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(54) Method and system to quickly fade the luminance of an OLED display

Verfahren und System zum schnellen Fading der Helligkeit einer OLED-Anzeige

Procédé et système pour rapidement réduire la luminosité d'un affichage OLED

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Description**BACKGROUND**

[0001] Mobile devices are incorporating advanced display technology, such as liquid crystal light-emitting diode displays and organic light-emitting diode (OLED) based displays. As the capabilities of the display technology advances so too does the consumer's expectations in terms of functionality and esthetics associated with the display. Consumers demand high quality displays that are capable of fast response and vibrant display. One such capability commonly expected of a mobile device display is the ability to rapidly and smoothly fade or brighten the display in response to user input, programming, or external lighting conditions.

[0002] EP 1962267 discloses an organic light emitting display and method of controlling the same. An active matrix OLED display is driven using data signals (D1-Dm), scan signals (S1-Sm) and emission control signals (EM1-EMn) and comprises a control system including a first through fourth controller (400,500,600,700). The first controller (400) selects a gamma value in accordance with ambient illumination and outputs corresponding gamma gradation voltages to the data driver (300). The second controller (500) compares the ambient illumination level with a reference value to generate a selection signal (Ssel), and provides either luminance/saturation changed or unchanged image data (R'G'B' Data) to the data driver (300) in accordance with the selection signal (Ssel). The third controller (600) extracts characteristics of the input image data to determine and apply a scaling factor to the input image data (RGB Data), and outputs scaled image data (R"G"B" Data) to the data driver (300). The fourth controller (700) controls the pulse width of the emission control signals in accordance with the overall image brightness. The disclosure aims at reducing power consumption and improving the visibility in bright ambient environments.

[0003] Aspects of the invention are defined in the accompanying independent claims.

BRIEF DESCRIPTION OF THE DRAWINGS**[0004]**

FIG. 1 is a block diagram illustrating a portion of an OLED driver circuit, according to an example embodiment.

FIG. 2 is a block diagram of a section of an OLED driver IC, according to an example embodiment.

FIG. 3 is a block diagram illustrating a system for rapidly fading the luminance of an OLED display, according to an example embodiment.

FIG. 4 is a flowchart illustrating an example method for varying the illumination output of an OLED display according to a luminance scaling signal, according to an example embodiment.

FIG. 5 is a flowchart illustrating an example method of varying the luminance of an OLED display, according to an example embodiment.

FIG. 6 is a flowchart illustrating an example method of varying the luminance of an OLED display based on receiving a triggering event, according to an example embodiment.

FIG. 7 is a block diagram depicting a mobile device, according to an example embodiment.

DETAILED DESCRIPTION

[0005] In the following description, numerous specific details are set forth in order to provide a thorough understanding of example embodiments. It is to be understood, however, that the various embodiments may be practiced without these specific details. For example, logical, electrical and structural changes may be made without departing from the spirit and scope of the present subject matter. The following detailed description is, therefore, not to be taken in a limiting sense.

[0006] Methods and systems to quickly fade the luminance of an organic light-emitting diode (OLED) display panel are described. Embodiments described herein are directed to mobile device OLED display driver circuits that provide for efficient variable control over output brightness (luminance) through a single input. However, the concepts discussed herein are applicable to any OLED display (e.g., computer monitor, television). Mobile devices that utilize an OLED display can include cell phones, personal digital assistants (PDAs), smartphones, and tablet-style computers, among others. In an example, control over OLED luminance can be accomplished through the use of a scaling register associated with the gamma values programmed to control per pixel output within the OLED display. Gamma values refer to gamma correction used to code and decode luminance values in graphic display systems (e.g., video or still image electronic displays, such as a computer monitor or mobile device screen).

[0007] A mobile device can use a variety of display technologies, such as a liquid crystal display (LCD). Some mobile devices use an LCD-type display that includes a backlight or an active array of transistors (e.g., an active thin-film transistor matrix, or the like), or both, to control each pixel in the display. Backlit LCD displays can provide for fast response times and vibrant displays desired by today's mobile device consumer. Backlit LCD displays allow for rapid

variations in display luminance simply by varying the output of the backlights. However, LCDs including a backlight or an active transistor matrix, or both, can have high power demands, thus shortening battery life of the mobile device.

[0008] OLED display technology is rapidly gaining ground versus LCDs for use in mobile devices due to the potential for improved power efficiency, improved color reproduction, and potential for thinner displays. Additionally, OLED displays can achieve faster response rates, achieve higher contrast levels, and produce higher saturated color reproduction. Unlike traditional LCD technology that requires a backlight to illuminate the display, OLED pixels are self-emissive (i.e. produce their own light). An OLED is an LED whose emissive electroluminescent layer can be composed of a thin-film of organic compounds capable of producing light when an electrical current is passed through it. OLEDs are capable of greater contrast ratios, thinner packaging, and deeper black levels, when compared to traditional LCD displays. However, fading or controlling the brightness of an OLED display can be more complicated than with LCD displays. As mentioned above, LCD displays are typically backlit; thus, varying the output level is a matter of varying the backlight.

[0009] Within a traditional LCD display, varying the output brightness can be accomplished by a backlight driver integrated circuit (IC). Typical driver ICs can use a pulse-width modulated (PWM) signal to vary the power delivered to the LEDs and thus vary the output brightness. Because OLEDs are self-emissive and depend upon programmed gamma values to map pixel input values to output voltages (e.g., to maintain color balance), current OLED driver ICs cannot effectively utilize a similar PWM signal to directly control brightness. Currently available driver ICs for OLEDs require reprogramming of the gamma values (e.g., reprogramming a look-up table mapping input values to output voltages) to change the brightness (luminance) of the OLEDs in a controlled manner. Reprogramming of the gamma values used for mapping digital input values to output voltages can require additional command traffic over a control interface, additional storage of pre-programmed gamma value mappings, or both.

[0010] FIG. 1 is a block diagram illustrating a portion of an OLED driver circuit, according to an example embodiment. In an example, a circuit 100 can include a pixel input 110, a splitter 120, gamma adjustment circuits 130A, 130B, 130N (collectively referred to as gamma adjustment circuits 130), and pixel-level voltage outputs 140A, 140B, and 140N (collectively referred to as pixel-level voltage outputs 140). In this example, the pixel input 110 can be a 24-bit value containing information to address an RGB (red, green, and blue) color space pixel. In another example, the pixel input 110 can be an 8-bit value containing information to address a grey-scale (0-254) pixel. In yet another example, the pixel input 110 can be a 32-bit (or greater) value containing information to address a CMYK (cyan, magenta, yellow, and key black) color space pixel.

[0011] In the example illustrated by FIG. 1, the splitter 120 can receive a 24-bit RGB color space pixel and divide the pixel input 110 into three individual 8-bit color values (e.g., 8-bit red value 122, 8-bit green value 124, and 8-bit blue value 126). In this example, the splitter 120 can pass the individual color components to associated gamma adjustment circuits 130. The gamma adjustment circuits 130 can map the individual color components into analog pixel-level voltage outputs 140. In some examples, the gamma adjustment circuits 130 can use look-up tables (LUTs) to map between input and output values. In other examples, the gamma adjustment circuits 130 can use circuit elements to transform input values into desired output values. The pixel-level voltage outputs 140 can be used to drive an individual pixel to emit light associated with the pixel input 110. In the example illustrated by FIG. 1, varying (or fading) the luminance of the OLED display requires reprogramming of the gamma adjustment circuits 130. Varying the luminance or intensity of light emitted by a display is often referred to as fading the display.

[0012] In an example embodiment, an OLED driver IC can be configured to accept a single scaling input that can be used to rapidly vary the brightness (luminance) output of an OLED display. The single scaling input can be either digital or analog (e.g., PMW signal). The OLED driver IC can use the scaling input to attenuate the gamma-adjusted voltage. For example, the scaling input can be applied to attenuate the gamma-adjusted voltage after the pixel input has been mapped by a gamma adjustment portion of the OLED driver IC. The use of a scaling input to enable rapid adjustment of the luminance of an OLED display is discussed further below in reference to FIGs. 2 - 6.

