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(54) **Pixel circuit for time-divisionally driven subpixels in an OLED display**

Pixelschaltung zur Zeitmultiplexansteuerung von Unterpixeln in einer OLED-Farbanzeige

Circuit d'attaque de pixel à multiplexage temporel de sous-pixels dans un affichage couleur à OLED

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Description

BACKGROUND OF THE INVENTION

Field of the invention

[0001] The present invention relates to a self-emissive organic display device, and more particularly, to a time-divisional driving type organic electroluminescent display device in which red, green and blue light emitting elements are time-divisionally driven by one driving element and a driving method of the time-divisional driving type organic electroluminescent display device.

Description of Related Art

[0002] A pixel circuit wherein three light emitting elements are connected to a single driving circuit is disclosed in EP 0 762 374 A1.

[0003] Liquid crystal display (LCD) device and organic electroluminescent display device are often used in portable information appliances due to their lightweight and thin characteristics. The organic electroluminescent display device is being noticed as the next generation flat panel display device as the organic electroluminescent display device has better luminance and viewing angle characteristics compared to the LCD device.

[0004] Ordinarily, one pixel of an active matrix organic electroluminescent display device includes red, green and blue unit pixels, wherein each red, green and blue unit pixel is equipped with an electroluminescent (EL) device. Red, green and blue organic emitting layers are respectively interposed between anode electrode and cathode electrode in each EL device so that light is emitted from the red, green and blue organic emitting layers by a voltage applied to the anode electrode and cathode electrode.

[0005] FIG. 1 illustrates structure of a conventional active matrix organic electroluminescent display device.

[0006] Referring to FIG. 1, a conventional active matrix organic electroluminescent display device 10 includes a pixel part 100, a gate line driving circuit 110, a data line driving circuit 120 and a control part (not illustrated in FIG. 1). The pixel part 100 includes a plurality of gate lines 111~11m for providing scan signals S1~Sm from the gate line driving circuit 110, a plurality of data lines 121~12n for providing data signals DR1, DG1, DB1~DRn, DGn, DBn from the data line driving circuit 120 and a plurality of power supply lines 131~13n for providing power supply voltage VDD1~VDDn.

[0007] The pixel part 100 includes a plurality of pixels P11~Pmn arranged in a matrix format and connected to the plurality of gate lines 111~11m, the plurality of data lines 121~12n and the plurality of power supply lines 131~13n. Each of the pixels P11~Pmn includes three unit pixels, i.e., corresponding ones of red, green and blue unit pixels PR11~PRmn, PG11~PGmn, PB11~PBmn, so that each of the red, green and blue unit pixels PR11~PRmn, PG11~PGmn, PB11~PBmn is connected to a corresponding one of the gate lines, a corresponding one of the data lines and a corresponding one of the power supply lines.

[0008] For example, a pixel P11 includes a red unit pixel PR11, a green unit pixel PG11 and a blue unit pixel PB11, and is connected to a first gate line 111 for providing a first scan signal S1, a first data line 121 and a first power supply line 131.

[0009] In more detail, the red unit pixel PR11 of the pixel P11 is connected to the first gate line 111, an R data line 121 R for providing an R data signal DR1 and an R power supply line 131 R. In addition, the green unit pixel PG11 is connected to the first gate line 111, a G data line 121 G for providing a G data signal DG1 and a G power supply line 131G. Further, the blue unit pixel PB11 is connected to the first gate line 111, a B data line 121 B for providing a B data signal DB1 and a B power supply line 131 B.

[0010] FIG. 2 illustrates a pixel circuit P11 of a conventional organic electroluminescent display device. In particular, FIG. 2 illustrates a circuit diagram of the pixel P11 of FIG. 1, which includes red, green and blue unit pixels.

[0011] Referring to FIG. 2, the red unit pixel PR11 of the pixel P11 includes a switching transistor M1_R for which the scan signal S1 applied from the first gate line 111 is supplied to a gate, and the data signal DR1 is supplied to a source from the red data line 121R. The red unit pixel PR11 also includes a driving transistor M2_R for which a gate is connected to a drain of the switching transistor M1_R, and a power supply voltage VDD1 is supplied to a source from the power supply line 131R. Further, the red unit pixel PR11 includes a capacitor C1_R connected between the gate and the source of the driving transistor M2_R, and a red EL device EL1_R having an anode connected to a drain of the driving transistor M2_R and a cathode connected to a ground voltage VSS.

[0012] Similarly, the green unit pixel PG11 includes a switching transistor M1_G for which the scan signal S1 applied from the first gate line 111 is supplied to a gate, and the data signal DG1 is supplied to a source from the green data line 121G. The green unit pixel PG11 also includes a driving transistor M2_G for which a gate is connected to a drain of the switching transistor M1_G, and the power supply voltage VDD1 is supplied to a source from the power supply line 131G. Further, the green unit pixel PG11 includes a capacitor C1_G connected between the gate and the source of the driving transistor M2_G, and a green EL device EL1_G having an anode connected to a drain of the driving transistor M2_G and a cathode connected to a ground voltage VSS.

[0013] Further, the blue unit pixel PB11 includes a switching transistor M1_B for which the scan signal S1 applied from the first gate line 111 is supplied to a gate, and the data signal DB1 is supplied to a source from the blue data line 121 B. The blue unit pixel PB11 also includes a driving transistor M2_B for which a gate is connected to a drain of the switching transistor M1_B, and the power supply voltage VDD1 is supplied to a source from the power supply line 131B. Further, the blue unit pixel PB11 includes a capacitor C1_B connected between the gate and the source of the driving transistor M2_B, and a blue EL device EL1_B having an anode connected to a drain of the driving transistor M2_B and a cathode connected to a ground voltage VSS.

[0014] In operation of the above described pixel circuit P11, the switching transistors M1_R, M1_G, M1_B of the red, green and blue unit pixels are driven, and red, green and blue data DR1, DG1, DB1 are applied to the gates of the driving transistors M2_R, M2_G, M2_B from the red, green and blue data lines 121 R, 121G, 121B, respectively, when the scan signal S1 is applied to the gate line 111.

[0015] The driving transistors M2_R, M2_G, M2_B supply to the EL devices EL1_R, EL1_G, EL1_B a driving current corresponding to the difference between the data signals DR1, DG1, DB1 applied to the gate and the power supply voltage VDD1 respectively supplied from the red, green and blue power supply lines 131R, 131G, 131 B. The driving current applied through the driving transistors M2_R, M2_G, M2_B to drive the pixel P11 drives the EL devices EL1_R, EL1_G, EL1_B. The capacitors C1_R, C1_G, C1_B store the data signals DR1, DG1, DB1 applied, respectively, to the red, green and blue data lines 121 R, 121G, 121B.

[0016] Operations of a conventional organic electroluminescent display device having the above described structure are described as follows in reference to driving waveform diagrams of FIG. 3.

[0017] First, the first gate line 111 is driven, and pixels P11~P1n connected to the first gate line 111 are driven when the scan signal S1 is applied to the first gate line 111.

[0018] In other words, the switching transistors of the red, green and blue unit pixels PR11~PR1n, PG11~PG1n, PB11~PB1n of the pixels P11~P1n connected to the first gate line 111 are driven by the scan signal S1 applied to the first gate line 111. Red, green and blue data signals D(S1) (DR1~DRn, DG1~DGn, DB1~DBn) are simultaneously applied to the gates of the driving transistors of the red, green and blue unit pixels, respectively, through the red, green and blue data lines 121R~12nR, 121G~12nG, 121B~12nB composing first to n^{th} data lines 121~12n according to the driving of the switching transistors.

[0019] The driving transistors of the red, green and blue unit pixels supply a driving current corresponding to the red, green and blue data signals D(S1) (DR1~DRn, DG1~DGn, DB1~DBn) applied to the red, green and blue data lines 121R~12nR, 121G~12nG, 121B~12nB, respectively, to the red, green and blue EL devices. Therefore, the EL devices of the red, green and blue unit pixels PR11~PR1n, PG11~PG1n, PB11~PB1n of the pixels P11~P1n connected to the first gate line 111 are simultaneously driven when the scan signal S1 is applied to the first gate line 111.

[0020] Similarly, if a scan signal S2 for driving a second gate line 112 is applied, data signals D(S2)(DR1~DRn, DG1~DGn, DB1~DBn) are applied to red, green and blue unit pixels PR21~PR2n, PG21~PG2n, PB21~PB2n of pixels P21~P2n connected to the second gate line 112 through red, green and blue data lines 121R~12nR, 121G~12nG, 121B~12nB composing first to n^{th} data lines 121~12n.

[0021] EL devices of the red, green and blue unit pixels PR21~PR2n, PG21~PG2n, PB21~PB2n of the pixels P21~P2n connected to the second gate line 112 are simultaneously driven by a driving current corresponding to the data signals D(S2)(DR1~DRn, DG1~DGn, DB1~DBn).

[0022] EL devices of red, green and blue unit pixels PRm1~PRmn, PGm1~PGmn, PBm1~PBmn of pixels Pm1~Pmn connected to the m^{th} gate line 11m are simultaneously driven according to red, green and blue data signals D(Sm)(DR1~DRn, DG1~DGn, DB1~DBn) applied to the red, green and blue data lines 121R~12nR, 121G~12nG, 121B~12nB when a scan signal Sm is finally applied to m^{th} gate line 11 m by repeating the foregoing actions.

[0023] Therefore, an image is displayed by sequentially driving pixels (P11~P1n)~(Pm1~Pmn) connected to the respective gate lines 111~11m, thereby driving pixels during one frame when the scan signals S1~Sm are sequentially applied starting with the first gate line 111 and ending with the m^{th} gate line 11 m.

[0024] However, in an organic electroluminescent display device having this structure, each pixel includes red, green and blue unit pixels, and driving elements for driving red, green and blue EL devices (i.e., a switching thin film transistor, a driving thin film transistor and a capacitor) are respectively arranged per the red, green and blue unit pixels. Further, data lines and power supply lines for supplying data signal and power supply ELVDD to each driving element are respectively arranged per the unit pixels.

[0025] Therefore, three data lines and three power supply lines are arranged per pixel, and at least six transistors including three switching thin film transistors and three driving thin film transistors and at least three capacitors are required in each pixel. On the other hand, at least four signal lines are required per red, green and blue unit pixels as a separate emission control line for providing emission control signal is required in case that each pixel is controlled by emission control signals. Therefore, the circuit structure for the pixels in a conventional organic electroluminescent display device is complicated as a plurality of wirings and a plurality of elements are arranged per each pixel, and yield is reduced as probability of generating defects is increased accordingly.

[0026] Further, the area of each pixel is reduced as the resolution of the display device is being increased, and not only is it difficult to arrange many elements on one pixel, but also the aperture ratio is reduced accordingly.

SUMMARY OF THE INVENTION

[0027] The present invention relates to a flat panel display device and a method for driving the same as defined by claims 1-7.

