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(54) **DATA DRIVER AND ORGANIC LIGHT  
EMITTING DISPLAY DEVICE USING THE  
SAME**

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(57) **ABSTRACT**

A data driver to display an image with desired brightness, and an organic light emitting display device using the same. The data driver includes a register to temporarily store external data; a voltage digital-analog converter to generate a data voltage corresponding to the data stored in the register part; a current digital-analog converter to generate a data current corresponding to the data stored in the register part; a buffer part to supply the data voltage as a data signal to pixels via a data line; a data control unit to receive a pixel current corresponding to the data voltage from the pixel via the data line and to control a digital value of the data stored in the register part; and a selection unit to selectively couple the data line with either of the buffer part or the data control unit.

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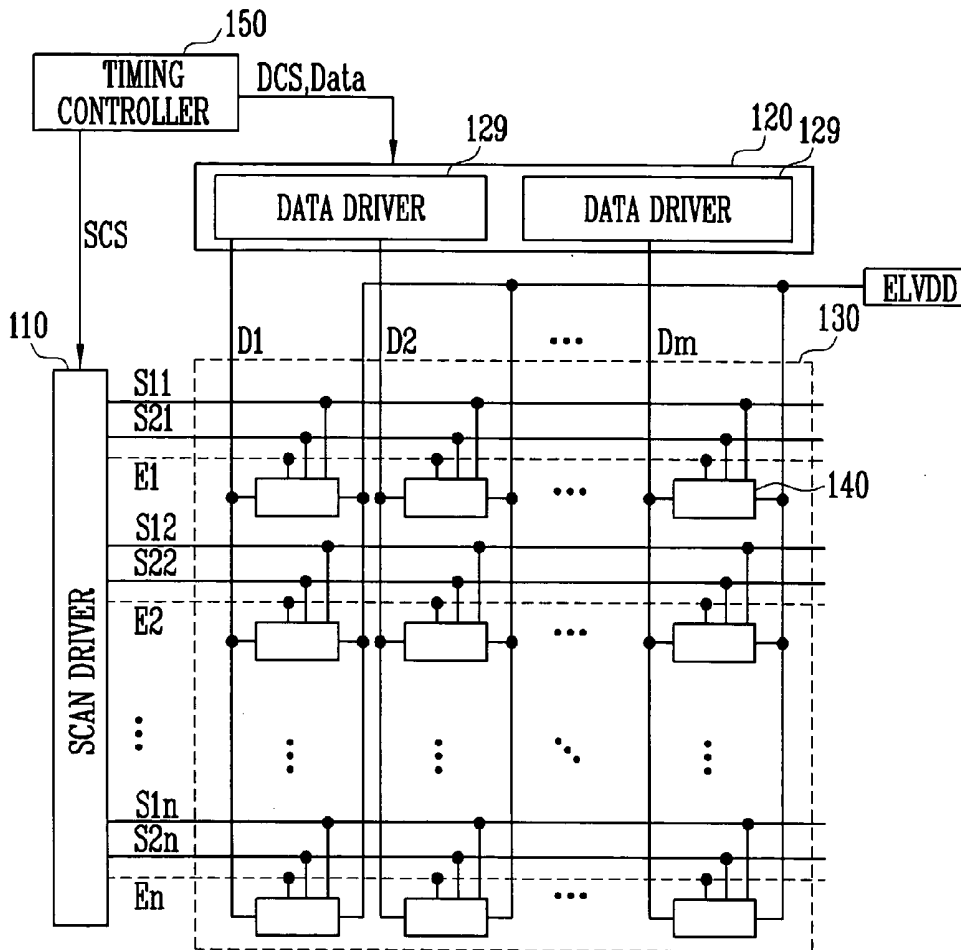


FIG. 1  
(PRIOR ART)

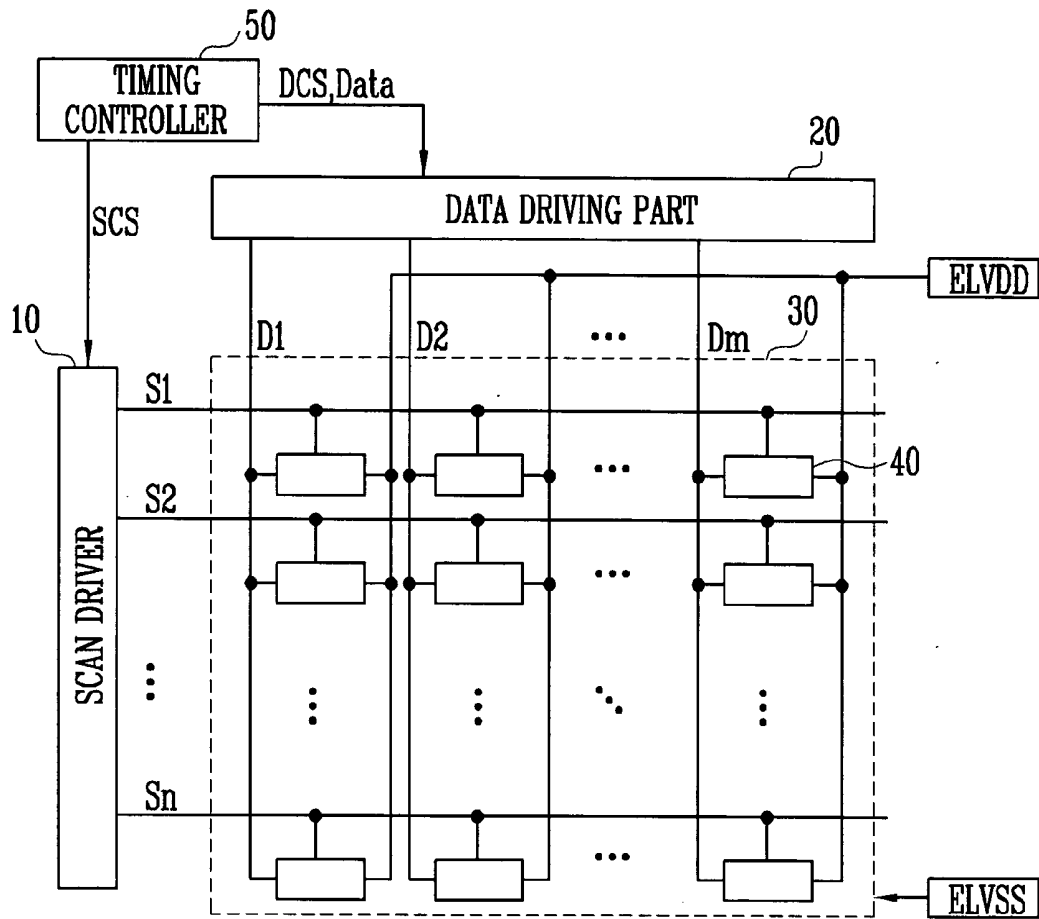
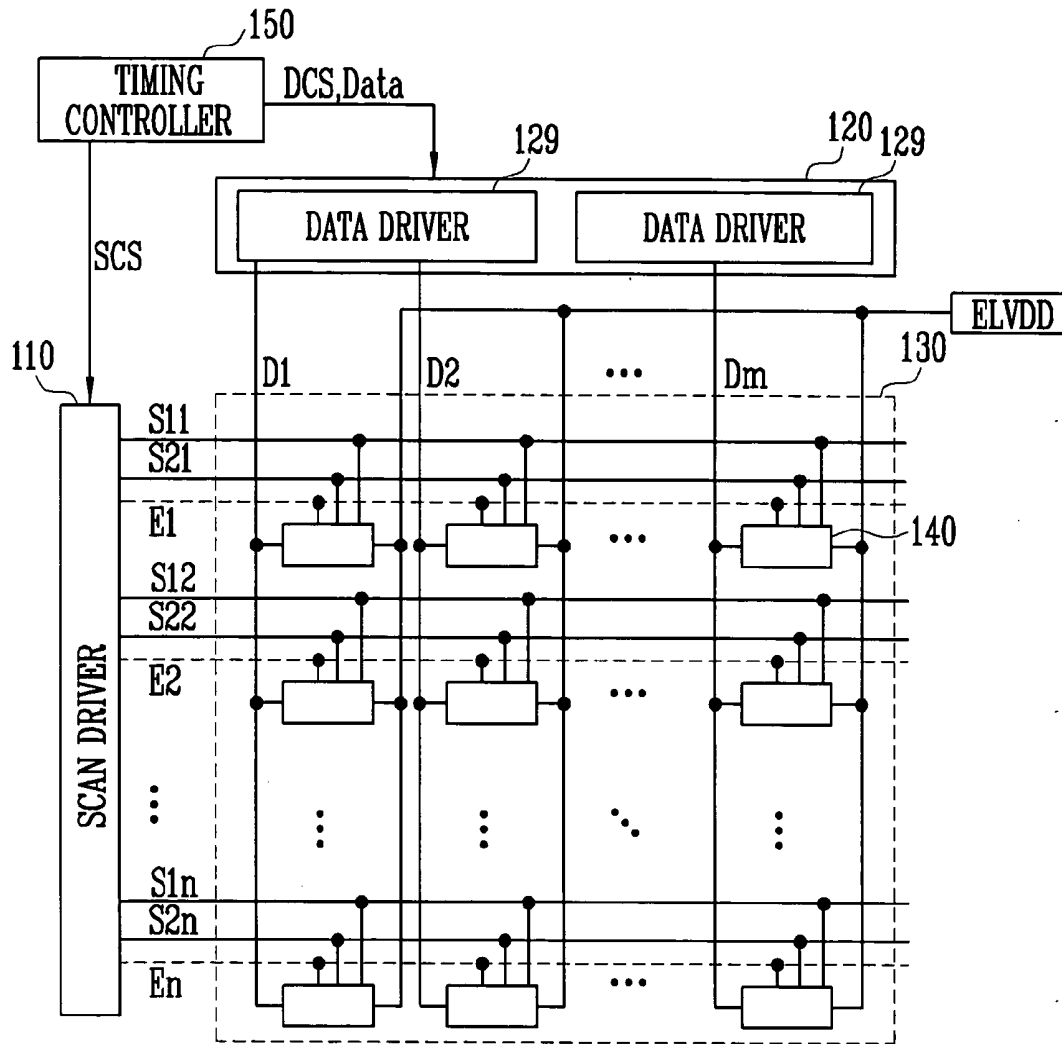


