convenant aux sous-pixels blancs ; et
la génération des tensions de commande (VAN_R, VAN_G, VAN_B, VAN_W) pour com-

mander les sous-pixels rouges, verts , bleus et blancs en fonction des premier au quatrième jeux de tension de référence, des signaux d'entrée rouge, vert et bleu et du signal de composante blanche.

11. La méthode telle que revendiquée dans la revendication 10, dans laquelle les tensions de commande comportent au moins une tension de commande pour le rouge générée en fonction du premier jeu de tensions de référence et du signal d'entrée pour le rouge, une tension de commande pour le vert générée en fonction du second jeu de tensions de référence et du signal d'entrée vert, une tension de commande pour le bleu générée en fonction du troisième jeu de tensions de référence et du signal d'entrée bleu et une tension de commande pour le blanc générée en fonction du quatrième jeu de tensions de référence et du signal de composante blanche.

12. La méthode telle que revendiquée dans la revendication 10, comportant en outre l'échantillonnage du signal de composante blanche (Wi) et des signaux d'entrée rouge, vert et bleu (Ri, Gi, Bi) avant la génération des tensions de commande.

13. La méthode telle que revendiquée dans la revendication 10, dans laquelle le signal de composante blanche (Wi) et les signaux d'entrée rouge, vert et bleu (Ri, Gi, Bi) se composent d'une donnée numérique comprenant N bits.

14. La méthode telle que revendiquée dans la revendication 10, dans laquelle le signal de composante blanche (Wi) et les signaux d'entrée rouge, vert et bleu (Ri, Gi, Bi) se composent chacun d'une donnée numérique sur N bits, et le signal de composante blanche (Wi) est obtenu au moyen d'une opération logique ET sur M bits des signaux d'entrée rouge, vert et bleu (Ri, Gi, Bi), et $0 < M < N$.

15. La méthode telle que revendiquée dans la revendication 10, comportant en outre l'échantillonnage des tensions de commande générées.

16. la méthode telle que revendiquée dans la revendication 10, dans lequel le système comporte un système d'affichage, et le système d'affichage est un dispositif électroluminescent organique, un dispositif d'affichage à cristaux liquides ou un dispositif électroluminescent.

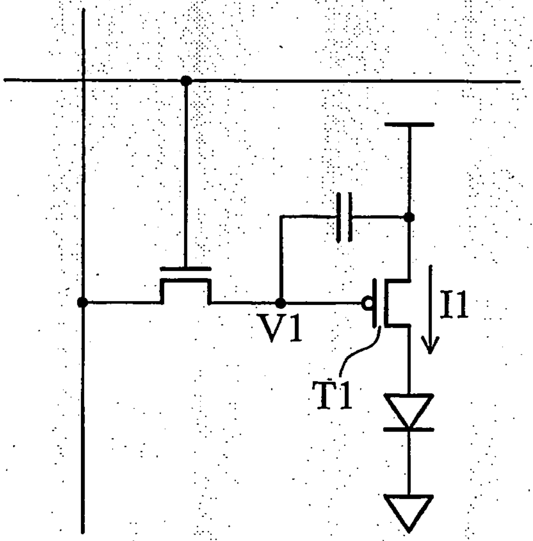

FIG. 1A (RELATED ART)

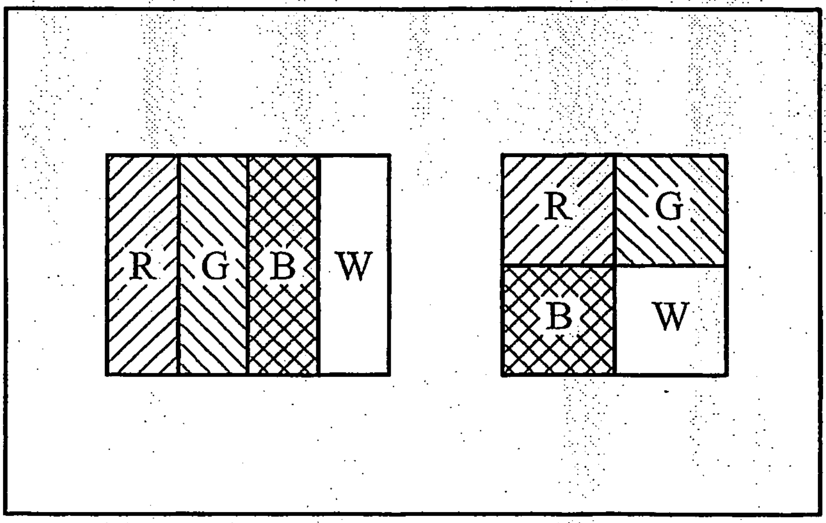

FIG. 1B (RELATED ART)

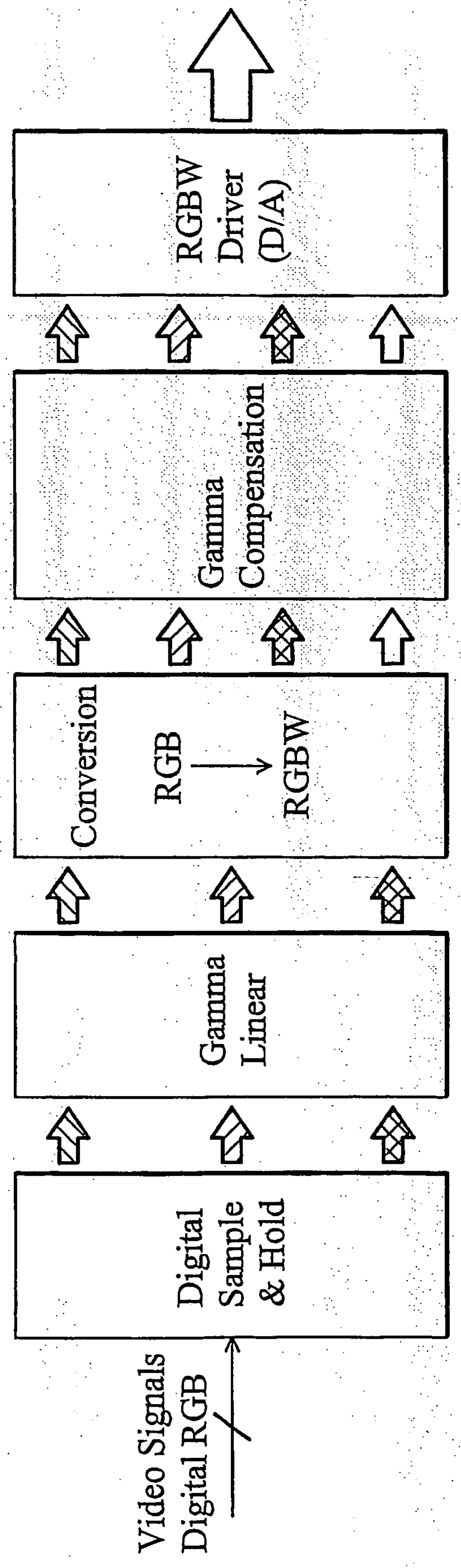

FIG. 1C (RELATED ART)