[0028] The present invention will be better understood from the following detailed description of the examplary embodiments thereof taken in conjunction with the accompanying drawings, and its scope will be pointed out in the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0029] The above and other features of the present invention will become more apparent to those of ordinary skill in the art with the following description in detail of certain exemplary embodiments thereof with reference to the attached drawings in which:

FIG. 1 is a structural view of a conventional organic electroluminescent display device;
FIG. 2 is a circuit diagram of a pixel circuit of the organic electroluminescent display device of FIG. 1;
FIG. 3 is a waveform diagram of operation of the organic electroluminescent display device of FIG. 1;
FIG. 4 is a block structural view of an organic electroluminescent display device according to a first exemplary embodiment of the present invention;
FIG. 5A illustrates a block structural view of a pixel part applicable to the organic electroluminescent display device of FIG. 4;
FIG. 5B illustrates a block structural view of another pixel part applicable to the organic electroluminescent display device of FIG. 4;
FIG. 6 is a drawing schematically illustrating a pixel circuit of an organic electroluminescent display device according to the first exemplary embodiment of the present invention;
FIG. 7A is a block structural view of a pixel circuit of the pixel part of FIG. 5A;
FIG. 7B is a block structural view of a pixel circuit of the pixel part of FIG. 5B;
FIG. 8A is a detailed circuit diagram of the pixel circuit of FIG. 7A;
FIG. 8B is a detailed circuit diagram of the pixel circuit of FIG. 7B;
FIG. 9 is a driving waveform diagram of a pixel circuit of an organic electroluminescent display device according to the first exemplary embodiment of the present invention;
FIG. 10 is a driving waveform diagram illustrating white balance control in an organic electroluminescent display device according to the first exemplary embodiment of the present invention;
FIG. 11 is a block structural view of an organic electroluminescent display device according to a second exemplary embodiment of the present invention; and
FIG. 12 is a block structural view of an organic electroluminescent display device according to a third exemplary embodiment of the present invention.

DETAILED DESCRIPTION

[0030] The present invention will now be described in detail in connection with certain exemplary embodiments with reference to the accompanying drawings. In the drawings, like reference numerals/characters designate like elements.

[0031] FIG. 4 illustrates a block structural view of an organic electroluminescent display device according to a first exemplary embodiment of the present invention.

[0032] Referring to FIG. 4, an organic electroluminescent display device 50 according to the first exemplary embodiment includes a pixel part 500, a gate line driving circuit 510, a data line driving circuit 520 and an emission control signal generating circuit 590. The gate line driving circuit 510 sequentially generates scan signals S1'~Sm' to gate lines of the pixel part 500 during one frame. The data line driving circuit 520 sequentially supplies red, green and blue data signals D1'~Dn' to data lines of the pixel part 500 whenever scan signals are applied during one frame. The emission control signal generating circuit 590 sequentially supplies emission control signals EC_R, G, B1~ EC_R, G, Bm for controlling emission of red, green and blue EL devices to emission control lines 591~59m of the pixel part 500 whenever scan signals are applied during one frame. In this and other embodiments, the EL devices may be arranged in stripe type, delta type or mosaic type. Further, at least one of the gate line driving circuit 510, the data line driving circuit 520 and the emission control signal generating circuit may have a redundancy function.

[0033] FIG. 5A illustrates one example of block structure of pixel part in an organic electroluminescent display device according to the first exemplary embodiment of the present invention.

[0034] Referring to FIG. 5A, a pixel part 500' of an organic electroluminescent display device 50' includes a plurality of gate lines 511~51m to which scan signals S1'~Sm' are supplied from a gate line driving circuit 510, and a plurality of data lines 521~52n to which data signals D1'~Dn' are supplied from a data line driving circuit 520. The pixel part 500' also includes a plurality of emission control lines 591~59m to which emission control signals EC_R, G, B1 ~ EC_R, G, Bm are supplied from an emission control signal generating circuit 590, and a plurality of power supply lines 531~53n for supplying power supply voltage VDD1 ~ VDDn.

[0035] The pixel part 500' further includes a plurality of pixels P11'~Pmn' arranged in a matrix format, and connected to the plurality of gate lines 511~51m, the plurality of data lines 521~52n, the plurality of emission control lines 591~59m and the plurality of power supply lines 531~53n. Each of the plurality of pixels P11'~Pmn' is connected to one corresponding gate line in the plurality of gate lines 511~51m, one corresponding data line in the plurality of data lines 521~52n, one corresponding emission control line in the plurality of emission control lines 591~59m and one corresponding power supply line in the plurality of power supply lines 531~53n.

[0036] For example, the pixel P11' is connected to the first gate line 511 for supplying the first scan signal S1', the first data line 521 for supplying the first data signal D1', the first emission control line 591 for supplying the first emission control signal EC_R, G, B1, and the first power supply line 531 for supplying the first power supply voltage VDD1.

[0037] Therefore, corresponding scan signals are applied to the pixels P11'~Pmn' through corresponding scan lines, and the corresponding red, green and blue data signals are sequentially supplied to the pixels P11'~Pmn' through corresponding data lines. Further, corresponding red, green and blue emission control signals are sequentially supplied to the pixels P11'~Pmn' through corresponding emission control lines, and corresponding power supply voltage is supplied to the pixels P11'~Pmn' through corresponding power supply lines. Each of the pixels indicates a certain color, such that an image is displayed during one frame by sequentially applying corresponding red, green and blue data signals to the pixels whenever corresponding scan signals are applied to the pixels and sequentially driving red, green and blue EL devices according to red, green and blue emission control signals, thereby sequentially emitting lights corresponding to the red, green and blue data signals.

[0038] FIG. 6 schematically illustrates a pixel circuit for one pixel in a time-divisionally driving type organic electroluminescent display device according to the first exemplary embodiment of the present invention. FIG. 6 illustrates one pixel P11' in a plurality of pixels.

[0039] Referring to FIG. 6, the pixel includes an active element 570 connected to the first gate line 511, the first data line 521, the first emission control line 591 and the first common power supply line 531, and red, green and blue EL devices EL1_R', EL1_G', EL1_B' connected in parallel between the active element 570 and a common voltage (e. g., ground) VSS. First electrodes, e.g., anode electrodes, are connected to the active element 570, and second electrodes, e.g., cathode electrodes, are commonly connected to the common voltage VSS, in the red, green and blue EL devices EL1_R', EL1_G', EL1_B'.

[0040] The red, green and blue EL devices EL1_R', EL1_G', EL1_B' should be time-divisionally driven so that a pixel P11' displays a certain color by driving the three red, green and blue EL devices EL1_R', EL1_G', EL1_B' during one frame since the red, green and blue EL devices EL1_R', EL1_G', EL1_B' share one active element 570 in a pixel circuit having the structure of FIG. 6. That is, the red, green and blue EL devices EL1_R', EL1_G', EL1_B' are time-divisionally driven during one frame so that the pixel P11' realizes a certain color by dividing one frame into three sub frames and driving one of the red, green and blue EL devices EL1_R', EL1_G', EL1_B' during each sub frame.

[0041] In other words, the active element 570 drives the red EL device EL1_R' using the emission control signal EC_R1 generated to the emission control line 591 from the emission control signal generating circuit 590 so that red color corresponding to red data is emitted if red data DR1' is applied as a data D1' applied to the data line 521 as the scan signal S1' is applied from the gate line 511 to the active element 570 in the first sub frame of one frame. Similarly, when the scan signal S1' is applied from the gate line 511 to the active element 570 in the second sub frame, green data DG1' is applied as the data D1' applied to the data line 521, and the green EL device EL1_G' is emitted by the emission control signal EC_G1 generated to the emission control line 591 from the emission control signal generating circuit 590 so that green color corresponding to the green data is emitted. Finally, when the scan signal S1' is applied from the gate line 511 to the active element 570 in the third sub frame, blue data DB1' is applied as the data D1' applied to the data line 521, and the blue EL device EL1_B' is emitted by the emission control signal EC_B1 generated to the emission control line 591 from the emission control signal generating circuit 590 so that blue color corresponding to the blue data is emitted. Therefore, red, green and blue EL devices are sequentially driven time-divisionally during one frame so that each pixel emits a certain color to display an image.

[0042] Although red, green and blue colors are emitted to realize a certain color by driving the EL devices in the order of red, green and blue EL devices during the three sub frames of one frame in the first exemplary embodiment of the present invention, emission sequence of red, green and blue EL devices or red, green, blue and white EL devices may be temporarily or permanently changed, and/or one frame may be divided into more than three sub frames so that at least one color out of red, green and blue colors is further emitted in the remaining sub frame(s) in order to adjust chromaticity, brightness or luminance.

[0043] For example, one color of red, green, blue or white can be further emitted during an additional one sub frames such as RRGB, RGGB, RGBB and RGBW by dividing one frame into four sub frames, and the additional emitted color is emitted from an appropriate sub frame in a plurality of sub frames, wherein one EL device in the red, green, blue and white EL devices is driven, or at least two EL devices in the red, green, blue and white EL devices are driven so that one color of red, green, blue or white is further emitted during the additional one or more sub frames.

[0044] Further, although the first exemplary embodiment of the present invention discloses that red, green and blue EL devices are sequentially driven during one frame of three sub frames, the plurality of sub frames are sequentially driven time-divisionally by dividing red, green, blue or white into a plurality of sub frames during one frame, or the plurality of sub frames are sequentially driven time-divisionally by dividing at least two colors in the red, green, blue and white into a plurality of sub frames during one frame.

[0045] FIG. 7A illustrates a block structural view of a pixel circuit of time-divisional driving type organic electroluminescent display device according to one exemplary embodiment of the present invention, and FIG. 8A illustrates one example of detailed circuit diagram of the pixel circuit of FIG. 7A. Pixel circuits of FIG. 7A and FIG. 8A illustrate examples of pixel circuit for sequentially driving red, green and blue EL devices EL1_R', EL1_G', EL1_B' time-divisionally during one frame.

[0046] Referring to FIG. 7A and FIG. 8A, the pixel P11' includes one gate line 511, one data line 521, three emission control lines 591 r, 591 g, 591 b, the power supply line 531, and an indication unit 560 time-divisionally driven by signals applied through the lines. The indication unit 560 includes a light emitting element for self-emitting light. The light emitting element includes red, green and blue EL devices EL1_R', EL1_G', EL1_B' for emitting red, green and blue respectively.

[0047] Further, the pixel P11' includes the active element 570 for sequentially driving the red, green and blue EL devices EL1_R', EL1_G', EL1_B' time-divisionally. The active element 570 includes a driving unit 540 for supplying driving current corresponding to red, green and blue data signals DR1', DG1', DB1' to the EL devices EL1_R', EL1_G', EL1_B' of the indication unit 560 whenever the scan signal S1' is applied, and a sequential control unit 550 for controlling the driving current corresponding to the red, green and blue data signals DR1', DG1', DB1'. The data signals are sequentially supplied to the red, green and blue EL devices EL1_R', EL1_G'. EL1_B' from the driving unit 540 according to the emission control signals EC_R1, EC_G1, EC_B1.

[0048] As shown in FIG. 8A, the driving unit 540 includes a switching transistor M51 in which the scan signal S1' is supplied to gate from the gate line 511, and red, green and blue data signals DR1', DG1', DB1' are time-divisionally supplied to a source from the data line 521. The driving unit 540 also includes a driving transistor M52 having a gate connected to a drain of the switching transistor M51. A power supply voltage VDD1 is supplied to a source from the power supply voltage line 531, and a drain is connected to the sequential control unit 550. A capacitor C51 is connected between a gate and a source of the driving transistor M52.