FIG. 2



# FIG. 3

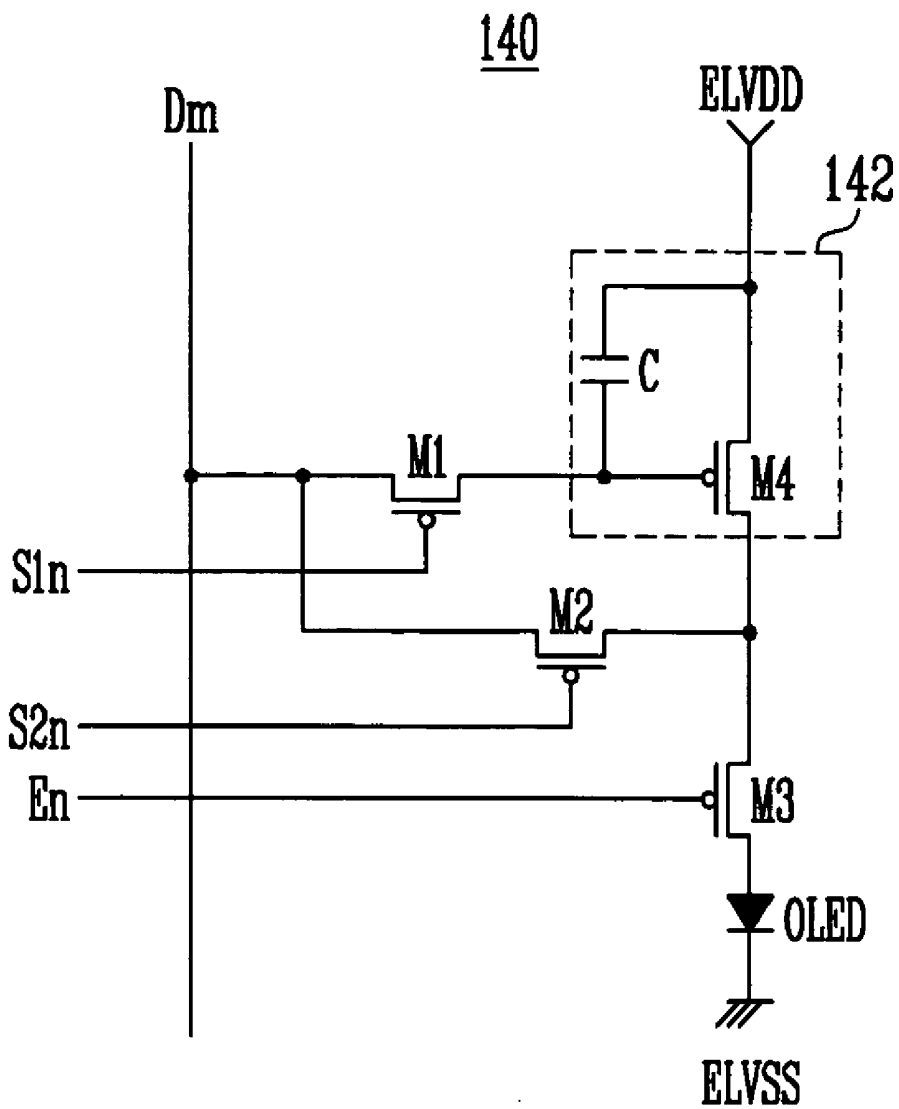


FIG. 4

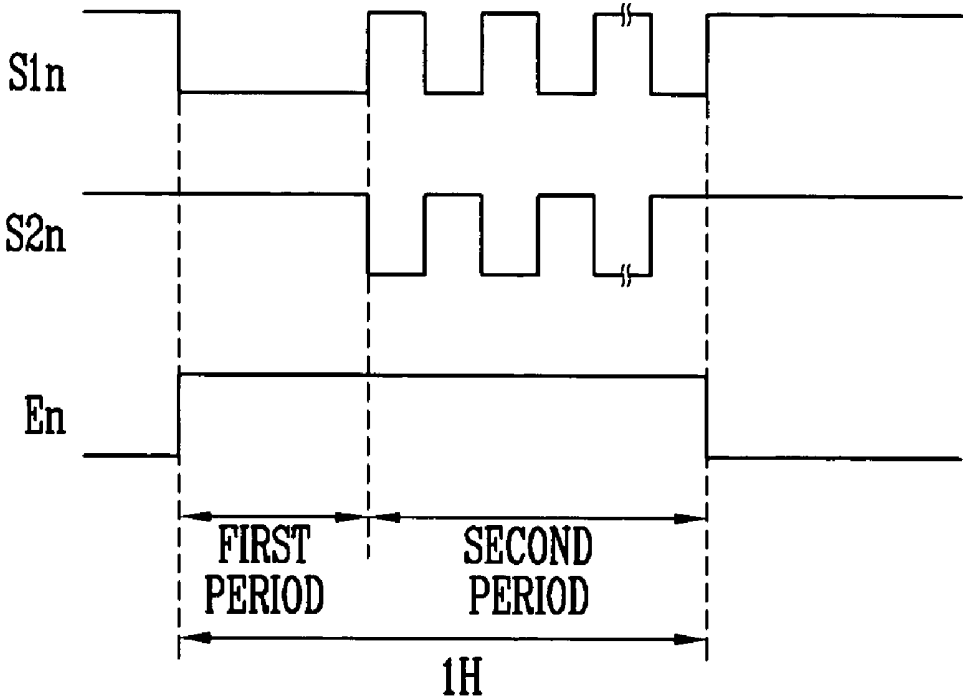


FIG. 5

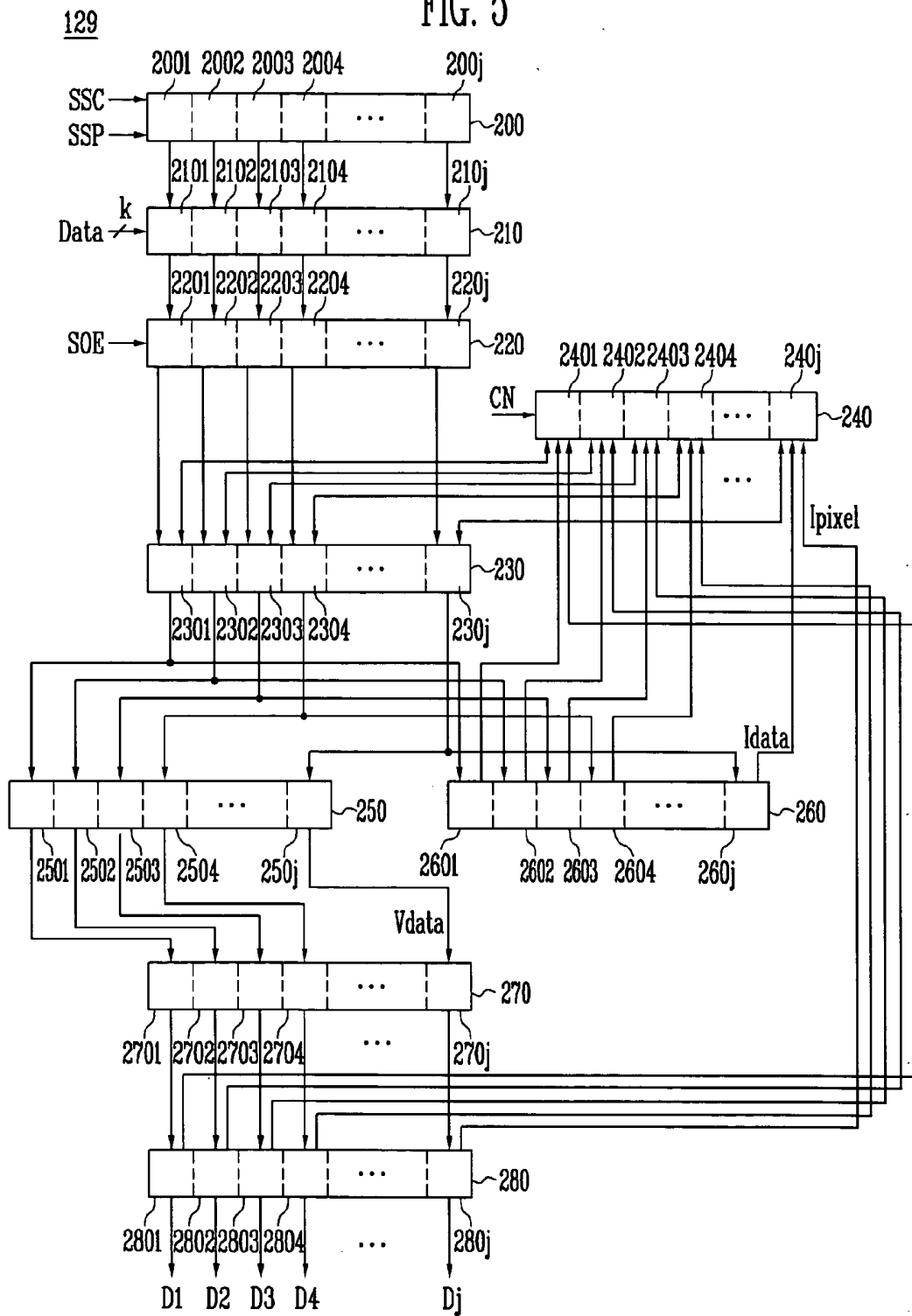