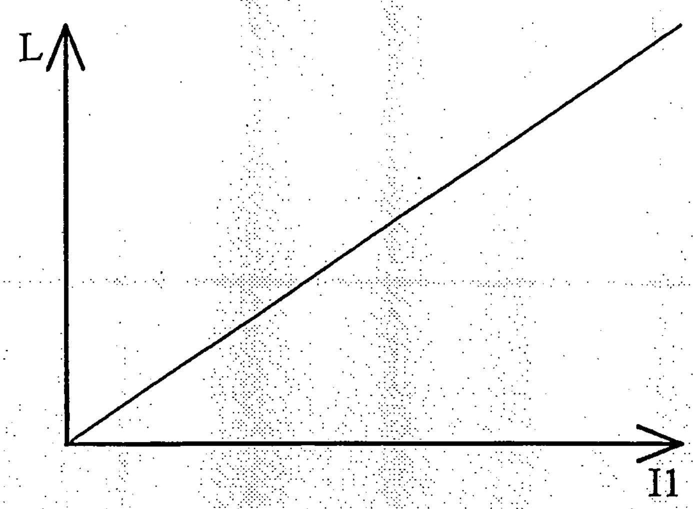

FIG. 2A (RELATED ART)

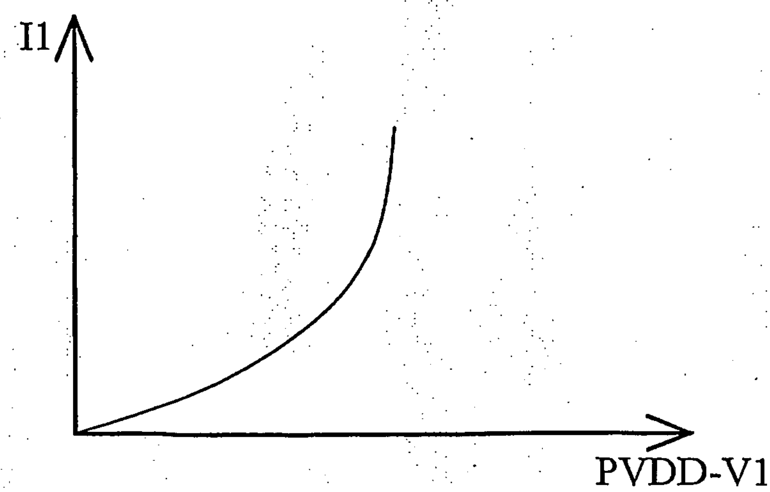

FIG. 2B (RELATED ART)

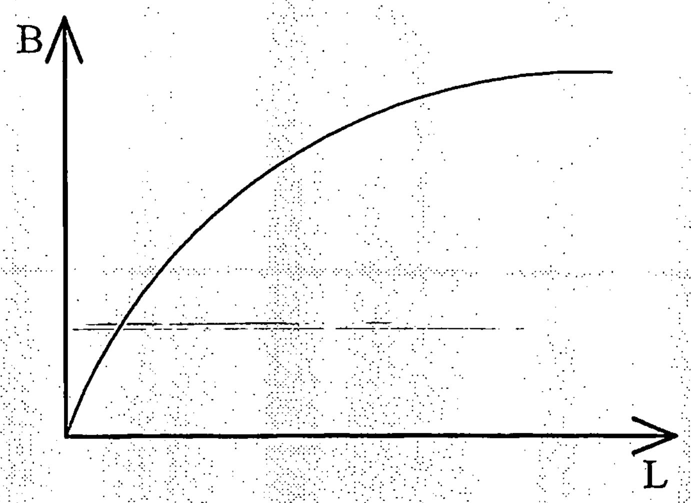

FIG. 2C (RELATED ART)

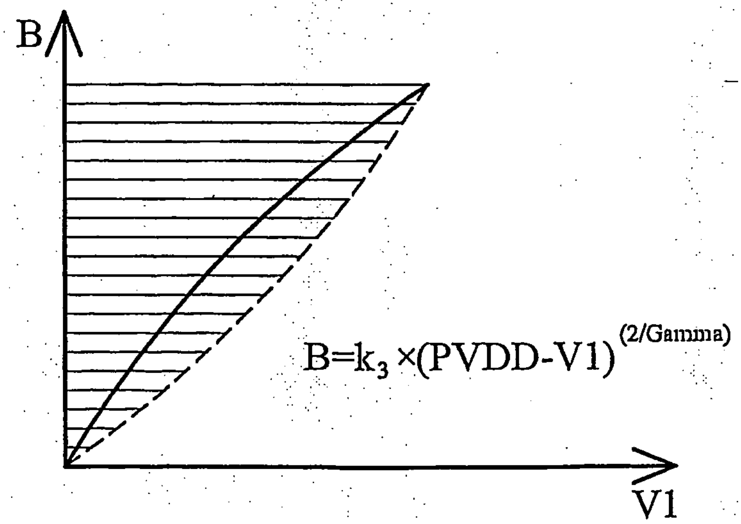

FIG. 2D (RELATED ART)

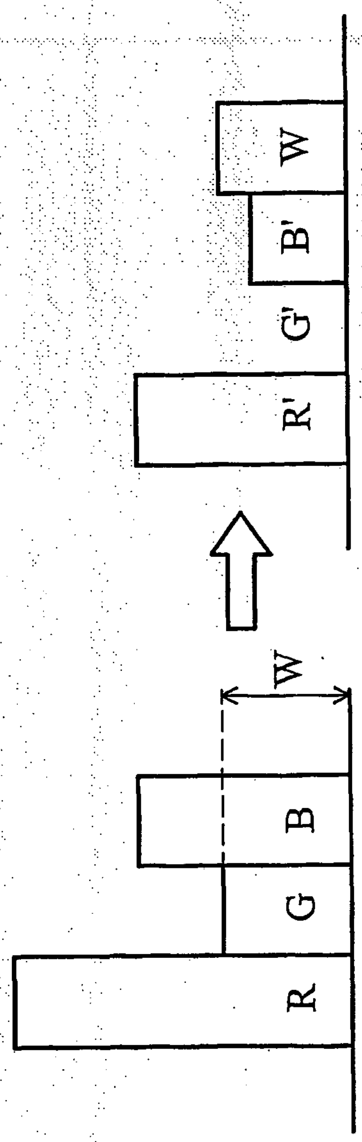

FIG. 3 (RELATED ART)