[0049] Although the driving unit 540 includes two thin film transistors of switching transistor and driving transistor and one capacitor in the described embodiment of the present invention, any suitable structure capable of driving light emitting element including the indication unit 560 may be used. Further, the driving unit 540 of FIG. 7A may also include any device capable of improving driving characteristics for driving the light emitting element of the indication unit 560, e.g., a threshold compensation device. Although all thin film transistors in the driving unit 540 are P type thin film transistors, the thin film transistors can be N type thin film transistors or any combination of N type thin film transistors and P type thin film transistors. In addition, N type or P type thin film transistors of depletion mode and/or enhancement mode may be used. Further, the driving unit 540 may be constructed using various types of switching elements such as thin film diode, diode, TRS (triodic rectifier switch), etc. instead of or in addition to the thin film transistors.

[0050] The sequential control unit 550 is connected between the driving unit 540 and the indication unit 560 to time-divisionally and sequentially drive red, green and blue EL devices EL1_R', EL1_G', EL1_B' of the indication unit 560 according to red, green and blue emission control signals EC_R1, EC_G1, EC_B1 supplied through emission control lines 591r, 591g, 591b from the emission control signal generating circuit 590.

[0051] The sequential control unit 550 includes first, second and third control devices connected between the drain of the driving transistor M52 and anodes of the red, green and blue EL devices EL1_R', EL1_G', EL1_B', respectively, to sequentially control time-divisional driving of the red, green and blue EL devices EL1_R', EL1_G', EL1_B' according to the emission control signals EC_R1, EC_G1, EC_B1.

[0052] The first control device includes a thin film transistor M55_R on which the first emission control signal EC_R1 is applied to a gate, a source is connected to the drain of the driving transistor M52, and a drain is connected to the anode of the red EL device EL1_R' to drive the red EL device EL1_R' correspondingly to a red data signal applied through the driving transistor M52 by the first emission control signal EC_R1.

[0053] The second control device includes a thin film transistor M55_G to which the second emission control signal EC_G1 is applied to a gate, a source is connected to the drain of driving transistor M52, and a drain is connected to the anode of the green EL device EL1_G' to drive the green EL device EL1_G' correspondingly to a green data signal applied through the driving transistor M52 by the second emission control signal EC_G1.

[0054] The third control device includes a thin film transistor M55_B to which the third emission control signal EC_B1 is applied to a gate, a source is connected to the drain of the driving transistor M52, and a drain is connected to the anode of the blue EL device EL1_B' to drive the blue EL device EL1_B' correspondingly to a blue data signal applied through the driving transistor M52 by the third emission control signal EC_B1.

[0055] Although the sequential control unit 550 includes P type thin film transistors in the described embodiment, the sequential control unit 550 can be formed of N type thin film transistors or any suitable combination of N type thin film transistors and P type thin film transistors. N type and/or P type thin film transistors of depletion mode or enhancement mode may be used. Further, the sequential control unit 550 can be constructed by using various types of switching elements such as a thin film diode, a diode, a TRS, etc., instead of or in addition to the thin film transistors. The sequential control unit 550 can be constructed as any suitable device capable of sequentially driving the red, green and blue EL devices.

[0056] Although in the described exemplary embodiment of the present invention, a structure in which red, green and blue light emitting elements are time-divisionally driven by one active element is described in reference to the red, green and blue EL devices, the structure can also be applied to other light emitting display devices such as FED (field emission display) and PDP (plasma display panel).

[0057] The process of time-divisionally driving a pixel circuit of an organic electroluminescent display device in exemplary embodiments of the present invention is described as follows.

[0058] Conventionally, each one of scan signals S1~Sm is sequentially applied to a plurality of gate lines from the gate line driving circuit 110 so that m scan signals are applied during one frame, and red, green and blue data signals DR1~DRn, DG1-DGn, DB1~DBn are simultaneously applied to red, green and blue data lines from the data line driving circuit 120 whenever the respective scan signals S1~Sm are applied so that pixels are driven as illustrated in FIG. 3.

[0059] In the described exemplary embodiment of the present invention, however, one frame is divided into three sub frames, scan signals are respectively applied to gate lines from gate line driving circuit 510 during each sub frame so that 3m scan signals are applied during one frame. In case of the first pixel, when the scan signal S1' is applied to the first gate line 511 during the first sub frame, the switching transistor M51 is turned on so that the red data signal DR1' is supplied to the driving transistor M52 from the data line 521, wherein the sequential control unit 550 drives the red EL device EL1_R' correspondingly to the red data signal DR1' as the thin film transistor M55_R (i.e., the first control device) is turned on by the first emission control signal EC_R1.

[0060] Next, the sequential control unit 550 drives the green EL device EL1_G' correspondingly to the green data signal DG1' as the scan signal S1' is applied to the first gate line 511 during the second sub frame so that the green data signal DG1' is supplied to the driving transistor M52 from the data line 521, and the thin film transistor M55_G (i.e., the second control device) is turned on by the second emission control signal EC_G1.

[0061] Finally, the sequential control unit 550 drives the blue EL device EL1_B' correspondingly to the blue data signal DB1' as the scan signal S1' is applied to the first gate line 511 during the third sub frame so that the blue data signal DB1' is supplied to the driving transistor M52 from the data line 521, and the thin film transistor M55_B (i.e., the third control device) is turned on by the third emission control signal EC_B1.

[0062] In this manner, the red data signals DR1'~DRn', the green data signals DG1'~DGn' and the blue data signals DB1'~DBn' are sequentially applied to the data lines so that red, green and blue EL devices EL_R', EL_G', EL_B' of pixels P11'~Pmn' are sequentially driven time-divisionally whenever the scan signals S1'~Sm' are applied during the respective sub frames during one frame.

[0063] Therefore, circuit structure can be simplified in a pixel circuit of the present invention as the red, green and blue EL devices EL_R', EL_G', EL_B' of the pixel P11' share an active element 570 so that each pixel requires one gate line, one data line, three emission control lines and one power supply line only.

[0064] FIG. 5B illustrates another block structure of a pixel part 500" in an organic electroluminescent display device 50" according to the first exemplary embodiment of the present invention. FIG. 7B illustrates another block structural view of a pixel circuit P11" of a time-divisional driving type organic electroluminescent display device of the present invention illustrated in FIG. 5B, and FIG. 8B illustrates a detailed circuit diagram of the pixel circuit P11" of FIG. 7B.

[0065] The pixel circuit P11" illustrated in FIG. 5B, FIG. 7B and FIG. 8B is substantially the same as the pixel circuit P11' of FIG. 5A, FIG. 7A and FIG. 8A except that a separate power supply line is installed so that a power supply voltage VDD1 is supplied to a capacitor C51' of a driving unit 540' in an active element 570', through a power supply line 531 b, and the power supply voltage VDD1 is supplied to a source of a driving transistor M52' through a power supply line 531a. This is different from the pixel circuit P11' wherein the same power supply voltage VDD1 is supplied to the capacitor C51 of a driving unit 540 and the source of the driving transistor M52 through the same power supply line 531. Hence, in the pixel circuit P11", data signals are stored in the capacitor C51' more stably by separating power supply line supplied to the capacitor C51' from the power supply line supplied to the driving transistor M52'. In the pixel circuit P11", a driving transistor M51' is coupled in substantially the same manner as the driving transistor M51 is in the pixel circuit P11'.

[0066] A method for time-divisionally and sequentially driving an organic electroluminescent display device according to the first exemplary embodiment of the present invention as described above is described in detail as follows in reference to the driving waveform diagram of FIG. 9. The description will be made in reference to the illustrated embodiment of FIGs. 5A, 7A and 8A with the understanding that the description applies equally as well to the illustrated embodiment of FIGs. 5B, 7B and 8B.

[0067] First, when a scan signal S1'(R) is applied to the first gate line 511 from the gate line driving circuit 510 during a first sub frame 1SF_R in one frame, the first gate line 511 is driven, and red data signals DR1'~DRn' are supplied as data signals D1'~Dn' to the driving transistor of the pixels P11'~P1n' connected to the first gate line 511 from the data line driving circuit 520'.

[0068] When the emission control signal EC_R1 from the emission control signal generating circuit 590 for controlling the red EL device EL_R' of the pixels P11'-P1 n' connected to the first gate line is applied to the sequential control unit 550 through the emission control line 591 r, the thin film transistor M55_R is turned on, and driving current corresponding to the red data signals DR1'~DRn' is supplied to the red EL device so that the red EL device is driven.

[0069] Subsequently, when a second scan signal S1'(G) is applied to the first gate line 511 during a second sub frame 1SF_G of the first frame 1F, green data signals DG1'~DGn' are supplied to the driving transistor M52 through the data lines 521~52n. When the emission control signal EC_G1 from the emission control signal generating circuit 590 for controlling the green EL device EL_G' of the pixels P11'~P1n' connected to the first gate line 511 is applied to the sequential control unit 550 through the emission control line 591g, the thin film transistor M55_G is turned on, and driving current corresponding to the green data signals DG1'~DGn' is supplied to the green EL device so that the green EL device is driven.

[0070] Finally, when a third scan signal S1'(B) is applied to the first gate line 511 during a third sub frame 1SF_B of the first frame 1 F, blue data signals DB1'~DBn' are supplied to the driving transistor M52 through the data lines 521~52n. When the emission control signal EC_B1 from the emission control signal generating circuit 590 for controlling the blue EL device EL_B' of the pixels P11'~P1n' connected to the first gate line 511 is applied to the sequential control unit 550 through the emission control line 591 b, the thin film transistor M55_B is turned on, and driving current corresponding to the blue data signals DB1'~DBn' is supplied to the blue EL device so that the blue EL device is driven.

[0071] Subsequently, when a scan signal S2' is applied to the second gate line 512 per each sub frame of one frame, red, green and blue data signals DR1'~DRn', DG1'~DGn', DB1'~DBn' are sequentially applied to the data lines 521~52n. Further, emission control signals EC_R2, EC_G2, EC_B2 from the emission control signal generating circuit 590 for sequentially controlling the red, green and blue EL devices of the pixels P21'~P2n' connected to the second gate line 512 are sequentially applied to the sequential control unit 550 through the emission control lines 591 r, 591 g, 591 b, respectively, as described above. Therefore, the thin film transistors M55_R, M55_G, M55_B are sequentially turned on, and driving currents corresponding to the red, green and blue data signals DR1'~DRn', DG1'~DGn', DB1'~DBn' are sequentially supplied to the red, green and blue EL devices so that the red, green and blue EL devices are time-divisionally driven.

[0072] The red, green and blue data signals DR1'~DRn', DG1'~DGn', DB1'~DBn' are sequentially applied to the data lines 521~52n, and emission control signals EC_Rm, EC_Gm, EC_Bm from the emission control signal generating circuit 590 for sequentially controlling the red, green and blue EL devices of the pixels Pm1'~Pmn' connected to the m^{th} gate line 51m are sequentially applied to the sequential control unit 550 through the emission control lines 591 a, 591 b, 591 c, respectively, when the scan signal is applied to the m^{th} gate line 51 m per each sub frame of one frame by repeating the above described actions. Accordingly, the thin film transistors M55_R, M55_G, M55_B are sequentially turned on, and driving currents corresponding to the red, green and blue data signals DR1'~DRn', DG1'~DGn', DB1'~DBn' are sequentially supplied to the red, green and blue EL devices so that the red, green and blue EL devices are time-divisionally driven.

