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(54) **Colour display with time-divisionally driving of subpixels**

Farbanzeigevorrichtung mit Zeitmultiplexansteuerung von Teilbildpunkten

Affichage couleur à multiplexage temporel de sous-pixels

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Description

BACKGROUND OF THE INVENTION

(a) Field of the Invention

[0001] The present invention relates to a display device and a driving method thereof. More specifically, the present invention relates to an organic electroluminescent (EL) display using electroluminescence of organic matter, and a driving method thereof.

(b) Description of the Related Art

[0002] In general, an organic EL display is a display device for electrically exciting phosphorous organic compounds and emitting light. The organic EL display drives organic light emission cells arranged in a matrix format to represent images. An organic light emission cell having a diode characteristic is referred to as an organic light emission diode (OLED) and has a structure including an anode electrode layer, an organic thin film, and a cathode electrode layer. Holes and electrons injected through the anode electrode and the cathode electrode are combined on the organic thin film, and emit light. The organic light emission cell emits different amounts of light according to injected amounts of electrons and holes, that is, depending on the applied current.

[0003] In the organic EL display, a pixel includes a plurality of sub-pixels each of which has one of a plurality colors (e.g., primary colors of light), and colors are represented through combinations of the colors emitted by the sub-pixels. In general, a pixel includes a sub-pixel for displaying red R, a sub-pixel for displaying green G, and a sub-pixel for displaying blue B, and the colors are displayed by combinations of red, green, and blue (RGB).

[0004] Each sub-pixel in the organic EL display includes a driving transistor for driving an organic EL element, a switching transistor, and a capacitor. Also, each sub-pixel has a data line for transmitting a data signal, and a power line for transmitting a power supply voltage VDD. Therefore, many wires are required for transmitting voltages or signals to the transistors and capacitor formed at each pixel. It is difficult to arrange such wires in the pixel, and the aperture ratio corresponding to a light emission area of the pixel is reduced.

[0005] In EP 0 762 374 A1 a single pixel circuit drives a plurality of light-emitting elements using a time-multiplexing scheme. Due to the sequential provision of pixel data to the single pixel circuit, the number of data lines can be reduced. However, perceived display quality may decrease because of the sequential provision of colour information to the display panel.

SUMMARY OF THE INVENTION

[0006] Therefore, a first aspect of the invention provides a display device including a plurality of scan lines including a plurality of first scan lines and a plurality of second scan lines for applying select signals, a plurality of data lines including a plurality of first data lines and a plurality of second data lines for applying data signals for displaying an image during a field having a plurality of subfields, and a plurality of pixel circuits coupled to the scan lines and the data lines. Each of the pixel circuits comprises at least two emit elements for emitting light having different colors, wherein each of the emit elements emits light responsive to an applied current, a capacitor for storing a voltage corresponding to one of the data signals applied in response to one of the select signals, a switching transistor for applying one of the data signals provided by one of the data lines to the capacitor in response to one of the select signals provided by one of the scan lines, a driving transistor for outputting the applied current corresponding to the voltage stored in the capacitor, at least two emitting transistors coupled between the driving transistor and the emit elements, and one of the emit elements emits light in response to an operation of the emitting transistors, and at least two emit signal lines which are respectively coupled to gates of the emitting transistors and apply control signals for controlling the operation of the emitting transistors, wherein one of the emitting transistors is turned on by one of the control signals applied through the emit signal lines and the applied current is applied to one of the emit elements from the driving transistor. According to the invention, the plurality of pixel circuits are grouped into a plurality of groups of pixel circuits, wherein each group of pixel circuits is connected to a corresponding one of the first scan lines, the second scan lines, the first data lines, and the second data lines. Each group of pixel circuits comprises a first pixel circuit, a second pixel circuit, a third pixel circuit, and a fourth pixel circuit, wherein, in a first one of the subfields, one of the emit elements of a first color starts emitting light in the first pixel circuit, which is coupled to the first scan line and the first data line, one of the emit elements of a color which is different from the first color starts emitting light in the second pixel circuit, which is coupled to the first scan line and the second data line, one of the emit elements of a second color which is different from the first color starts emitting light in the third pixel circuit, which is coupled to the second scan line and the first data line, and one of the emit elements of a color which is different from the second color starts emitting light in the fourth pixel circuit, which is coupled to the second scan line and the second data line.

[0007] A second aspect of the invention provides a method for driving a display device including a plurality of pixel circuits arranged in rows and columns, wherein each of the pixel circuits comprises at least two emit elements for emitting light of different colors responsive to an applied current, and a transistor coupled to the emit elements supplies the applied current to one of the emit elements through at least one switch, and wherein the plurality of pixel circuits are grouped into a plurality of groups of pixel circuits, wherein each group of pixel cir-

cuits is connected to a corresponding one of a plurality of first scan lines, of a plurality of second scan lines, of a plurality of first data lines, and of a plurality of second data lines; and wherein each group of pixel circuits comprises a first pixel circuit, a second pixel circuit, a third pixel circuit, and a fourth pixel circuit, the method of driving during a field having a plurality of subfields comprising:

[0008] start emitting, in a first one of the subfields, one of the emit elements of a first color in each first pixel circuit provided on a row of a first row group including at least one of the rows and a column of a first column group including at least one of the columns;

[0009] start emitting, in the first one of the subfields, one of the emit elements of a second color which is different from the first color in each second pixel circuit provided on a row of the first row group and a column of a second column group including at least one of the columns;

[0010] start emitting, in the first one of the subfields, one of the emit elements of a third color which is different from the first color in each third pixel circuit provided on a row of a second row group including at least one of the rows and a column of the first group;

[0011] start emitting, in a second one of the subfields, the emit elements of colors in each of the first and second pixels circuits, respectively, which are different from the first and second colors, respectively; and

start emitting, in the second one of the subfields, one of the emit elements of a color which is different from the third color in each third pixel circuit.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The accompanying drawings illustrate exemplary embodiments of the present invention, and, together with the description, serve to explain the principles of the invention:

[0013] FIG. 1 shows a plan view of an organic EL display used to implement exemplary embodiments of the present invention;

[0014] FIG. 2 shows a conceptual diagram of a pixel in the organic EL display of FIG. 1;

[0015] FIG. 3 shows a circuit diagram of a pixel in an organic EL display according to a first exemplary embodiment of the present invention;

[0016] FIG. 4 shows a signal timing diagram of an organic EL display according to the first exemplary embodiment of the present invention;

[0017] FIGs. 5 and 6 show signal timing diagrams of an organic EL display according to second and third exemplary embodiments of the present invention;

[0018] FIG. 7 shows a circuit diagram of a pixel in an organic EL display according to a fourth exemplary embodiment of the present invention;

[0019] FIG. 8 shows a signal timing diagram of the organic EL display according to the fourth exemplary embodiment of the present invention;

[0020] FIG. 9 shows a circuit diagram of a number of pixels in an organic EL display according to a fifth exemplary embodiment of the present invention; and

[0021] FIG. 10 shows a signal timing diagram of the organic EL display according to the fifth exemplary embodiment of the present invention.

DETAILED DESCRIPTION

[0022] In the following detailed description, only certain exemplary embodiments of the present invention are shown and described, simply by way of illustration. As those skilled in the art would realize, the described embodiments may be modified in various different ways, all without departing from the scope of the present invention. Accordingly, the drawings and description are to be regarded as illustrative in nature, and not restrictive. There may be parts shown in the drawings, or parts not shown in the drawings, that are not discussed in the specification as they are not essential to a complete understanding of the invention. Like reference numerals designate like elements.

[0023] A light emission display and driving method according to exemplary embodiments of the present invention will be described in detail with reference to drawings, and an organic EL display will be exemplified and described in the exemplary embodiments.

[0024] FIG. 1 shows a plan view of an organic EL display used to implement exemplary embodiments of the present invention, and FIG. 2 shows a conceptual diagram of a pixel in the organic EL display of FIG. 1.

[0025] As shown in FIG. 1, the organic EL display includes a display 100, a select scan driver 200, an emit scan driver 300, and a data driver 400. The display 100 includes a plurality of scan lines S1 to Sn and E1 to En arranged in the row direction, and a plurality of data lines D1 to Dm, a plurality of power lines VDD, and a plurality of pixels 110 respectively arranged in the column direction. The pixels are formed at pixel areas formed by two adjacent ones of the scan lines S1 to Sn and two adjacent ones of the data lines D1 to Dm. Referring to FIG. 2, the pixel 110 includes organic EL elements OLEDr, OLEDg, and OLEDb for emitting red, green, and blue lights, respectively, and a driver 111 on which elements for driving the organic EL elements OLEDr, OLEDg, and OLEDb are formed. The organic EL elements emit light having brightness corresponding to the applied current.

[0026] The select scan driver 200 sequentially transmits select signals for selecting corresponding lines to the select scan lines S1 to Sn in order to apply data signals to pixels of the corresponding lines, the emit scan driver 300 sequentially transmits emit signals for controlling light emission of the organic EL elements OLEDr, OLEDg, and OLEDb to the emit scan lines E1 to En, and the data driver 400 applies data signals corresponding to the pixels of lines to which select signals are applied to the data lines D 1 to Dm each time the select signals are sequentially applied.

[0027] The select and emit scan drivers 200 and 300 and the data driver 400 are coupled to a substrate on which the display 100 is formed. In addition, the select and emit scan drivers 200 and 300 and/or the data driver 400 can be installed directly on the substrate of the display 100, and they can be substituted with a driving circuit which is formed on the same layer on the substrate of the display 100 as the layer on which scan lines, data lines, and transistors are formed. Further, the select and emit scan drivers 200 and 300 and/or the data driver 400 can be installed in a chip format on a tape carrier package (TCP), a flexible printed circuit (FPC), or a tape automatic bonding unit (TAB) coupled to the select and emit scan drivers 200 and 300 and/or the data driver 400.

[0028] One field is divided into three subfields and then driven, and red, green, and blue data are written on the three subfields to emit light in the first exemplary embodiment. For this purpose, the select scan driver 200 sequentially transmits select signals to the select scan lines S1 to Sn for each subfield, the emit scan driver 300 applies emit signals to the emit scan lines E1 to En so that the organic EL element for each color may emit light in a subfield, and the data driver 400 applies data signals respectively corresponding to the red, green, and blue organic EL elements to the data lines D1 to Dm.

[0029] A detailed operation of the organic EL display according to a first exemplary embodiment will be described with reference to FIGs. 3 and 4.

[0030] FIG. 3 shows a circuit diagram of a pixel 110' in the organic EL display according to the first exemplary embodiment of the present invention, and FIG. 4 shows a signal timing diagram of the organic EL display according to the first exemplary embodiment of the present invention. The pixel 110', for example, can be used as the pixel 110 of FIGs. 1 and 2. In detail, FIG. 3 shows a voltage programmed pixel coupled to the select scan line S 1 of the first row and the data line D1 of the first column. The pixel 110' includes p-channel transistors. No other pixels will be described in reference to the first exemplary embodiment since the pixels of first exemplary embodiment have substantially the same structure as that shown in FIG. 3.

[0031] As shown in FIG. 3, the pixel circuit 110' according to the first exemplary embodiment includes a driver 111' and organic EL elements OLEDr, OLEDg, and OLEDb. The driver 111' includes a driving transistor M1, a switching transistor M2, and emitting transistors M3r, M3g, and M3b for controlling light emission of the organic EL elements OLEDr, OLEDg, and OLEDb. One emit scan line E1 includes three emit signal lines E1r, E1g, and E1b, and while not illustrated in FIG. 3, other emit scan lines E2 to En respectively include three emit signal lines E2r to Enr, E2g to Eng, and E2b to Enb. The emitting transistors M3r, M3b, and M3b and the emit signal lines E1r, E1g, and E1b form a switch for selectively transmitting the current provided by the driving transistor M1 to the organic EL elements OLEDr, OLEDg, and OLEDb.

[0032] In detail, the switching transistor M2 having a gate coupled to the select scan line S1 and a source coupled to the data line D1 transmits the data voltage provided by the data line D1 in response to the select signal provided by the select scan line S1. The driving transistor has a source coupled to the power line VDD for supplying a power supply voltage, and has a gate coupled to a drain of the switching transistor M2, and a capacitor C1 is coupled between a source and a gate of the driving transistor M1. The driving transistor M1 has a drain coupled to sources of the emit transistors M3r, M3g, and M3b, and gates of the emit transistors M3r, M3g, and M3b are coupled to the emit signal lines E1r, E1g, and E1b, respectively. Drains of the emit transistors M3r, M3g, and M3b are coupled, respectively, to anodes of the organic EL elements OLEDr, OLEDg, and OLEDb, and a power supply voltage VSS is applied to cathodes of the organic EL elements OLEDr, OLEDg, and OLEDb. The power supply voltage VSS in the first exemplary embodiment can be a negative voltage or a ground voltage.

[0033] The switching transistor M2 transmits the data voltage provided by the data line D1 to the gate of the driving transistor M1 in response to a low-level select signal provided by the select scan line S1, and the voltage which corresponds to a difference between the data voltage transmitted to the gate of the transistor M1 and the power supply voltage VDD is stored in the capacitor C1. When the emitting transistor M3r is turned on in response to a low-level emit signal provided by the emit signal line E1r, the current which corresponds to the voltage stored in the capacitor C1 is transmitted to the red organic EL element OLEDr from the driving transistor M1 to emit light. In a like manner, when the emitting transistor M3g is turned on in response to a low-level emit signal provided by the emit signal line E1g, the current which corresponds to the voltage stored in the capacitor C1 is transmitted to the green organic EL element OLEDg from the driving transistor M1 to emit light. Further, when the emitting transistor M3b is turned on in response to a low-level emit signal provided by the emit signal line E1b, the current which corresponds to the voltage stored in the capacitor C1 is transmitted to the blue organic EL element OLEDb from the driving transistor M1 to emit light. Three emit signals applied to the three emit signal lines respectively have low-level periods without repetition during one field so that one pixel can display red, green, and blue.