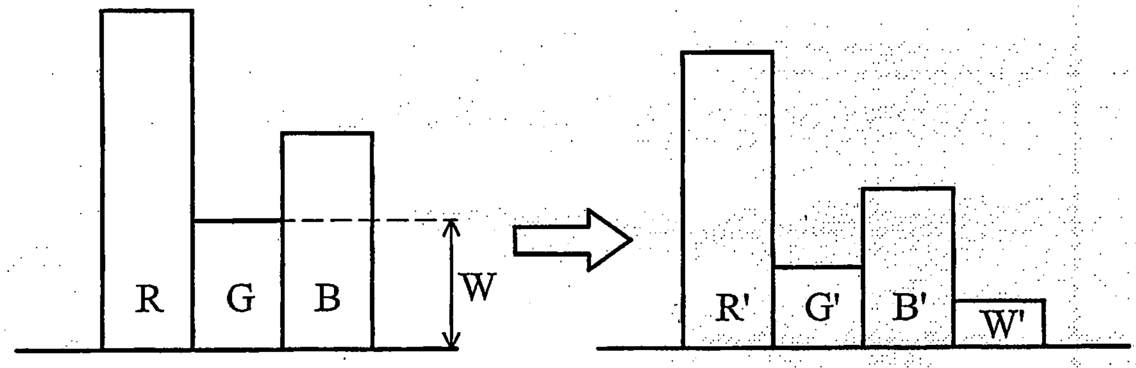

FIG. 4 (RELATED ART)

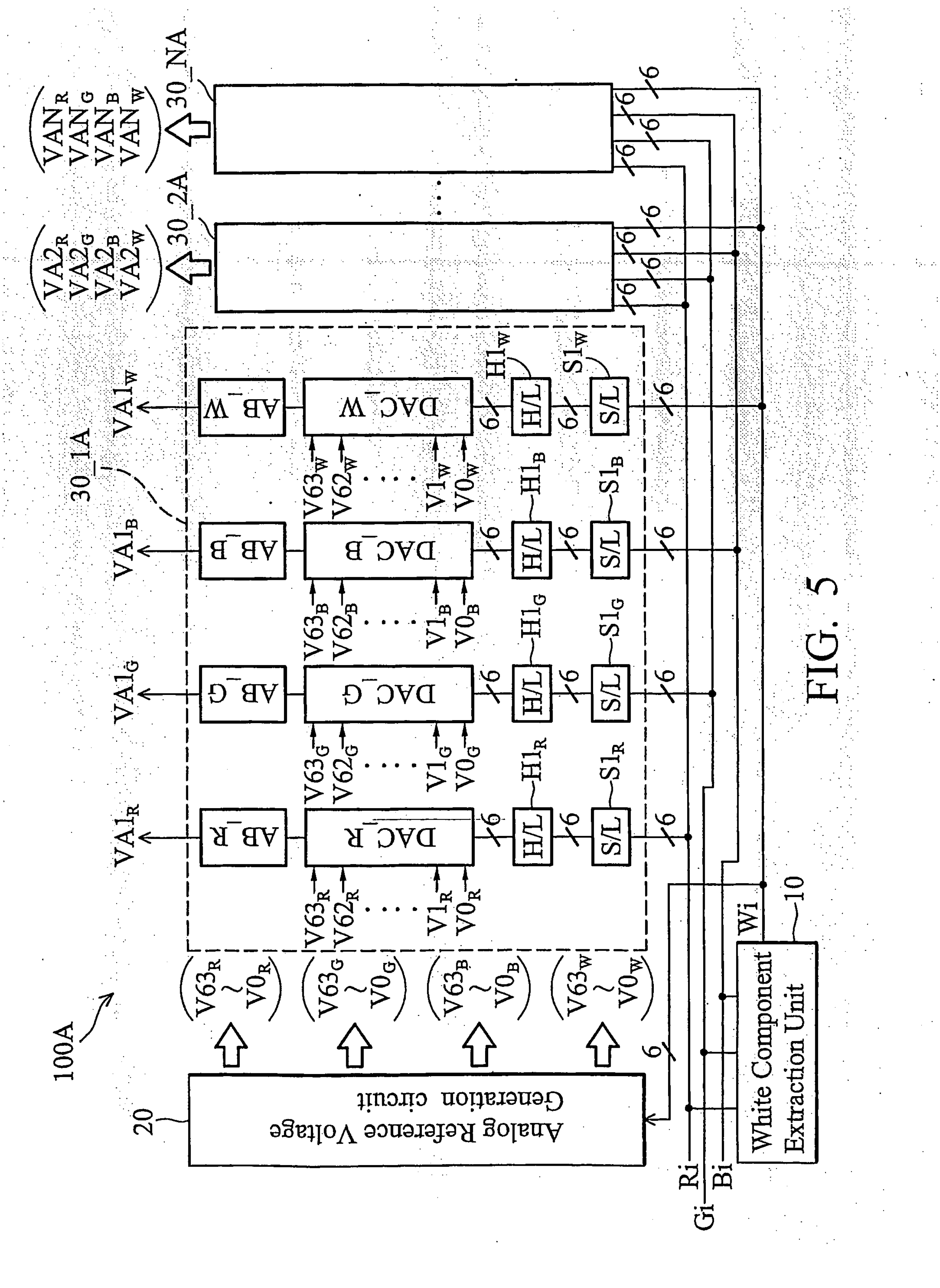
100A
20
Analog Reference Voltage Generation circuit
10
White Component Extraction Unit
Ri
Gi
Bi
Wi
30_1A
30_2A
30_NA
AB_R
AB_G
AB_B
AB_W
DAC_R
DAC_G
DAC_B
DAC_W
H/L
S/L
VA1R
VA1G
VA1B
VA1W
VA2R
VA2G
VA2B
VA2W
VANR
VANG
VANB
VANW
H1R
H1G
H1B
H1W
S1R
S1G
S1B
S1W
6