[0073] Therefore, one frame is divided into three sub frames in the described exemplary embodiment, and an image is displayed by time-divisionally sequentially driving red, green and blue EL devices during the three sub frames. The image displayed using time-divisional driving of the EL devices is perceived by people as simultaneous driving of the EL devices since sequential driving time of the red, green and blue EL devices is very fast although the red, green and blue EL devices are time-divisionally driven.

[0074] Further, an organic electroluminescent display device according to the first exemplary embodiment of the present invention is capable of controlling white balance by controlling emission time of the red, green and blue EL devices, wherein the organic electroluminescent display device is capable of controlling white balance by controlling turn on times of the thin film transistors M55_R, M55_G, M55_B of the sequential control unit 550 of FIG. 8A and FIG. 8B, thereby controlling emission time of the red, green and blue EL devices.

[0075] In more detail, turn on times tr, tg, tb of the red, green and blue emission control signals EC_R1, EC_G1, EC_B1 generated from the emission control signal generating circuit 590 are controlled per each sub frame as illustrated in FIG. 10, and times for turning on the thin film transistors M55_R, M55_G, M55_B of the sequential control unit 550 are determined accordingly. Therefore, white balance is controlled by controlling emission times of the red, green and blue EL devices.

[0076] Although it is illustrated in FIG. 10 that white balance is achieved by relatively lengthening the turn on time tr of the red emission control signal EC_R1 as compared to the turn on times tg, tb of the green and blue emission control signals EC_G1, EC_B1, and shortening the turn on time tg of the green emission control signal EC_G1 as compared to the turn on time tb of the blue emission control signal EC_B, the present invention is not restricted to this. In fact, it is possible to control white balance by adjusting the turn on times of the red, green and blue emission control signals EC_R1, EC_G1, EC_B1 in various different combinations. Of course, the white balance control scheme of FIG. 10 is broadly applicable to all of the red, green and blue control signals EC_R, EC_G and EC_B for all of the pixels rather than being limited to EC_R1, EC_G1 and EC_B1.

[0077] As described above, in exemplary embodiments of the present invention, not only white balance is controlled by controlling red, green and blue emission times, but also the red, green and blue emission times may further be controlled to optimize brightness in the state that the red, green and blue emission times are primarily controlled so that white balance is controlled.

[0078] FIG. 11 illustrates a block structural view of an organic electroluminescent display device 60 having a pixel part 600, according to a second exemplary embodiment of the present invention. An organic electroluminescent display device of FIG. 11 has the similar structure and operation as the organic electroluminescent display device 50 of FIG. 4 except that two gate line driving circuits 510a, 510b and two emission control signal generating circuits 590a, 590b are arranged.

[0079] That is, it is constructed in such a way that scan signals are supplied to some of the gate lines from a first gate line driving circuit 510a, and scan signals are supplied to the rest of the gate lines from a second gate line driving circuit 510b, wherein the scan signals are applied to the upper part of the gate lines from the first gate line driving circuit 510a, and the scan signals are sequentially applied to the lower part of the gate lines from the second gate line driving circuit 510b. In further embodiments, the scan signals may be applied to even numbered gate lines from a first gate line driving circuit, and scan signals may be applied to odd numbered gate lines from a second gate line driving circuit so as to reduce density of the gate lines arranged in the pixel part. In such cases, each of the first and second gate line driving circuits 510a, 510b may have circuitry for generating only half the scan signals so as to save cost and space.

[0080] In the organic electroluminescent display device 60, scan signals may be substantially simultaneously supplied to the gate lines from the driving circuits 510a, 510b to reduce signal delay and/or to supply redundancy. To provide such signal delay reduction or redundancy capabilities, the first and second gate line driving circuits 510a, 510b may generate scan signals S11~S1m and scan signals S21~S2m, respectively, corresponding to all of the scan lines.

[0081] In the organic electroluminescent display device 60, emission control signals are supplied to some of the emission control lines from a first emission control signal generating circuit 590a, and emission control signals are supplied to the rest of the emission control lines from a second emission control signal generating circuit 590b, wherein the emission control signals are applied to the upper part of the emission control signal lines from the first emission control signal generating circuit 590a, and the emission control signals are sequentially applied to the lower part of the emission control signal lines from the second emission control signal generating circuit 590b. In further embodiments, the emission control signals may be applied to even numbered emission control lines from a first emission control signal generating circuit, and the emission control signals may be applied to odd numbered emission control lines from a second emission control signal generating circuit, so as to reduce density of emission control lines arranged in the pixel part. In such cases, each of the first and second emission control line generating circuits 590a, 590b may have circuitry for generating only half the emission control signals so as to save cost and space.

[0082] In the organic electroluminescent display device 60, emission control signals may be substantially simultaneously supplied to the emission control lines from the first and second emission control signal generating circuits 590a, 590b to reduce signal delay and/or to supply redundancy. To provide such signal delay reduction or redundancy capabilities, the first and second emission control generating circuits 590a, 590b may generate emission control signals EC_R.G,B11~EC_R,G, B1m and emission control signals EC_R,G,B21~EC_R, G,B2m, respectively, corresponding to all of the emission control lines.

[0083] FIG. 12 illustrates a block structural view of an organic electroluminescent display device 70 having a pixel part 700 according to a third exemplary embodiment of the present invention. The organic electroluminescent display device 70 of FIG. 12 has the similar structure and operation as the organic electroluminescent display device 60 of FIG. 11 except that arrangement positions of two gate line driving circuits 510a', 510b' and two emission control signal generating circuits 590a', 590b' are different from the corresponding circuits of FIG. 11. The first gate line driving circuit 510a' may generate scan signals S11'~S1m', and the second gate line driving circuit 510b' may generate scan signals S21'~S2m'. In other embodiments, the first and second gate line driving circuits 510a', 510b' may each generate only half of the scan signals so as to save cost and space.

[0084] The first emission control signal generating circuit 590a' may generate emission control signals EC_R, G, B11~EC_R, G, B1m', and the second emission control signal generating circuit 590b' may generate emission control signals EC_R, G, B21'~EC_R, G, B2m'. In other embodiments, the first and second emission control signal generating circuits may each generate only half of the emission control signals so as to save cost and space.

[0085] While it is shown in certain exemplary embodiments of the present invention that a plurality of gate line driving circuits and emission control signal generating circuits can be used in an organic electroluminescent display device, a plurality of data line driving circuits may also be used in other embodiments.

[0086] An organic electroluminescent display device according to the above described exemplary embodiments of the present invention enables high accuracy fineness by having a driving thin film transistor and a switching thin film transistor shared by red, green and blue EL devices so that the red, green and blue EL devices are time sharingly driven and improves opening ratio and yield by decreasing the number of elements and wirings. An organic electroluminescent display device according to the present invention also results in the reduction of RC delay and voltage drop (IR drop).

[0087] Further, an organic electroluminescent display device according to the present invention also enables controlling of white balance and brightness by controlling emission time of the red, green and blue EL devices.

Claims

1. A flat panel display device comprising:

a plurality of gate lines, data lines and power supply lines; and
a plurality of pixels, each said pixel connected to a corresponding said gate line, a corresponding said data line and a corresponding said power supply line,

wherein each of the pixels comprises
red, green and blue EL devices;
a first thin film transistor having of the source and the drain commonly coupled to the red, green and blue EL devices to time-divisionally drive the red, green and blue EL devices; and
second, third and fourth thin film transistors connected between the first thin film transistor and the red, green and blue EL devices, respectively, to control the red, green and blue EL devices so that the red, green and blue EL devices time-divisionally emit light inside one frame comprising a plurality of sub frames, in accordance with the sub frames.

2. The flat panel display device of claim 1, wherein each of the pixels further comprises:

a fifth thin film transistor having a gate connected to the corresponding said gate line, one of a source and a drain connected to the corresponding said data line and the other one of the source and the drain to a gate of the first thin film transistor;
and a capacitor connected between the gate and said one of the source and the drain of the first thin film transistor;

wherein
the first thin film transistor has one of a source and a drain connected to the corresponding said power supply line;
the second thin film transistor has one of a source and a drain connected to the other one of the source and the drain of the first thin film transistor, and a first emission control signal applied to a gate;
the third thin film transistor has one of a source and a drain connected to the other one of the source and the drain of the first thin film transistor, and a second emission control signal applied to a gate;
the fourth thin film transistor has one of a source and a drain connected to the other one of the source and the drain of the first thin film transistor, and a third emission control signal applied to a gate; and
wherein the red, green and blue EL devices have first electrodes connected to the other ones of the source and the drain of the second, third, and fourth thin film transistors, respectively, and second electrodes commonly connected to a reference voltage (Vss).

3. The flat panel display device of claim 1 further comprising:

at least one gate line driving circuit for supplying a plurality of scan signals to the gate lines;
at least one data line driving circuit for time-divisionally supplying red, green and blue data signals to the data lines; and
at least one emission control signal generating circuit for supplying emission control signals to the emission control lines.

4. The flat panel display device according to claim 3, wherein at least one of the gate line driving circuit, the data line driving circuit and the emission control signal generating circuit has a redundancy function.

5. A method for driving a flat panel display device according to one of the preceeding claims, the method comprising: time-divisionally supplying red, green and blue data during a plurality of sub display periods within a display period of time through a same data line to each said pixel, and sequentially driving said red, green and blue EL devices by controlling the conducting states of said second, third and fourth thin film transistors, respectively, so as to realize a certain color in the display period of time.

6. The method for driving a flat panel display device according to claim 5, the method further comprising the steps of:

generating scan signals at the corresponding said gate line within a sub display period of time in the display period of time, time-divisionally applying red, green and blue data to the corresponding said data line whenever the scan signals are generated so that red, green and blue driving currents are generated, and time-divisionally driving red, green and blue EL devices of the pixels connected to the corresponding said gate line using R, G and B emission control signals.

7. The driving method of the flat panel display device according to claim 6, wherein the display period of time includes three sub display periods of time, and the red, green and blue EL devices emit light one by one during the three sub display periods of time so that the red, green and blue EL devices time-divisionally emit light during the display period of time.

Patentansprüche

1. Eine Flachbildschirmvorrichtung, umfassend:

eine Mehrzahl von Gateleitungen, Datenleitungen und Stromversorgungsleitungen; und
eine Mehrzahl von Pixeln, wobei jedes besagte Pixel mit einer entsprechenden besagten Gateleitung, einer entsprechenden besagten Datenleitung und einer entsprechenden besagten Stromversorgungsleitung verbunden ist,

wobei jedes der Pixel umfasst
rote, grüne und blaue EL-Bauelemente;
einen ersten Dünnfilmtransistor, bei dem zur zeitgeteilten Ansteuerung der roten, grünen und blauen EL-Bauelemente ein aus der Source und dem Drain Gewähltes mit den roten, grünen und blauen EL-Bauelemente gemeinsam verschaltet ist; und
zweite, dritte und vierte Dünnfilmtransistoren, die zwischen dem ersten Dünnfilmtransistor und den roten, grünen beziehungsweise blauen EL-Bauelementen angeschlossen sind, um die roten, grünen und blauen EL-Bauelemente zu steuern, so dass die roten, grünen und blauen EL-Bauelemente zeitgeteilt innerhalb eines eine Mehrzahl von Unterbildern umfassenden Bildes entsprechend den Unterbildern Licht emittieren.