FIG. 6

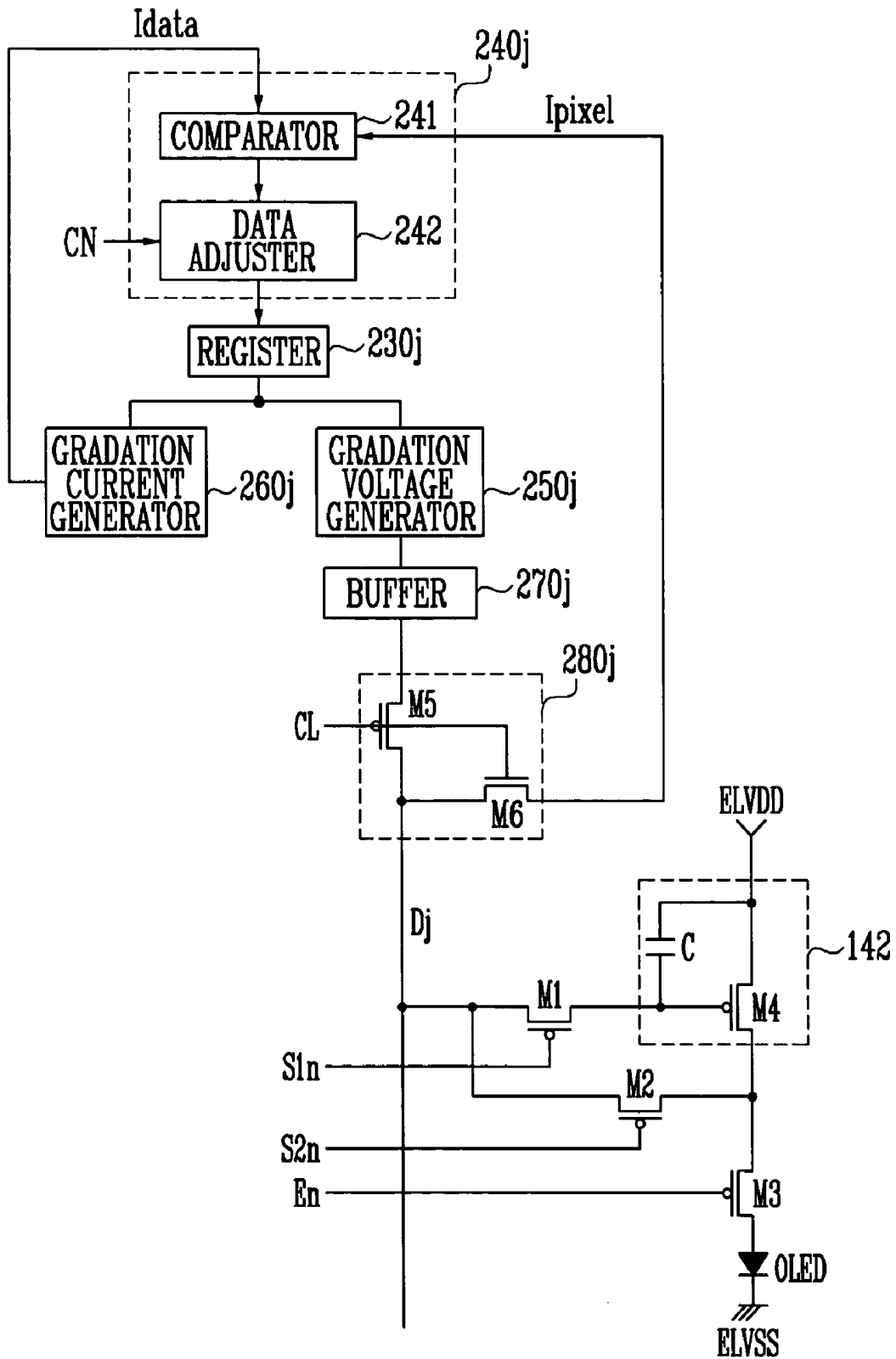
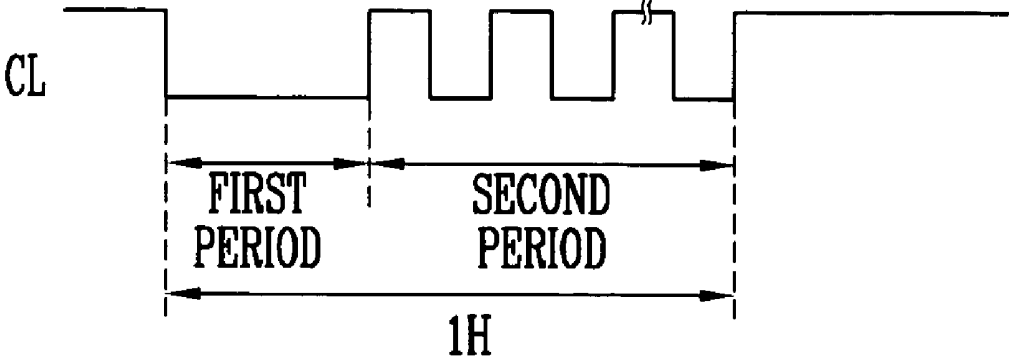
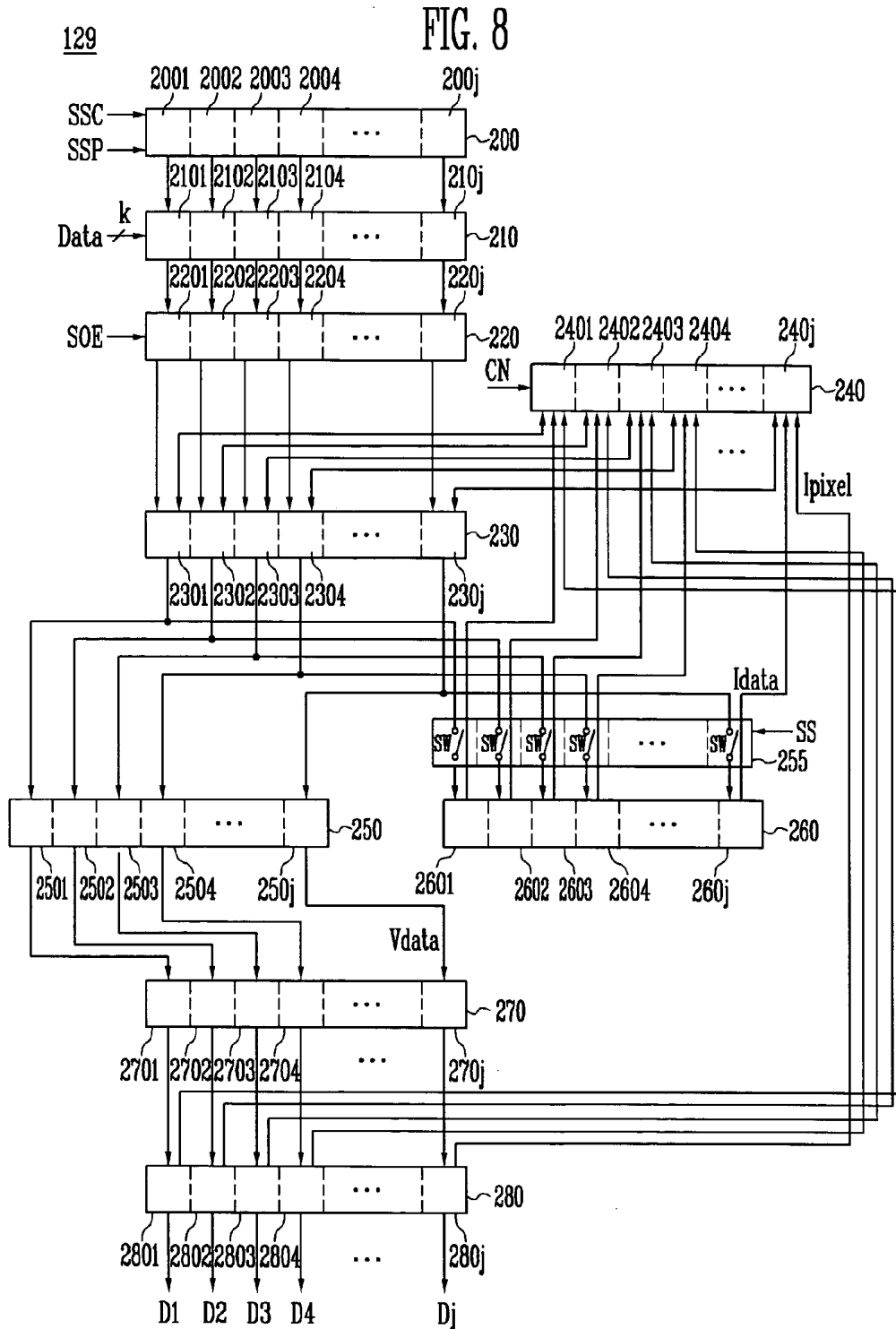