FIG. 5

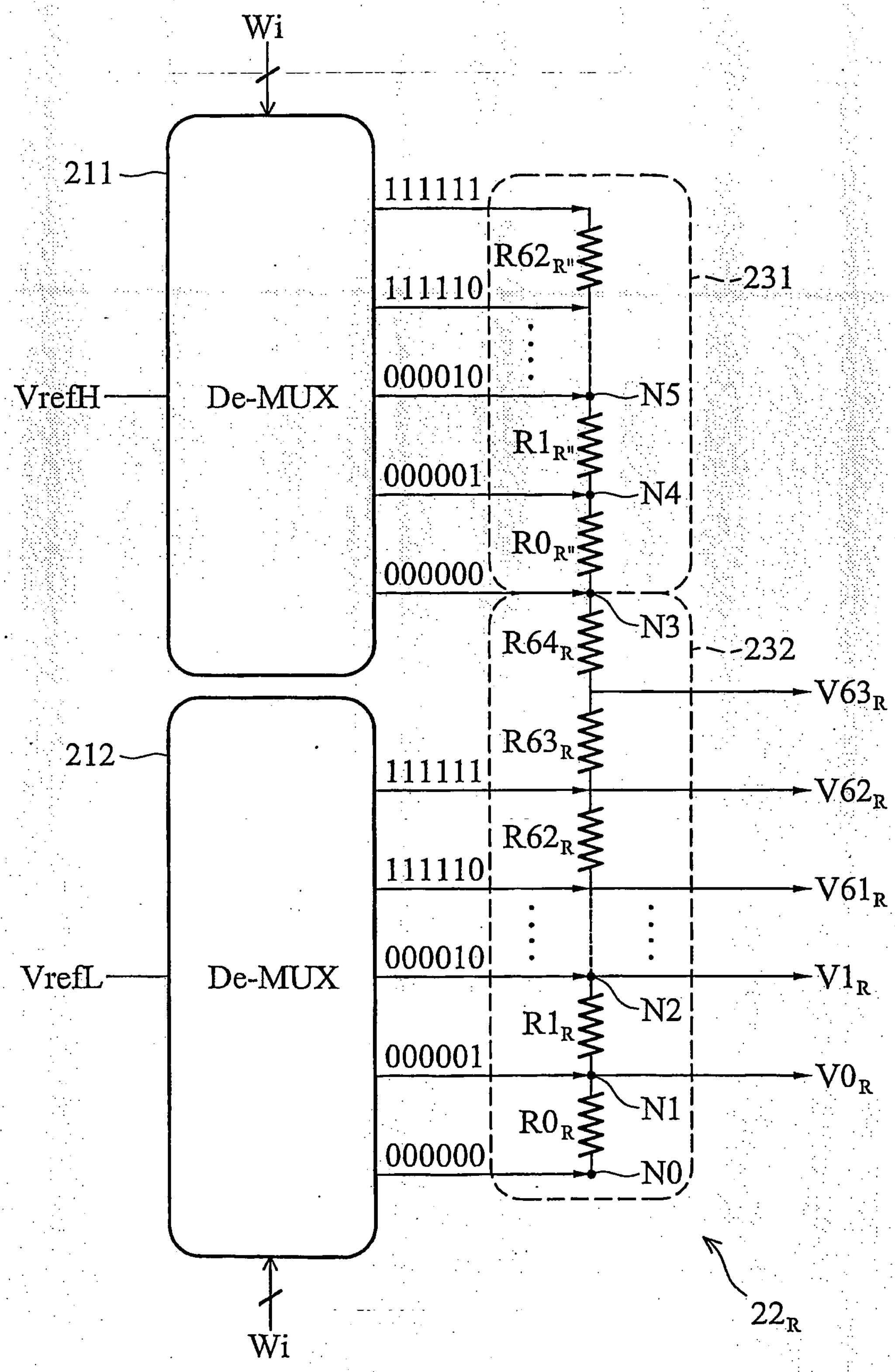
Wi
211
212
VrefH
VrefL
De-MUX
De-MUX
111111
111110
000010
000001
000000
111111
111110
000010
000001
000000
R62R"
R1R"
R0R"
R64R
R63R
R62R
R1R
R0R
N5
N4
N3
N2
N1
N0
231
232
V63R
V62R
V61R
V1R
V0R
22R
Wi

FIG. 6A

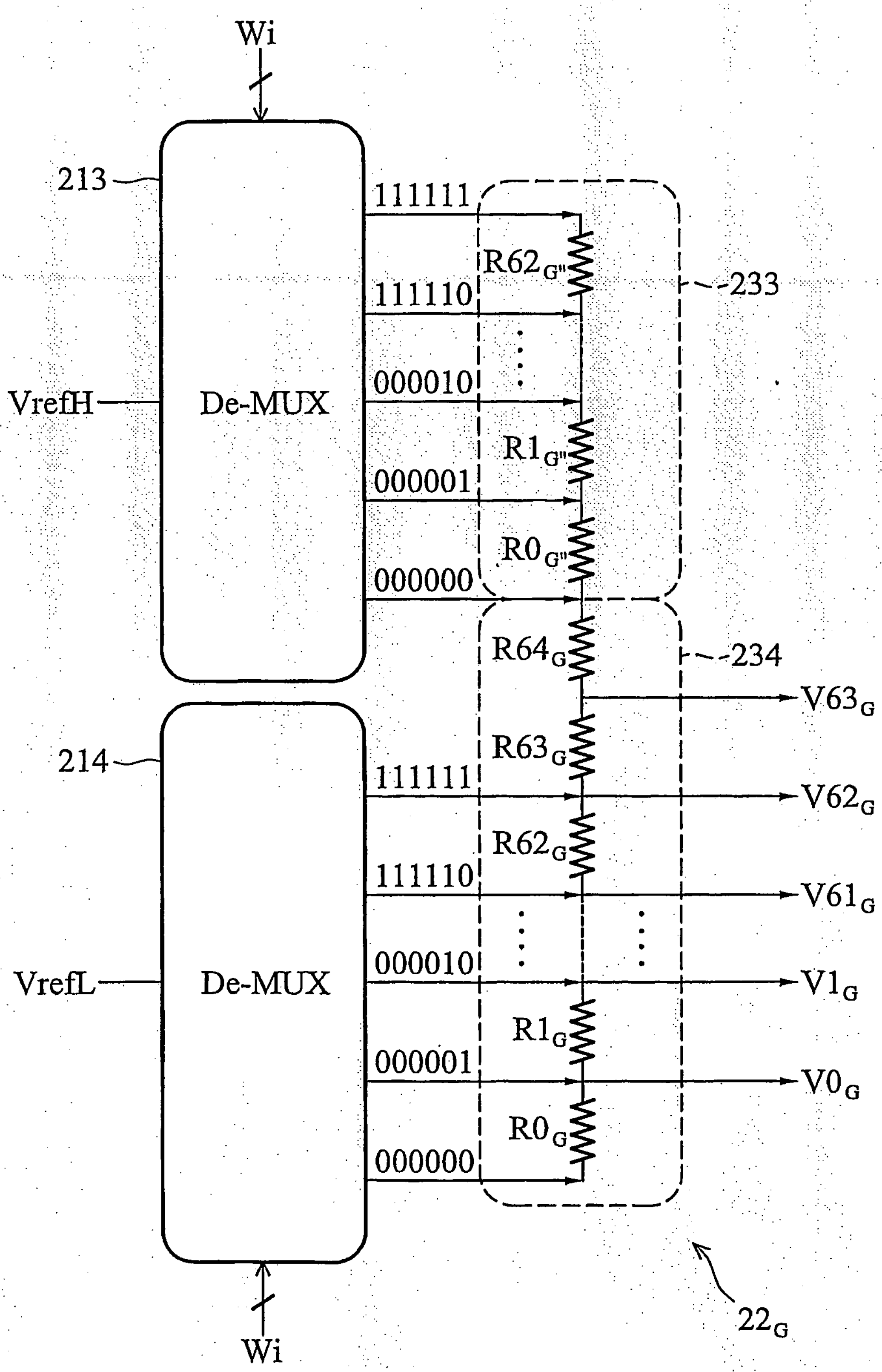
Wi
213
VrefH
De-MUX
111111
111110
000010
000001
000000
R62G"
R1G"
R0G"
233
R64G
234
V63G
214
R63G
V62G
R62G
V61G
VrefL
De-MUX
111111
111110
000010
000001
000000
V1G
R1G
V0G
R0G
22G
Wi