[0034] An organic EL display driving method will be described in detail with reference to FIG. 4. Referring to FIG. 4, one field 1TV includes three subfields 1SF, 2SF, and 3 SF, and signals for driving the red, green, and blue organic EL elements are applied to the subfields1SF, 2SF, and 3SF, periods of which are the same.

[0035] In the subfield 1SF, when a low-level select signal is applied to the select scan line S 1 on the first row, data voltages of R corresponding to red of the pixels on the first row are applied, respectively, to the data lines D1 to Dm, and a low-level emit signal is applied to the emit signal line E1r on the first row. The corresponding one of the data voltages of R is applied to the capacitor

C1 through the switching transistor M2 of each pixel on the first row, and a voltage corresponding to the corresponding one of the data voltages of R is charged in the capacitor C1. The emitting transistor M3r of the pixel on the first row is turned on, and a current corresponding to a gate-source voltage stored in the capacitor C1 is transmitted to the red organic EL element OLEDr from the driving transistor M1 to thus emit light.

[0036] Next, when a low-level select signal is applied to the select scan line S2 on the second row, the data voltages of R corresponding to the red of pixels of the second row are applied, respectively, to the data lines D1 to Dm, a low-level emit signal is applied to the emit signal line E2r of the second row, and a current corresponding to the corresponding one of the data voltages of R provided by a corresponding one of the data lines D1 to Dm is supplied to the red organic EL element OLEDg of each pixel on the second row to thus emit light.

[0037] Then the data voltages are sequentially applied to pixels of from the third to (n-1)th rows to emit the red organic EL element OLEDr. When a low-level select signal is applied to the select scan line Sn on the nth row, the data voltages of R corresponding to the red of the pixels of the nth row are applied to the data lines D1 to Dm, and a low-level emit signal is applied to the emit signal line Enr of the nth row. A current corresponding to a corresponding one of the data voltages of R provided by the data lines D1 to Dm is accordingly supplied to the red organic EL element OLEDr of each pixel on the nth row to thus emit light.

[0038] As a result, the data voltages of R corresponding to red are applied to the respective pixels formed on the display panel 100 during the subfield 1 SF. The emit signals applied to the emit signal lines E1r to Enr are maintained at the low level for a predetermined time, and the organic EL element OLEDr coupled to the emitting transistor M3r to which the corresponding emit signal is applied during the emit signal is at the low level consecutively emits light. This period is illustrated to correspond to the subfield 1SF in FIG. 4. That is, the red organic EL element OLEDr for each pixel emits light with brightness which corresponds to the data voltage applied during the period which corresponds to the subfield.

[0039] In the subfield 2SF, in a like manner as the subfield 1SF, a low-level select signal is sequentially applied to the select scan lines S1 to Sn of from the first to the nth rows, and when the select signal is applied to the respective select scan lines S1 to Sn, data voltages of G corresponding to green of pixels of the corresponding rows are applied, respectively, to the data lines D1 to Dm. A low-level emit signal is sequentially applied to the emit signal line E1g to Eng in synchronization with sequentially applying the low-level select signal to the select scan lines S1 to Sn. A current corresponding to the applied data voltage is transmitted to the green organic EL element OLEDg through the emitting transistor M3g in each pixel to emit light.

[0040] In the subfield 3SF, in a like manner as the subfield 2SF, a low-level select signal is sequentially applied to the select scan lines S 1 to Sn of from the first to the nth rows, and when the select signal is applied to the respective select scan lines S1 to Sn, data voltages of B corresponding to blue of pixels of the corresponding rows are applied, respectively, to the data lines D1 to Dm. A low-level emit signal is sequentially applied to the emit signal lines E1b to Enb in synchronization with sequentially applying the low-level select signal to the select scan lines S1 to Sn. A current corresponding to the applied data voltage of B is transmitted to the blue organic EL element OLEDb through the emitting transistor M3b in each pixel to emit light.

[0041] As described above, one field is divided into three subfields, and the subfields are sequentially driven in the organic EL display driving method according to the first exemplary embodiment. One color organic EL element of one pixel in each subfield emits light, and the organic EL elements of three colors (red, green, and blue) sequentially emit light through three subfields to thus represent colors.

[0042] The signal timing diagram of FIG. 4 illustrates that the organic EL display is driven from the single scan method to the progressive scan method. In addition, the organic EL display can be driven using a dual scan method, an interlaced scan method, and other scan methods without being restricted to them.

[0043] Also, the red, green, and blue organic EL elements have been described to emit light during the same period according to the first exemplary embodiment, but the white balance can be incorrect because of different efficiency of the organic EL elements of respective colors when they emit light during the same period. In this case, the emit periods of the organic EL elements of respective colors are to be modified, which will be described with reference to FIG. 5.

[0044] FIG. 5 shows a signal timing diagram of the organic EL display according to a second exemplary embodiment of the present invention.

[0045] As shown in FIG. 5 differing from FIG. 4, low-level periods of emit signals applied to the emit signal lines E1r to Enr corresponding to red, emit signals applied to the emit signal lines E1g to Eng corresponding to green, and emit signals applied to the emit signal lines E1b to Enb corresponding to blue are different from each other. As described above, the emit periods of the organic EL elements depend on low-level periods of the emit signals applied to the gates of the emitting transistors M3r, M3g, and M3b coupled to the corresponding organic EL elements, and hence, emit times of the respective organic EL elements can be varied by providing different low-level periods of emit signals.

[0046] For example in FIG. 5, low-level periods of emit signals applied to the emit signal lines E1r to Enr coupled to the gate of the transistor M3r coupled to the red organic EL element OLEDr are established to be the longest, and low-level periods of emit signals applied to the emit signal lines E1b to Enb coupled to the gate of the transistor M3b

coupled to the blue organic EL element OLEDb are established to be the shortest. An emit time of the red organic EL element OLEDr is lengthened, and an emit time of the blue organic EL element OLEDb is shortened. The white balance is controlled well through the above-noted process when the emit efficiency of the red organic EL element OLEDr is the worst and the emit efficiency of the blue organic EL element OLEDb is the best.

[0047] The colors are controlled to emit light in the order of red, green, and blue in FIGs. 4 and 5, and they can emit light in other orders. Also, it is possible to divide a field into four subfields rather than three subfields and control the fourth subfield to drive an organic EL element of one color to emit light, or drive organic EL elements of two or more colors concurrently. Further, it is possible to add an organic EL element for displaying white in addition to the three organic EL elements, and either drive the white organic EL element during a subfield or drive four-color organic EL elements respectively during four subfields.

[0048] Also, referring to FIGs. 4 and 5, the select signal has been illustrated to be low-level and the emit signal has been illustrated to be concurrently low-level in one pixel. Alternatively, the emit signal can be low-level after the select signal is switched to high-level from low-level. That is, referring to FIG. 6, the select signal becomes high-level and the emit signal applied to the emit signal lines E1r, E1g, and E1b becomes low-level after the select signal applied to the select scan line S1 changes from low-level to high-level and a voltage which corresponds to the data voltage provided by the data lines D1 to Dm is programmed to the capacitor C1 of each pixel according to the third exemplary embodiment. As a result, the organic EL elements are prevented from emitting light while the data are programmed.

[0049] P-channel transistors have been applied to the pixels according to the first to third exemplary embodiments, and n-channel transistors, combinations of p-channel and n-channel transistors, and other switches having similar functions as the p-channel and n-channel transistors can also be used in addition to the p-channel transistors.

[0050] The emitting transistors M3r, M3g, and M3b have been driven by individual emit signal lines in the first to third exemplary embodiments. That is, three emit signal lines have been used for each pixel. Differing from this, all three of the pixels can be driven using only two emit signal lines, which will now be described with reference to FIGs. 7 and 8.

[0051] FIG. 7 shows a circuit diagram of a pixel 110" in the organic EL display according to a fourth exemplary embodiment of the present invention, and FIG. 8 shows a signal timing diagram of the organic EL display according to the fourth exemplary embodiment of the present invention. In detail, FIG. 7 illustrates a voltage programming pixel 110" coupled to the select scan line S1 of the first row and the data line D1 of the first column. The pixel 110", for example, can be used as the pixel 110 of FIGs. 1 and 2.

[0052] Referring to FIG. 7, differing from the pixel circuit of FIG. 3, the pixel circuit according to the fourth exemplary embodiment has two emitting transistors for each color's organic EL element, and the emitting transistors are driven by two emit signal lines. An emit scan line E1 includes two emit signal lines E11 and E 12, and other emit scan lines E2 to En have two emit signal lines E21 to En1 and E22 to En2, respectively.

[0053] In detail, a p-channel emitting transistor M31r and an n-channel emitting transistor M32r are coupled in series between a drain of the driving transistor M1 and a red organic EL element OLEDr, an n-channel emitting transistor M31g and a p-channel emitting transistor M32g are coupled in series between the drain of the driving transistor M1 and a green organic EL element OLEDg, and n-channel emitting transistors M31b and M32b are coupled in series between the drain of the driving transistor M1 and a blue organic EL element OLEDb. Gates of the emitting transistors M31r, M31g, and M31b are coupled in common to the emit signal line E11, and gates of the emitting transistors M32r, M32g, and M32b are coupled in common to the emit signal line E12.

[0054] Accordingly, the current is supplied to the red organic EL element OLEDr when an emit signal applied to the emit signal line E11 is low-level and an emit signal applied to the emit signal line E12 is high-level, the current is supplied to the green organic EL element OLEDg when an emit signal applied to the emit signal line E11 is high-level and an emit signal applied to the emit signal line E12 is low-level, and the current is supplied to the blue organic EL element OLEDb when both the emit signals applied to the emit signal lines E11 and E12 are high-level. That is, when the emit signals are supplied in the three subfields according to the above-described method, the red, green, and blue organic EL elements are sequentially driven with two emit signals according to the signal timing of FIG. 8.

[0055] An organic EL display driving method according to the fourth exemplary embodiment of the present invention will be described with reference to FIG. 8. One field (1TV) includes three subfields 1SF, 2SF, and 3 SF, and signals for driving red, green, and blue organic EL elements of each pixel are applied to the subfields 1SF, 2SF, and 3SF in a like manner as FIG. 4.

[0056] Referring to FIG. 8, emit signals applied to the emit signal lines E11 to En1 have the same timing as that applied to the emit signal lines E1r to Enr of FIG. 4, and emit signals applied to the emit signal lines E12 to En2 have the same timing as that applied to the emit signal lines E1g to Eng of FIG. 4.

[0057] In the subfield 1SF, since the emit signal applied to the emit signal line E11 is low-level and the emit signal applied to the emit signal line E12 is high-level, the emitting transistors M31r and M32r are turned on, and hence, the current is supplied to the red organic EL element OLEDr to emit light. However, no current is supplied to the green and blue organic EL elements OLEDg and

OLEDb since the n-channel transistors M31g and M31b coupled to the emit signal line E11 are turned off.

[0058] In the subfield 2SF, since the emit signal applied to the emit signal line E11 is high-level and the emit signal applied to the emit signal line E12 is low-level, the emitting transistors M31g and M32g are turned on, and hence, the current is supplied to the green organic EL element OLEDg to emit light. However, no current is supplied to the red and blue organic EL elements OLEDr and OLEDb since the n-channel transistors M32r and M32b coupled to the emit signal line E12 are turned off.

[0059] In the subfield 3 SF, since the emit signals applied to the emit signal lines E11 and E12 are high-level, the emitting transistors M31b and M32b are turned on, and hence, the current is supplied to the blue organic EL element OLEDb to emit light. However, no current is supplied to the red and green organic EL elements OLEDr and OLEDg since the p-channel transistors M31r and M32g respectively coupled to the emit signal lines E11 and E12 are turned off.

[0060] Therefore, the three-colored organic EL elements are controlled by using two emit signal lines in the fourth exemplary embodiment. The transistors M31r and M32g are p-channel transistors and the transistors M32r, M31g,M31b, and M32b are n-channel transistors in FIGs. 7 and 8. In other embodiments, conductivity types of these transistors can be combined in different manners when the transistors are controllable in a manner similar to that illustrated by the timing diagram of FIG. 8. Also, the timing diagrams similar to those of second and third exemplary embodiments in FIGs. 5 and 6 can be used with the pixel circuit 110" of FIG. 7 according to the fourth exemplary embodiment.

[0061] The voltage programming pixel circuit using switching transistors and driving transistors has been described in the first to fourth exemplary embodiments, and a voltage programming pixel circuit using transistors for compensating for threshold voltages of the driving transistors or transistors for compensating for voltage dropping as well as the switching transistors and driving transistors is applicable. Also, the present invention is applicable to current programming pixel circuits when the driving waveform described with reference to FIG. 5, that is, the driving waveform in which the emit signal is high-level while the select signal is low-level.

[0062] The organic EL elements sequentially emit light of one color in one subfield, and other organic EL elements sequentially emit light of other colors in the next subfield in the first to fourth exemplary embodiments. The color emitted at upper rows of the display panel is different from the color emitted at lower rows thereof at an instance during the above-noted driving. Referring to FIG. 4, the red organic EL elements emit light in the upper region of the display area and the blue organic EL elements emit light in the lower region of the display area in the temporally middle part of one subfield 1 SF. When the organic EL display is shaken in this instance, red areas and blue areas may look separated, which is generally referred to as a color separation phenomenon.

[0063] An exemplary embodiment for eliminating or reducing the color separation phenomenon will now be described with reference to FIGs. 9 and 10.

[0064] FIG. 9 is a circuit diagram of a number of pixels of a display 200 in an organic EL display according to a fifth exemplary embodiment of the present invention, and FIG. 10 is a signal timing diagram of the organic EL display according to the fifth exemplary embodiment of the present invention. By way of example, the display 200 can be used in the organic EL display of FIG. 1 instead of the display 100 to realize an organic EL display according to the fifth exemplary embodiment. The display 200 has a pattern in which nine pixel circuits formed by three rows and three columns are repeated. FIG. 9 illustrates only a portion of the display 200, in which nine pixel circuits are formed at regions defined by first to third rows S1 to S3 and first to third columns D1 to D3.