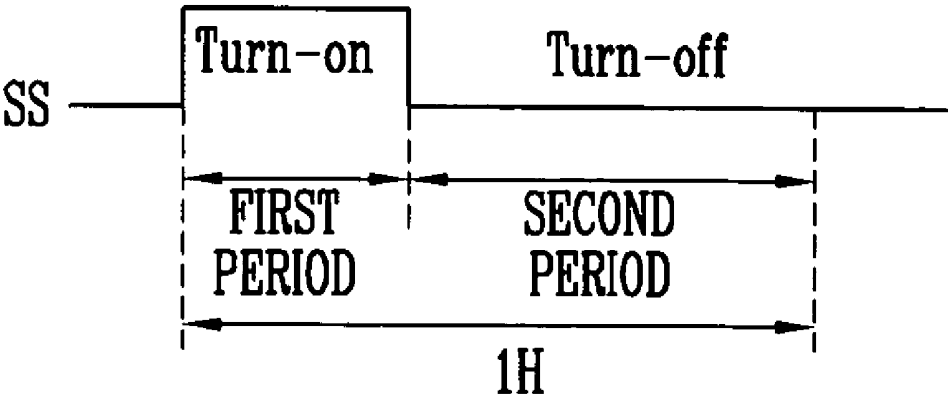
FIG. 7



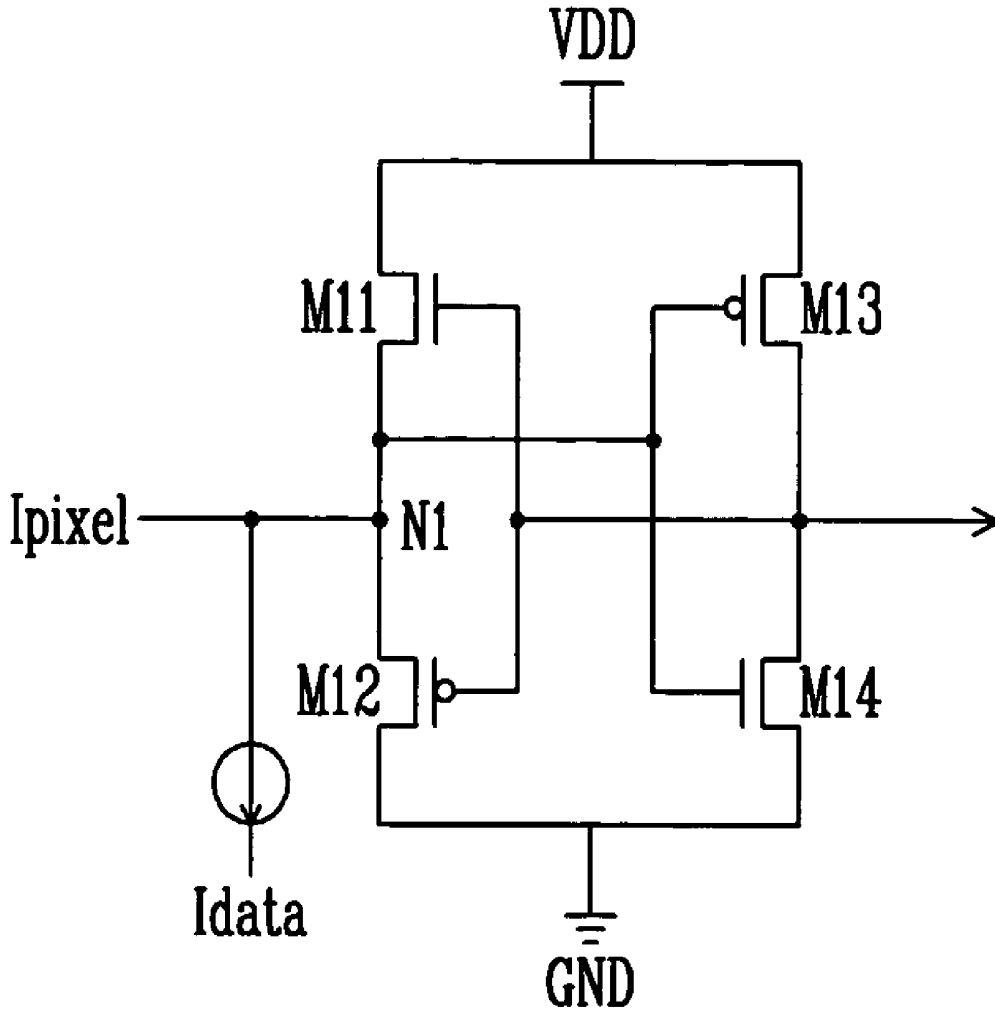


129

# FIG. 9



# FIG. 10



## DATA DRIVER AND ORGANIC LIGHT EMITTING DISPLAY DEVICE USING THE SAME

### CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims priority to and the benefit of Korean Patent Application No. 10-2004-0112521, filed on Dec. 24, 2004, in the Korean Intellectual Property Office, the entire content of which is incorporated herein by reference.

### BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates to a data driver, an organic light emitting display device using the same, and more particularly, to a data driver to display an image with desired brightness and an organic light emitting display device using the same.

[0004] 2. Description of Related Art

[0005] Various flat panel displays have recently been developed as alternatives to a relatively heavy and bulky cathode ray tube (CRT) display. The flat panel displays include liquid crystal display (LCD), field emission display (FED), plasma display panel (PDP), organic light emitting display device (OLED), and the like.

[0006] Among the flat panel displays, the organic light emitting display device can emit light by electron-hole recombination. The organic light emitting display device has advantages of relatively fast response time and relatively low power consumption. Generally, the organic light emitting display device employs a transistor provided in each pixel for supplying current corresponding to a data signal to a light emitting device, thereby causing the light emitting device to emit light.

[0007] FIG. 1 illustrates a conventional organic light emitting display device. The conventional organic light emitting display device includes a display region 30 including pixels 40 formed in a region defined by intersection of scan lines S1 to Sn and data lines D1 to Dm; a scan driver 10 to drive the scan lines S1 to Sn; a data driving part 20 to drive the data lines D1 to Dm; and a timing controller 50 to control the scan driver 10 and the data driving part 20. Each pixel 40 includes a transistor for supplying current to a light emitting device (not shown).

[0008] The timing controller 50 generates a data control signal DCS and a scan control signal SCS corresponding to an external synchronization signal. The data control signal DCS and the scan control signal SCS are supplied from the timing controller 50 to the data driving part 20 and the scan driver 10, respectively. Further, the timing controller 50 supplies external data to the data driving part 20.

[0009] The scan driver 10 receives the scan control signal SCS from the timing controller 50. The scan driver 10 generates scan signals on the basis of the scan control signal SCS and supplies the scan signals to the scan lines S1 to Sn.