FIG. 6B

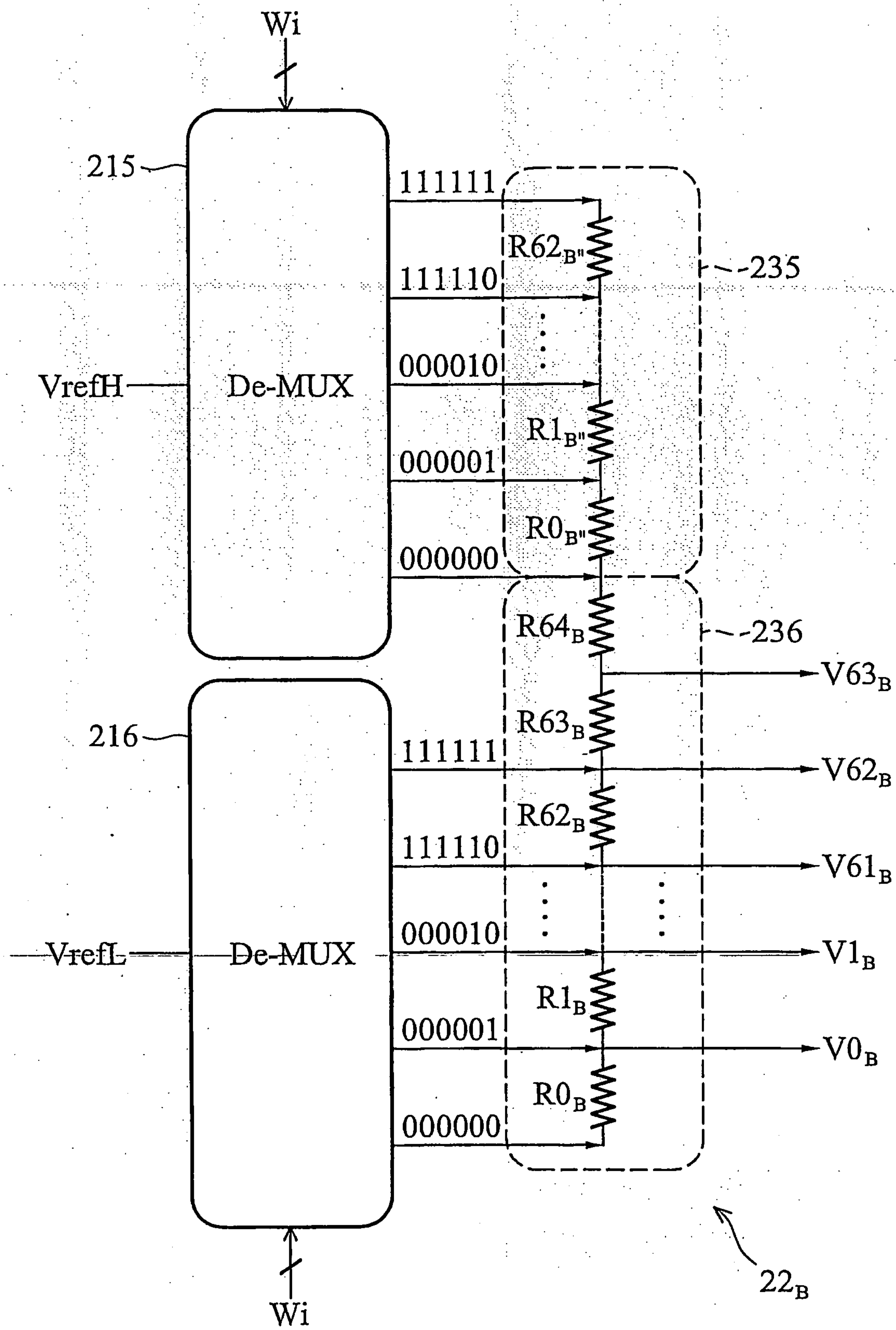
Wi
215
De-MUX
VrefH
111111
111110
000010
000001
000000
R62B"
R1B"
R0B"
235
R64B
236
V63B
216
R63B
111111
V62B
R62B
111110
V61B
VrefL
De-MUX
000010
V1B
R1B
000001
V0B
R0B
000000
Wi
22B