[0013] FIG. 2 is a block diagram of a section of an OLED driver IC, according to an example embodiment. In an example, a circuit 200 can include a pixel input 205, a luminance scaling input 210, a gamma block 220, a scaler circuit 240, and an output 250. In certain examples, the gamma block 220 and the scaler circuit 240 can be integrated into a voltage mapping circuit 215. In an example, the pixel input 205 can be a digital signal including eight (8) or more bits of data. In this example, the pixel input 205 is a 24-bit digital signal representing an RGB color space pixel value. In an example, the luminance scaling input 210 can be a digital or analog input that can be converted into a value between zero (0) and one (1) by the scaler circuit 240. In this example, the luminance scaling input is an 8-bit digital input. In another example, the luminance scaling input can be a PMW signal. In certain examples, the luminance scaling input 210 is programmable. In an example, the luminance scaling input 210 can be provided by a programmable processor, such as a processor within a mobile device. In this example, the programmable processor can vary the luminance scaling input 210 over a range that when converted is smaller than between zero (0) and one (1) (e.g., between .5 and 1). Varying the luminance scaling input 210 over a smaller range can result in quickly scaling the luminance uniformly across an OLED display above a threshold (i.e. minimum level of brightness). Other programmatic manipulation of the luminance scaling input 210 can produce various rapid uniform changes to the luminance across an OLED display. In some

examples, the luminance scaling input is referred to as a scaling factor.

[0014] In an example, the circuit 200 includes a gamma block 220 that can be used to map pixel input 205 into a representative pixel-level analog voltage. The pixel-level analog voltage can be used to drive a pixel within an OLED display. In an example, the gamma block 220 contains a look-up table (LUT) with a fixed number of entities to map from a digital input signal to an analog output voltage level. In this example, the gamma block 220 contains a LUT with eight (8) voltage mappings (e.g., 225A - 225N). In this example, the LUT is configured to directly map digital input values of 0, 1, 32, 80, 172, 220, 254, and 255 to corresponding pixel-level analog voltage values. In this example, the gamma block 220 can interpolate digital values that fall between the directly mapped values. Interpolation ranges are depicted within FIG. 2 by ranges 230A - 230N. In an example, the gamma block 220 can use a linear interpolation to map the voltage of a value between directly mapped values. In another example, the gamma block 220 can simply round up or down to the nearest directly mapped value when interpolating inputs that fall between directly mapped values. In certain examples, the gamma block 220 can include a LUT with two-hundred and fifty five (255) directly mapped values, eliminating the need to interpolate for a given 8-bit input value.

[0015] In the example depicted by FIG. 2, the gamma block 220 outputs a mapped pixel-level voltage to a scaler circuit 240 (also referred to as a scaling circuit in some examples). In an example, the scaler circuit 240 can multiply the pixel-level voltage by the luminance scaling input 210 to reduce (fade) the pixel-level output voltage sent to the output 250. In an example, the luminance scaling input 210 can be interpreted by the scaler circuit 240 as a value between zero (0) and one (1). A value of one (1) will result in a full brightness (maximum luminance) output from the addressed pixel within the OLED display. A value of zero (0) can result in the addressed pixel being turned off (e.g., faded to zero luminance). Varying the luminance scaling input 210 between zero (0) and one (1) can result in the OLED display pixel varying between zero (0) output and full luminance.

[0016] In one example, the scaler circuit 240 can use the following equation to scale the output voltage:

$$V_{out_X} = (L/L_{max}) * \text{Gamma_LUT}[X(7:0)]$$

In the scaling equation, V_{out_X} represents the scaled pixel-level output voltage. L represents the luminance scaling input 210, L_{max} represents the maximum value that can be input for the luminance scaling input 210, and Gamma_LUT represents the mapped pixel-level voltage for a given pixel input, such as pixel input 205 (e.g., $X(23:0)$, which is an 24-bit digital input in this example.). This equation allows for the scaling input 210 to be interpreted as any value less than the maximum allowable scaling input. For example, $L(7:0)$ is an 8-bit digital scaling input value that can vary between 0 and 254, with 254 being the maximum allowable scaling input (L_{max}).

[0017] FIG. 3 is a block diagram illustrating a system 300 for rapidly fading the luminance of an OLED display. In an example, the system 300 includes an image source 305, a scaling source 306, a luminance event source 308, a display driver circuit 310, and a display device 350. In one example, the display driver circuit 310 includes a scaling input 312, an image input 314, one or more gamma registers 320, a multiplier 330, an event input 335, and an output 340. In this example, the scaling input 312 can receive either a digital signal or a PWM analog signal from the scaling source 306. The scaling source 306 can include a general purpose processor or a dedicated ambient light control circuit. In certain examples, the general purpose processor can be programmed to provide scaling signals to the scaling input 312 in response to programmatic events. In some example, the general purpose processor can be programmed to provide scaling signals to the scaling input 312 in response to inputs received through a user interface displayed on the OLED display.

[0018] In the example depicted in FIG. 3, the image input 314 is coupled to the image source 305. The image source 305 can include dedicated or general purpose device memory accessed by a dedicated graphics processor or a general purpose device processor. In an example, the image source 305 can provide a stream of digital data addressed to individual pixels within the display device 350.

[0019] In an example, the gamma registers 320 can include one or more LUTs configured to map the digital pixel data received over the image input 314 into pixel-level voltages used to drive the individual pixels within the display device 350. In one example, the gamma registers 320 can include three LUTs (325A, 325B, and 325N), which can be used to map digital pixel data in an RGB color space (e.g., an 8-bit red value, an 8-bit green value, and an 8-bit blue value). In an example, the output of the gamma registers 320 can be operated on by the multiplier 330. The multiplier 330 can use the scaling input 312 to scale the output of the gamma registers 320 according to the desired luminance level (represented by the scaling input 312).

[0020] In an example, the display driver circuit 310 can be structured to bypass the gamma registers 320 and pass the image source 305 data received by the image input 314 directly to the multiplier 330. In this example, the multiplier 330 can include circuitry structured to convert the image source 305 data into pixel-level voltages as well as scaling the pixel-level voltages according to the scaling input 312.

[0021] In certain examples, the multiplier 330 can be activated when a luminance event is received at the event input 335 from the luminance event source 308. The luminance event source 308 can include a general purpose processor or a user activated switch, among other structures. In an example, a general purpose processor can include programming that triggers luminance events in response to user input or other programming, such as a low battery power indication. In these examples, the multiplier 330 applies the scaling input 312 in response to receiving a luminance event from the event input 335.

[0022] FIG. 4 is a flowchart illustrating an example method 400 for varying the illumination output of an OLED display according to a luminance scaling signal. In an example, the method 400 includes operations for receiving a luminance scaling signal (410), receiving a first pixel input signal (420), determining a first pixel output voltage (430), scaling the first pixel output voltage (440), and outputting the scaled first pixel output voltage (450). In one example, the method 400 can begin at operation 410, with respect to system 300 of Figure 3, with the display driver circuit 310 receiving a luminance scaling signal on the scaling input 312. In certain examples, the scaling input 312 is configured to receive a digital input that can be used to scale the luminance of an OLED panel. In some examples, the scaling input 312 can be configured to receive a PWM signal that can be used by the display driver circuit 310 to vary the luminance of an OLED display.

[0023] At operation 420, the method 400 continues with the display driver circuit 310 receiving a first pixel input signal on the image input 314. At operation 430, the method 400 continues with the display driver circuit 310 determining a first pixel output voltage based on the first pixel input signal. In an example, the display driver circuit 310 communicates the first pixel input signal into the gamma registers 320, which can include one or more LUTs used to map the pixel input signal to an appropriate output voltage. At operation 440, the method 400 continues with the display driver circuit 310 scaling the first pixel output voltage. In an example, the display driver circuit 310 can use the multiplier 330 to scale the first pixel output voltage according to the luminance scaling signal received on the scaling input 312. At operation 450, the method 400 can conclude with the display driver circuit 310 outputting a scaled first pixel output voltage to the display device 350. In an example, the display driver circuit 310 can send the scaled first pixel output voltage to the display device 350 via an output 340.

[0024] FIG. 5 is a flowchart illustrating an example method 500 of varying the luminance of an OLED display. As discussed above, an image source, such as image source 305, can consist of a stream of pixel values that include red, green, and blue components (or portions). In an example, the image source can provide a 24-bit value that contains three (3) 8-bit values representing red, blue, and green portions of each pixel. The method 500 provides an example of scaling individual color component output voltages (e.g., in an RGB color space, output of scaled red, green, and blue output voltages). In an example, the method 500 includes operations for receiving a luminance scaling signal (505), receiving a first pixel input signal (510), separating color components of the first pixel input signal (515), determining a red pixel component voltage (520), determining a green pixel component voltage (540), determining a blue pixel component voltage (560), scaling the red pixel component voltage (525), scaling the green pixel component voltage (545), scaling the blue pixel component voltage (565), outputting the scaled red pixel component voltage (530), outputting the scaled green pixel component voltage (550), and outputting the scaled blue pixel component voltage (570). Example method 500 can be described with respect to example system 300 of Figure 3.