[0010] The data driving part 20 receives the data control signal DCS from the timing controller 50. The data driving part 20 generates data signals on the basis of the data control signal DCS and supplies the data signals to the data lines D1 to Dm while synchronizing with the scan signals.

[0011] The display region 30 receives first voltage ELVDD and second voltage ELVSS from a power source, and supplies them to the pixels 40. When the first voltage ELVDD and the second voltage ELVSS are applied to the pixels 40, each pixel 40 controls and causes a current corresponding to the data signal to flow from a first voltage ELVDD power source line to a second voltage ELVSS power source line via the light emitting device, thereby emitting light corresponding to the data signal.

[0012] That is, in the conventional organic light emitting display device, each pixel 40 emits light with a predetermined brightness corresponding to the data signal, but cannot emit light with desired brightness because transistors provided in the respective pixels 40 are different in threshold voltage from each other. Further, in the conventional organic light emitting display device, there is no method of measuring and controlling the real current in each pixel 40 corresponding to the data signal.

### SUMMARY OF THE INVENTION

[0013] Accordingly, the present invention provides a data driver for displaying an image with desired brightness, an organic light emitting display device using this data driver, and a method of driving the organic light emitting display device.

[0014] In one embodiment of the invention, the organic light emitting display device uses a data driver, which compares a data current corresponding to data with a pixel current in a pixel, and controls a digital value of the data on the basis of the outcome of the comparison so as to approximately equalize the pixel current with the data current, thereby displaying an image with desired brightness. Particularly, according to an embodiment of the present invention, the pixel current is supplied from the pixel to the data driver via a data line, and a data voltage is supplied from the data driver to the pixel via the data line. That is, according to embodiments of the present invention, the data line is shared to also drive the pixel, so that additional lines are not needed, thereby enhancing aperture ratio and simplifying the fabricating process.

[0015] The foregoing and other aspects of the present invention are achieved by providing a data driving part including: a register part to temporarily store external data; a voltage digital to analog or digital-analog converter to generate a data voltage corresponding to the data stored in the register part; a current digital to analog converter to generate a data current corresponding to the data stored in the register part; a buffer part to supply the data voltage as a data signal to pixels via a data line; a data control unit to receive a pixel current corresponding to the data voltage from the pixel via the data line and to control a digital value of the data stored in the register part; and a selection unit to selectively couple the data line with either of the buffer part or the data control unit.

[0016] According to an aspect of the invention, the selection unit couples the data line with the buffer part for a first period of one horizontal period, and alternately couples the data line with either of the buffer part or the data control unit for a second period of one horizontal period except the first period. Further, the selection unit includes selectors, each selector including: a first transistor coupled between the buffer part and the data line; and a second transistor coupled

between the data line and the data control unit. The first transistor is turned on for the first period, and the first transistor is tuned on and off alternately with the second transistor for the second period. Also, the data voltage is supplied to the pixel via the data line when the first transistor is turned on, and the pixel current is supplied from the pixel to the data control unit via the data line when the second transistor is turned on.

[0017] Other aspects of the present invention are achieved by providing an organic light emitting display device including first and second scan lines, data lines formed in a direction intersecting the direction of the first and second scan lines, a display region including pixels coupled to the first and second scan lines and the data line, a scan driver to sequentially supply first and second scan signals to the first and second scan lines, respectively, and a data driving part coupled to the data line, converting external data into a data voltage, and supplying the data voltage to the data line, wherein the data driving part receives a pixel current that flows in each pixel corresponding to the data voltage from each pixel via the data line, and controlling a digital value of the data in accordance with the received pixel current.

[0018] According to an aspect of the invention, each pixel includes a light emitting device, a driver to generate the pixel current corresponding to the data voltage, a first transistor coupled between the driver and the data line, and controlled by a first scan signal supplied through the first scan line, and a second transistor coupled between the data line and a common node formed between the driver and the light emitting device, and controlled by a second scan signal supplied through the second scan line. Further, the first transistor is turned on corresponding to the first scan signal for a first period of a predetermined horizontal period, and turned on and off at least once for a second period of the horizontal period. Also, the second transistor is turned off corresponding to the second scan signal for the first period, and turned on and off alternately with the first transistor for the second period.

[0019] Another aspect of the invention provides a method for controlling image brightness corresponding to data received in an organic light emitting display device having a pixel for emitting light. The method includes converting the data into a data voltage and a data current, supplying the data voltage to the pixel to generate a pixel current corresponding to the data voltage, comparing the pixel current with the data current, and controlling the data voltage to provide a desired image brightness by incrementing the data voltage if the pixel current is lower than the data current and decrementing the data voltage if the pixel current is higher than the data current.

[0020] In another embodiment, the method may also include allowing the data current to flow into the pixel by supplying a first scan signal to the pixel, and allowing a pixel current generated in the pixel to flow out of the pixel by supplying a second scan signal to the pixel. The first scan signal and the second scan signal are supplied non-concurrently. A control signal may be received for selecting either supplying the data voltage to the pixel or receiving the pixel current from the pixel. The pixel may be driven during frames and each frame may be divided into a first period and a second period separate from the first period. The control signal for supplying the data voltage to the pixel may be

received during the entire first period, and the control signal for the supplying the data voltage to the pixel and the control signal for the receiving the pixel current from the pixel may be received alternately during the second period. The data may be converted into the data current while supplying the data voltage to the pixel but not while receiving a pixel current from the pixel.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[0021] FIG. 1 is a layout diagram showing a conventional organic light emitting display device.

[0022] FIG. 2 is a layout diagram showing an organic light emitting display device according to an embodiment of the present invention.

[0023] FIG. 3 is a circuit diagram of a pixel illustrated in FIG. 2.

[0024] FIG. 4 shows waveforms of signals for driving the pixel illustrated in FIG. 3.

[0025] FIG. 5 is a schematic block diagram showing an embodiment of data driver illustrated in FIG. 2.

[0026] FIG. 6 is a detailed unit diagram of a data controller and a selector provided in the data driver illustrated in FIG. 5.

[0027] FIG. 7 shows a waveform of a signal for driving the selector illustrated in FIG. 6.

[0028] FIG. 8 is a schematic block diagram showing another embodiment of a data driver illustrated in FIG. 2.

[0029] FIG. 9 shows a waveform of a signal for driving a switching part illustrated in FIG. 8.

[0030] FIG. 10 is a circuit diagram of a comparator illustrated in FIG. 6.

#### DETAILED DESCRIPTION

[0031] FIG. 2 illustrates an organic light emitting display device according to an embodiment of the present invention. This organic light emitting display device includes a display region 130 having pixels 140 formed in regions defined by first scan lines S11 to S1n, second scan lines S21 to S2n, emission control lines E1 to En, and data lines D1 to Dm; a scan driver 110 to drive the first scan lines S11 to S1n, the second scan lines S21 to S2n, and the emission control lines E1 to En; a data driving part 120 to drive the data lines D1 to Dm; and a timing controller 150 to control the scan driver 110 and the data driving part 120.

[0032] The display region 130 includes the pixels 140 formed in regions defined by the first scan lines S11 to S1n, the second scan lines S21 to S2n, the emission control lines E1 to En and the data lines D1 to Dm. The pixels 140 receive external first voltage ELVDD. In alternative embodiments, an external second voltage ELVSS (not shown) may also be coupled to the pixels 140. When the first voltage ELVDD and the second voltage ELVSS are applied to the pixels 140, each pixel 140 controls a pixel current causing it to flow from a first voltage ELVDD source line to a second voltage ELVSS source line via a light emitting device corresponding to a data signal transmitted through the corresponding one of the data lines D1 to Dm. Further, the pixel 140 supplies the

pixel current to the data driving part **120** via the corresponding one of the data lines  $D1$  to  $Dm$  for a partial horizontal period.

[0033] The timing controller **150** generates a data control signal DCS and a scan control signal SCS in response to external synchronization signals. The timing controller **150** supplies the data control signal DCS and the scan control signal SCS to the data driving part **120** and the scan driver **110**, respectively. Further, the timing controller **150** supplies external data Data to the data driving part **120**.

[0034] The scan driver **110** receives the scan control signal SCS from the timing controller **150**. In response to the scan control signal SCS, the scan driver **110** sequentially supplies first scan signals to the first scan lines  $S11$  to  $S1n$ , and at the same time sequentially supplies second scan signals to the second scan lines  $S21$  to  $S2n$ .

[0035] FIG. 3 is a circuit diagram of a pixel illustrated in FIG. 2 and FIG. 4 shows waveforms of signals for driving the pixel illustrated in FIG. 3. These two figures, FIG. 3 and FIG. 4, are discussed together.