FIG. 6C

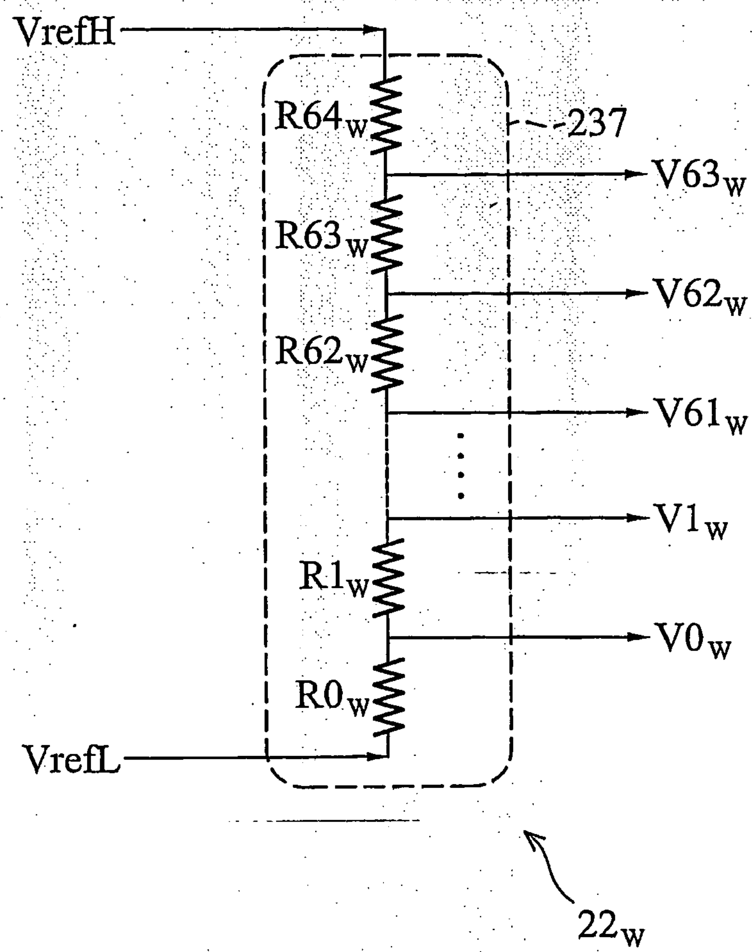
VrefH
R64w
237
V63w
R63w
V62w
R62w
V61w
V1w
R1w
V0w
R0w
VrefL
22w

FIG. 6D

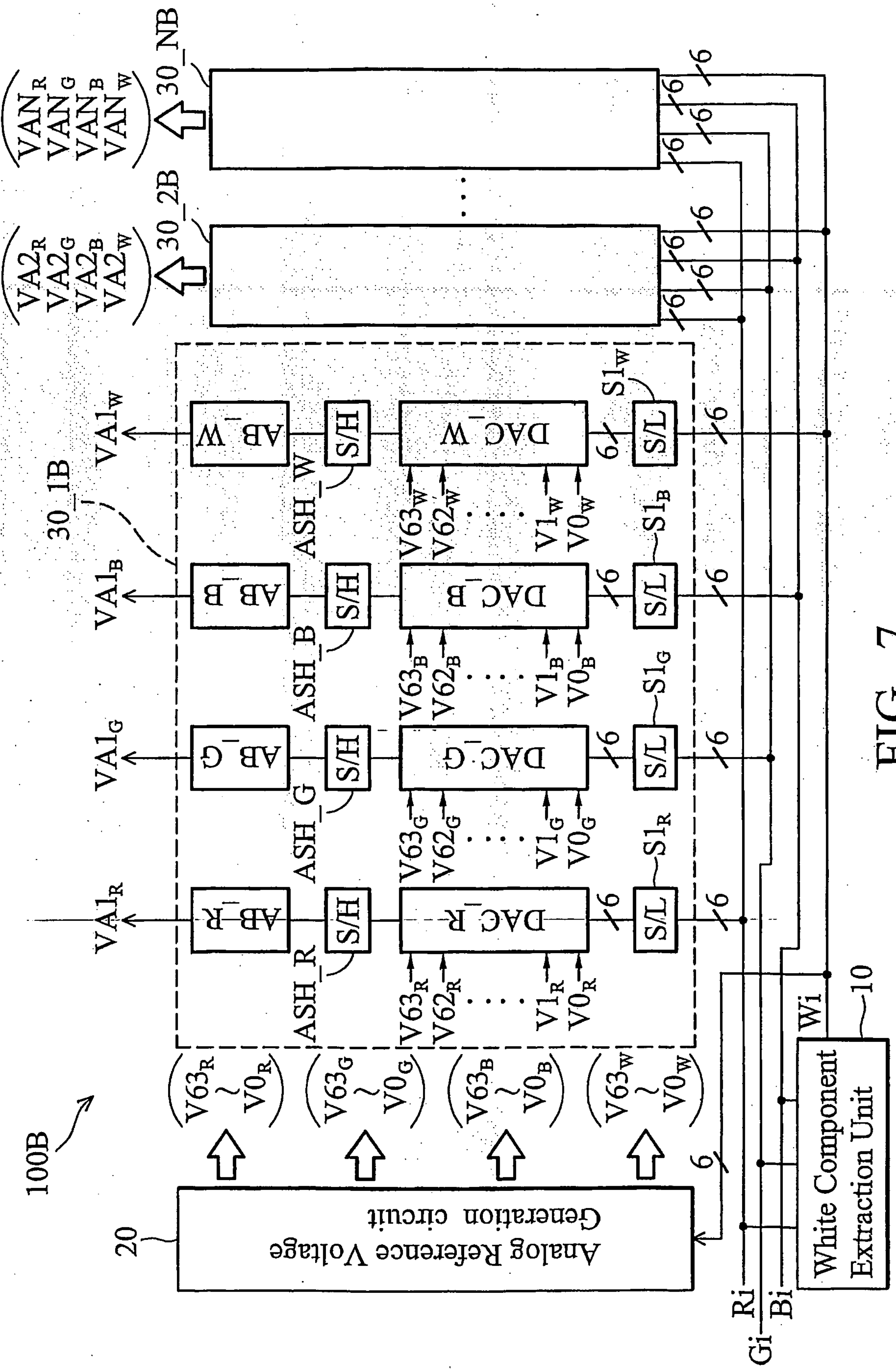
100B
20
Analog Reference Voltage Generation circuit
$V63_R \sim V0_R$
$V63_G \sim V0_G$
$V63_B \sim V0_B$
$V63_W \sim V0_W$
30_1B
30_2B
30_NB
$VA1_R$
$VA1_G$
$VA1_B$
$VA1_W$
$VA2_R$ $VA2_G$ $VA2_B$ $VA2_W$
VAN_R VAN_G VAN_B VAN_W
AB_R
AB_G
AB_B
AB_W
S/H
ASH_R
ASH_G
ASH_B
ASH_W
DAC_R
DAC_G
DAC_B
DAC_W
$V63_R$ $V62_R$ $V1_R$ $V0_R$
$V63_G$ $V62_G$ $V1_G$ $V0_G$
$V63_B$ $V62_B$ $V1_B$ $V0_B$
$V63_W$ $V62_W$ $V1_W$ $V0_W$
S/L
$S1_R$
$S1_G$
$S1_B$
$S1_W$
6
Ri
Gi
Bi
Wi
White Component Extraction Unit
10