2. Die Flachbildschirmvorrichtung nach Anspruch 1, wobei jedes der Pixel ferner umfasst:

einen fünften Dünnfilmtransistor, bei dem ein Gate mit der entsprechenden besagten Gateleitung, ein aus einer Source und einem Drain Gewähltes mit der entsprechenden besagten Datenleitung und das Verbleibende aus der Source und dem Drain mit einem Gate des ersten Dünnfilmtransistors verbunden ist;
und einen Kondensator, der zwischen dem Gate und besagtem aus der Source und dem Drain Gewählten des ersten Dünnfilmtransistors angeschlossen ist;

wobei
bei dem ersten Dünnfilmtransistor ein aus einer Source und einem Drain Gewähltes mit der entsprechenden besagten Stromversorgungsleitung verbunden ist;
bei dem zweiten Dünnfilmtransistor ein aus einer Source und einem Drain Gewähltes mit dem Verbleibenden aus der Source und dem Drain des ersten Dünnfilmtransistors verbunden ist und ein erstes Emissionskontrollsignal an ein Gate angelegt ist;
bei dem dritten Dünnfilmtransistor ein aus einer Source und einem Drain Gewähltes mit dem Verbleibenden aus der Source und dem Drain des ersten Dünnfilmtransistors verbunden ist und ein zweites Emissionskontrollsignal an ein Gate angelegt ist;
bei dem vierten Dünnfilmtransistor ein aus einer Source und einem Drain Gewähltes mit dem Verbleibenden aus der Source und dem Drain des ersten Dünnfilmtransistors verbunden ist und ein drittes Emissionskontrollsignal an ein Gate angelegt ist; und
wobei bei den roten, grünen und blauen EL-Bauelementen erste Elektroden mit den Verbleibenden aus der Source und dem Drain der zweiten, dritten beziehungsweise vierten Dünnfilmtransistoren verbunden sind und zweite Elektroden gemeinsam mit einer Bezugsspannung (Vss) verbunden sind.

3. Die Flachbildschirmvorrichtung nach Anspruch 1, ferner umfassend:

mindestens eine Gateleitungsansteuerschaltung zum Liefern einer Mehrzahl von Abtastsignalen an die Gateleitungen;
mindestens eine Datenleitungsansteuerschaltung zum zeitgeteilten Liefern von Rot-, Grün- und Blau-Datensignalen an die Datenleitungen; und
mindestens eine Emissionssteuersignal-Erzeugungsschaltung zum Liefern von Emissionssteuersignalen an die Emissionssteuerleitungen.

4. Die Flachbildschirmvorrichtung nach Anspruch 3, wobei mindestens eine aus der Gateleitungsansteuerschaltung, der Datenleitungsansteuerschaltung und der Emissionssteuersignal-Erzeugungsschaltung Gewählte eine Redundanzfunktion aufweist.

5. Verfahren zum Ansteuern einer Flachbildschirmvorrichtung nach einem der vorhergehenden Ansprüche, wobei das Verfahren umfasst: zeitgeteiltes Liefern von Rot-, Grün- und Blau-Daten während einer Mehrzahl von Unteranzeigezeitabschnitten innerhalb eines Anzeigezeitabschnittes durch eine selbe Datenleitung zu jedem besagten Pixel und sequentielles Ansteuern besagter roter, grüner und blauer EL-Bauelemente durch Steuern der Durchlasszustände besagter zweiter, dritter beziehungsweise vierter Dünnfilmtransistoren, um eine bestimmte Farbe in dem Anzeigezeitabschnitt hervorzubringen.

6. Das Verfahren zum Ansteuern einer Flachbildschirmvorrichtung nach Anspruch 5, wobei das Verfahren ferner die folgenden Schritte umfasst:

Erzeugen von Abtastsignalen an den entsprechenden besagten Gateleitungen innerhalb eines Unteranzeigezeitabschnittes in dem Anzeigezeitabschnitt, wobei jedesmal, wenn die Abtastsignale erzeugt werden, zeitgeteilt Rot-, Grün- und Blau-Daten an die entsprechende Datenleitung angelegt werden, so dass Rot-, Grün- und Blau-Ansteuerströme erzeugt werden, und zeitgeteiltes Ansteuern roter, grüner und blauer EL-Bauelemente der mit den entsprechenden besagten Gateleitungen verbundenen Pixel unter Verwendung von R-, G- und B-Emissionssteuersignalen.

7. Verfahren zum Ansteuern einer Flachbildschirmvorrichtung nach Anspruch 6, wobei der Anzeigezeitabschnitt drei Unteranzeigezeitabschnitte beinhaltet und die roten, grünen und blauen EL-Bauelemente während der drei Unteranzeigezeitabschnitte nacheinander Licht emittieren, so dass die roten, grünen und blauen EL-Bauelemente während des Anzeigezeitabschnittes zeitgeteilt Licht emittieren.

Revendications

1. Dispositif d'affichage à panneau plat comprenant :

une pluralité de lignes de porte, de lignes de données et de lignes d'alimentation en puissance ; et
une pluralité de pixels, chaque dit pixel étant relié à une dite ligne de porte correspondante, une dite ligne de données correspondante et une dite ligne d'alimentation en puissance correspondante ;

dans lequel chacun des pixels comporte :

des dispositifs EL rouges, verts et bleus ;
un premier transistor à couche mince ayant l'un parmi la source et le drain relié de façon commune aux dispositifs EL rouges, verts et bleus pour entraîner de façon divisionnelle dans le temps les dispositifs EL rouges, verts et bleus ; et
un deuxième, un troisième et un quatrième transistor à couche mince reliés respectivement entre le premier transistor à couche mince et les dispositifs EL rouges, verts et bleus, pour commander les dispositifs EL rouges, verts et bleus de sorte que les dispositifs EL rouges, verts et bleus émettent de la lumière de façon divisionnelle dans le temps à l'intérieur d'un cadre comprenant une pluralité de cadres secondaires, selon les cadres secondaires.

2. Dispositif d'affichage à panneau plat selon la revendication 1, dans lequel chacun des pixels comporte de plus :

un cinquième transistor à couche mince ayant une porte reliée à ladite ligne de porte correspondante, l'un parmi une source et un drain étant relié à la ligne de données correspondante et l'autre parmi la source et le drain à une porte du premier transistor à couche mince ;
et un condensateur relié entre la porte et ledit un parmi la source et le drain du premier transistor à couche mince ;

dans lequel
le premier transistor à couche mince a l'un parmi une source et un drain relié à la ligne d'alimentation en puissance correspondante ;
le deuxième transistor à couche mince a l'un parmi une source et un drain relié à l'autre parmi la source et le drain du premier transistor à couche mince, et un premier signal de commande d'émission appliqué à une porte ;
le troisième transistor à couche mince a l'un parmi une source et un drain relié à l'autre parmi la source et le drain du premier transistor à couche mince, et un deuxième signal de commande d'émission appliqué à une porte ;
le quatrième transistor à couche mince a l'un parmi une source et un drain relié à l' autre parmi la source et le drain du premier transistor à couche mince, et un troisième signal de commande d'émission appliqué à une porte ; et
dans lequel les dispositifs EL rouges, verts et bleus ont des premières électrodes reliées respectivement aux autres de la source et du drain des deuxième, troisième, et quatrième transistors de la couche mince, et des deuxièmes électrodes reliées de façon commune à une tension de référence (Vss).

3. Dispositif d'affichage à panneau plat selon la revendication 1 comprenant de plus :

au moins un circuit d'entraînement de ligne de porte destiné à fournir une pluralité de signaux de balayage aux lignes de porte ;
au moins un circuit d'entraînement de ligne de données destiné à fournir de façon divisionnelle dans le temps des signaux de données rouges, vertes et bleues aux lignes de données ; et
au moins un circuit de production de signaux de commande d'émission destiné à fournir des signaux de commande d'émission aux lignes de commande d'émission.

4. Dispositif d'affichage à panneau plat selon la revendication 3, dans lequel au moins l'un parmi le circuit d'entraînement de ligne de porte, le circuit d'entraînement de ligne de données et le circuit de production de signaux de commande d'émission possède une fonction de redondance.

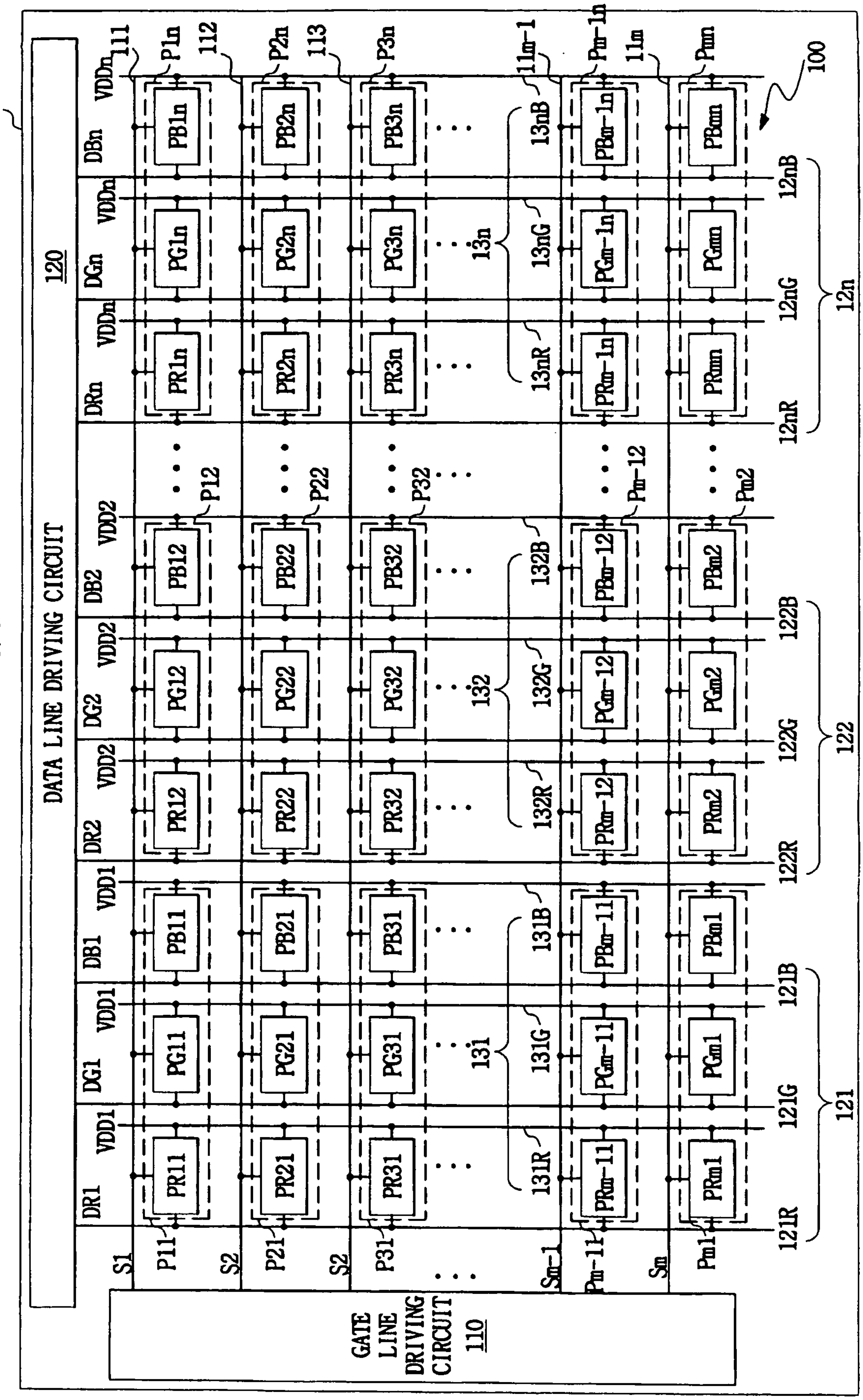
5. Procédé destiné à entraîner un dispositif d'affichage à panneau plat selon l'une des revendications précédentes, le procédé comprenant : une fourniture de façon divisionnelle dans le temps de données rouges, vertes et bleues pendant une pluralité de périodes d'affichage secondaires au cours d'une période de temps d'affichage par l'intermédiaire d'une même ligne de données à chaque dit pixel et un entraînement de façon séquentielle desdits dispositifs EL rouges, verts et bleus en commandant respectivement les états passants desdits deuxième, troisième et quatrième transistors à couche mince, afin de réaliser une certaine couleur dans la période de temps d'affichage.