[0036] As shown in FIG. 4, the scan driver **110** supplies a first scan signal  $S1n$  to turn on a first transistor **M1** provided in the pixel **140**, shown in FIG. 3, for a first period of one horizontal period  $1H$ , and to repeatedly turn on and off the first transistor **M1** for a second period of the one horizontal period  $1H$ . Further, the scan driver **110** supplies a second scan signal  $S2n$  to turn off a second transistor **M2** provided in the pixel **140** for the first period of the one horizontal period  $1H$ , and to repeatedly turn on and off the second transistor **M2** alternately with the first transistor **M1**. Also, the scan driver **110** supplies an emission control signal  $En$  to turn off a third transistor **M3** provided in the pixel **140** for a predetermined horizontal period during which the first and second scan signals  $S1n$ ,  $S2n$  are supplied, and to turn on the third transistor **M3** for the other period. According to an embodiment of the present invention, the emission control signal  $En$  is supplied overlapping with the first and second scan signals  $S1n$ ,  $S2n$ , and has a duration or width equal to or larger than that of the first scan signal  $S1n$ .

[0037] Referring back to FIG. 2, the data driving part **120** receives the data control signal DCS from the timing controller **150**. Then, the data driving part **120** generates the data signal in response to the data control signal DCS, and supplies the data signal to the data lines  $D1$  to  $Dm$ . The data driving part **120** supplies a predetermined data voltage as the data signal to the data lines  $D1$  to  $Dm$ .

[0038] The data driving part **120** receives a pixel current from the pixel **140** for a partial second period of one horizontal period, and checks whether the received pixel current has a level corresponding to the data Data. For example, when a pixel current in the pixel **140** corresponding to a digital value (or level) of the data Data is  $10\ \mu\text{A}$ , the data driving part **120** checks whether the received pixel current is  $10\ \mu\text{A}$ . When the data driving part **120** receives an undesired current from each pixel **140**, the data driving part **120** controls the data voltage, thereby allowing a desired current to flow in each pixel **140**. The data driving part **120** includes at least one data driver **129** having  $j$  channels where  $j$  is a natural number. Detailed configuration of the data driver **129** will be described later.

[0039] FIG. 3 is a circuit diagram of a pixel illustrated in FIG. 2. For the sake of convenience, FIG. 3 exemplarily

illustrates a pixel that is coupled to the  $m$ th data line  $Dm$ , the  $n$ th first scan line  $S1n$ , the  $n$ th second scan line  $S2n$ , and the  $n$ th emission control line  $En$ .

[0040] The pixel **140** according to an embodiment of the present invention includes a first transistor **M1**, a second transistor **M2**, a third transistor **M3** and a driver **142**.

[0041] The first transistor **M1** is coupled between the data line  $Dm$  and the driver **142**, and supplies the data voltage from the data line  $Dm$  to the driver **142**. The first transistor **M1** is controlled by the first scan signal transmitted through the  $n$ th first scan line  $S1n$ .

[0042] The second transistor **M2** is coupled between a data line  $Dm$  and the driver **142**, and supplies the pixel current from the driver **142** to the data line  $Dm$ . The second transistor **M2** is controlled by the second scan signal transmitted through the  $n$ th second scan line  $S2n$ .

[0043] The third transistor **M3** is coupled between the driver **142** and a light emitting device OLED. The third transistor **M3** is controlled by the emission control signal transmitted through the  $n$ th emission control line  $En$ . At this time, the emission control signal is supplied overlapping with the first and second scan signals respectively supplied through the  $n$ th first and second scan lines  $S1n$  and  $S2n$ . The third transistor **M3** is turned off while the emission control signal is supplied, and is turned on while the emission control signal is not supplied.

[0044] The driver **142** supplies the pixel current to the second transistor **M2** and the third transistor **M3** corresponding to the data signal received from the first transistor **M1**. The driver **142** includes a fourth transistor **M4**, coupled between a first power source line supplying first voltage ELVDD and the third transistor **M3**, and a capacitor  $C$  coupled between a gate electrode of the fourth transistor **M4** and the first power source line supplying first voltage ELVDD. Alternatively, the driver **142** is not limited to the configuration shown in FIG. 3, and may include one of various circuits well-known in the art. Also, the transistors **M1** through **M4** are illustrated as p-channel metal oxide semiconductor (PMOS) transistors, but not limited to this type.

[0045] The operation of the pixel **140** may be explained also by referring to FIGS. 3 and 4. For a predetermined horizontal period  $1H$  of one frame, the first scan signal is supplied through the  $n$ th first scan line  $S1n$ , and at the same time, the second scan signal is supplied through the  $n$ th second scan line  $S2n$ . The first transistor **M1** receives the first scan signal and is turned on for the first period of the one horizontal period  $1H$ . As the first transistor **M1** is turned on, the data signal of the data line  $Dm$  is supplied to the capacitor  $C$  for the first period. At this time, the capacitor  $C$  is charged to a predetermined voltage corresponding to the data signal received by **M1**. The second transistor **M2** receives the second scan signal and stays turned off for the duration of the first period.

[0046] Next, the first transistor **M1** is turned off and the second transistor **M2** is turned on for a part of the second period. As the second transistor **M2** is turned on, the pixel current is supplied from the fourth transistor **M4** to the data line  $Dm$  corresponding to the predetermined voltage to which the capacitor  $C$  was charged. The pixel current is supplied from the data line  $Dm$  to the data driving part **120**,

and the data driving part **120** increments or decrements the level of the data voltage in accordance with the pixel current, thereby allowing a desired pixel current to flow to the pixel **140**.

[0047] Afterward, the second transistor **M2** is turned off, and the first transistor **M1** is turned on for a portion of the second period. As the first transistor **M1** is turned on, the data voltage, increased or decreased by the data driving part **120**, is supplied to the capacitor **C**, thereby controlling the level of the voltage to which the capacitor **C** is charged. In essence, the first transistor **M1** and the second transistor **M2** are alternately turned on and off at least one time for the second period, so that the voltage charged in the capacitor **C** is controlled to allow the desired pixel current to flow through the pixel **140**.

[0048] The emission control signal is supplied to the *n*th emission control line **En** for the predetermined horizontal period **1H**, so that the third transistor **M3** is turned off. Therefore, the pixel current is not supplied to the light emitting device **OLED**. The emission control signal is not supplied to the *n*th emission control line **En** after the lapse of the predetermined horizontal period **1H**, so that the pixel current is supplied to the light emitting device **OLED**. Here, the pixel current is adjusted or controlled into a desired current level for the duration of the predetermined horizontal period **1H**, so that the light emitting device **OLED** can emit light with the desired brightness.

[0049] FIG. 5 is a unit diagram showing an embodiment of a data driver **129** illustrated in FIG. 2. For the sake of convenience, FIG. 5 exemplarily illustrates a pixel Driver having *j* channels.

[0050] The data driver **129** includes a shift register **200** to generate sampling signals in sequence, a sampling latch **210** to store the data **Data** in sequence in response to the sampling signals, a holding latch **220** to temporarily store the data **Data** of the sampling latch **210** and supply the stored data **Data** to a register **230**, the register **230** to temporarily store the data **Data** supplied from the holding latch **220**, a data control unit **240** to increment or decrement the digital value of the data **Data** stored in the register **230**, a voltage digital-analog converter (VDAC) **250** to generate the data voltage **Vdata** corresponding to the digital value of the data **Data** stored in the register **230**, a current digital-analog converter (IDAC) **260** to generate the data current **Idata** corresponding to the digital value of the data **Data** stored in the register **230**, a buffer **270** to supply the data voltage **Vdata** from the VDAC **250** to the data lines **D1** to **Dj**, and a selection unit **280** to selectively couple the data lines **D1** to **Dj** with either of the buffer **270** or the data control unit **240**. The data current **Idata** may alternatively be called a sensing current.

[0051] The shift register **200** receives a source shift clock **SSC** and a source start pulse **SSP** from the timing controller **150** and shifts the source start pulse **SSP** per period of the source shift clock **SSC**, thereby generating *j* sampling signals in sequence. The shift register **200** includes *j* shift registers **2001** through **200j**.

[0052] The sampling latch **210** stores the data **Data** in sequence, in response to the sampling signals sequentially supplied from the shift register **200**. The sampling latch **210** may include *j* sampling latches **2101** through **210j** to store *j*

data **Data**. Further, the size of each sampling latches **2101** through **210j** corresponds to a digital value of the data **Data**. For example, in the case where the data **Data** is of *k* bits, each of the sampling latches **2101** through **210j** has a size corresponding to *k* bits.

[0053] The holding latch **220** receives the data **Data** from the sampling latch **210** and stores it in response to a source output enable signal **SOE**. Further, the holding latch **220** supplies the data **Data** stored in the holding latch **220** to the register **230** in response to the source output enable signal **SOE**. The holding latch **220** may include *j* holding latches **2201** through **220j** each corresponding to *k* bits.

[0054] The register **230** temporarily stores the data **Data** supplied from the holding latch **220**. The data **Data** stored in the register **230** is supplied to the data control unit **240**, the VDAC **250**, and the IDAC **260**. The register **230** may include *j* registers **2301** through **230j** each corresponding to *k* bits.