FIG. 7

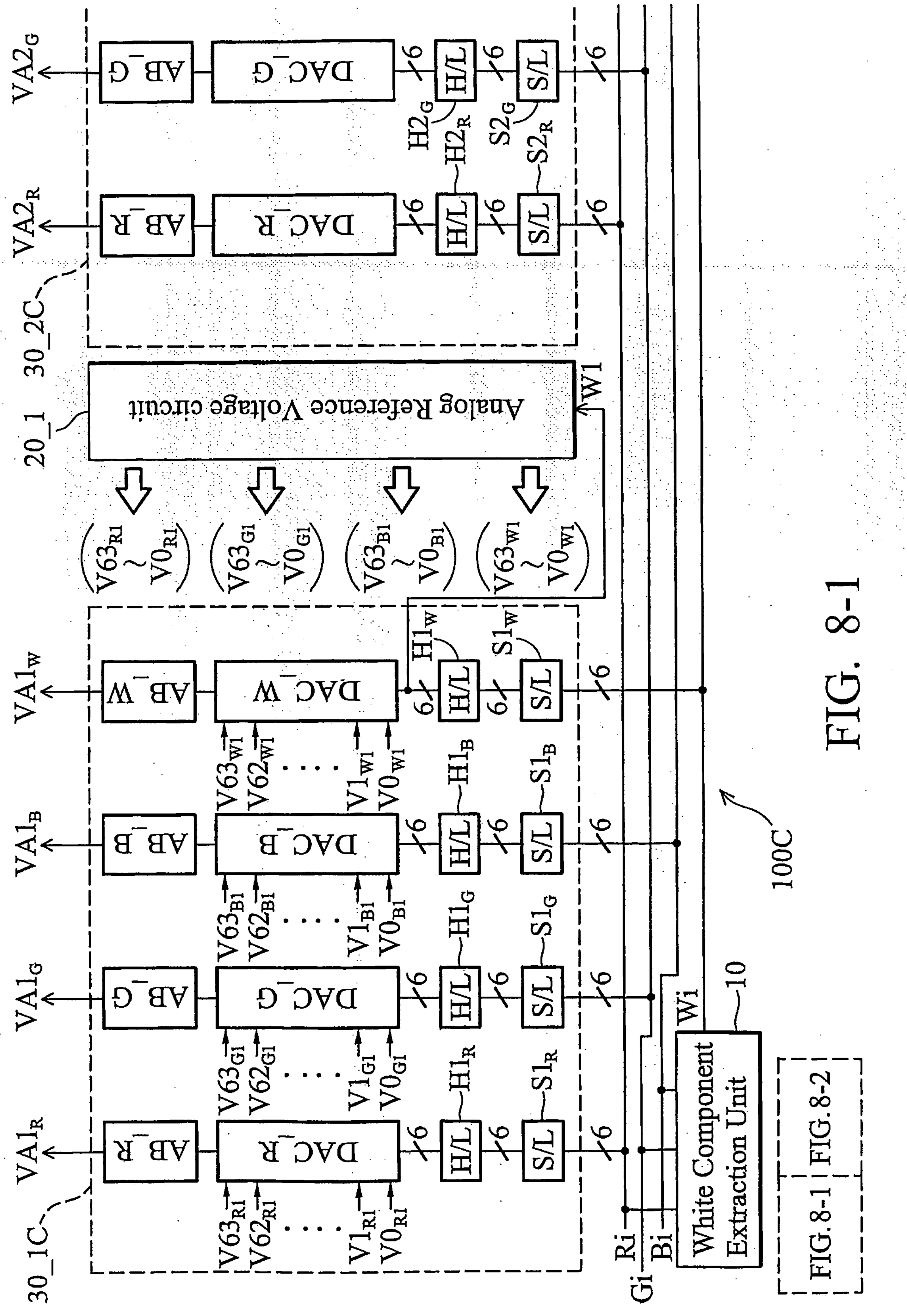
VA2G
VA2R
VA1W
VA1B
VA1G
VA1R
AB_G
DAC_G
AB_R
DAC_R
AB_W
DAC_W
AB_B
DAC_B
H/L
S/L
6
H2G
H2R
S2G
S2R
H1W
S1W
H1B
S1B
H1G
S1G
H1R
S1R
30_2C
20_1
30_1C
Analog Reference Voltage circuit
W1
V63R1 ~ V0R1
V63G1 ~ V0G1
V63B1 ~ V0B1
V63W1 ~ V0W1
V63W1
V62W1
V1W1
V0W1
V63B1
V62B1
V1B1
V0B1
V63G1
V62G1
V1G1
V0G1
V63R1
V62R1
V1R1
V0R1
100C
10
Wi
Ri
Gi
Bi
White Component Extraction Unit
FIG.8-1
FIG.8-2