[0065] Referring to FIG. 9, in the three pixel circuits coupled to the scan line S1 on the first row, gates of a transistor M3r of the pixel circuit coupled to the data line D1, a transistor M3g of the pixel circuit coupled to the data line D2, and a transistor M3b of the pixel circuit coupled to the data line D3 are coupled to an emit signal line E1r. In a like manner, gates of a transistor M3g of the pixel circuit coupled to the data line D1, a transistor M3b of the pixel circuit coupled to the data line D2, and a transistor M3r of the pixel circuit coupled to the data line D3 are coupled to an emit signal line E1g. Also, gates of a transistor M3b of the pixel circuit coupled to the data line D1, a transistor M3r of the pixel circuit coupled to the data line D2, and a transistor M3g of the pixel circuit coupled to the data line D3 are coupled to an emit signal line E1b.

[0066] In the three pixel circuits coupled to the scan line S2 on the second row, gates of a transistor M3g of the pixel circuit coupled to the data line D1, a transistor M3b of the pixel circuit coupled to the data line D2, and a transistor M3r of the pixel circuit coupled to the data line D3 are coupled to an emit signal line E2r. In a like manner, gates of a transistor M3b of the pixel circuit coupled to the data line D1, a transistor M3r of the pixel circuit coupled to the data line D2, and a transistor M3g of the pixel circuit coupled to the data line D3 are coupled to an emit signal line E2g. Also, gates of a transistor M3r of the pixel circuit coupled to the data line D1, a transistor M3g of the pixel circuit coupled to the data line D2, and a transistor M3b of the pixel circuit coupled to the data line D3 are coupled to an emit signal line E2b.

[0067] In the three pixel circuits coupled to the scan line S3 on the third row, gates of a transistor M3b of the pixel circuit coupled to the data line D1, a transistor M3r of the pixel circuit coupled to the data line D2, and a transistor M3g of the pixel circuit coupled to the data line D3 are coupled to an emit signal line E3r. In a like manner, gates of a transistor M3r of the pixel circuit coupled to the data line D1, a transistor M3g of the pixel circuit coupled to the data line D2, and a transistor M3b of the pixel

circuit coupled to the data line D3 are coupled to an emit signal line E3g. Also, gates of a transistor M3g of the pixel circuit coupled to the data line D1, a transistor M3b of the pixel circuit coupled to the data line D2, and a transistor M3r of the pixel circuit coupled to the data line D3 are coupled to an emit signal line E3b.

[0068] Accordingly, a pixel circuit coupled to a scan line S(3i-2) of the (3i-2)th row (where 'i' is an integer less than 'n/3' when assuming that 'n' is a multiple of 3) and a (3j-2)th data line D(3j-2) (where 'j' is an integer less than 'm/3' when assuming that 'm' is a multiple of 3) has the same coupling relation as that of a pixel circuit coupled to the scan line S1 and the data line D1, a pixel circuit coupled to the scan line S(3i-2) and a (3j-1)th data line D(3j-1) has the same coupling relation as that of a pixel circuit coupled to the scan line S 1 and the data line D2, and a pixel circuit coupled to the scan line S(3i-2) and a (3j)th data line D(3j) has the same coupling relation as that of a pixel circuit coupled to the scan line S 1 and the data line D3. Also, a pixel circuit coupled to the scan line S(3i-1) of the (3i-1)th row and the data line D(3j-2) has the same coupling relation as that of a pixel circuit coupled to the scan line S2 and the data line D1, a pixel circuit coupled to the scan line S(3i-1) and the data line D(3j-1) has the same coupling relation as that of a pixel circuit coupled to the scan line S2 and the data line D2, and a pixel circuit coupled to the scan line S(3i-1) and the data line D(3j) has the same coupling relation as that of a pixel circuit coupled to the scan line S2 and the data line D3. In a like manner, a pixel circuit coupled to the scan line S(3i) of the (3i)th row and the data line D(3j-2) has the same coupling relation as that of a pixel circuit coupled to the scan line S3 and the data line D1, a pixel circuit coupled to the scan line S(3i) and the data line D (3j-1) has the same coupling relation as that of a pixel circuit coupled to the scan line S3 and the data line D2, and a pixel circuit coupled to the scan line S(3i) and the data line D(3j) has the same coupling relation as that of a pixel circuit coupled to the scan line S3 and the data line D3.

[0069] Referring to FIG. 10, in a subfield 1SF, when a select signal is applied to the scan line S 1 of the first row, data voltages of R, G, and B corresponding to the red, green, and blue organic EL elements OLEDr, OLEDg, and OLEDb are respectively applied to the (3j-2)th data lines D1, D4, ..., Dm-2, the (3j-1)th data lines D2, D5, ..., Dm-1, and the (3j)th data lines D3, D6, ..., Dm, and an emit signal is applied to the emit signal line E1r so that the red, green, and blue organic EL elements OLEDr, OLEDg, and OLEDb emit light in the three pixel circuits which are adjacent in the row direction.

[0070] When a select signal is applied to the scan line S2 of the second row, data voltages of G, B, and R corresponding to the green, blue, and red organic EL elements OLEDg, OLEDb, and OLEDr are respectively applied to the (3j-2)th data lines D1, D4, ..., Dm-2, the (3j-1)th data lines D2, D5, ..., Dm-1, and the (3j)th data lines D3, D6, ..., Dm, and an emit signal is applied to the emit signal line E2r so that the green, blue, and red organic EL elements OLEDg, OLEDb, and OLEDr emit light in the three pixel circuits which are adjacent in the row direction.

[0071] When a select signal is applied to the scan line S3 of the third row, data voltages of B, R, and G corresponding to the blue, red, and green organic EL elements OLEDb, OLEDr, and OLEDg are respectively applied to the (3j-2)th data lines D1, D4, ..., Dm-2, the (3j-1)th data lines D2, D5, ..., Dm-1, and the (3j)th data lines D3, D6, ..., Dm, and an emit signal is applied to the emit signal line E3r so that the blue, red, and green organic EL elements OLEDb, OLEDr, and OLEDg emit light in the three pixel circuits which are adjacent in the row direction.

[0072] In a like manner, in the subfield 1SF, when a select signal is applied to the (3i-2)th scan lines S1, S4, ..., Sn-2, data voltages of R, G, and B corresponding to the red, green, and blue organic EL elements OLEDr, OLEDg, and OLEDb are respectively applied to the (3j-2)th data lines D1, D4, ..., Dm-2, the (3j-1)th data lines D2, D5, ..., Dm-1, and the (3j)th data lines D3, D6, ..., Dm so that the red, green, and blue organic EL elements OLEDr, OLEDg, and OLEDb emit light in the three pixel circuits which are adjacent in the row direction. When a select signal is applied to the (3i-1)th scan lines S2, S5, ..., Sn-1, data voltages of G, B, and R corresponding to the green, blue, and red organic EL elements OLEDg, OLEDb, and OLEDr are respectively applied to the (3j-2)th data lines D1, D4, ..., Dm-2, the (3j-1)th data lines D2, D5, ..., Dm-1, and the (3j)th data lines D3, D6, ..., Dm so that the green, blue, and red organic EL elements OLEDg, OLEDb, and OLEDr emit light in the three pixel circuits which are adjacent in the row direction. Also, when a select signal is applied to the (3i)th scan lines S3, S6, ..., Sn, data voltages of B, R, and G corresponding to the blue, red, and green organic EL elements OLEDb, OLEDr, and OLEDg are respectively applied to the (3j-2)th data lines D1, D4, ..., Dm-2, the (3j-1)th data lines D2, D5, ..., Dm-1, and the (3j)th data lines D3, D6, ..., Dm so that the blue, red, and green organic EL elements OLEDb, OLEDr, and OLEDg emit light in the three pixel circuits which are adjacent in the row direction.

[0073] In a subsequent subfield 2SF, when a select signal is applied to the scan line S1, data voltages of G, B, and R corresponding to the green, blue, and red organic EL elements OLEDg, OLEDb, and OLEDr are respectively applied to the data lines D1, D4, ..., Dm-2, the data lines D2, D5, ..., Dm-1, and the data lines D3, D6, ..., Dm, and an emit signal is applied to the emit signal line E1g so that the green, blue, and red organic EL elements OLEDg, OLEDb, and OLEDr emit light in the three pixel circuits which are adjacent in the row direction.

[0074] When a select signal is applied to the scan line S2, data voltages of B, R, and G, corresponding to the blue, red, and green organic EL elements OLEDb, OLEDr, and OLEDg are respectively applied to the data lines D1, D4, ..., Dm-2, the data lines D2, D5, ..., Dm-1, and the data lines D3, D6, ..., Dm, and an emit signal is

applied to the emit signal line E2g so that the blue, red, and green organic EL elements OLEDb, OLEDr, and OLEDg emit light in the three pixel circuits which are adjacent in the row direction.

[0075] When a select signal is applied to the scan line S3, data voltages of R, G, and B corresponding to the red, green, and blue organic EL elements OLEDr, OLEDg, and OLEDb are respectively applied to the data lines D1, D4, ..., Dm-2, the data lines D2, D5, ..., Dm-1, and the data lines D3, D6, ..., Dm, and an emit signal is applied to the emit signal line E3g so that the red, green, and blue organic EL elements OLEDr, OLEDg, and OLEDb emit light in the three pixel circuits which are adjacent in the row direction.

[0076] In a like manner, in the subfield 2SF, when a select signal is applied to the (3i-2)th scan lines S1, S4, ..., Sn-2, data voltages of G, B, and R corresponding to the green, blue, and red organic EL elements OLEDg, OLEDb, and OLEDr are respectively applied to the (3j-2)th data lines D1, D4, ..., Dm-2, the (3j-1)th data lines D2, D5, ..., Dm-1, and the (3j)th data lines D3, D6, ..., Dm so that the green, blue, and red organic EL elements OLEDg, OLEDb, and OLEDr emit light in the three pixel circuits which are adjacent in the row direction. When a select signal is applied to the (3i-1)th scan lines S2, S5, ..., Sn-1, data voltages of B, R, and G corresponding to the blue, red, and green organic EL elements OLEDb, OLEDr, and OLEDg are respectively applied to the (3j-2)th data lines D1, D4, ..., Dm-2, the (3j-1)th data lines D2, D5, ... , Dm-1, and the (3j)th data lines D3, D6, ..., Dm so that the blue, red, and green organic EL elements OLEDb, OLEDr, and OLEDg emit light in the three pixel circuits which are adjacent in the row direction. Also, when a select signal is applied to the (3i)th scan lines S3, S6, ..., Sn, data voltages of R, G, and B corresponding to the red, green, and blue organic EL elements OLEDr, OLEDg, and OLEDb are respectively applied to the (3j-2)th data lines D1, D4, ..., Dm-2, the (3j-1)th data lines D2, D5, ..., Dm-1, and the (3j)th data lines D3, D6, ..., Dm so that the red, green, and blue organic EL elements OLEDr, OLEDg, and OLEDb emit light in the three pixel circuits which are adjacent in the row direction.

[0077] In a subsequent subfield 3SF, when a select signal is applied to the scan line S1, data voltages of B, R, and G corresponding to the blue, red, and green organic EL elements OLEDb, OLEDr, and OLEDg are respectively applied to the (3j-2)th data lines D1, D4, ..., Dm-2, the (3j-1)th data lines D2, D5, ..., Dm-1, and the (3j)th data lines D3, D6, ..., Dm, and an emit signal is applied to the emit signal line E1b so that the blue, red, and green organic EL elements OLEDb, OLEDr, and OLEDg emit light in the three pixel circuits which are adjacent in the row direction.

[0078] When a select signal is applied to the scan line S2, data voltages of R, G, and B corresponding to the red, green, and blue organic EL elements OLEDr, OLEDg, and OLEDb are respectively applied to the (3j-2)th data lines D1, D4, ..., Dm-2, the (3j-1)th data lines D2, D5, ..., Dm-1, and the (3j)th data lines D3, D6, ..., Dm, and an emit signal is applied to the emit signal line E2b so that the red, green, and blue organic EL elements OLEDr, OLEDg, and OLEDb emit light in the three pixel circuits which are adjacent in the row direction.

[0079] When a select signal is applied to the scan line S3, data voltages of G, B, and R corresponding to the green, blue, and red organic EL elements OLEDg, OLEDb, and OLEDr are respectively applied to the (3j-2)th data lines D1, D4, ..., Dm-2, the (3j-1)th data lines D2, D5, ..., Dm-1, and the (3j)th data lines D3, D6, ..., Dm, and an emit signal is applied to the emit signal line E3g so that the green, blue, and red organic EL elements OLEDg, OLEDb, and OLEDr emit light in the three pixel circuits which are adjacent in the row direction.

[0080] In a like manner, in the subfield 3SF, when a select signal is applied to the (3i-2)th scan lines S1, S4, ..., Sn-2, data voltages of B, R, and G corresponding to the blue, red, and green organic EL elements OLEDb, OLEDr, and OLEDg are respectively applied to the (3j-2)th data lines D1, D4, ..., Dm-2, the (3j-1)th data lines D2, D5, ..., Dm-1, and the (3j)th data lines D3, D6, ..., Dm so that the blue, red, and green organic EL elements OLEDb, OLEDr, and OLEDg emit light in the three pixel circuits which are adjacent in the row direction. When a select signal is applied to the (3i-1)th scan lines S2, S5, ..., Sn-1, data voltages of R, G, and B corresponding to the red, green, and blue organic EL elements OLEDr, OLEDg, and OLEDb are respectively applied to the (3j-2)th data lines D1, D4, ..., Dm-2, the (3j-1)th data lines D2, D5, ..., Dm-1, and the (3j)th data lines D3, D6, ..., Dm so that the red, green, and blue organic EL elements OLEDr, OLEDg, and OLEDb emit light in the three pixel circuits which are adjacent in the row direction. Also, when a select signal is applied to the (3i)th scan lines S3, S6, ..., Sn, data voltages of G, B, and R corresponding to the green, blue, and red organic EL elements OLEDg, OLEDb, and OLEDr are respectively applied to the (3j-2)th data lines D1, D4, ..., Dm-2, the (3j-1)th data lines D2, D5, ..., Dm-1, and the (3j)th data lines D3, D6, ..., Dm so that the green, blue, and red organic EL elements OLEDg, OLEDb, and OLEDr emit light in the three pixel circuits which are adjacent in the row direction.