[0025] At operation 505, the method 500 begins with the display driver circuit 310 receiving a luminance scaling signal over the scaling input 312. At operation 510, the method 500 continues with the display driver circuit 310 receiving a first pixel input signal over the image input 314. In this example, the first pixel input signal is a 24-bit RGB color space pixel value that includes 8-bits of data for the red, green, and blue components of a single pixel. In some examples, the first pixel input signal can include a stream of pixel data that is processed by the display driver circuit 310 in a similar fashion.

[0026] At operation 515, the method 500 continues with the display driver circuit 310 separating the color components (e.g., red, green, and blue) for further processing. The remaining operations of the method 500 can be performed in parallel or sequentially depending upon the configuration of the display driver circuit 310 and associated hardware. In certain examples, the gamma registers 320 include individual registers associated with each color component (325A, 325B, 325N). In an example, the display driver circuit 310 can include multiple multipliers, such as multiplier 330, to assist in parallel processing of a signal color pixel input signal.

[0027] At operation 520, the method 500 continues with the display driver circuit 310 determining a red pixel component voltage. In an example, the display driver circuit 310 can use the gamma registers 320 to map the red component of the first pixel input signal to the red pixel component voltage. At operation 525, the method 500 continues with the display driver circuit 310 scaling the red pixel component voltage according to the luminance scaling signal. In an example, the display driver circuit 310 can use the multiplier 330 to scale the red pixel component voltage. At operation 530, the method 500 continues with the display driver circuit 310 outputting the scaled red pixel component voltage to a pixel on the display device 350.

[0028] Operations 540 through 570 of method 500 mirror operations 520 - 530 for the green and blue components of the first pixel input signal. The method 500 concludes by outputting three discrete voltage signals representing the red, green, and blue components of the first pixel input signal to the display device 350. In an example, the three voltage

signals are sent to the display device 350 simultaneously.

[0029] FIG. 6 is a flowchart illustrating an example method 600 of varying the luminance of an OLED display based on receiving a triggering event, according to an example embodiment. The method 600 includes operations for receiving an image input signal (610), determining per pixel output voltages for the image input signal (620), determining whether a scaling event has been received (630), reading a luminance scaling signal (640), scaling the per pixel output voltages (650), and outputting the per pixel output voltages (660). Example method 500 can be described with respect to example system 300 of Figure 3.

[0030] The method 600 begins at operation 610 with the display driver circuit 310 receiving an image input signal over the image input 314. In an example, the image input signal is received from an image source 305. At operation 620 the method 600 continues with the display driver circuit 310 determining per pixel output voltages for the image input signal received by image input 314. In an example, the display driver circuit 310 can use the gamma registers 320 to map each pixel within the image input signal to an associated pixel output voltage. In certain examples, the image input signal can represent a still image to be displayed on the OLED display. In some examples, the image input signal can represent a dynamic image (e.g., video feed or graphical user-interface) sampled at a certain frequency, such as 60 Hz.

[0031] At operation 630, the method 600 continues with the display driver circuit 310 determining whether a scaling event has been received over event input 335. In an example, the scaling event can be used by the display driver circuit 310 to enable or disable scaling of the per pixel output voltages. Scaling of the per pixel output voltages can result in rapidly fading the luminance of the OLED display. If no scaling event has been received by the display driver circuit 310, the method 600 concludes at operation 660 with the display driver circuit 310 outputting the non-scaled per pixel output voltages over the output 340 to the display device 350.

[0032] If a scaling event has been received the method 600 continues at operation 640 with the display driver circuit 310 reading the luminance scaling signal received on the scaling input 312. At 650, the method 600 continues with the display driver circuit 310 using the scaling signal to scale the per pixel output voltages. In some examples, the scaling can be done incrementally over multiple scans of the image input signal to create a smooth effect on the OLED display. For example, when a scaling event is received the display driver circuit 310 can incrementally scale the per pixel output voltages over a certain number of scans of the 60 Hz input image signal, such as over 30 scans. This example would result in the luminance of the display fading smoothly over a half second period of time. At 660, the method 600 concludes with the display driver circuit outputting the scaled per pixel output voltages to the display device 350 via output 340.

[0033] FIG. 7 is a block diagram depicting a mobile device 700 according to an example embodiment. In an example, the mobile device 700 includes a processing unit 702, memory 704, removable storage 712, non-removable storage 714, display 722, and display driver 728. The processing unit 702 may include one or more processing units or may include one or more multiple-core processing units. Memory 704 may include volatile memory 706 and non-volatile memory 708. Mobile device 700 may include a variety of device-readable media, such as volatile memory 706 and non-volatile memory 708, removable storage 712 and non-removable storage 714. The storage may include random access memory (RAM), read-only memory (ROM), erasable programmable read-only memory (EPROM) and electrically erasable programmable read-only memory (EEPROM), flash memory or other memory technologies, or any other medium capable of storing machine-readable instructions and data that may be present in a mobile electronic device. Mobile device 700 may include input 716, output 718, and a communication connection device 720.

[0034] The mobile device 700 typically operates in a networked environment using the communication connection device 720 to connect to one or more networks, such as a wireless telephone network. Through the communication connection device 720, the mobile device 700 may connect to one or more remote computers. The remote computer may include a personal computer (PC), server, router, network PC, a peer device, or other common network input, or the like. The communication connection device 720 may connect to various network types that may include a wireless telephone network, a Local Area Network (LAN), a Wide Area Network (WAN), the Internet, a proprietary subscription-based network, or other networks. The mobile device 700 also may include wireless telephone capabilities to provide voice telephone service via a wireless telephone network.

[0035] Machine-readable instructions stored on a machine-readable medium are executable by the processing unit 702 of the mobile device 700. The memory 704, removable storage 712, and non-removable storage 714 are examples of articles including a machine-readable medium. For example, a program with instructions that may be stored in memory 704 and when executed by the processing unit 702 can cause the mobile device 700 to perform one or more of the methods described herein. Other programs may also be stored on a machine-readable medium, such as a browser application providing web browsing functionality for the mobile device 700.

[0036] Method examples described herein can be machine or computer-implemented, at least in part. Some examples can include a computer-readable medium or machine-readable medium encoded with instructions operable to configure an electronic device to perform methods as described in the above examples. An implementation of such methods can include code, such as microcode, assembly language code, a higher-level language code, or the like. Such code can include computer-readable instructions for performing various methods. The code may form portions of computer program products. Further, the code may be stored on one or more volatile or non-volatile computer-readable media during

execution or at other times. These computer-readable media may include, but are not limited to, hard disks, removable magnetic disks, removable optical disks (e.g., compact disks and digital video disks), magnetic cassettes, memory cards or sticks, random access memories (RAMs), read-only memories (ROMs), and the like.

[0037] The above detailed description includes references to the accompanying drawings, which form a part of the detailed description. The drawings show, by way of illustration, specific embodiments in which the subject matter can be practiced. These embodiments are also referred to herein as "examples." Such examples can include elements in addition to those shown and described. However, the present inventors also contemplate examples in which only those elements shown and described are provided. It will be readily understood to those skilled in the art that various other changes in the details, material, and arrangements of the parts and method stages which have been described and illustrated herein may be made without departing from the principles of the inventive subject matter.

[0038] In this document, the terms "a" or "an" are used, as is common in patent documents, to include one or more than one, independent of any other instances or usages of "at least one" or "one or more." In this document, the term "or" is used to refer to a nonexclusive or, such that "A or B" includes "A but not B," "B but not A," and "A and B," unless otherwise indicated. In the appended claims, the terms "including" and "in which" are used as the plain-English equivalents of the respective terms "comprising" and "wherein." Also, in the following claims, the terms "including" and "comprising" are open-ended, that is, a system, device, article, or process that includes elements in addition to those listed after such a term in a claim are still deemed to fall within the scope of that claim. Moreover, in the following claims, the terms "first," "second," and "third," etc. are used merely as labels, and are not intended to impose numerical requirements on their objects.