[0055] The data control unit **240** receives the data current **Idata**, the pixel current **Ipixel**, and the data **Data**. The data control unit **240** compares the data current **Idata** with the pixel current **Ipixel**, and controls the digital value of the data **Data** on the basis of the result of the comparison. Ideally, the data control unit **240** controls the digital value of the data **Data** to make the data current **Idata** equal to the pixel current **Ipixel**. The data **Data** adjusted or controlled in the data control unit **240** (hereinafter, referred to as "reset data") is supplied to the register **230**. The data control unit **240** may include *j* data controllers **2401** through **240j**.

[0056] The VDAC **250** generates the data voltage **Vdata** corresponding to the digital value of the data **Data** or the reset data **Data**, and supplies the data voltage **Vdata** to the buffer **270**. The VDAC **250** may generate *j* data voltages **Vdata** corresponding to *j* data **Data** (or *j* reset data) supplied from the register **230**. The VDAC **250** may include *j* data voltage generators **2501** through **250j**.

[0057] The IDAC **260** generates the data current **Idata** corresponding to the digital value of the data **Data**, and supplies the data current **Idata** to the data control unit **240**. The IDAC **260** may generate *j* data current **Idata** corresponding to *j* data **Data** supplied from the register **230**. The VDAC **250** may also include *j* data current generators **2601** through **260j**.

[0058] The buffer **270** supplies the data voltage **Vdata** from the VDAC **250** to the selection unit **280**. The buffer **270** may include *j* buffers **2701** through **270j**. The selection unit **280** selectively couples the data lines **D1** to **Dj** to either the buffer **270** or the data control unit **240**. The selection unit **280** may include *j* selectors **2801** through **280j**.

[0059] FIG. 6 is a detailed unit diagram of a data controller and a selector provided in the data driver illustrated in FIG. 5. For the sake of convenience, FIG. 6 exemplarily illustrates the *j*th data controller **240j** and the *j*th selector **280j**. The selector **280j** includes a fifth transistor **M5** coupled between the buffer **270j** and the data line **Dj**, and a sixth transistor **M6** coupled between the data controller **240j** and the data line **Dj**.

[0060] The fifth transistor **M5** and the sixth transistor **M6** are turned on alternately with each other so that when one is on the other is off. These transistors **M5**, **M6** couple the data

line  $D_j$  with either the buffer **270j** or the data controller **240j**. To achieve this task, the fifth transistor **M5** and the sixth transistor **M6** are different in conductivity type. For example, if one is an NMOS, the other would be a PMOS. The fifth transistor **M5** and the sixth transistor **M6** may be controlled by a selection signal supplied through a control line **CL**.

[0061] **FIG. 7** shows a waveform of a signal for driving the selector illustrated in **FIG. 6**. The selection signal **CL** is supplied during the first period of one horizontal period **1H** to turn on the fifth transistor **M5**. Further, the selection signal **CL** is supplied to turn on and off the fifth and sixth transistors **M5** and **M6** alternately during the second period. In essence, during the second period, the selection signal **CL** is supplied to turn on and turn off the fifth transistor **M5** in accordance with the first transistor **M2**, and turn on and turn off the sixth transistor **M6** in accordance with the second transistor **M2**.

[0062] Referring back to **FIG. 6**, the data controller **240j** includes a comparator **241**, and a data adjuster **242**. The comparator **241** receives the data current  $I_{data}$  from the data current generator **260j**, and receives the pixel current  $I_{pixel}$  from the pixel **140** via the selector **280j**. The pixel current  $I_{pixel}$  may be supplied from the pixel **140** receiving the first and second scan signals. The comparator **241** receives the pixel current  $I_{pixel}$  and the data current  $I_{data}$ , and compares the pixel current  $I_{pixel}$  with the data current  $I_{data}$ . Then, the comparator **241** supplies a first control signal or a second control signal to the data adjuster **242** on the basis of the result of the comparison. For example, when the data current  $I_{data}$  is higher than the pixel current  $I_{pixel}$ , the comparator **241** generates the first control signal. On the other hand, when the data current  $I_{data}$  is lower than the pixel current  $I_{pixel}$ , the comparator **241** generates the second control signal.

[0063] The data adjuster **242** receives the data **Data** from the register **230j** and stores it. Further the data adjuster **242** receives the first control signal or the second control signal from the comparator **241**, and receives a constant value **CN** from the outside. Then, the data adjuster **242** increments or decrements the digital value of the data **Data** by the constant value **CN**, thereby controlling the data **Data**. The data **Data** adjusted by the data adjuster **242** is supplied to the register **230j**.

[0064] The data controller **240j** operates as follows. For the first period of one horizontal period **1H**, the register **230j** supplies the data **Data** from the holding latch **220j** to the data adjuster **242**, the data voltage generator **250j**, and the data current generator **260j**. The data voltage generator **250j** receives the data **Data**, and generates the data voltage  $V_{data}$  corresponding to the digital value of the data **Data**, thereby supplying the data voltage  $V_{data}$  to the buffer **270j**. Then, the data current generator **260j** receives the data **Data**, and generates the data current  $I_{data}$  corresponding to the digital value of the data **Data**, thereby supplying the data current  $I_{data}$  to the comparator **240j**.

[0065] For the first period of one horizontal period **1H**, the fifth transistor **M5** and the first transistor **M1** are turned on, but the sixth transistor **M6** and the second transistor **M2** are turned off. When the fifth transistor **M5** and the first transistor **M1** are turned on, the data voltage  $V_{data}$  generated by the data voltage generator **250j** is supplied to the driver **142** via

the buffer **270j**, the fifth transistor **M5**, the data line  $D_j$ , and the first transistor **M1**. Then, the capacitor **C** provided in the driver **142** is charged with a voltage corresponding to the data voltage  $V_{data}$ . In essence, the first period is set to allow the capacitor **C** of the pixel **140** to be charged with a predetermined voltage corresponding to the first data voltage  $V_{data}$ .

[0066] After the capacitor **C** is charged with the voltage corresponding to the first data voltage  $V_{data}$ , at the beginning of the second period, the sixth and second transistors **M6**, **M2** are turned on, and the switching device **SW1** and the fifth and first transistors **M5**, **M1** are turned off. As the sixth and second transistors **M6**, **M2** are turned on, the pixel current  $I_{pixel}$  generated by the driver **142** is supplied to the comparator **241** via the second transistor **M2**, the data line  $D_j$ , and the sixth transistor **M6**.

[0067] The comparator **252** receives the pixel current  $I_{pixel}$  and the data current  $I_{data}$ , and compares the pixel current  $I_{pixel}$  with the data current  $I_{data}$ , thereby outputting the first or second control signal to the voltage adjuster **242** on the basis of the compared results. The data current  $I_{data}$  is an ideal current that should flow through the pixel **140** corresponding to the data **Data**, and the pixel current  $I_{pixel}$  is a real current through the pixel **140**.

[0068] The data adjuster **242** receives the first control signal or the second control signal, and increments or decrements the stored data **Data** by the constant value **CN**, thereby generating the reset data **Data**. The adjusted data **Data** is supplied to the register **230j**. The data adjuster **242** controls the digital value of the data **Data** to make the pixel current  $I_{pixel}$  approximately equal with the data current  $I_{data}$ . For example, in the case where the data adjuster **242** receives the first control signal, the data adjuster **242** decrements the digital value of the data **Data** by the constant value **CN**, thereby decreasing the pixel current  $I_{pixel}$ . On the other hand, in the case where the data adjuster **242** receives the second control signal, the data adjuster **242** increments the digital value of the data **Data** by the constant value **CN**, thereby increasing the pixel current  $I_{pixel}$ . The constant value **CN** is previously set with a predetermined value.

[0069] The adjusted data **Data** is supplied from the data adjuster **242** to the register **230j**. Then, the register **230j** supplies the adjusted data **Data** to the data voltage generator **250j**. Then, the data voltage generator **250j** generates the data voltage  $V_{data}$  using the adjusted data **Data**.

[0070] Thereafter, the fifth transistor **M5** and the first transistor **M1** are turned on, and the sixth transistor **M6** and the second transistor **M2** are turned off. Then, the data voltage  $V_{data}$  based on the reset data **Data** is supplied to the driver **142** via the buffer **270j**, the fifth transistor **M5**, the data line  $D_j$ , and the first transistor **M1**. At this time, the driver **142** generates the pixel current  $I_{pixel}$  corresponding to the data voltage  $V_{data}$ . According to an embodiment of the present invention, the sixth and second transistors **M2**, **M6** are turned on and off at least once alternately with the fifth and first transistors **M5**, **M1**, so that the data current  $I_{data}$  is similar to or equal to the pixel current  $I_{pixel}$  for the second period.