[0081] Therefore, three colors are mixed and emitted in the pixel circuits provided on the same row in one subfield, and three colors are mixed and emitted in the pixel circuits provided on the same column. That is, a plurality of pixel circuits which respectively emit red, green, and blue light on the total screen are provided in one subfield, and one pixel circuit emits different colors for each subfield so that the red, green, and blue are emitted in one field. As a result, since the three colors are mixed and emitted in the row direction and the column direction, the color separation phenomenon which may be caused because of different colors on the upper region and lower region of the screen is reduced or eliminated.

[0082] While each row has a different color emitted in the fifth exemplary embodiment, without being restricted

to this, it is possible to combine a plurality of rows into a group, and control each group to emit a different color. Also, while the emit elements of three colors have been described in the exemplary embodiments, the principles of the present invention are applicable to and the scope of the present invention includes pixel circuits having emit elements of two or more than three colors. These additional embodiments will not be described since those skilled in the art would understand them from the above-noted descriptions.

[0083] Further, while the colors are mixed and emitted in the row direction and the column direction in the fifth exemplary embodiment, it is also possible to emit light with the same color in the column direction and emit light with mixed colors in the row direction.

[0084] According to the exemplary embodiments of the present invention, the configuration of elements used within the pixels and the wiring design for transmitting the current, voltages, and signals are simplified since the emit elements of various colors on one pixel can be driven by common driving and switching transistors and capacitors, thereby improving the aperture ratio in the pixel. Further, the color separation phenomenon is reduced or eliminated by emitting different colors for the respective rows in one subfield.

Claims

1. A display device including a plurality of scan lines (S_1,...,S_n) including a plurality of first scan lines and a plurality of second scan lines for applying select signals, a plurality of data lines (D_1,...,D_m) including a plurality of first data lines and a plurality of second data lines for applying data signals for displaying an image during a field having a plurality of subfields (1SF,2SF,3SF), and a plurality of pixel circuits coupled to the scan lines and the data lines,
wherein each of the pixel circuits comprises:

at least two emit elements (OLEDr, OLEDg, OLEDb) for emitting light having different colors, wherein each of the emit elements emits light responsive to an applied current;
a capacitor (C1) for storing a voltage corresponding to one of the data signals applied in response to one of the select signals;
a switching transistor (M2) for applying one of the data signals provided by one of the data lines to the capacitor in response to one of the select signals provided by one of the scan lines;
a driving transistor (M1) for outputting the applied current corresponding to the voltage stored in the capacitor; the display device being **characterised by**:

at least two emitting transistors (M_{3r}, M_{3g} M_{3b}) which are coupled between the driving transistor and the emit elements, and one of the emit elements emits light in response to an operation of the corresponding emitting transistor; and
at least two emit signal lines (Eir, Eig, Eib) which are respectively coupled to gates of the emitting transistors and apply control signals for controlling the operation of the emitting transistors, wherein one of the emitting transistors is turned on by one of the control signals applied through the emit signal lines and the applied current is applied to one of the emit elements from the driving transistor;
the plurality of pixel circuits being grouped into a plurality of groups of pixel circuits, wherein each group of pixel circuits is connected to a corresponding one of the first scan lines, the second scan lines, the first data lines, and the second data lines; and
each group of pixel circuits comprising a first pixel circuit, a second pixel circuit, a third pixel circuit, and a fourth pixel circuit,
wherein the emit signal lines are connected to the emitting transistors of the pixel circuits such that in a first one of the subfields, one of the emit elements of a first color is selected to emit light in the first pixel circuit, which is coupled to the first scan line and the first data line, one of the emit elements of a color which is different from the first color is selected to emit light in the second pixel circuit, which is coupled to the first scan line and the second data line, one of the emit elements of a second color which is different from the first color is selected to emit light in the third pixel circuit, which is coupled to the second scan line and the first data line, and one of the emit elements of a color which is different from the second color is selected to emit light in the fourth pixel circuit, which is coupled to the second scan line and the second data line.

2. The display device of claim 1, wherein, in a second one of the subfields, one of the emit elements of a third color which is different from the first color starts emitting light in the first pixel circuit, one of the emit elements of a color which is different from the third color starts emitting light in the second pixel circuit, one of the emit elements of another color which is different from the third color starts emitting light in the third pixel circuit, and one of the emit elements of a color which is different from said another color starts emitting light in the fourth pixel circuit.

3. The display device of claim 1, wherein the emit elements emit light at least once during the field.

4. The display device of claim 1, wherein the emit elements comprise an emit element of a third color different from the first and the second color, and
wherein at least one of the pixel circuits further comprises a third emitting transistor coupled between the driving transistor and the emit element of the third color and having a gate coupled to a third emit signal line for controlling the operation of the third emitting transistor.

5. The display device of claim 4, wherein, in a second one of the subfields, the emit element of the second color starts emitting light in the first pixel circuit, and one of the emit elements of a color which is different from the second color starts emitting light in the second pixel circuit, and
wherein, in a third one of the subfields, the emit element of the third color starts emitting light in the first pixel circuit, and one of the emit elements of a color which is different from the third color starts emitting light in the second pixel circuit.

6. The display device of claim 5, wherein the emit element of the third color starts emitting light in the third pixel circuit in the second one of the subfields, and
wherein the emit element of the first color starts emitting light in the third pixel circuit in the third one of the subfields.

7. The display device of claim 5, wherein each group of pixel circuits further comprises a fifth pixel circuit coupled to a third data line and wherein one of the emit elements of a color which is different from colors of the emit elements which start emitting light in the first and second pixel circuits starts emitting light in the fifth pixel circuit of the pixel circuits, which is coupled to the first scan line and the third data line in the first, second and third ones of the subfields.

8. The display device of claim 7, wherein each group of pixel circuits further comprises a sixth pixel circuit coupled to a corresponding one of a plurality of third scan lines and wherein one of the emit elements of a color which is different from colors of the emit elements which start emitting light in the first and third pixel circuits starts emitting light in the sixth pixel circuit of the pixel circuits, which is coupled to the third scan line and the first data line in the first, second and third ones of the subfields.

9. The display device of claim 4, comprising an emit scan driver adapted to provide first, second, and third emit control signals to the first, second, and third emit signal lines such that the emit element of the first color, the emit element of the second color and the emit element of the third color emit light at least once during the field.

10. A method of driving a display device during a field having a plurality of subfields the display device including a plurality of pixel circuits arranged in rows and columns, wherein each of the pixel circuits comprises at least two emit elements for emitting light of different colors responsive to an applied current, and a transistor coupled to the emit elements supplies the applied current to one of the emit elements through at least one switch, and wherein the plurality of pixel circuits are grouped into a plurality of groups of pixel circuits, wherein each group of pixel circuits is connected to a corresponding one of a plurality of first scan lines, of a plurality of second scan lines, of a plurality of first data lines, and of a plurality of second data lines; and wherein each group of pixel circuits comprises a first pixel circuit, a second pixel circuit, a third pixel circuit, and a fourth pixel circuit, the method comprising the following steps:

start emission of light, in a first one of the subfields, by one of the emit elements of a first color in each first pixel circuit provided on a row of a first row group including at least one of the rows and a column of a first column group including at least one of the columns;
start emission of light, in the first one of the subfields, by one of the emit elements of a second color which is different from the first color in each second pixel circuit provided on a row of the first row group and a column of a second column group including at least one of the columns;
start emission of light, in the first one of the subfields, by one of the emit elements of a third color which is different from the first color in each third pixel circuit provided on a row of a second row group including at least one of the rows and a column of the first group;
start emission of light, in a second one of the subfields, by the emit elements of colors in each of the first and second pixels circuits, respectively, which are different from the first and second colors, respectively; and
start emission of light, in the second one of the subfields, by one of the emit elements of a color which is different from the third color in each third pixel circuit.

11. The method of claim 10, wherein the emit elements emit light at least once during the field.

Patentansprüche

1. Anzeigevorrichtung aufweisend eine Vielzahl von Ansteuerleitungen (S1, ..., Sn), die eine Vielzahl erster Ansteuerleitungen sowie eine Vielzahl zweiter Ansteuerleitungen zum Anlegen von Selektierungssignalen aufweisen, eine Vielzahl von Datenleitun-

gen (D1, ..., Dm), die eine Vielzahl erster Datenleitungen sowie eine Vielzahl zweiter Datenleitungen zum Anlegen von Datensignalen zur Anzeige eines Bildes während eines Feldes, welches eine Vielzahl von Teilfeldern (1SF, 2SF, 3SF) aufweist, aufweisen, und eine Vielzahl von Pixelschaltungen, die an die Ansteuerleitungen und an die Datenleitungen gekoppelt sind,
wobei jede der Pixelschaltungen aufweist:

zumindest zwei emittierende Elemente (OLEDr, OLEDg, OLEDb) zur Emission von verschiedene Farben aufweisendem Licht, wobei jedes der emittierenden Elemente Licht in Reaktion auf einen angelegten Strom emittiert;
einen Kondensator (C1) zur Speicherung einer Spannung entsprechend einem der in Reaktion auf eines der Selektierungssignale angelegten Datensignale;
einen Schalttransistor (M2) zum Anlegen eines der von einer der Datenleitungen am Kondensator bereitgestellten Datensignale in Reaktion auf eines der von einer der Ansteuerleitungen bereitgestellten Selektierungssignale;
einen Ansteuertransistor (M1) zur Ausgabe des angelegten Stroms entsprechend der im Kondensator gespeicherten Spannung;

wobei die Anzeigevorrichtung **gekennzeichnet ist durch**:

zumindest zwei emittierende Transistoren (M3r, M3g, M3b), die zwischen den Ansteuertransistor und die emittierenden Elemente gekoppelt sind, wobei eines der emittierenden Elemente in Reaktion auf einen Betrieb des entsprechenden emittierenden Transistors Licht emittiert; und
zumindest zwei Emissionssignalleitungen (Eir, Eig, Eib), die jeweils an die Gates der emittierenden Transistoren gekoppelt sind und Steuersignale zur Steuerung des Betriebs der emittierenden Transistoren anlegen, wobei einer der emittierenden Transistoren **durch** eines der über die Emissionssignalleitungen angelegten Steuersignale eingeschaltet wird und wobei der angelegte Strom vom Ansteuertransistor an eines der emittierenden Elemente angelegt wird;
wobei die Vielzahl von Pixelschaltungen in eine Vielzahl von Gruppen von Pixelschaltungen unterteilt ist, wobei jede Gruppe von Pixelschaltungen mit einer entsprechenden Leitung der ersten Ansteuerleitungen, der zweiten Ansteuerleitungen, der ersten Datenleitungen und der zweiten Datenleitungen verbunden ist; und
wobei jede Gruppe von Pixelschaltungen eine erste Pixelschaltung, eine zweite Pixelschaltung, eine dritte Pixelschaltung und eine vierte Pixelschaltung aufweist,
wobei die Emissionssignalleitungen derart mit den emittierenden Transistoren der Pixelschaltungen verbunden sind, dass in einem ersten der Teilfelder eines der emittierenden Elemente einer ersten Farbe selektiert wird, so dass es in der ersten Pixelschaltung, die an die erste Ansteuerleitung und die erste Datenleitung gekoppelt ist, Licht emittiert, eines der emittierenden Elemente einer Farbe, die sich von der ersten Farbe unterscheidet, selektiert wird, so dass es in der zweiten Pixelschaltung, die an die erste Ansteuerleitung und die zweite Datenleitung gekoppelt ist, Licht emittiert, eines der emittierenden Elemente einer zweiten Farbe, die sich von der ersten Farbe unterscheidet, selektiert wird, so dass es in der dritten Pixelschaltung, die an die zweite Ansteuerleitung und die erste Datenleitung gekoppelt ist, Licht emittiert, und eines der emittierenden Elemente einer Farbe, die sich von der zweiten Farbe unterscheidet, selektiert wird, so dass es in der vierten Pixelschaltung, die an die zweite Ansteuerleitung und die zweite Datenleitung gekoppelt ist, Licht emittiert.

2. Anzeigevorrichtung nach Anspruch 1, wobei in einem zweiten der Teilfelder eines der emittierenden Elemente einer dritten Farbe, die sich von der ersten Farbe unterscheidet, beginnt, in der ersten Pixelschaltung Licht zu emittieren, eines der emittierenden Elemente einer Farbe, die sich von der dritten Farbe unterscheidet, beginnt, in der zweiten Pixelschaltung Licht zu emittieren, eines der emittierenden Elemente einer weiteren Farbe, die sich von der dritten Farbe unterscheidet, beginnt, in der dritten Pixelschaltung Licht zu emittieren, und eines der emittierenden Elemente einer Farbe, die sich von der besagten weiteren Farbe unterscheidet, beginnt, in der vierten Pixelschaltung Licht zu emittieren.

3. Anzeigevorrichtung nach Anspruch 1, wobei die emittierenden Elemente zumindest einmal während des Feldes Licht emittieren.

4. Anzeigevorrichtung nach Anspruch 1, wobei die emittierenden Elemente ein emittierendes Element einer dritten Farbe, die sich von der ersten und der zweiten Farbe unterscheidet, aufweisen, und
wobei zumindest eine der Pixelschaltungen weiterhin einen dritten emittierenden Transistor aufweist, der zwischen den Ansteuertransistor und das emittierende Element der dritten Farbe gekoppelt ist und ein Gate aufweist, das an eine dritte Emissionssignalleitung gekoppelt ist, die den Betrieb des dritten emittierenden Transistors steuert.