Claims

1. An organic light emitting diode, OLED, display driver circuit (310) comprising:

a first input (312) to receive a luminance scaling signal representing a scaling value between 0 and 1;
 a second input (314) to receive an image input signal, the image input signal including a digital representation of a desired output for a pixel within an OLED display;
 a gamma register (320) coupled to the second input to map the digital representation of a desired output for the pixel to a pixel-level output voltage;
 and
 a luminance scaling circuit (330) to multiply the pixel-level output voltage from the gamma register (320), corresponding to the image input signal, by the scaling value.

2. The OLED display driver circuit (310) of claim 1, wherein the luminance scaling signal is a pulse-width modulated signal.

3. The OLED display driver circuit (310) of any one of claims 1 and 2, wherein the second input is structured to receive an image input signal representing a gray-scale pixel value.

4. The OLED display driver circuit (310) of any one of claims 1 through 3, in which the gamma register (320) contains a look-up table, the look-up table being configured to map the digital representation of a desired output for the pixel to the pixel-level output voltage.

5. The OLED display driver circuit (310) of claim 4, wherein the second input is structured to receive an image input signal representing a color pixel value, the image input signal including a first component representing red, a second component representing green, and a third component representing blue.

6. The OLED display driver circuit (310) of claim 5, wherein the look-up table is associated with each of the first component, the second component, and the third component of the image input signal representing the color pixel value.

7. The OLED display driver circuit (310) of any one of claims 4 through 6, wherein the gamma register (320) is structured to map:

an 8-bit value representing a red portion of the digital representation of the desired output for the first pixel to a first pixel-level output voltage;
 an 8-bit value representing a green portion of the digital representation of the desired output for the first pixel

to a second pixel-level output voltage; and

an 8-bit value representing a blue portion of the digital representation of the desired output for the first pixel to a third pixel-level output voltage.

8. The OLED display driver circuit (310) of claim 7, wherein the luminance scaling circuit is to scale the first, second, and third pixel-level output voltages using the scaling value.

9. A method at a driver circuit (310) for controlling an organic light emitting diode, OLED, display, the driver circuit (310) comprising a first input (312), a second input (314), a gamma register (302) coupled to the second input (314), and a luminance scaling circuit (330), the method comprising:

receiving (410), at the first input (310), a luminance scaling signal representing a scaling value between 0 and 1; receiving (420), at the second input (314), an image input signal, the image input signal including a digital representation of a desired output for a pixel within the OLED display;

determining (430), at the gamma register (320), a pixel-level output voltage from the image input signal by mapping the digital representation of a desired output for the pixel to a pixel-level output voltage;

scaling (440), at the luminance scaling circuit (330), the pixel-level output voltage determined by the gamma register (320) using the scaling value to produce a scaled pixel output voltage; and outputting (450) the scaled pixel output voltage.

10. The method of claim 9, wherein the gamma register (320) includes a look-up table, and wherein said determining (430) the pixel-level output voltage from the image input signal includes using the look-up table, the look-up table including gamma values that map digital pixel input signals to pixel-level output voltages.

11. The method of claim 9 or claim 10, wherein the luminance scaling signal is a pulse-width modulated signal.

12. The method of any one of claims 9 through 11, wherein receiving the image input signal includes receiving an image input signal representing a color pixel value, the image input signal including a first component addressing a red portion of a pixel, a second component addressing a green portion of the pixel, and a third component addressing a blue portion of the pixel.

13. A system comprising:

a processor (702) coupled to a memory circuit (704);

an organic light emitting diode, OLED, display (350) including a plurality of individually addressable pixels;

an OLED display driver circuit (310) according to any of claims 1 to 8, the OLED display driver circuit (310) being coupled to the OLED display (350).

Patentansprüche

1. Ansteuerungsschaltkreis (310) für eine organische lichtemittierende Diodenanzeige, OLED-Anzeige, umfassend:

einen ersten Eingang (312) zum Empfangen eines Leuchtdichteskalierungssignals, das einen Skalierungswert zwischen 0 und 1 repräsentiert;

einen zweiten Eingang (314) zum Empfangen eines Bildeingabesignals, wobei das Bildeingabesignal eine digitale Darstellung einer gewünschten Ausgabe für ein Pixel innerhalb einer OLED-Anzeige enthält;

ein Gamma-Register (320), das an den zweiten Eingang gekoppelt ist, um die digitale Darstellung einer gewünschten Ausgabe für das Pixel auf eine Ausgangsspannung auf Pixelebene abzubilden;

und

einen Leuchtdichteskalierungsschaltkreis (330), um die Ausgangsspannung auf Pixelebene vom Gamma-Register (320), die dem Bildeingabesignal entspricht, mit dem Skalierungswert zu multiplizieren.

2. OLED-Anzeigeansteuerungsschaltkreis (310) nach Anspruch 1, wobei das Leuchtdichteskalierungssignal ein pulswertenmoduliertes Signal ist.

3. OLED-Anzeigeansteuerungsschaltkreis (310) nach einem der Ansprüche 1 und 2, wobei der zweite Eingang strukturiert ist, um ein Bildeingabesignal zu empfangen, das einen Grauskalenpixelwert repräsentiert.

4. OLED-Anzeigeansteuerungsschaltkreis (310) nach einem der Ansprüche 1 bis 3, wobei das Gamma-Register (320) eine Nachschlagetabelle beinhaltet, wobei die Nachschlagetabelle ausgelegt ist, die digitale Darstellung einer gewünschten Ausgabe für das Pixel auf die Ausgangsspannung auf Pixelebene abzubilden.

5. OLED-Anzeigeansteuerungsschaltkreis (310) nach Anspruch 4, wobei der zweite Eingang strukturiert ist, ein Bildeingabesignal zu empfangen, das einen Farbpixelwert repräsentiert, wobei das Bildeingabesignal eine erste Komponente, die rot repräsentiert, eine zweite Komponente, die grün repräsentiert, und eine dritte Komponente enthält, die blau repräsentiert.

6. OLED-Anzeigeansteuerungsschaltkreis (310) nach Anspruch 5, wobei die Nachschlagetabelle mit jeder der ersten Komponente, der zweiten Komponente und der dritten Komponente des Bildeingabesignals assoziiert ist, das den Farbpixelwert repräsentiert.

7. OLED-Anzeigeansteuerungsschaltkreis (310) nach einem der Ansprüche 4 bis 6, wobei das Gamma-Register (320) strukturiert ist, abzubilden:

einen 8-Bit-Wert, der einen roten Abschnitt der digitalen Darstellung der gewünschten Ausgabe für das erste Pixel repräsentiert, auf eine erste Ausgangsspannung auf Pixelebene;
einen 8-Bit-Wert, der einen grünen Abschnitt der digitalen Darstellung der gewünschten Ausgabe für das erste Pixel repräsentiert, auf eine zweite Ausgangsspannung auf Pixelebene; und
einen 8-Bit-Wert, der einen blauen Abschnitt der digitalen Darstellung der gewünschten Ausgabe für das erste Pixel repräsentiert, auf eine dritte Ausgangsspannung auf Pixelebene.

8. OLED-Anzeigeansteuerungsschaltkreis (310) nach Anspruch 7, wobei der Leuchtdichteskalierungsschaltkreis die erste, zweite und dritte Ausgangsspannung auf Pixelebene unter Verwendung des Skalierungswerts zu skalieren hat.

9. Verfahren an einem Ansteuerungsschaltkreis (310) zum Steuern einer organischen lichtemittierenden Diodenanzeige, OLED-Anzeige, wobei der Ansteuerungsschaltkreis (310) einen ersten Eingang (312), einen zweiten Eingang (314), ein Gamma-Register (302), das an den zweiten Eingang (314) gekoppelt ist, und einen Leuchtdichteskalierungsschaltkreis (330) umfasst, wobei das Verfahren umfasst:

Empfangen (410), am ersten Eingang (310), eines Leuchtdichteskalierungssignals, das einen Skalierungswert zwischen 0 und 1 repräsentiert;
Empfangen (420), am zweiten Eingang (314), eines Bildeingabesignals, wobei das Bildeingabesignal eine digitale Darstellung einer gewünschten Ausgabe für ein Pixel innerhalb der OLED-Anzeige enthält;
Ermitteln (430), am Gamma-Register (320), einer Ausgangsspannung auf Pixelebene aus dem Bildeingabesignal durch Abbilden der digitalen Darstellung einer gewünschten Ausgabe für das Pixel auf eine Ausgangsspannung auf Pixelebene;
Skalieren (440), am Leuchtdichteskalierungsschaltkreis (330), der Ausgangsspannung auf Pixelebene, die vom Gamma-Register (320) unter Verwendung des Skalierungswerts ermittelt wurde, um eine skalierte Pixelausgangsspannung zu erzeugen; und
Ausgeben (450) der skalierten Pixelausgangsspannung.