[0071] Referring to **FIG. 6**, the data current generator **260j** may generate the data current  $I_{data}$  correspondence to the reset data **Data**. Actually, the data current  $I_{data}$  generated

corresponding to the reset data is not an ideal current which should flow in the pixel 140. Therefore, when the data current  $I_{data}$  corresponding to the reset data  $Data$  is supplied to the comparator 241, an undesirable pixel current  $I_{pixel}$  flows through the pixel 140. To solve this problem, a switching part 255 can be additionally provided between the register 230 and IDAC 260 as shown in the FIG. 8.

[0072] FIG. 8 is a block diagram showing another embodiment of a data driver illustrated in FIG. 2. The switching part 255 includes switching devices SW provided in a number corresponding to the number of channels. For example, the switching part 255 includes  $j$  switch devices SW.

[0073] FIG. 9 shows a waveform of a signal for driving the switching part 255 illustrated in FIG. 8. The switching device SW is turned on in response to an external selection signal SS for the first period of one horizontal period, and turned off for the rest of one horizontal period 1H, i.e., for the duration of the second period. Then, the reset data  $Data$  is not supplied to the register 230, and thus the desired data current  $I_{data}$  is supplied to the comparator 241.

[0074] FIG. 10 is a circuit diagram of a comparator 241 illustrated in FIG. 6. The comparator circuit illustrated in FIG. 10 was disclosed by the Institute of Electrical and Electronics Engineers (IEEE) in 1992. However, the comparator 241 according to embodiments of the present invention is not limited to the circuit proposed by IEEE. Alternatively, various well-known comparators may be used in the present invention as long as it can compare the currents.

[0075] In FIG. 10, the current corresponding to the difference between the pixel current  $I_{pixel}$  and the data current  $I_{data}$  is supplied to a first node N1. From the first node N1, the current is supplied to gate terminals of a third transistor M13 and a fourth transistor M14 coupled together to form an inverter. This current turns on either the third transistor M13 or the fourth transistor M14, thereby applying a high voltage VDD or a low voltage GND to an output terminal. Here, the voltage applied to the output terminal is also supplied to the gate terminals of first and second transistors M11, M12, thereby maintaining the voltage at the output terminal stable.

[0076] Although a few embodiments of the present invention have been shown and described, it would be appreciated by those skilled in the art that changes might be made in these embodiments without departing from the principles and spirit of the invention, the scope of which is defined in the claims and their equivalents.

What is claimed is:

1. An organic light emitting display device comprising:
  - first and second scan lines;
  - a data line formed in a direction intersecting a direction of the first and second scan lines;
  - a display region including a pixel coupled to the first and second scan lines and to the data line;
  - a scan driver for supplying first and second scan signals to the first and second scan lines, respectively; and
  - a data driving part coupled to the data line for converting external data into a data voltage and for supplying the data voltage to the data line,

wherein the data driving part receives a pixel current that flows in the pixel corresponding to the data voltage from the pixel via the data line, and controls a digital value of the data in accordance with the received pixel current.

2. The organic light emitting display device according to claim 1, wherein the pixel comprises:

- a light emitting device;
- a driver for generating the pixel current corresponding to the data voltage;
- a first transistor coupled between the driver and the data line, and controlled by a first scan signal supplied through the first scan line; and
- a second transistor coupled between the data line and a common node formed between the driver and the light emitting device, and controlled by a second scan signal supplied through the second scan line.

3. The organic light emitting display device according to claim 2, wherein the first transistor is turned on corresponding to the first scan signal during a first period of a horizontal period, and turned on and off at least once during a second period of the horizontal period.

4. The organic light emitting display device according to claim 3, wherein the second transistor is turned off corresponding to the second scan signal during the first period, and turned on and off alternately with the first transistor during the second period.

5. The organic light emitting display device according to claim 2, further comprising a third transistor coupled between the driver and the light emitting device, the third transistor capable of being turned off by an emission control signal supplied through an emission control line during a period while the first scan signal is supplied to the first transistor, the third transistor capable of being turned on for a remaining period.

6. The organic light emitting display device according to claim 1, wherein the data driving part comprises at least one data driver, each data driver including:

- a register part to temporarily store the data;
- a voltage digital to analog converter for generating a data voltage corresponding to the data stored in the register part;
- a current digital-analog converter for generating a data current corresponding to the data stored in the register part;
- a buffer part for supplying the data voltage as a data signal to the pixels via a data line;
- a data control unit for comparing the data current with a pixel current in the pixel corresponding to the data voltage, and controlling a digital value of the data on the basis of comparison; and
- a selection unit for selectively coupling the data line with either of the buffer part or the data control unit.

7. A data driver for an organic light emitting diode display including pixels, the data driver comprising:

- a register part for storing external data in the register part;
- a voltage digital to analog converter coupled to the register part and receiving the data stored in the register

part for generating a data voltage corresponding to the data stored in the register part;

a current digital to analog converter coupled to the register part and receiving the data stored in the register part for generating a data current corresponding to the data stored in the register part;

a buffer part coupled to the voltage digital to analog converter and receiving the data voltage from the digital to analog converter for supplying the data voltage as a data signal to the pixels via a data line;

a data control unit coupled to the register part and to the current digital to analog converter for receiving a pixel current corresponding to the data voltage from the pixels via the data line and for controlling a value of the data stored in the register part; and

a selection unit coupled to the buffer part and to the data control unit, for selectively coupling the data line with either of the buffer part or the data control unit.

8. The data driver according to claim 7, wherein the selection unit couples the data line with the buffer part during a first period of a one horizontal period, and wherein the selection unit alternately couples the data line with either of the buffer part or the data control unit during a second period of the one horizontal period.

9. The data driver according to claim 8, wherein the selection unit comprises a selector including:

a first transistor coupled between the buffer part and the data line; and

a second transistor coupled between the data line and the data control unit.

10. The data driver according to claim 9, wherein the first transistor is turned on during the first period, and

wherein the first transistor and the second transistor are alternately turned on and off during the second period.

11. The data driver according to claim 10, wherein the data voltage is supplied to the pixel via the data line when the first transistor is turned on, and the pixel current is supplied from the pixel to the data control unit via the data line when the second transistor is turned on.

12. The data driver according to claim 7, wherein the data control unit compares the pixel current with the data current, and controls the value of the data stored in the register part on the basis of comparison.

13. The data driver according to claim 12, wherein the data control unit increments or decrements the value of the data by a preset value.

14. The data driver according to claim 12, wherein the data control unit comprises a data controller including:

a comparator for comparing the data current with the pixel current; and

a data adjuster for increasing or decreasing the digital value of the data stored in the register part based on comparator results.

15. The data driver according to claim 8, further comprising a switching part that is coupled between the current digital-analog converter and the register part, electrically coupling the register part with the current digital-analog converter during the first period, and electrically uncoupling the register part from the current digital to analog converter during the second period.

16. A method for controlling image brightness corresponding to data received in an organic light emitting display device having a pixel for emitting light, the method comprising:

converting the data into a data voltage and a data current; supplying the data voltage to the pixel to generate a pixel current corresponding to the data voltage;

comparing the pixel current with the data current; and

controlling the data voltage to provide a desired image brightness by incrementing the data voltage if the pixel current is lower than the data current and decrementing the data voltage if the pixel current is higher than the data current.

17. The method of claim 16, further comprising:

allowing the data current to flow into the pixel by supplying a first scan signal to the pixel; and

allowing a pixel current generated in the pixel to flow out of the pixel by supplying a second scan signal to the pixel,

wherein the first scan signal and the second scan signal are supplied non-concurrently.

18. The method of claim 16, further comprising:

receiving a control signal for selecting either supplying the data voltage to the pixel or receiving the pixel current from the pixel.

19. The method of claim 18, further comprising:

driving the pixel during frames;

dividing each frame into a first period and a second period separate from the first period;

receiving the control signal for supplying the data voltage to the pixel during the entire first period; and

alternately receiving the control signal for the supplying the data voltage to the pixel and the control signal for the receiving the pixel current from the pixel during the second period.

20. The method of claim 16, wherein the data is converted into the data current while supplying the data voltage to the pixel but not while receiving a pixel current from the pixel.

\* \* \* \* \*

专利名称(译)	数据驱动器和使用其的有机发光显示装置		
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摘要(译)

用于显示具有期望亮度的图像的数据驱动器，以及使用该数据驱动器的有机发光显示装置。数据驱动器包括临时存储外部数据的寄存器；电压数模转换器，用于产生与存储在寄存器部分中的数据相对应的数据电压；电流数模转换器，用于产生与存储在寄存器部分中的数据相对应的数据电流；缓冲部分，用于通过数据线将数据电压作为数据信号提供给像素；数据控制单元，用于通过数据线从像素接收与数据电压对应的像素电流，并控制存储在寄存器部分中的数据的数字值；选择单元，用于选择性地将数据线与缓冲器部分或数据控制单元中的任一个耦合。