5. Anzeigevorrichtung nach Anspruch 4, wobei in ei-

nem zweiten der Teilfelder das emittierende Element der zweiten Farbe beginnt, in der ersten Pixelschaltung Licht zu emittieren, und eines der emittierenden Elemente einer Farbe, die sich von der zweiten Farbe unterscheidet, beginnt, in der zweiten Pixelschaltung Licht zu emittieren, und
wobei in einem dritten der Teilfelder das emittierende Element der dritten Farbe beginnt, in der ersten Pixelschaltung Licht zu emittieren, und eines der emittierenden Elemente einer Farbe, die sich von der dritten Farbe unterscheidet, beginnt, in der zweiten Pixelschaltung Licht zu emittieren.

6. Anzeigevorrichtung nach Anspruch 5, wobei im zweiten der Teilfelder das emittierende Element der dritten Farbe beginnt, in der dritten Pixelschaltung Licht zu emittieren, und
wobei im dritten der Teilfelder das emittierende Elemente der ersten Farbe beginnt, in der dritten Pixelschaltung Licht zu emittieren.

7. Anzeigevorrichtung nach Anspruch 5, wobei jede Gruppe von Pixelschaltungen weiterhin eine fünfte Pixelschaltung aufweist, die an eine dritte Datenleitung gekoppelt ist, und wobei im ersten, zweiten und dritten der Teilfelder eines der emittierenden Elemente einer Farbe, die sich von den Farben der emittierenden Elemente unterscheidet, welche beginnen, in der ersten und zweiten Pixelschaltung Licht zu emittieren, beginnt, in der fünften Pixelschaltung der Pixelschaltungen, die an die erste Ansteuerleitung und die dritte Datenleitung gekoppelt ist, Licht zu emittieren.

8. Anzeigevorrichtung nach Anspruch 7, wobei jede Gruppe von Pixelschaltungen weiterhin eine sechste Pixelschaltung aufweist, die an eine entsprechende Leitung aus einer Vielzahl dritter Ansteuerleitungen gekoppelt ist, und wobei im ersten, zweiten und dritten der Teilfelder eines der emittierenden Elemente einer Farbe, die sich von den Farben der emittierenden Elemente unterscheidet, welche beginnen, in der ersten und dritten Pixelschaltung Licht zu emittieren, beginnt, in der sechsten Pixelschaltung der Pixelschaltungen, die an die dritte Ansteuerleitung und die erste Datenleitung gekoppelt ist, Licht zu emittieren.

9. Anzeigevorrichtung nach Anspruch 4, aufweisend einen Emissionsansteuerungstreiber, der ausgebildet ist, ein erstes, zweites und drittes Emissionskontrollsignal derart an der ersten, zweiten und dritten Emissionssignalleitung bereitzustellen, dass das emittierende Element der ersten Farbe, das emittierende Element der zweiten Farbe und das emittierende Element der dritten Farbe zumindest einmal während des Feldes Licht emittieren.

10. Verfahren zur Ansteuerung einer Anzeigevorrichtung während eines Feldes, das eine Vielzahl von Teilfeldern aufweist, wobei die Anzeigevorrichtung eine Vielzahl von Pixelschaltungen aufweist, die in Zeilen und Spalten angeordnet sind, wobei jede der Pixelschaltungen zumindest zwei emittierende Elemente zur Emission von Licht verschiedener Farben in Reaktion auf einen angelegten Strom aufweist, und wobei ein an die emittierenden Elemente gekoppelter Transistor eines der emittierenden Elemente über zumindest einen Schalter mit dem angelegten Strom versorgt, und wobei die Vielzahl von Pixelschaltungen in eine Vielzahl von Gruppen von Pixelschaltungen unterteilt ist, wobei jede Gruppe von Pixelschaltungen mit einer entsprechenden Leitung aus einer Vielzahl erster Ansteuerleitungen, einer Vielzahl zweiter Ansteuerleitungen, einer Vielzahl erster Datenleitungen und einer Vielzahl zweiter Datenleitungen verbunden ist; und wobei jede Gruppe von Pixelschaltungen eine erste Pixelschaltung, eine zweite Pixelschaltung, eine dritte Pixelschaltung und eine vierte Pixelschaltung aufweist, wobei das Verfahren die folgenden Schritte aufweist:

Beginn der Emission von Licht in einem ersten der Teilfelder durch eines der emittierenden Elemente einer ersten Farbe in jeder ersten Pixelschaltung, die in einer Reihe einer ersten Reihengruppe, welche zumindest eine der Reihen aufweist, und in einer Spalte einer ersten Spaltengruppe, welche zumindest eine der Spalten aufweist, bereitgestellt wird;
Beginn der Emission von Licht im ersten der Teilfelder durch eines der emittierenden Elemente einer zweiten Farbe, die sich von der ersten Farbe unterscheidet, in jeder zweiten Pixelschaltung, die in einer Reihe der ersten Reihengruppe und in einer Spalte einer zweiten Spaltengruppe, welche zumindest eine der Spalten aufweist, bereitgestellt wird;
Beginn der Emission von Licht im ersten der Teilfelder durch eines der emittierenden Elemente einer dritten Farbe, die sich von der ersten Farbe unterscheidet, in jeder dritten Pixelschaltung, die in einer Reihe einer zweiten Reihengruppe, welche zumindest eine der Reihen aufweist, und in einer Spalte der ersten Gruppe bereitgestellt wird;
Beginn der Emission von Licht in einem zweiten der Teilfelder durch die emittierenden Elemente der Farben, die sich jeweils von der ersten und zweiten Farbe unterscheiden, in jeder der ersten und zweiten Pixelschaltungen; und
Beginn der Emission von Licht im zweiten der Teilfelder durch eines der emittierenden Elemente einer Farbe, die sich von der dritten Farbe unterscheidet, in jeder dritten Pixelschaltung.

11. Verfahren nach Anspruch 10, wobei die emittierenden Elemente zumindest einmal während des Feldes Licht emittieren.

Revendications

1. Dispositif d'affichage comprenant de multiples lignes de balayage (S_1, ..., S_n) comprenant de multiples premières lignes de balayage et de multiples secondes lignes de balayage pour l'application de signaux de sélection, de multiples lignes de données (D_1, ... , D_m) comprenant de multiples premières lignes de données et de multiples secondes lignes de données pour l'application de signaux de données pour l'affichage d'une image pendant une trame ayant de multiples sous-trames (1SF, 2SF, 3SF), et de multiples circuits de pixels couplés aux lignes de balayage et aux lignes de données,
dans lequel chacun des circuits de pixels comporte :

au moins deux élément d'émission ($OLED_r$, $OLED_g$, $OLED_b$) pour l'émission de lumière ayant des couleurs différentes, chacun des éléments d'émission émettant de la lumière en réponse à un courant appliqué ;
un condensateur (C_1) destiné à emmagasiner une tension correspondant à l'un des signaux de données appliqués en réponse à l'un des signaux de sélection ;
un transistor de commutation (M_2) destiné à appliquer l'un des signaux de données fournis par l'une des lignes de données au condensateur en réponse à l'un des signaux de sélection fournis par l'une des lignes de balayage ;
un transistor d'attaque (M_1) destiné à délivrer en sortie le courant appliqué correspondant à la tension emmagasinée dans le condensateur ;
le dispositif d'affichage étant **caractérisé par** :

au moins deux transistors d'émission (M3r, M3g, M3b) qui sont couplés entre le transistor d'attaque et les éléments d'émission, l'un des éléments d'émission émettant de la lumière en réponse à une opération effectuée par le transistor d'émission correspondant ; et
au moins deux lignes de signaux d'émission (Eir, Eig, Eib) qui sont couplées respectivement aux grilles des transistors d'émission et appliquent des signaux de commande pour commander le fonctionnement des transistors d'émission, l'un des transistors d'émission étant débloqué par l'un des signaux de commande appliqués par l'intermédiaire des lignes de signaux d'émission et le courant appliqué étant appliqué à l'un des éléments d'émission depuis le transistor d'attaque ;
les multiples circuits de pixels étant groupés en de multiples groupes de circuits de pixels, où chaque groupe de circuits de pixels est connecté à l'une, correspondante, des premières lignes de balayage, des secondes lignes de balayage, des premières lignes de données et des secondes lignes de données ; et
chaque groupe de circuits de pixels comportant un premier circuit de pixels, un deuxième circuit de pixels, un troisième circuit de pixels et un quatrième circuit de pixels,
dans lequel les lignes de signaux d'émission sont connectées aux transistors d'émission des circuits de pixels de manière que, dans une première des sous-trames, l'un des éléments d'émission d'une première couleur soit sélectionné pour émettre de la lumière dans le premier circuit de pixels, qui est couplé à la première ligne de balayage et à la première ligne de données, l'un des éléments d'émission d'une couleur qui est différente de la première couleur soit sélectionné pour émettre de la lumière dans le deuxième circuit de pixels, qui est couplé à la première ligne de balayage et à la seconde ligne de données, l'un des éléments d'émission d'une deuxième couleur qui est différente de la première couleur soit sélectionné pour émettre de la lumière dans le troisième circuit de pixels, qui est couplé à la seconde ligne de balayage et à la première ligne de données, et l'un des éléments d'émission d'une couleur qui est différente de la deuxième couleur soit sélectionné pour émettre de la lumière dans le quatrième circuit de pixels, qui est couplé à la seconde ligne de balayage et à la seconde ligne de données.

2. Dispositif d'affichage selon la revendication 1, dans lequel, dans une deuxième des sous-trames, un des éléments d'émission d'une troisième couleur qui est différente de la première couleur commence à émettre de la lumière dans le premier circuit de pixels, l'un des éléments d'émission d'une couleur qui est différente de la troisième couleur commence à émettre de la lumière dans le deuxième circuit de pixels, l'un des éléments d'émission d'une autre couleur qui est différente de la troisième couleur commence à émettre de la lumière dans le troisième circuit de pixels, et l'un des éléments d'émission d'une couleur qui est différente de ladite autre couleur commence à émettre de la lumière dans le quatrième circuit de pixels.

3. Dispositif d'affichage selon la revendication 1, dans lequel les éléments d'émission émettent de la lumière au moins une fois pendant la trame.

4. Dispositif d'affichage selon la revendication 1, dans lequel les éléments d'émission comprennent un élément d'émission d'une troisième couleur différente des première et deuxième couleurs, et
dans lequel au moins l'un des circuits de pixels comporte en outre un troisième transistor d'émission couplé entre le transistor d'attaque et l'élément d'émission de la troisième couleur et ayant une grille couplée à une troisième ligne de signal d'émission pour commander le fonctionnement du troisième transistor d'émission.

5. Dispositif d'affichage selon la revendication 4, dans lequel, dans une deuxième des sous-trames, l'élément d'émission de la deuxième couleur commence à émettre de la lumière dans le premier circuit de pixels, et l'un des éléments d'émission d'une couleur qui est différente de la deuxième couleur commence à émettre de la lumière dans le deuxième circuit de pixels, et
dans lequel, dans une troisième des sous-trames, l'élément d'émission de la troisième couleur commence à émettre de la lumière dans le premier circuit de pixels, et l'un des éléments d'émission d'une couleur qui est différente de la troisième couleur commence à émettre de la lumière dans le deuxième circuit de pixels.

6. Dispositif d'affichage selon la revendication 5, dans lequel l'élément d'émission de la troisième couleur commence à émettre de la lumière dans le troisième circuit de pixels dans la deuxième des sous-trames, et
dans lequel l'élément d'émission de la première couleur commence à émettre de la lumière dans le troisième circuit de pixels dans la troisième des sous-trames.

7. Dispositif d'affichage selon la revendication 5, dans lequel chaque groupe de circuits de pixels comporte en outre un cinquième circuit de pixels couplé à une troisième ligne de données et dans lequel l'un des éléments d'émission d'une couleur qui est différente des couleurs des éléments d'émission qui commencent à émettre de la lumière dans les premier et deuxième circuits de pixels commence à émettre de la lumière dans le cinquième circuit de pixels des circuits de pixels, qui est couplé à la troisième ligne de balayage et à la troisième ligne de données dans les première, deuxième et troisième sous-trames.

8. Dispositif d'affichage selon la revendication 7, dans lequel chaque groupe de circuits de pixels comporte en outre un sixième circuit de pixels couplé à l'une, correspondante, de multiples troisièmes lignes de balayage, et dans lequel l'un des éléments d'émission d'une couleur qui est différente des couleurs des éléments d'émission qui commencent à émettre de la lumière dans les premier et troisième circuits de pixels commence à émettre de la lumière dans le sixième circuit de pixels des circuits de pixels, qui est couplé à la troisième ligne de balayage et à la première ligne de données dans les première, deuxième et troisième sous-trames.

9. Dispositif d'affichage selon la revendication 4, comportant un circuit d'attaque de balayage d'émission conçu pour fournir des premier, deuxième et troisième signaux de commande d'émission aux première, deuxième et troisième lignes de signaux d'émission de façon que l'élément d'émission de la première couleur, l'élément d'émission de la deuxième couleur et l'élément d'émission de la troisième couleur émettent de la lumière au moins une fois pendant la trame.