10. Verfahren nach Anspruch 9, wobei das Gamma-Register (320) eine Nachschlagetabelle enthält und wobei das Ermitteln (430) der Ausgangsspannung auf Pixelebene aus dem Bildeingabesignal ein Verwenden der Nachschlagetabelle enthält, wobei die Nachschlagetabelle Gammawerte enthält, die digitale Pixeleingabesignale auf Ausgangsspannungen auf Pixelebene abbilden.

11. Verfahren nach Anspruch 9 oder Anspruch 10, wobei das Leuchtdichteskalierungssignal ein pulsweitenmoduliertes Signal ist.

12. Verfahren nach einem der Ansprüche 9 bis 11, wobei das Empfangen des Bildeingabesignals ein Empfangen eines Bildeingabesignals enthält, das einen Farbpixelwert repräsentiert, wobei das Bildeingabesignal eine erste Komponente, die einen roten Abschnitt eines Pixels anspricht, eine zweite Komponente, die einen grünen Abschnitt des Pixels anspricht, und eine dritte Komponente enthält, die einen blauen Abschnitt des Pixels anspricht.

13. System, umfassend:

einen an einen Arbeitsspeicherschaltkreis (704) gekoppelten Prozessor (702);
 eine organische lichtemittierende Diodenanzeige, OLED-Anzeige, (350), die eine Vielzahl von individuell ansprechbaren Pixeln enthält;
 einen OLED-Anzeigeansteuerungsschaltkreis (310) nach einem der Ansprüche 1 bis 8, wobei der OLED-Anzeigeansteuerungsschaltkreis (310) an die OLED-Anzeige (350) gekoppelt ist.

Revendications

1. Circuit de commande de dispositif d'affichage à diodes électroluminescentes organiques (OLED) (310) comprenant :
 - une première entrée (312) pour recevoir un signal de mise à l'échelle de luminance représentant une valeur de mise à l'échelle comprise entre 0 et 1 ;
 - une seconde entrée (314) pour recevoir un signal d'entrée d'image, le signal d'entrée d'image comprenant une représentation numérique d'une sortie souhaitée pour un pixel dans un dispositif d'affichage OLED ;
 - un registre gamma (320) couplé à la seconde entrée pour mettre en correspondance la représentation numérique d'une sortie souhaitée pour le pixel avec une tension de sortie au niveau du pixel ;
 - et
 - un circuit de mise à l'échelle de luminance (330) pour multiplier la tension de sortie au niveau du pixel du registre gamma (320), correspondant au signal d'entrée d'image, par la valeur de mise à l'échelle.
2. Circuit de commande de dispositif d'affichage OLED (310) selon la revendication 1, dans lequel le signal de mise à l'échelle de luminance est un signal à modulation de largeur d'impulsion.
3. Circuit de commande de dispositif d'affichage OLED (310) selon l'une quelconque des revendications 1 et 2, dans lequel la seconde entrée est structurée pour recevoir un signal d'entrée d'image représentant une valeur de pixel de niveau de gris.
4. Circuit de commande de dispositif d'affichage OLED (310) selon l'une quelconque des revendications 1 à 3, dans lequel le registre gamma (320) contient une table de consultation, la table de consultation étant configurée pour mettre en correspondance la représentation numérique d'une sortie souhaitée pour le pixel avec la tension de sortie au niveau du pixel.
5. Circuit de commande de dispositif d'affichage OLED (310) selon la revendication 4, dans lequel la seconde entrée est structurée pour recevoir un signal d'entrée d'image représentant une valeur de pixel de couleur, le signal d'entrée d'image comprenant une première composante représentant le rouge, une deuxième composante représentant le vert et une troisième composante représentant le bleu.
6. Circuit de commande de dispositif d'affichage OLED (310) selon la revendication 5, dans lequel la table de consultation est associée à chaque composante parmi la première composante, la deuxième composante et la troisième composante du signal d'entrée d'image représentant la valeur de pixel de couleur.
7. Circuit de commande de dispositif d'affichage OLED (310) selon l'une quelconque des revendications 4 à 6, dans lequel le registre gamma (320) est structuré pour mettre en correspondance :
 - une valeur de 8 bits représentant une partie rouge de la représentation numérique de la sortie souhaitée pour le premier pixel avec une première tension de sortie au niveau du pixel ;
 - une valeur de 8 bits représentant une partie verte de la représentation numérique de la sortie souhaitée pour le premier pixel avec une deuxième tension de sortie au niveau du pixel ; et
 - une valeur de 8 bits représentant une partie bleue de la représentation numérique de la sortie souhaitée pour le premier pixel avec une troisième tension de sortie au niveau du pixel.
8. Circuit de commande de dispositif d'affichage OLED (310) selon la revendication 7, dans lequel le circuit de mise à l'échelle de luminance est destiné à mettre à l'échelle les première, deuxième et troisième tensions de sortie au niveau du pixel en utilisant la valeur de mise à l'échelle.
9. Procédé dans un circuit de commande (310) destiné à commander un dispositif d'affichage à diodes électroluminescentes organiques, OLED, le circuit de commande (310) comprenant une première entrée (312), une seconde

entrée (314), un registre gamma (302) couplé à la seconde entrée (314) et un circuit de mise à l'échelle de luminance (330), le procédé comprenant :

la réception (410), au niveau de la première entrée (310), d'un signal de mise à l'échelle de luminance représentant une valeur de mise à l'échelle comprise entre 0 et 1 ;
la réception (420), au niveau de la seconde entrée (314), d'un signal d'entrée d'image, le signal d'entrée d'image comprenant une représentation numérique d'une sortie souhaitée pour un pixel dans le dispositif d'affichage OLED ;
la détermination (430), au niveau du registre gamma (320), d'une tension de sortie au niveau du pixel à partir du signal d'entrée d'image en mettant en correspondance la représentation numérique d'une sortie souhaitée pour le pixel avec une tension de sortie au niveau du pixel ;
la mise à l'échelle (440), au niveau du circuit de mise à l'échelle de luminance (330), de la tension de sortie au niveau du pixel déterminée par le registre gamma (320) en utilisant la valeur de mise à l'échelle pour produire une tension de sortie du pixel mise à l'échelle ; et
la fourniture (450) de la tension de sortie du pixel mise à l'échelle.

10. Procédé selon la revendication 9, dans lequel le registre gamma (320) comprend une table de consultation, et dans lequel ladite détermination (430) de la tension de sortie au niveau du pixel à partir du signal d'entrée d'image comprend l'utilisation de la table de consultation, la table de consultation comprenant des valeurs gamma qui mettent en correspondance des signaux d'entrée de pixels numériques avec des tensions de sortie au niveau du pixel.

11. Procédé selon la revendication 9 ou la revendication 10, dans lequel le signal de mise à l'échelle de luminance est un signal à modulation de largeur d'impulsion.

12. Procédé selon l'une quelconque des revendications 9 à 11, dans lequel la réception du signal d'entrée d'image comprend la réception d'un signal d'entrée d'image représentant une valeur de pixel de couleur, le signal d'entrée d'image comprenant une première composante adressant une partie rouge d'un pixel, une deuxième composante adressant une partie verte du pixel et une troisième composante adressant une partie bleue du pixel.

13. Système comprenant :

un processeur (702) couplé à un circuit de mémoire (704) ;
un dispositif d'affichage à diodes électroluminescentes organiques, OLED, (350) comprenant une pluralité de pixels individuellement adressables ;
un circuit de commande de dispositif d'affichage OLED (310) selon l'une quelconque des revendications 1 à 8, le circuit de commande de dispositif d'affichage OLED (310) étant couplé au dispositif d'affichage OLED (350).