6. Procédé destiné à entraîner un dispositif d'affichage à panneau plat selon la revendication 5, le procédé comprenant de plus les étapes :

de production de signaux de balayage à ladite ligne de porte correspondante avec une période de temps d'affichage secondaire dans la période de temps d'affichage, d'application de façon divisionnelle dans le temps de données rouges, vertes et bleues à ladite ligne de données correspondante à chaque fois que les signaux de balayage sont produits de sorte que des courants d'entraînement rouges, verts et bleus soient produits, et d'entraînement de façon divisionnelle dans le temps de dispositifs EL rouges, verts et bleus des pixels reliés à ladite ligne de porte correspondante en utilisant des signaux de commande d'émission R, G et B.

7. Procédé d'entraînement du dispositif d'affichage à panneau plat selon la revendication 6, dans lequel la période de temps d'affichage comporte trois périodes de temps d'affichage secondaires, et les dispositifs EL rouges, verts et bleus émettent de la lumière un par un pendant les trois périodes de temps d'affichage secondaires de sorte que les dispositifs EL rouges, verts et bleus émettent de la lumière de façon divisionnelle dans le temps pendant la période de temps d'affichage.

FIG. 1



10
DATA LINE DRIVING CIRCUIT
120
GATE LINE DRIVING CIRCUIT
110
100

FIG.2

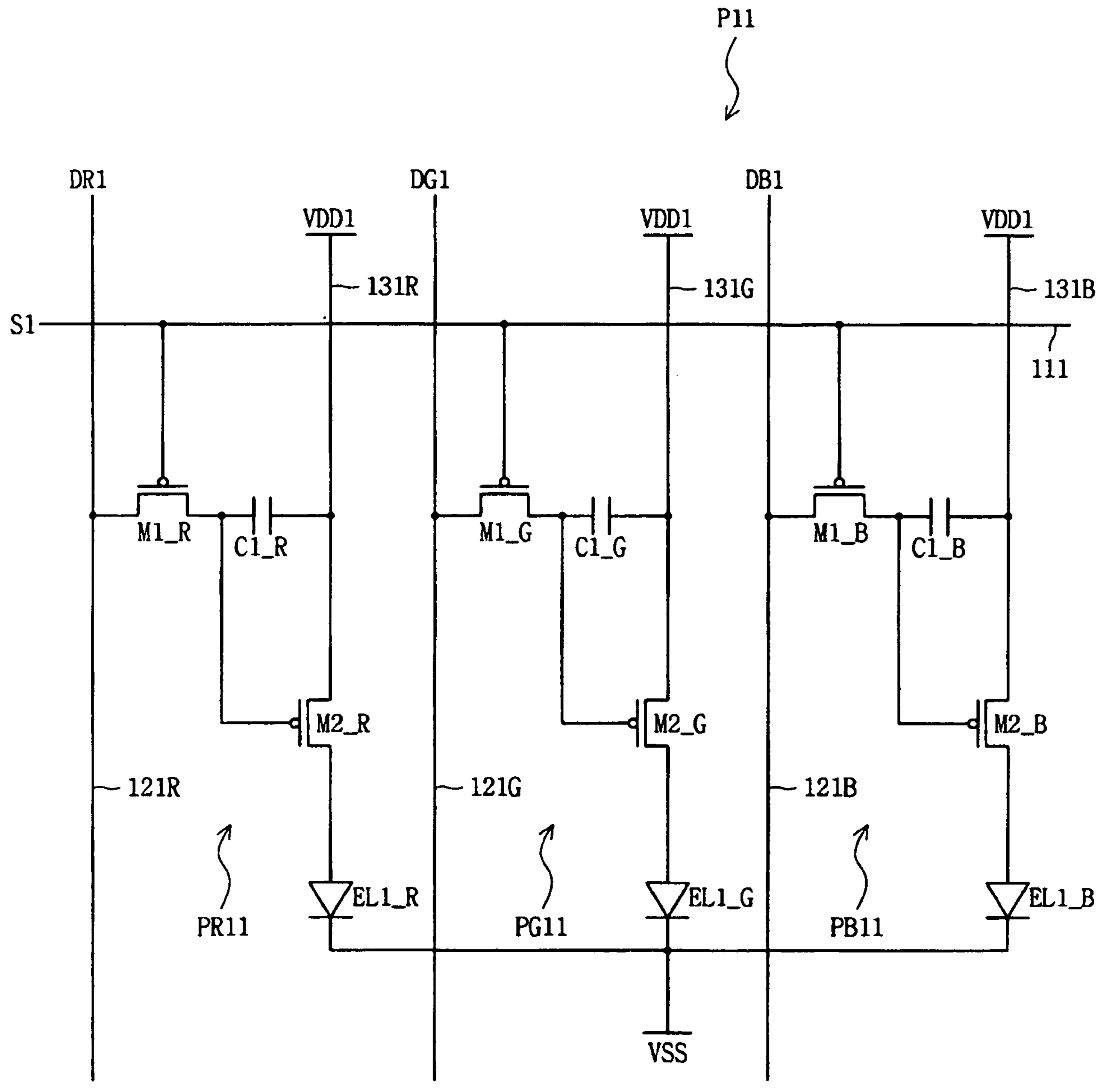

P11
DR1
DG1
DB1
VDD1
VDD1
VDD1
131R
131G
131B
S1
111
M1_R
C1_R
M1_G
C1_G
M1_B
C1_B
M2_R
M2_G
M2_B
121R
121G
121B
EL1_R
EL1_G
EL1_B
PR11
PG11
PB11
VSS

FIG.3

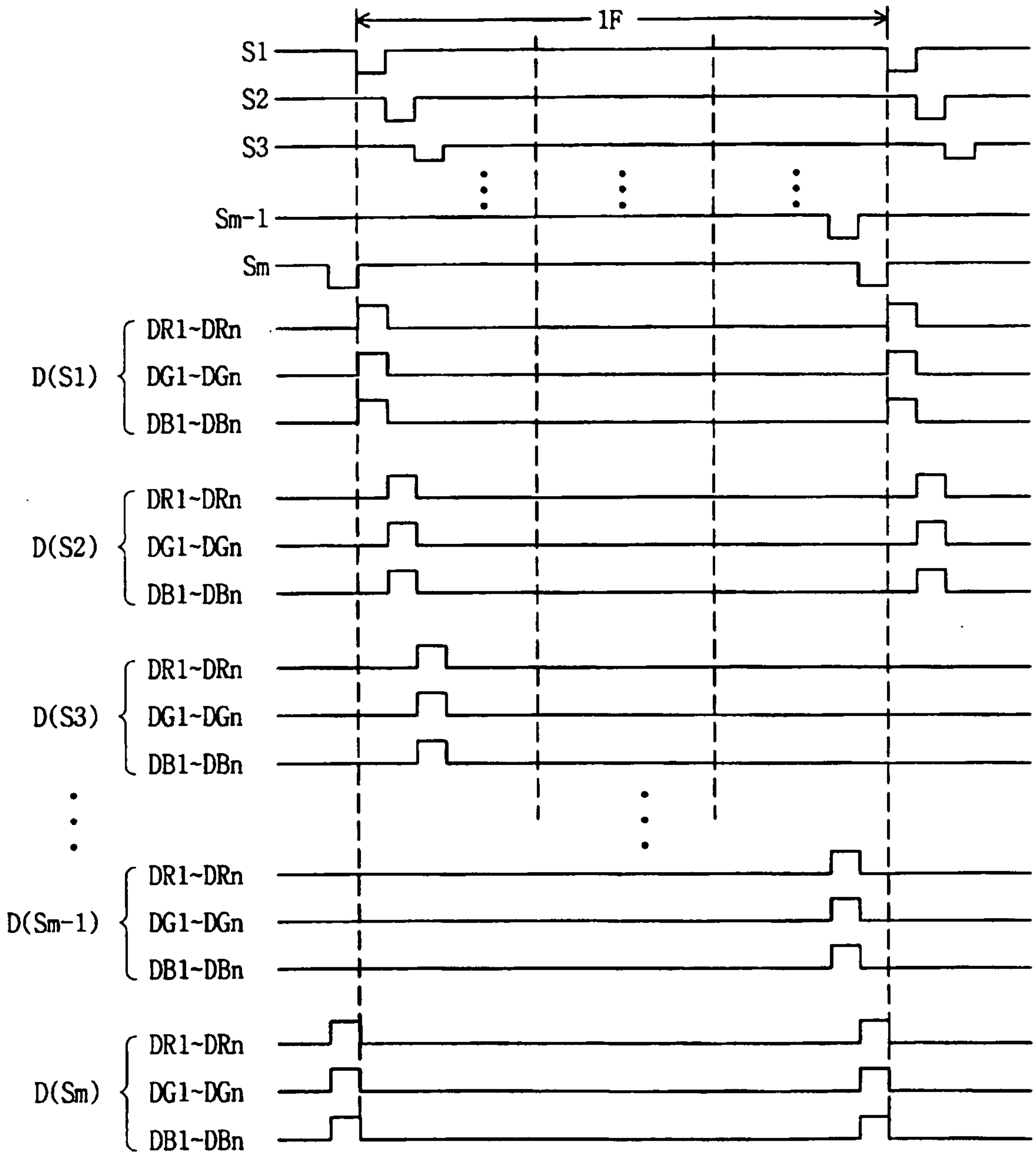

1F
S1
S2
S3
Sm-1
Sm
D(S1)
DR1~DRn
DG1~DGn
DB1~DBn
D(S2)
DR1~DRn
DG1~DGn
DB1~DBn
D(S3)
DR1~DRn
DG1~DGn
DB1~DBn
D(Sm-1)
DR1~DRn
DG1~DGn
DB1~DBn
D(Sm)
DR1~DRn
DG1~DGn
DB1~DBn