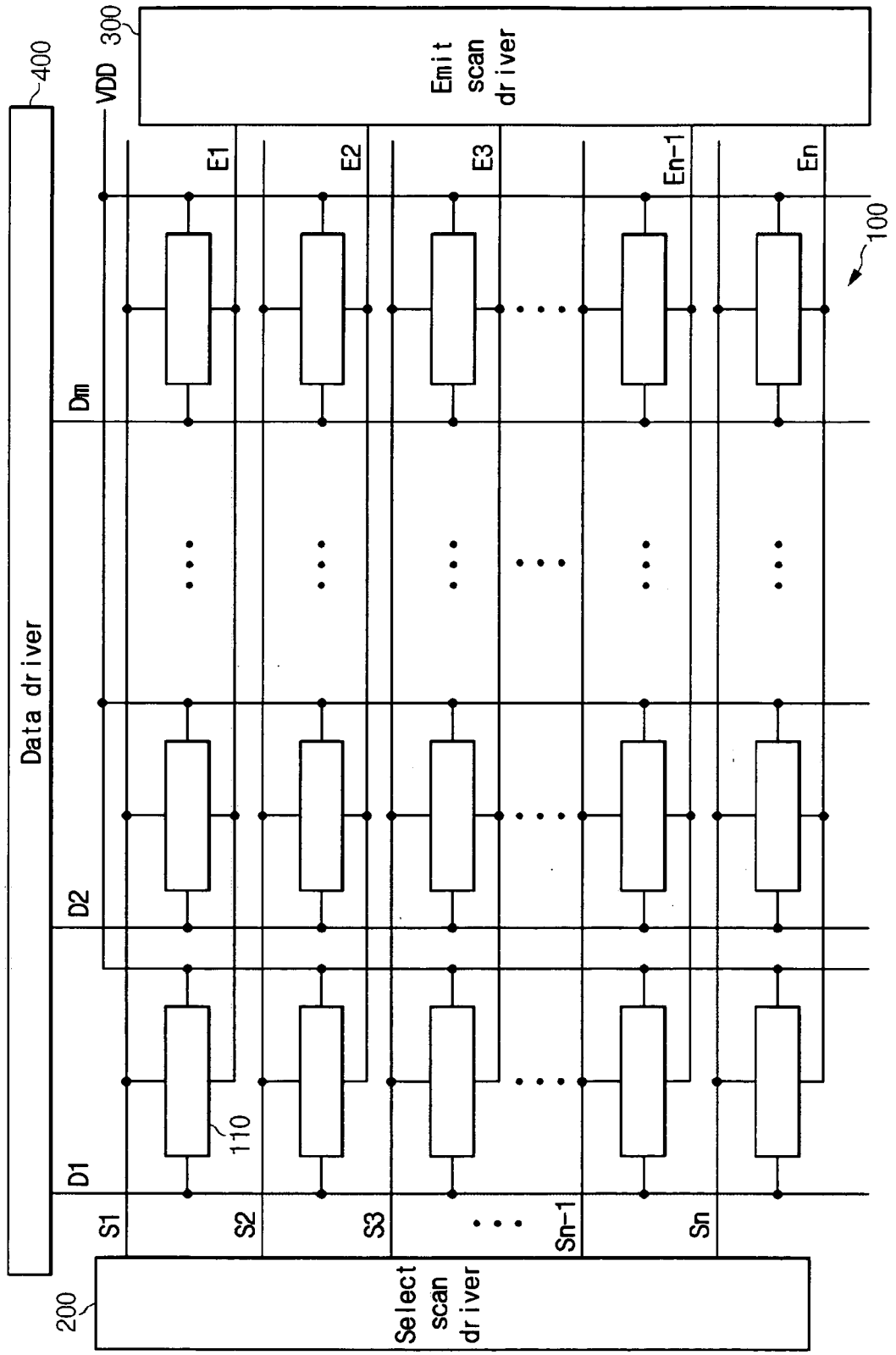
10. Procédé d'attaque d'un dispositif d'affichage pendant une trame ayant de multiples sous-trames, le dispositif d'affichage comprenant de multiples circuits de pixels agencés en rangées et en colonnes, dans lequel chacun des circuits de pixels comporte au moins deux éléments d'émission pour l'émission de lumières de couleurs différentes en réponse à un courant appliqué, et un transistor couplé aux éléments d'émission fournit le courant appliqué à l'un des éléments d'émission par l'intermédiaire d'au moins un commutateur, et dans lequel les multiples circuits de pixels sont groupés en de multiples groupes de circuits de pixels, où chaque groupe de circuits de pixels est connecté à l'une, correspondante, de multiples premières lignes de balayage, de multiples secondes lignes de balayage, de multiples premières lignes de données et de multiples secondes lignes de données ; et dans lequel chaque groupe de circuits de pixels comporte un premier circuit de pixels, un deuxième circuit de pixels, un troisième circuit de pixels et un quatrième circuit de pixels, le procédé comprenant les étapes suivantes :

un début d'émission de lumière, dans une première des sous-trames, par l'un des éléments d'émission d'une première couleur dans chaque premier circuit de pixels situé sur une rangée d'un premier groupe de rangées comprenant au moins l'une des rangées et sur une colonne d'un premier groupe de colonnes comprenant au moins l'une des colonnes ;
le début d'émission de lumière, dans la première des sous-trames, par l'un des éléments d'émission d'une deuxième couleur qui est différente de la première couleur dans chaque deuxième circuit de pixels situé sur une rangée du premier

groupe de rangées et sur une colonne du second groupe de colonnes comprenant au moins l'une des colonnes ;
le début d'émission de lumière, dans la première des sous-trames, par l'un des éléments d'émission d'une troisième couleur qui est différente de la première couleur dans chaque troisième circuit de pixels situé sur une rangée d'un second groupe de rangées comprenant au moins l'une des rangées et sur une colonne du premier groupe ;
le début d'émission de lumière, dans une seconde des sous-trames, par les éléments d'émission de couleurs dans chacun des premier et deuxième circuits de pixels, respectivement, qui sont différentes des première et deuxième couleurs, respectivement : et
le début d'émission de lumière, dans la deuxième des sous-trames, par l'un des éléments d'émission d'une couleur qui est différente de la troisième couleur dans chaque troisième circuit de pixels.

11. Procédé selon la revendication 10, dans lequel les éléments d'émission émettent de la lumière au moins une fois pendant la trame.

Fig. 1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VDD
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E1
E2
E3
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En
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Dm
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D1
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S1
S2
S3
Sn-1
Sn
200
Select scan driver

Fig. 2

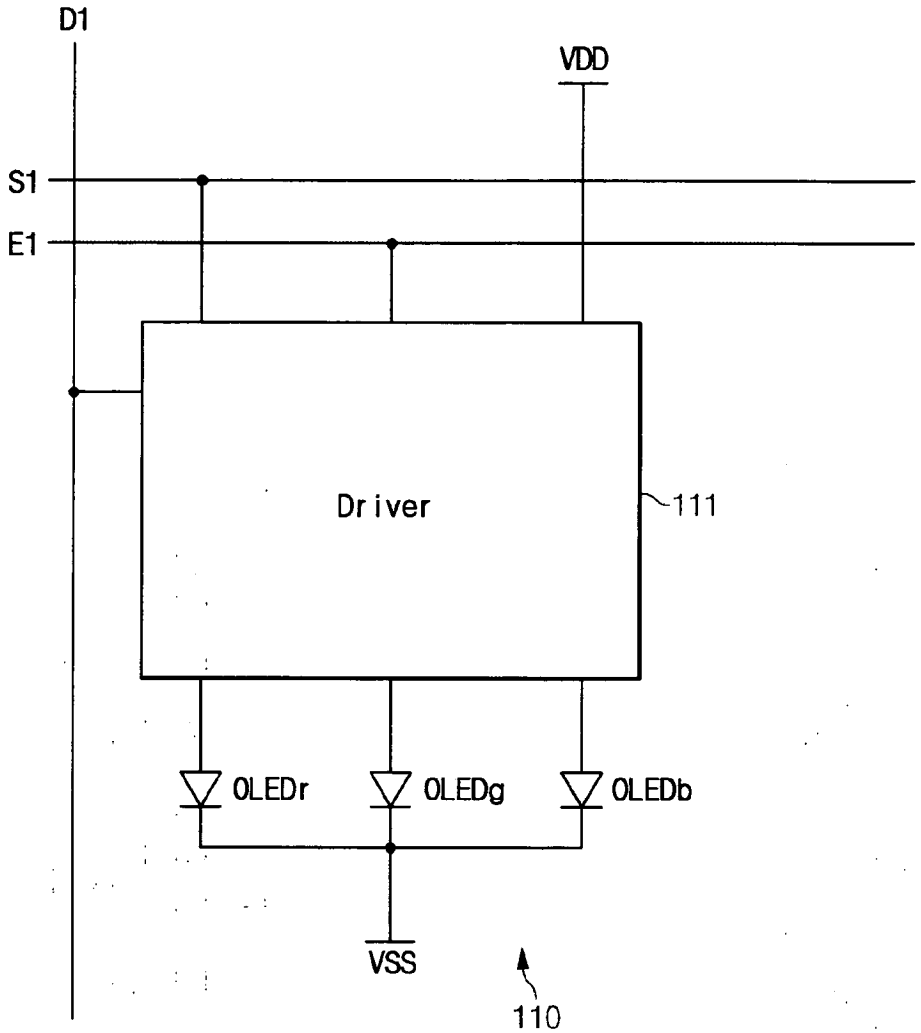


Fig. 3

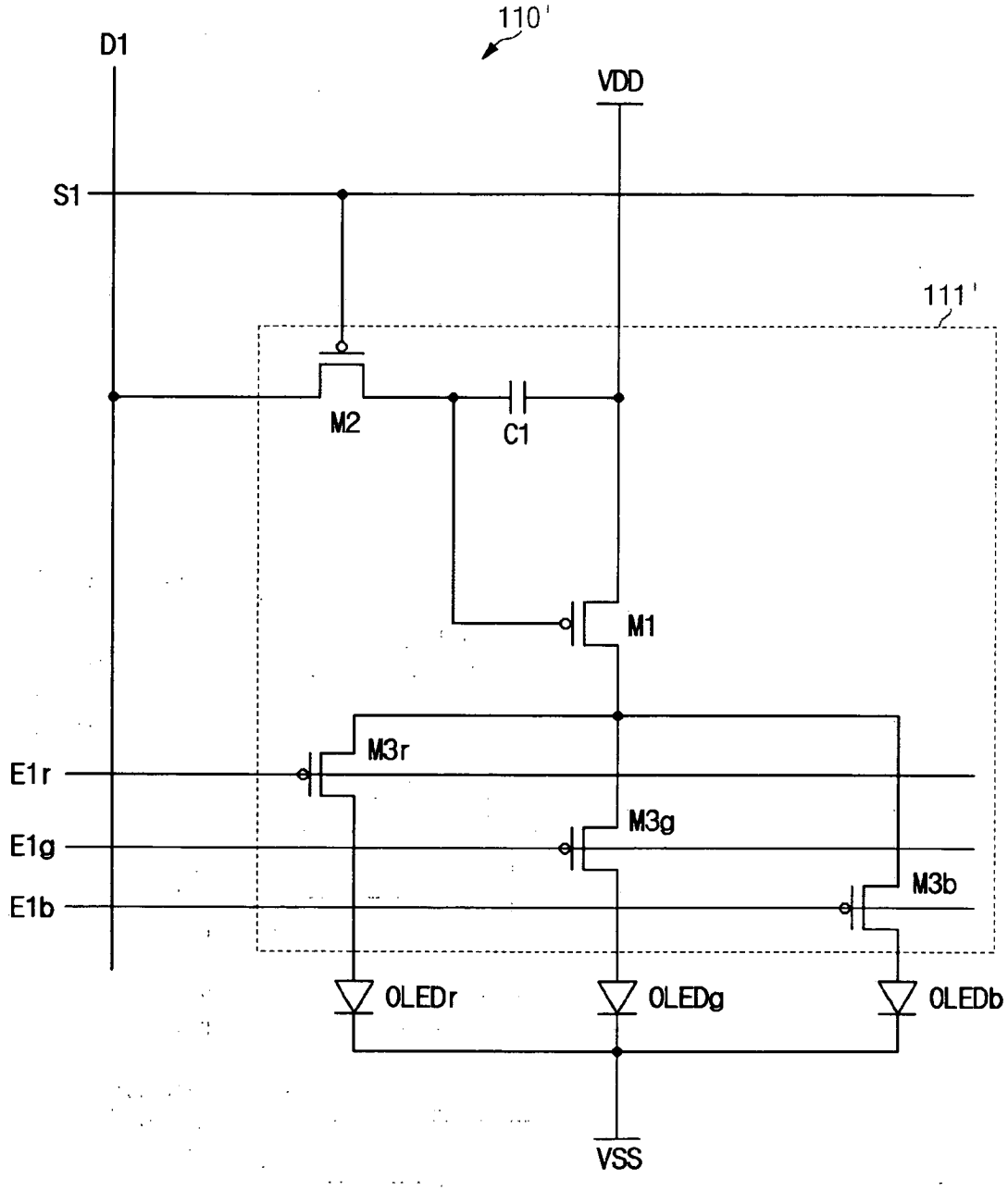
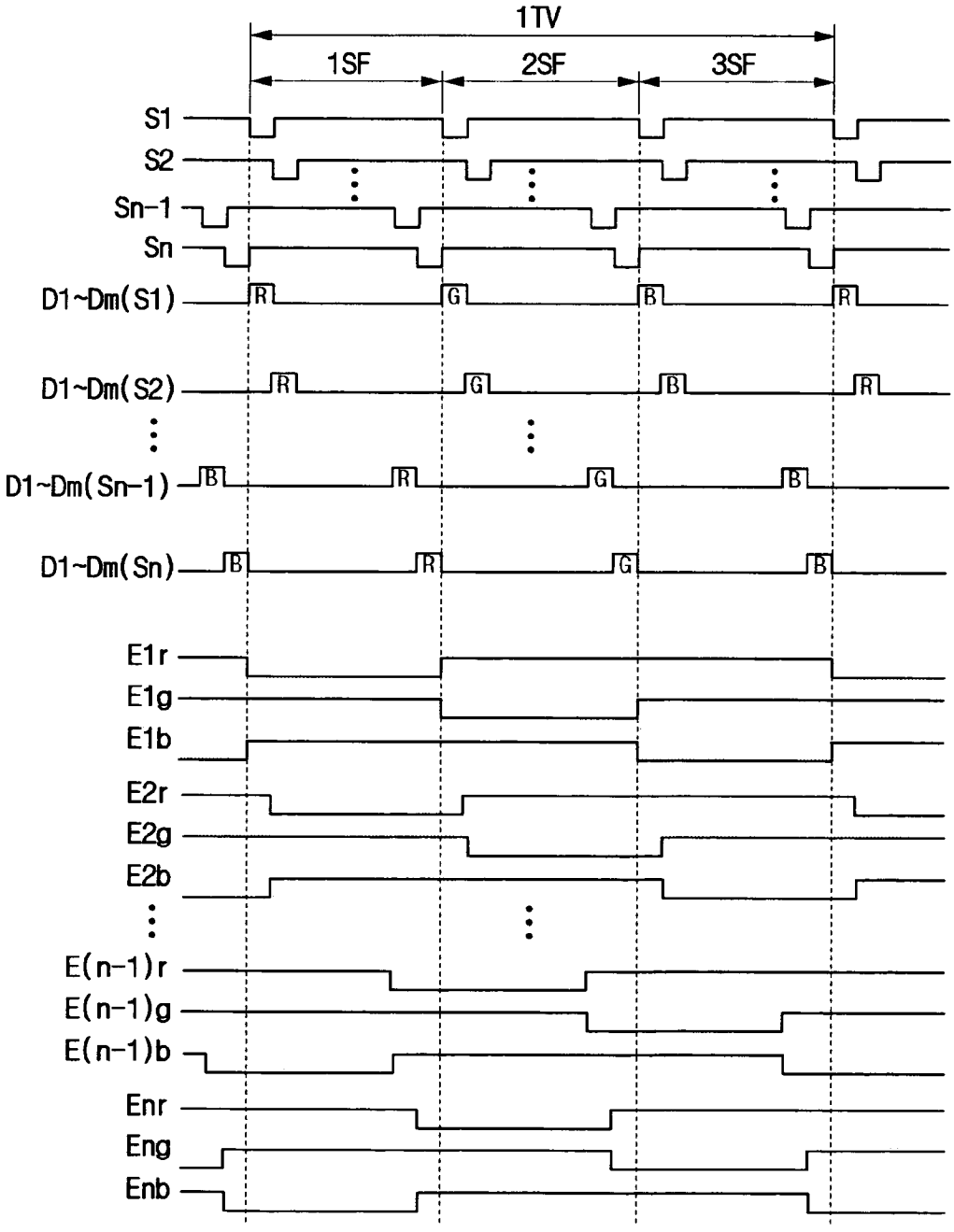