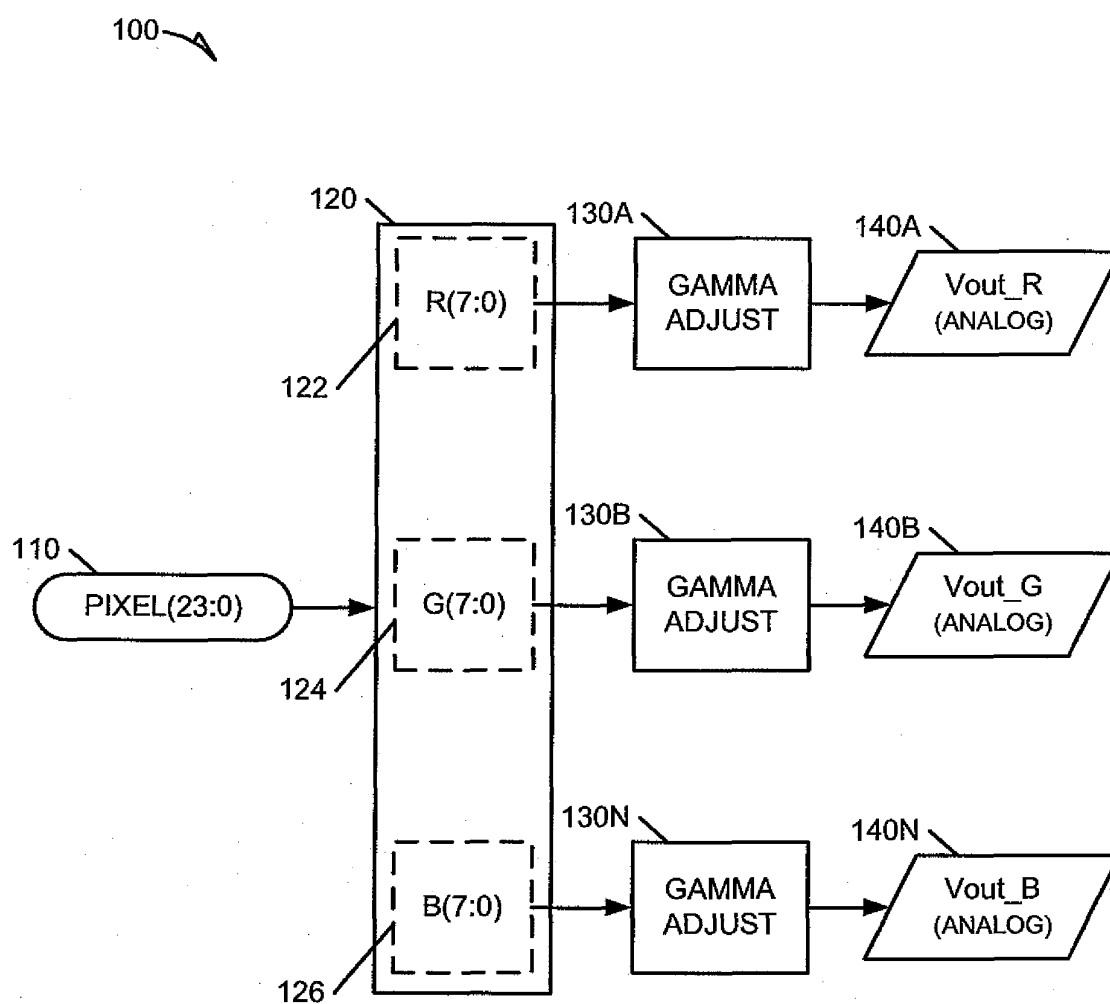


FIG. 1

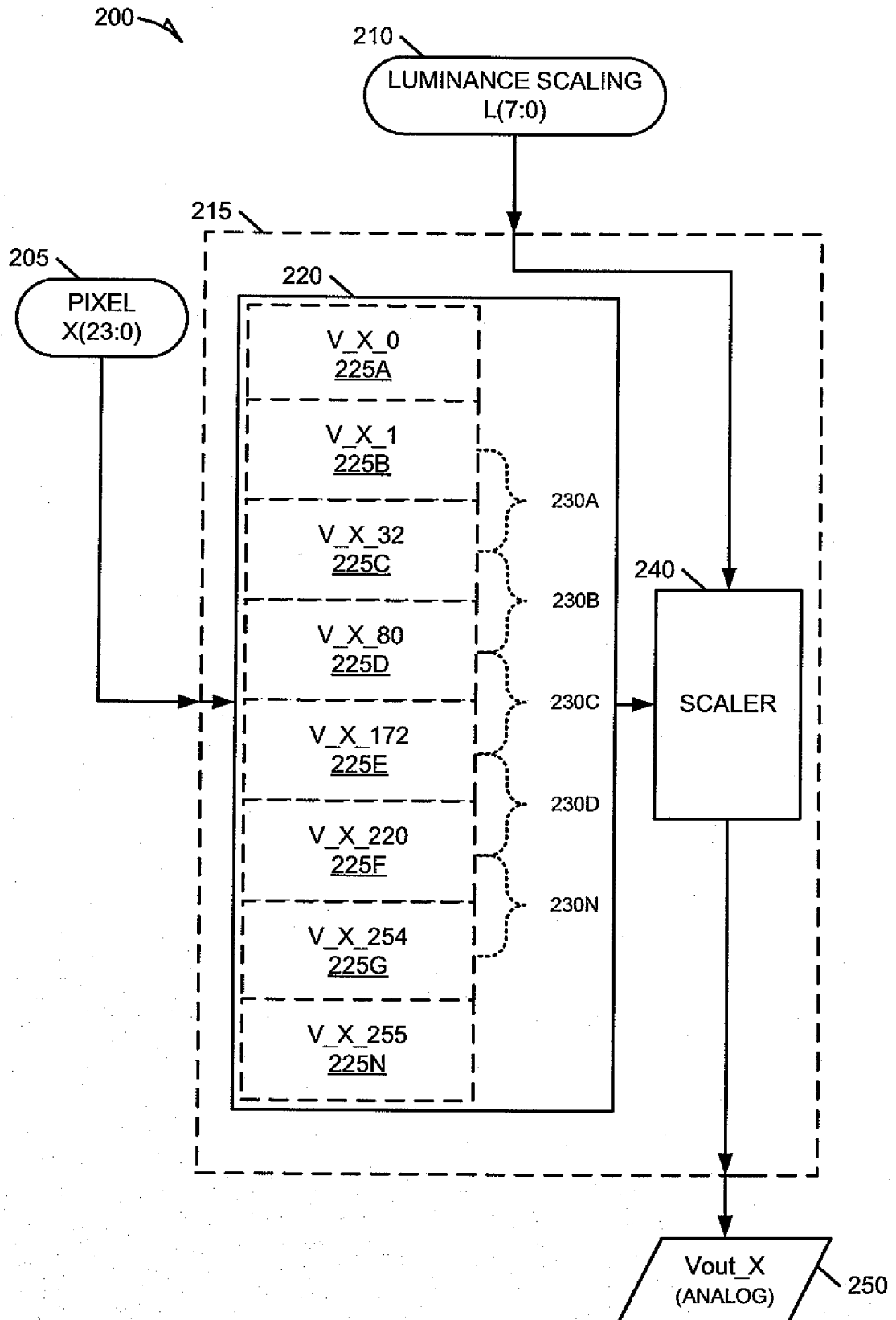