FIG. 4

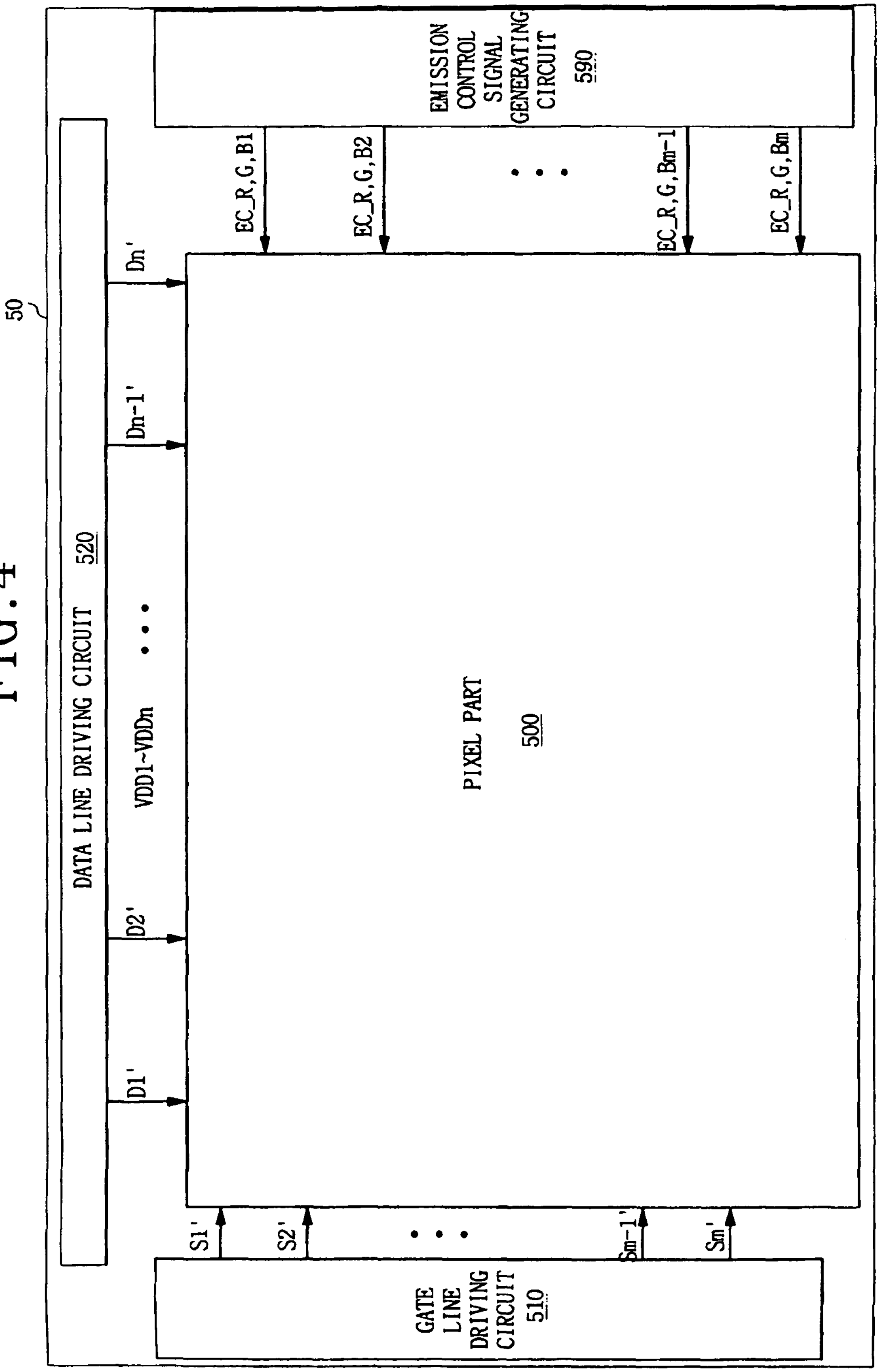

50
DATA LINE DRIVING CIRCUIT 520
VDD1~VDDn
D1'
D2'
Dn-1'
Dn'
EMISSION CONTROL SIGNAL GENERATING CIRCUIT 590
EC_R,G,B1
EC_R,G,B2
EC_R,G,Bm-1
EC_R,G,Bm
PIXEL PART 500
GATE LINE DRIVING CIRCUIT 510
S1'
S2'
Sm-1'
Sm'

FIG.5A

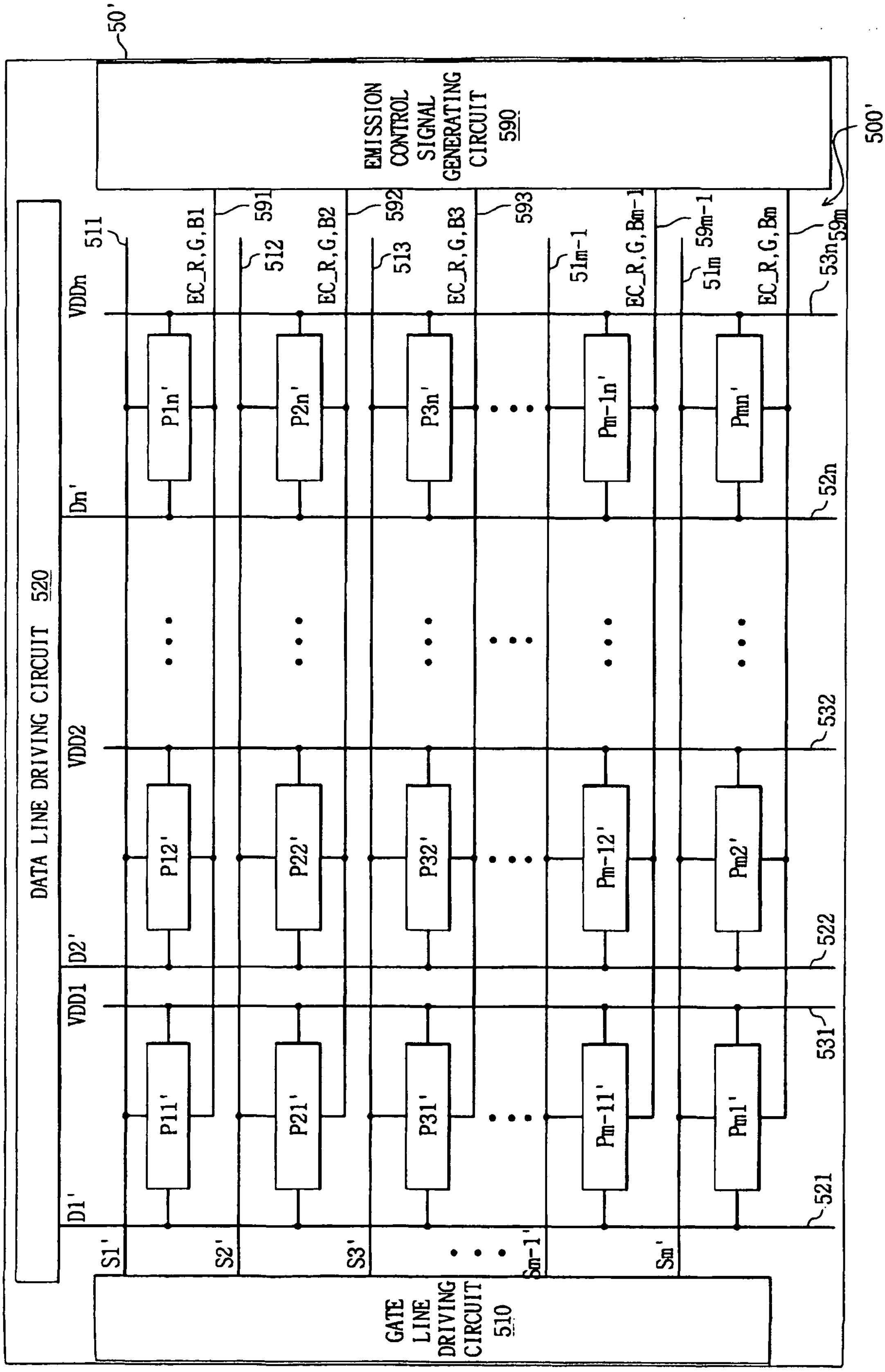

50'
500'
EMISSION CONTROL SIGNAL GENERATING CIRCUIT 590
DATA LINE DRIVING CIRCUIT 520
GATE LINE DRIVING CIRCUIT 510
D1'
D2'
Dn'
VDD1
VDD2
VDDn
S1'
S2'
S3'
Sm-1'
Sm'
EC_R,G,B1
EC_R,G,B2
EC_R,G,B3
EC_R,G,Bm-1
EC_R,G,Bm
511
512
513
51m-1
51m
591
592
593
59m-1
59m
521
522
531
532
52n
53n
P11'
P21'
P31'
Pm-11'
Pm1'
P12'
P22'
P32'
Pm-12'
Pm2'
P1n'
P2n'
P3n'
Pm-1n'
Pmn'