110'
D1
VDD
S1
111'
M2
C1
M1
M3r
E1r
M3g
E1g
M3b
E1b
OLEDr
OLEDg
OLEDb
VSS

Fig. 4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1SF
2SF
3SF
S1
S2
Sn-1
Sn
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D1~Dm(Sn)
E1r
E1g
E1b
E2r
E2g
E2b
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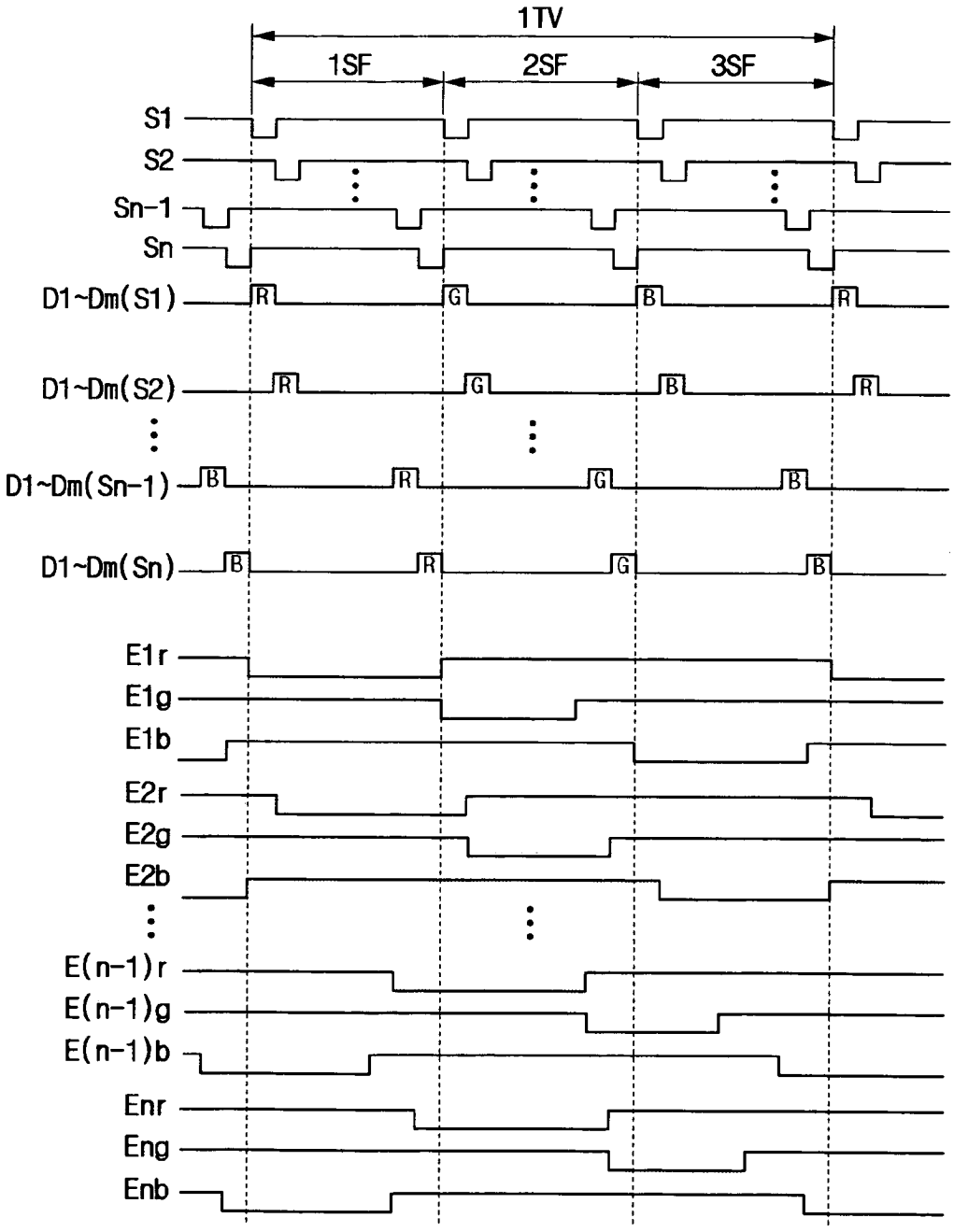
E(n-1)g
E(n-1)b
Enr
Eng
Enb
R
G
B

Fig. 5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S2
Sn-1
Sn
D1~Dm(S1)
D1~Dm(S2)
D1~Dm(Sn-1)
D1~Dm(Sn)
R
G
B
E1r
E1g
E1b
E2r
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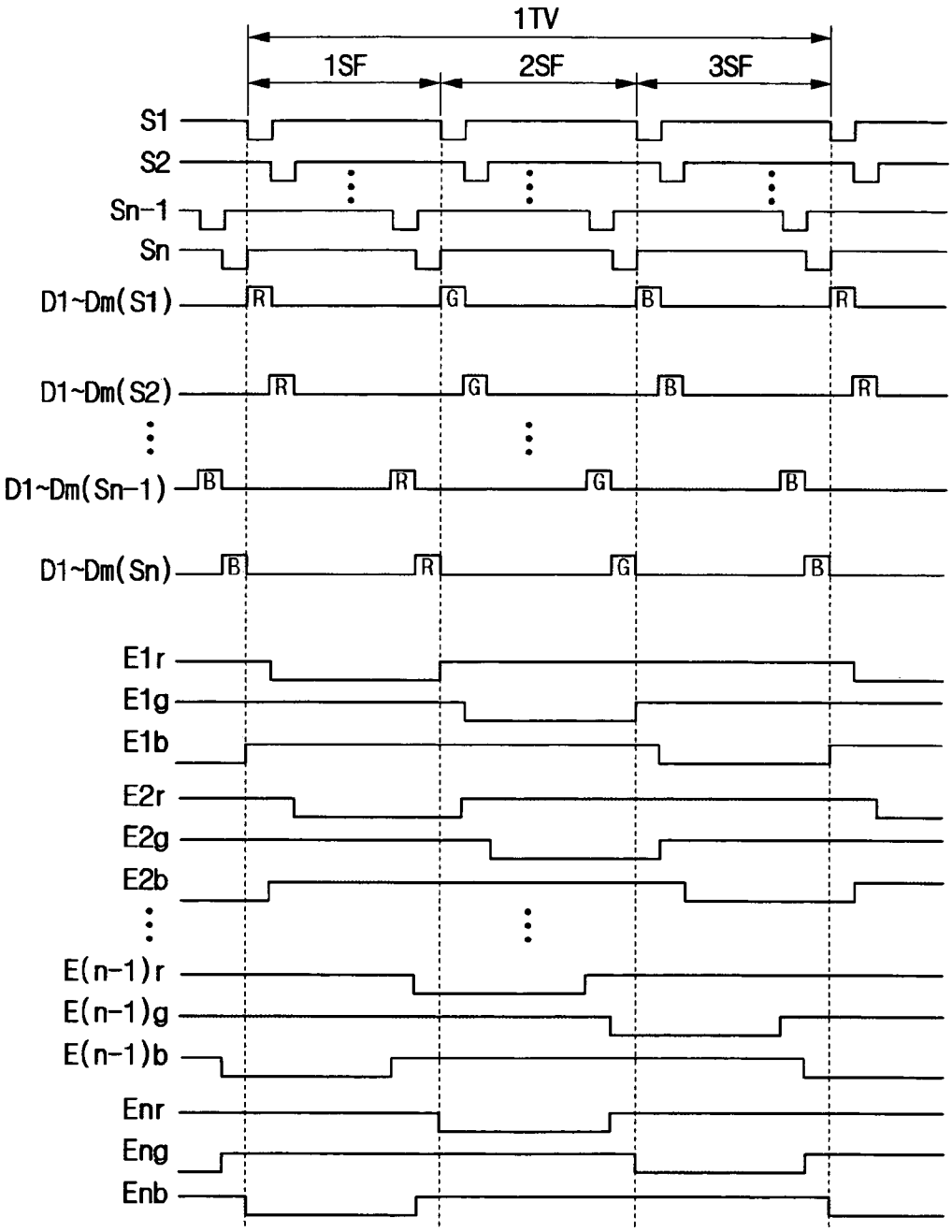
E2b
E(n-1)r
E(n-1)g
E(n-1)b
Enr
Eng
Enb

Fig. 6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D1~Dm(S2)
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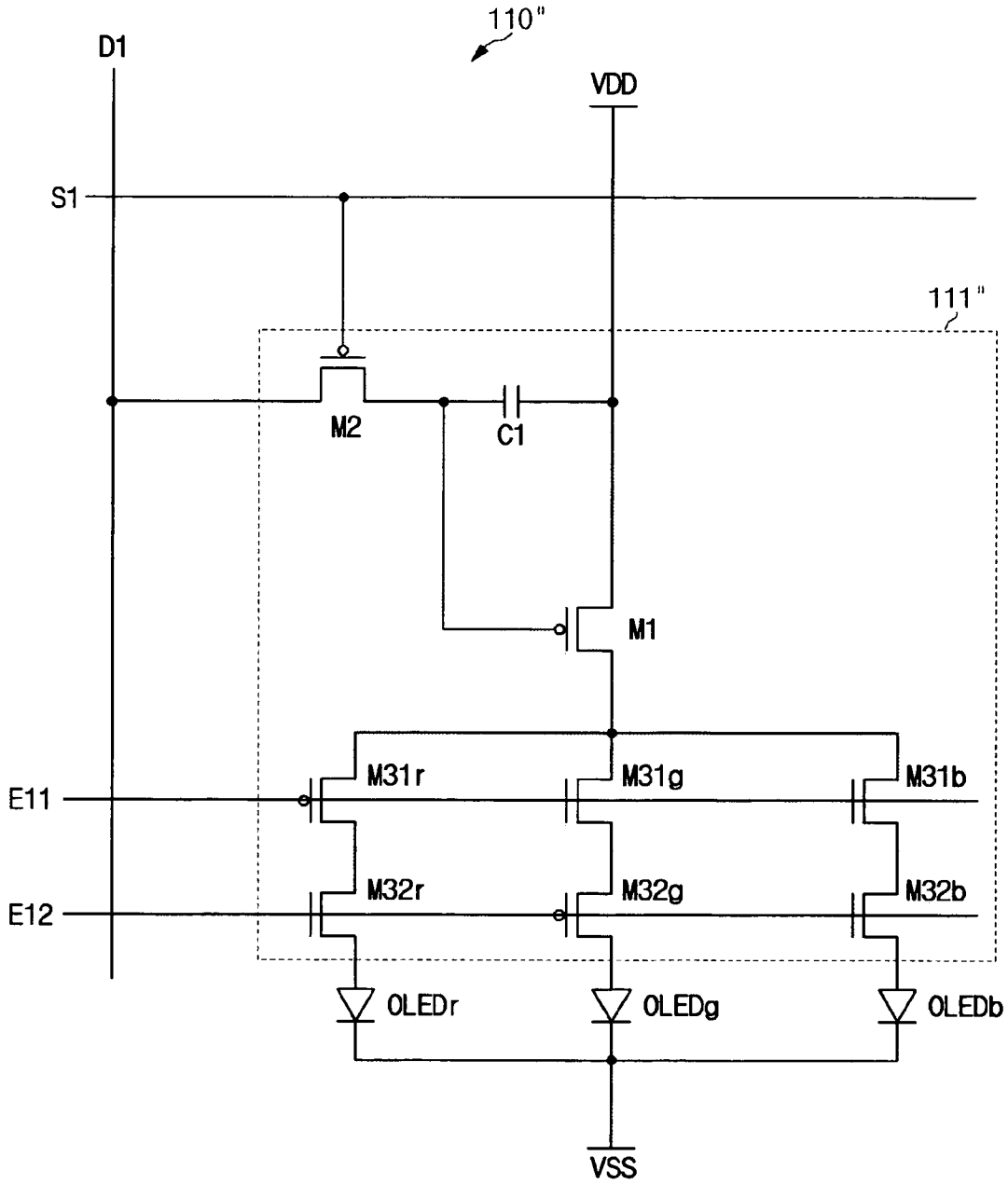
D1~Dm(Sn)
R
G
B
E1r
E1g
E1b
E2r
E2g
E2b
E(n-1)r
E(n-1)g
E(n-1)b
Enr
Eng
Enb