FIG. 2

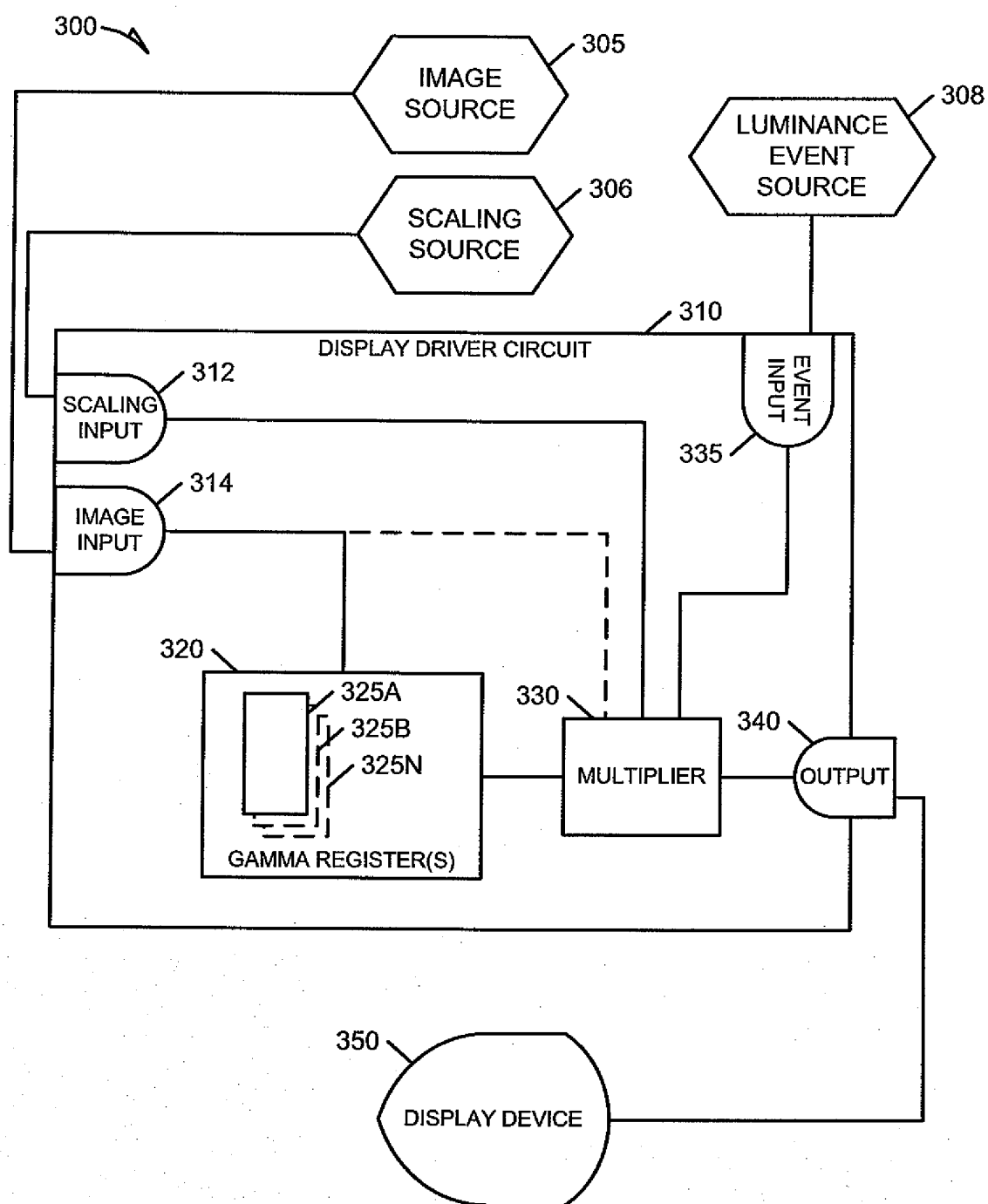
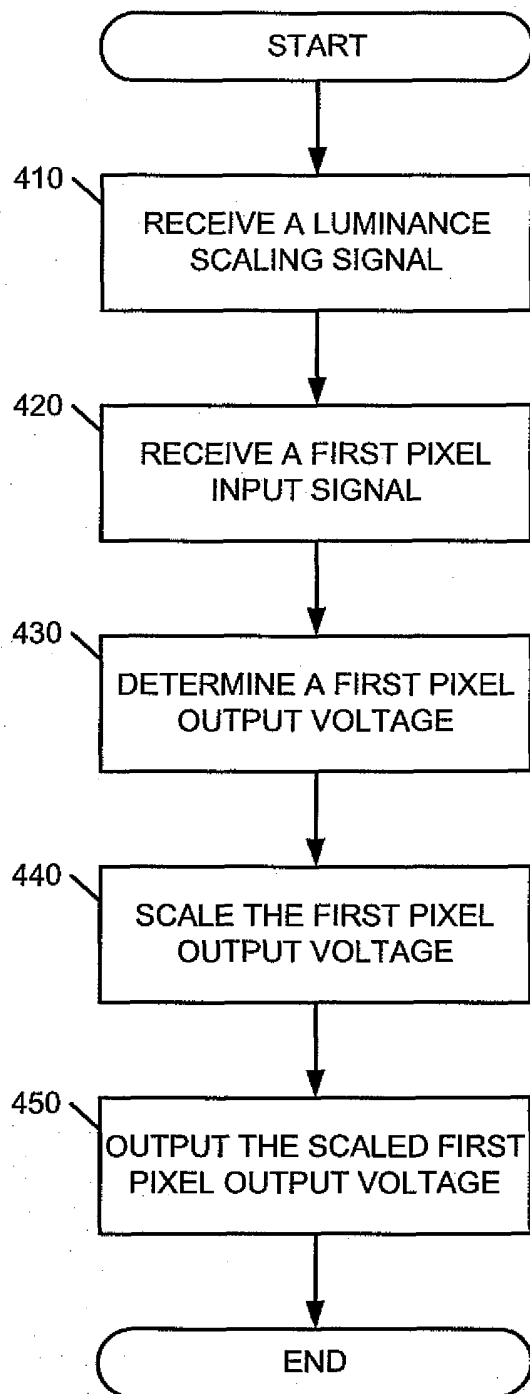