FIG. 8-1

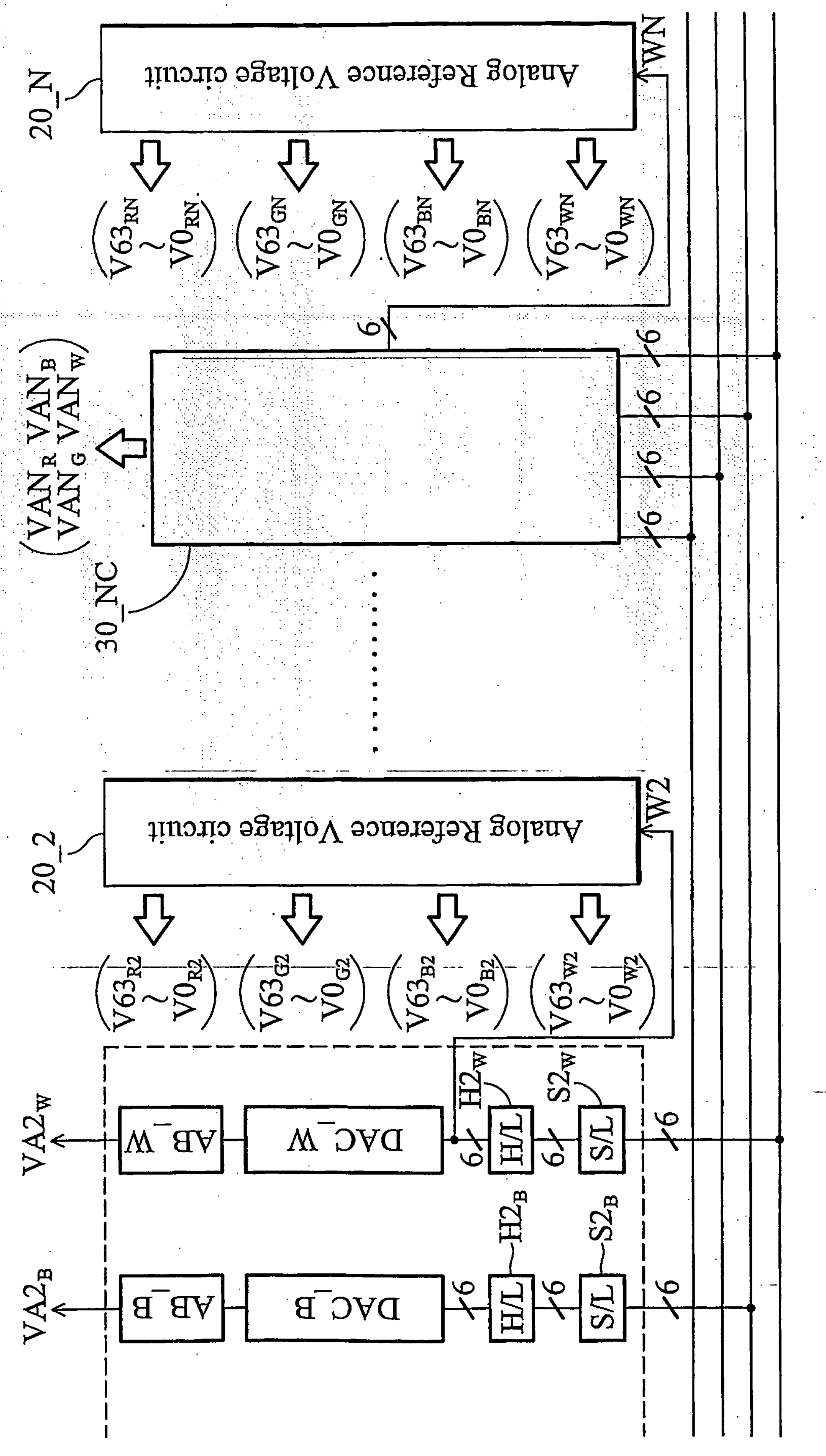
20_N
Analog Reference Voltage circuit
WN
20_2
Analog Reference Voltage circuit
W2
30_NC
VA2_W
VA2_B
AB_W
DAC_W
AB_B
DAC_B
H/L
S/L
H2_W
S2_W
H2_B
S2_B
6

FIG. 8-2

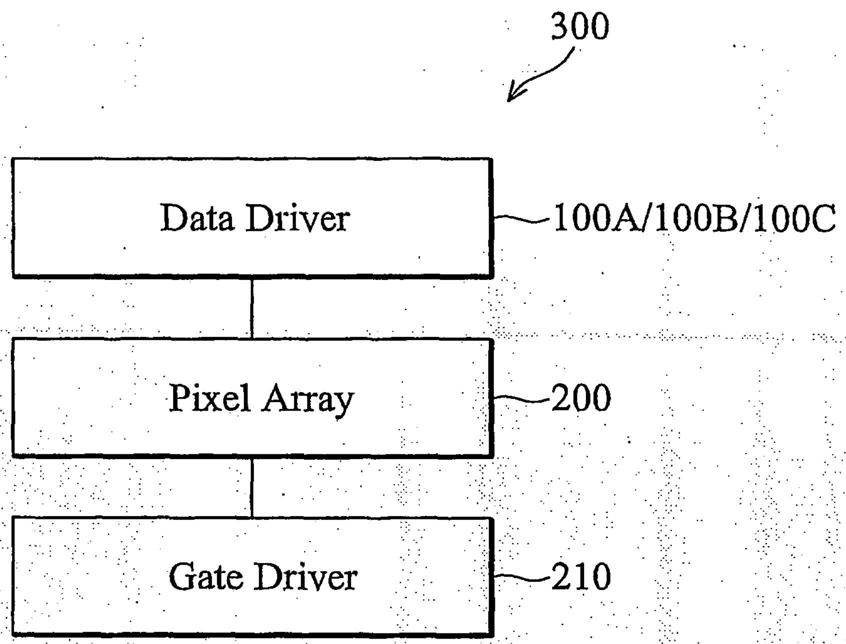
300
Data Driver
100A/100B/100C
Pixel Array
200
Gate Driver
210

FIG. 9

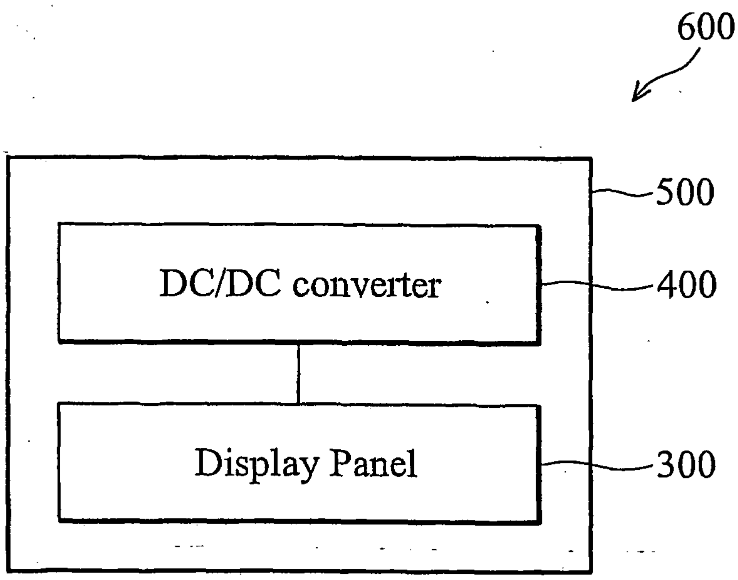
600
500
DC/DC converter
400
Display Panel
300

FIG. 10

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 1298637 A2 **[0011]**
- EP 0547603 A2 **[0012]**
- US 6593934 B1 **[0012]**