Fig. 7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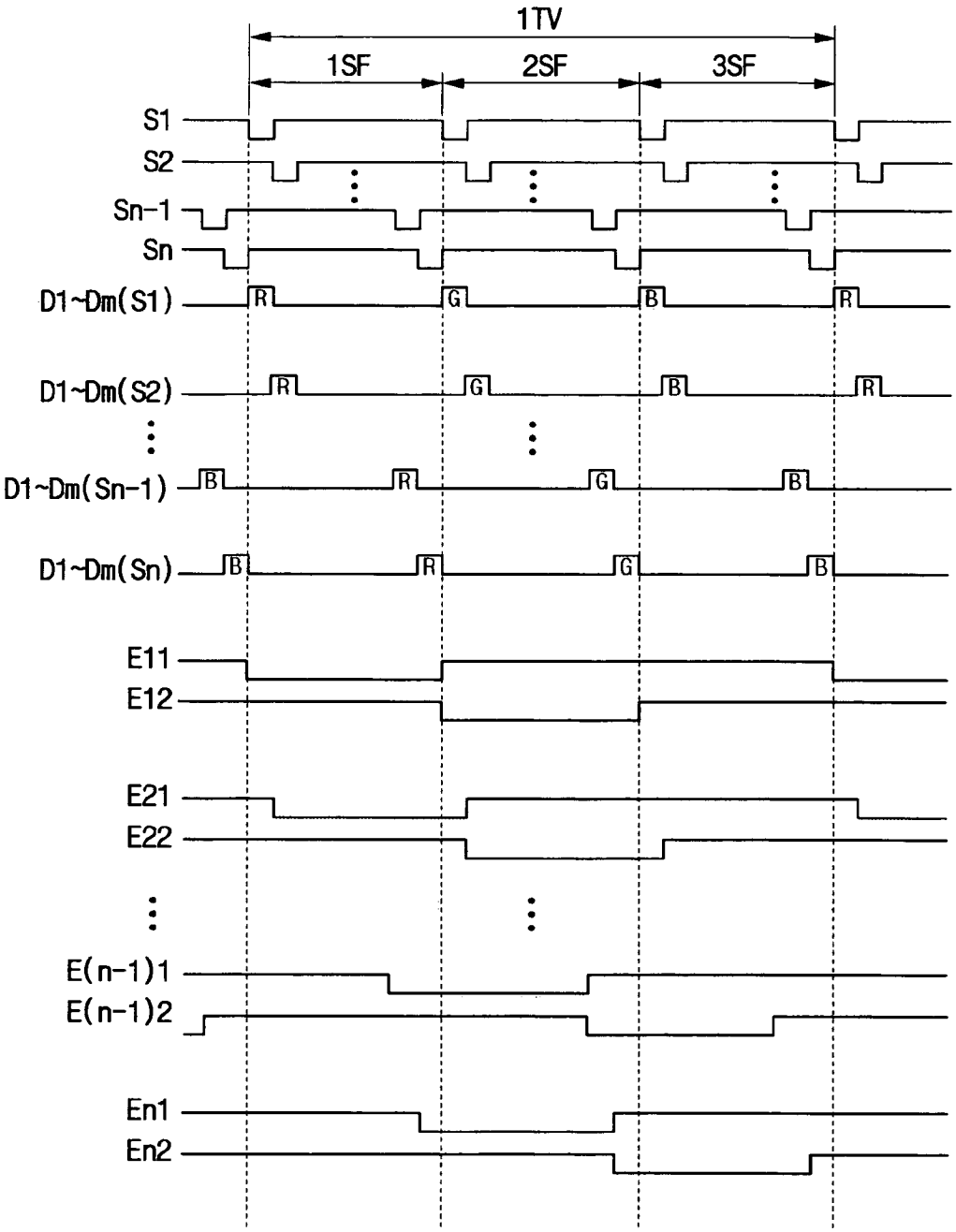
D1
VDD
S1
111"
M2
C1
M1
M31r
M31g
M31b
E11
M32r
M32g
M32b
E12
OLEDr
OLEDg
OLEDb
VSS

Fig. 8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S2
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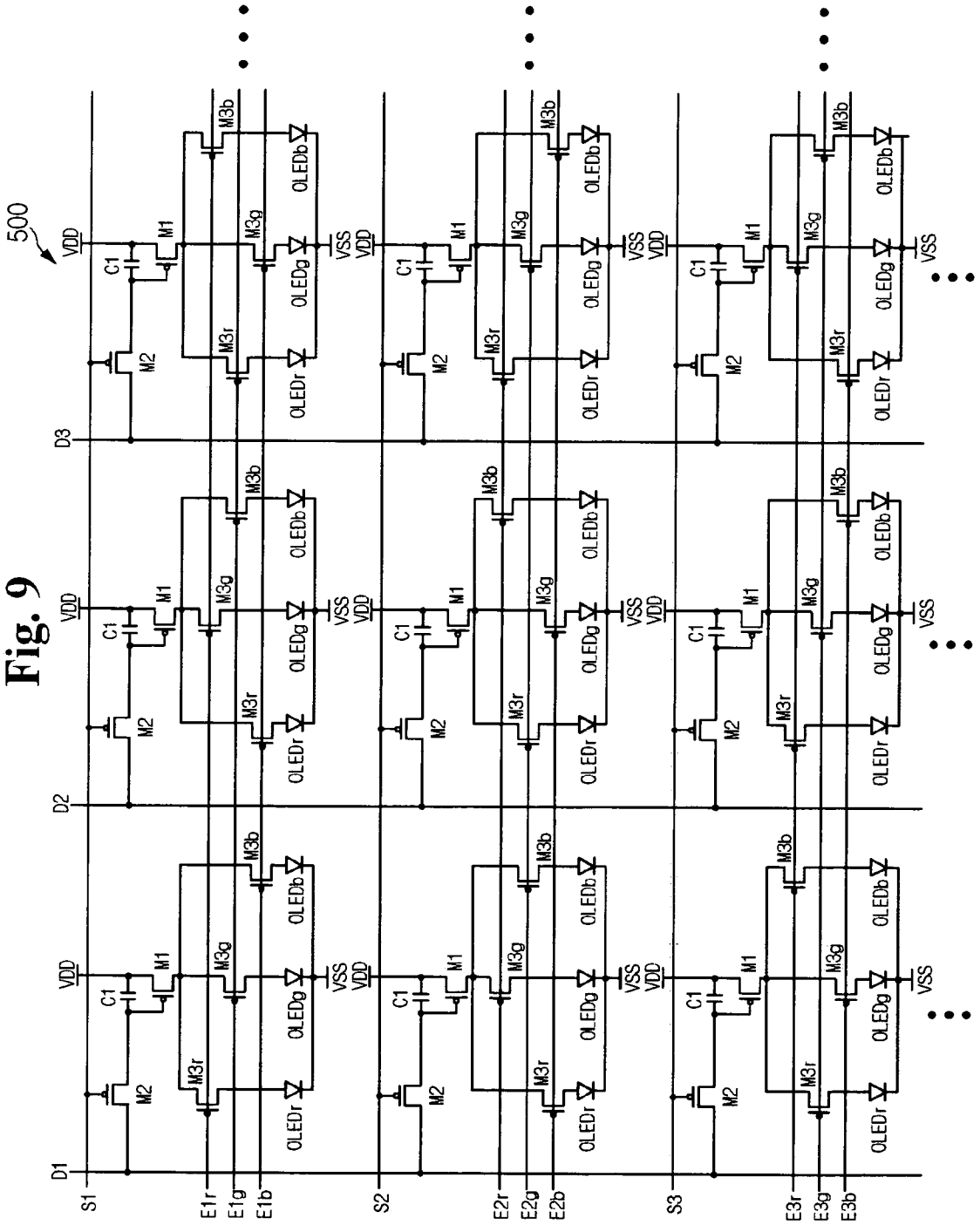
Sn
D1~Dm(S1)
D1~Dm(S2)
D1~Dm(Sn-1)
D1~Dm(Sn)
R
G
B
E11
E12
E21
E22
E(n-1)1
E(n-1)2
En1
En2

Fig. 9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VSS
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M1
M2
M3r
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M3b
OLEDr
OLEDg
OLEDb
D1
D2
D3
S1
S2
S3
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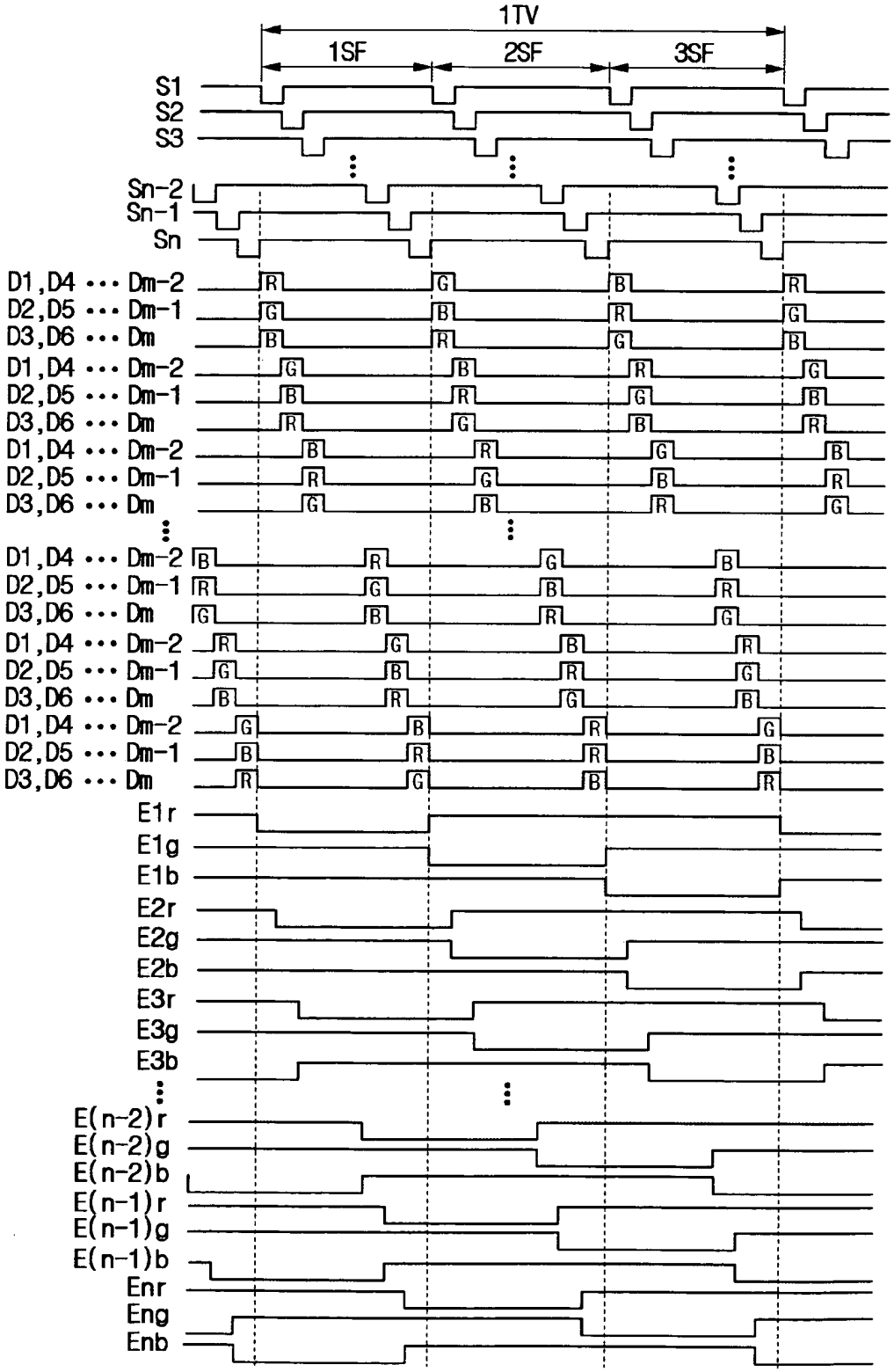
E1g
E1b
E2r
E2g
E2b
E3r
E3g
E3b

Fig. 10


1TV
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2SF
3SF
S1
S2
S3
Sn-2
Sn-1
Sn
D1,D4 ••• Dm-2
D2,D5 ••• Dm-1
D3,D6 ••• Dm
E1r
E1g
E1b
E2r
E2g
E2b
E3r
E3g
E3b
E(n-2)r
E(n-2)g
E(n-2)b
E(n-1)r
E(n-1)g
E(n-1)b
Enr
Eng
Enb

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 0762374 A1 **[0005]**

专利名称(译)	彩色显示器，分时驱动子像素		
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代理机构(译)	hengelhaupt，Jürgen		
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外部链接	Espacenet		

摘要(译)

形成在有机EL显示器中的像素上的红色，绿色和蓝色有机电致发光（EL）元件由驱动晶体管驱动。电容器耦合在驱动晶体管的栅极和源极之间，以将电压保持预定时间。发射控制晶体管分别耦合在驱动晶体管和红色，绿色和蓝色有机EL元件之间。一个场被分成三个子场，并且每个像素中的红色，绿色和蓝色有机EL元件之一开始在每个子场中发光，从而表示全色屏幕。红色，绿色和蓝色在场的每个子场中在行方向和列方向上混合并发射。