FIG. 3

400

*FIG. 4*

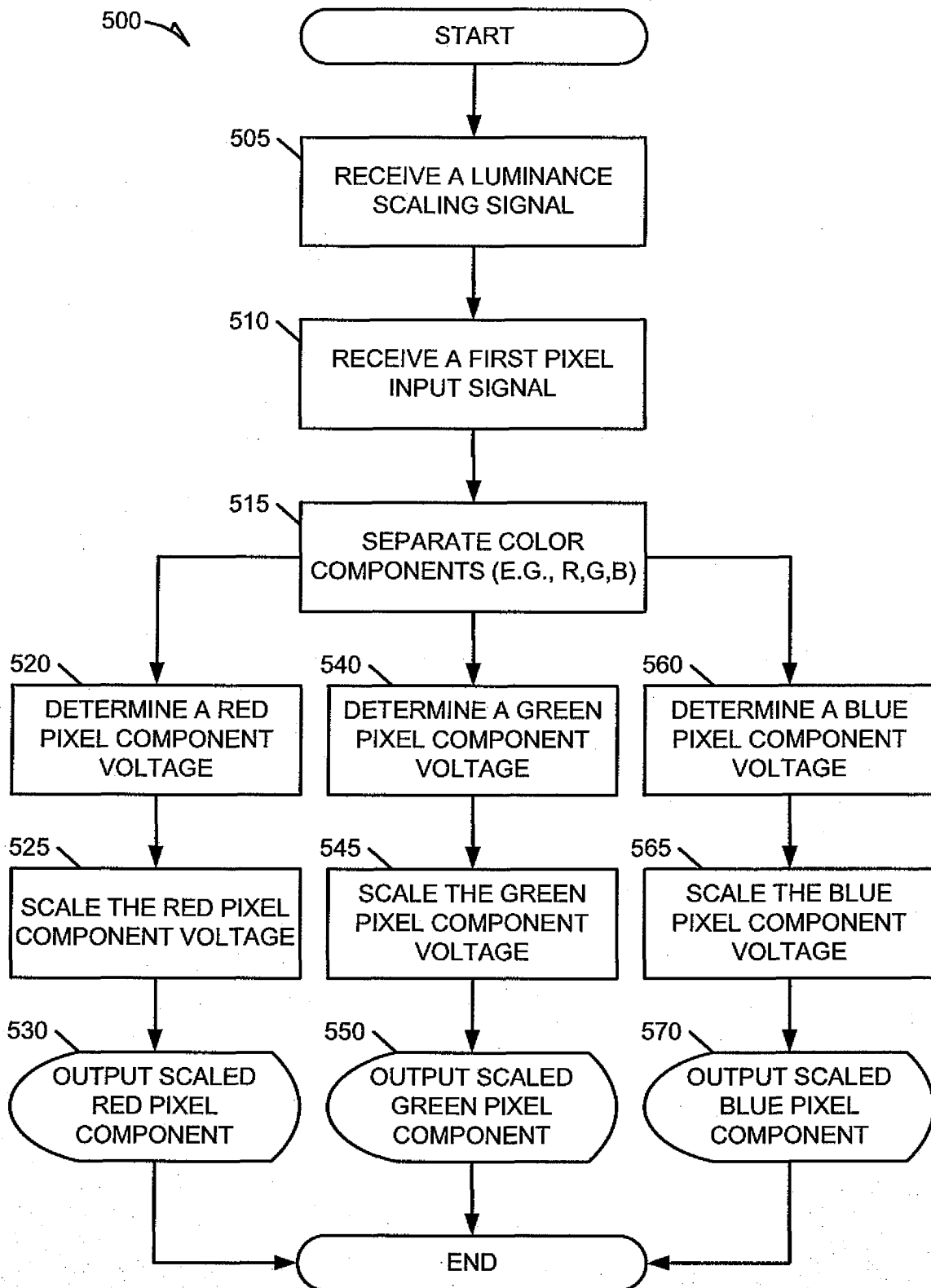
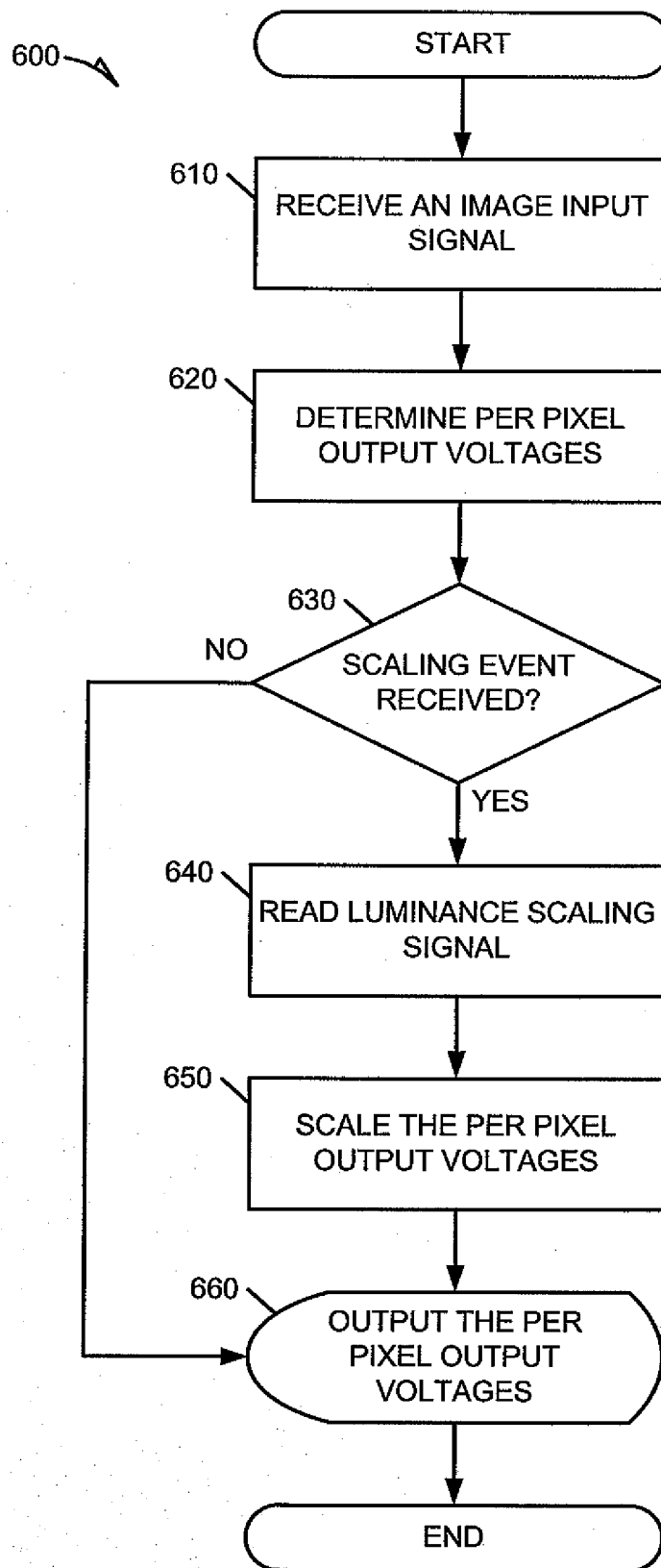


FIG. 5

*FIG. 6*

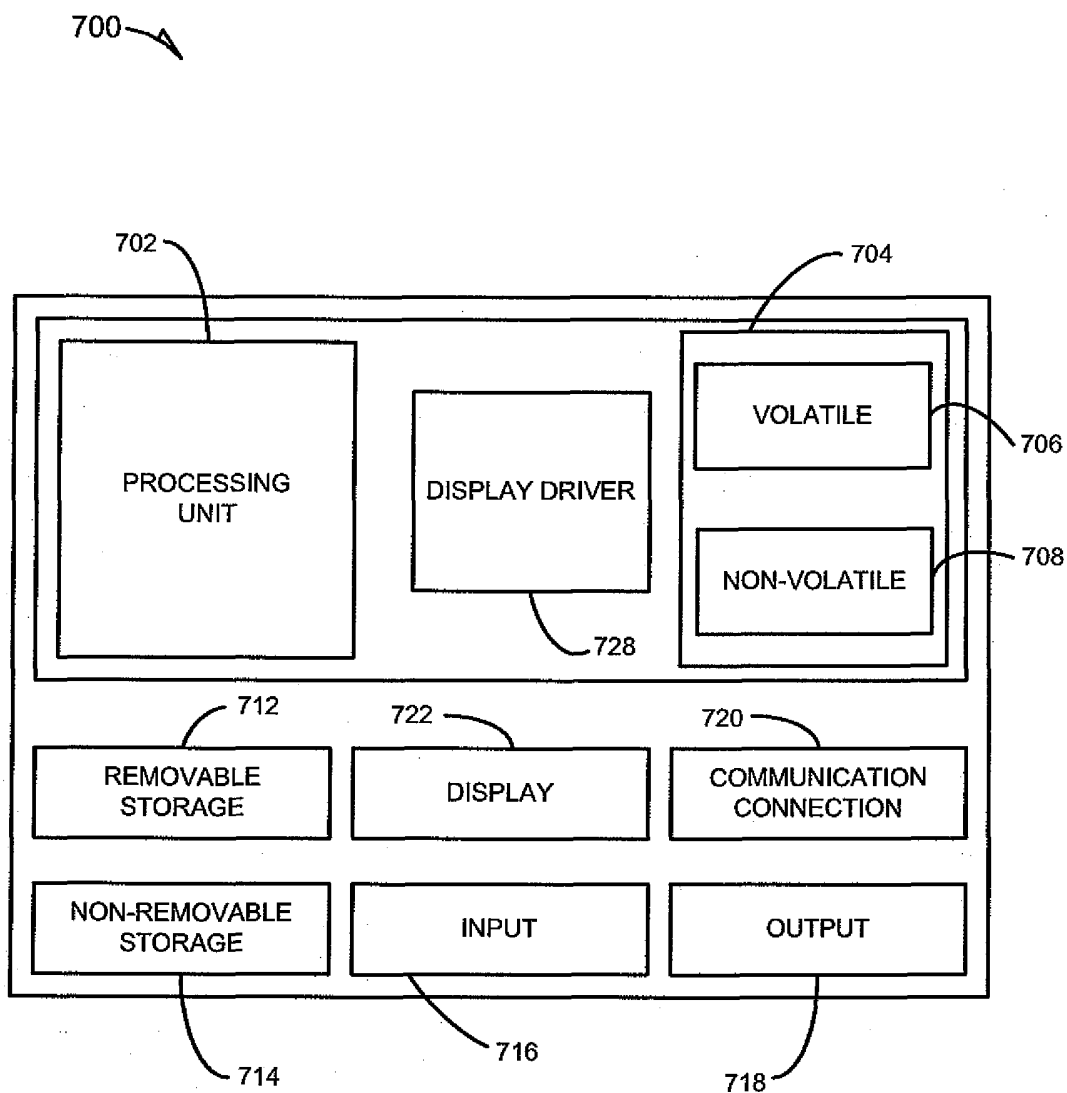


FIG. 7

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 1962267 A [0002]

专利名称(译)	快速降低OLED显示器的亮度的方法和系统		
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申请(专利权)人(译)	RESEARCH IN MOTION LIMITED		
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其他公开文献	EP2492903A1 EP2492903A9		
外部链接	Espacenet		

摘要(译)

各种实施例包括允许OLED显示面板的亮度快速变化的设备，方法，电路，数据结构和软件。 OLED显示驱动器电路可以包括第一输入，第二输入和缩放电路。 第一个输入是接收比例因子。 第二输入将接收图像输入信号，该图像输入信号包括像素的期望输出的数字表示。 缩放电路将与像素的期望输出相关联的像素级输出电压乘以缩放因子。