FIG.5B

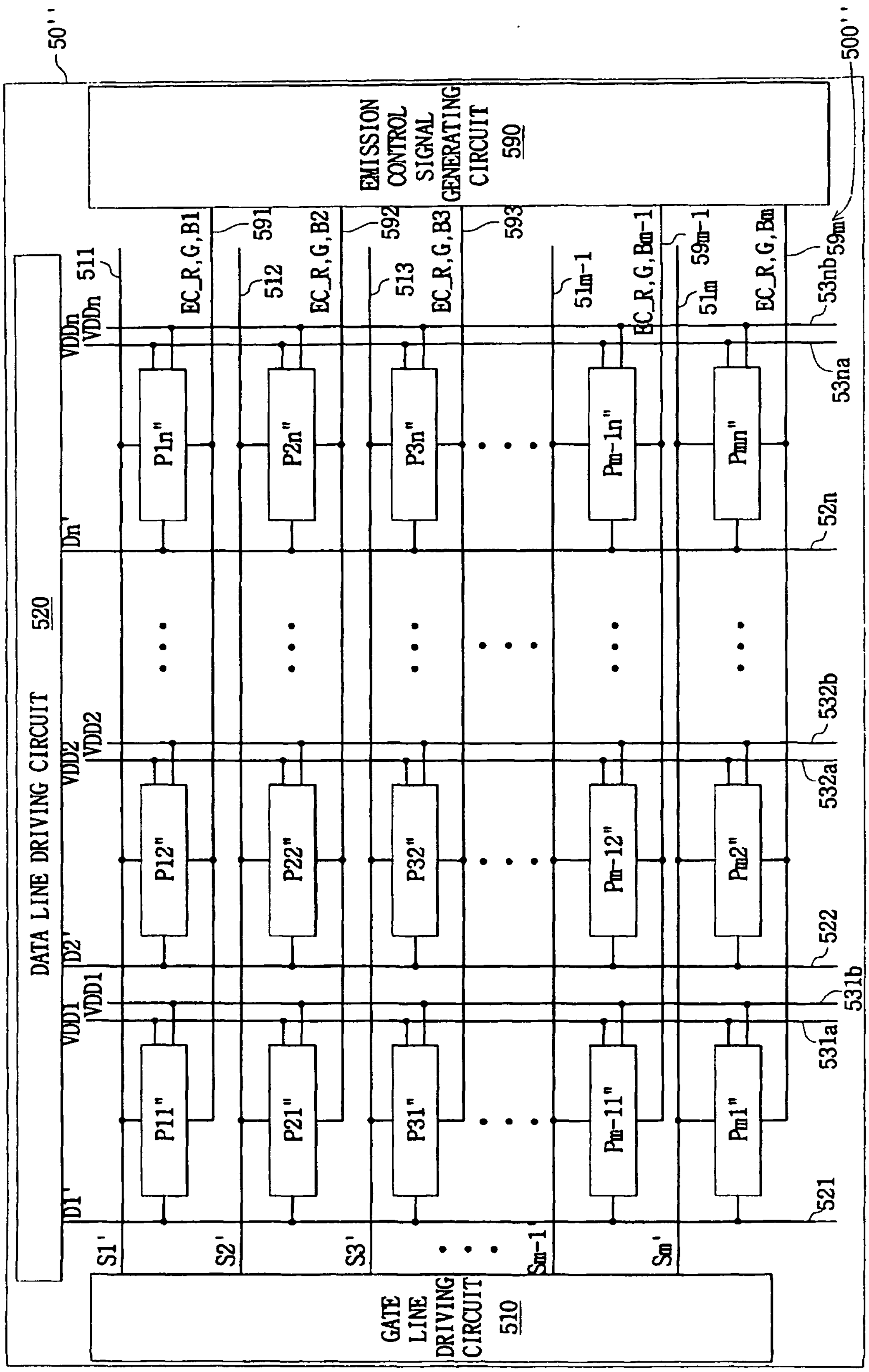

50''
500''
EMISSION CONTROL SIGNAL GENERATING CIRCUIT 590
DATA LINE DRIVING CIRCUIT 520
GATE LINE DRIVING CIRCUIT 510
EC_R,G,B1
EC_R,G,B2
EC_R,G,B3
EC_R,G,Bm-1
EC_R,G,Bm
591
592
593
59m-1
59m
511
512
513
51m-1
51m
VDDn
VDD2
VDD1
Dn'
D2'
D1'
S1'
S2'
S3'
Sm-1
Sm'
P1n"
P2n"
P3n"
Pm-1n"
Pmn"
P12"
P22"
P32"
Pm-12"
Pm2"
P11"
P21"
P31"
Pm-11"
Pm1"
53nb
53na
52n
532b
532a
522
531b
531a
521

FIG.6

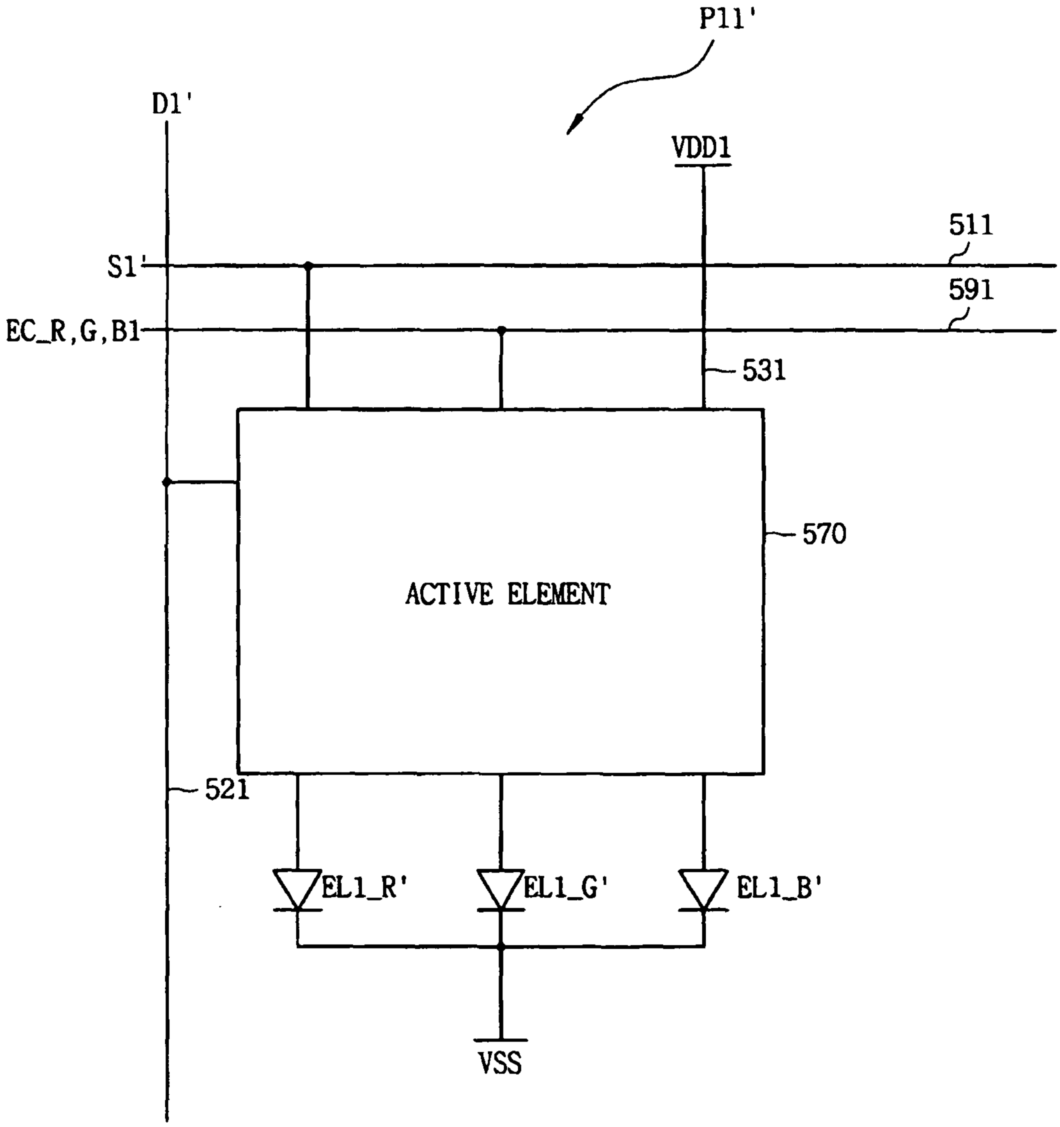

P11'
D1'
VDD1
511
S1'
591
EC_R,G,B1
531
570
ACTIVE ELEMENT
521
EL1_R'
EL1_G'
EL1_B'
VSS

FIG.7A

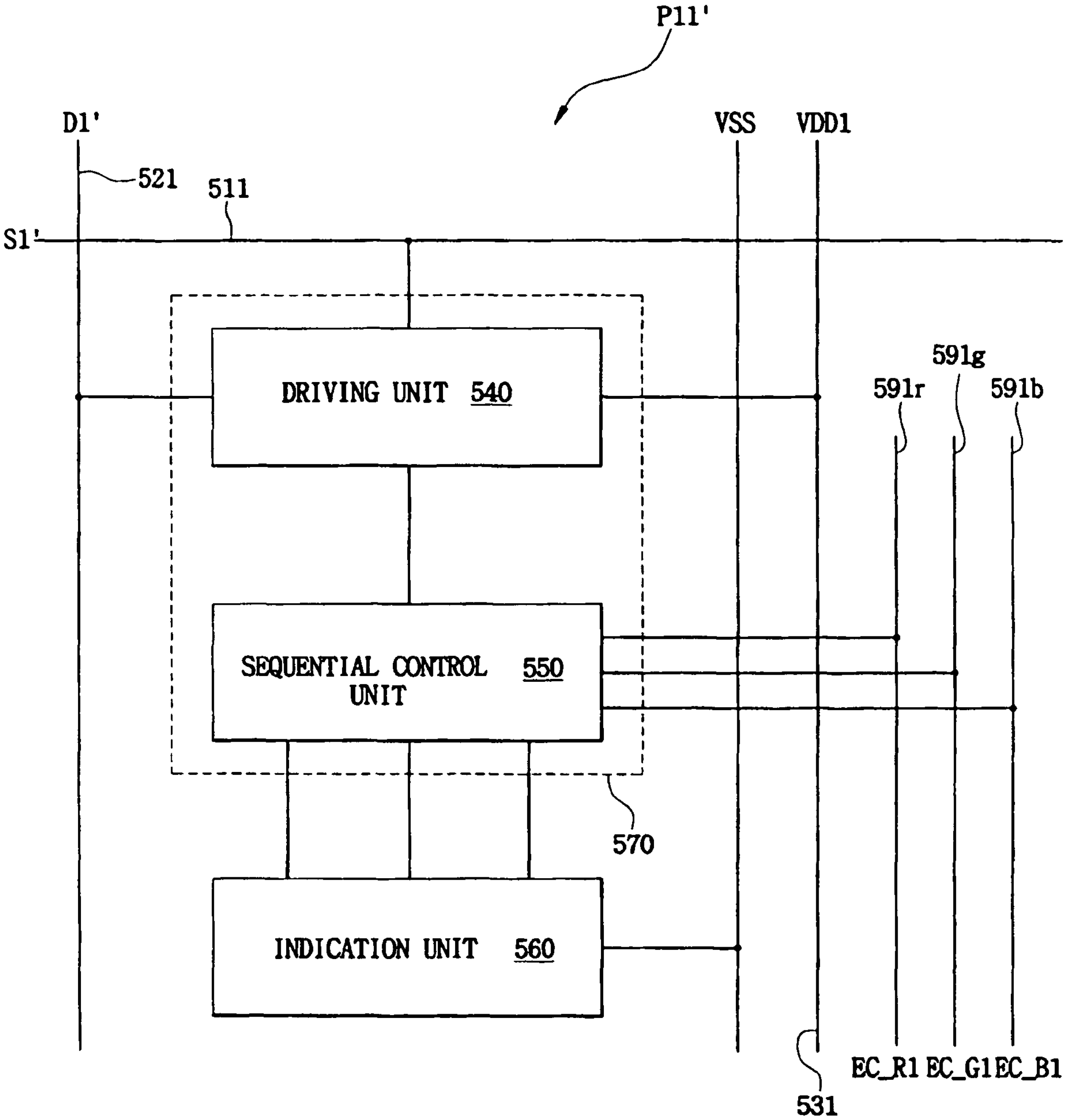

P11'
D1'
521
511
S1'
VSS
VDD1
DRIVING UNIT 540
591g
591r
591b
SEQUENTIAL CONTROL UNIT 550
570
INDICATION UNIT 560
531
EC_R1 EC_G1 EC_B1

FIG.7B

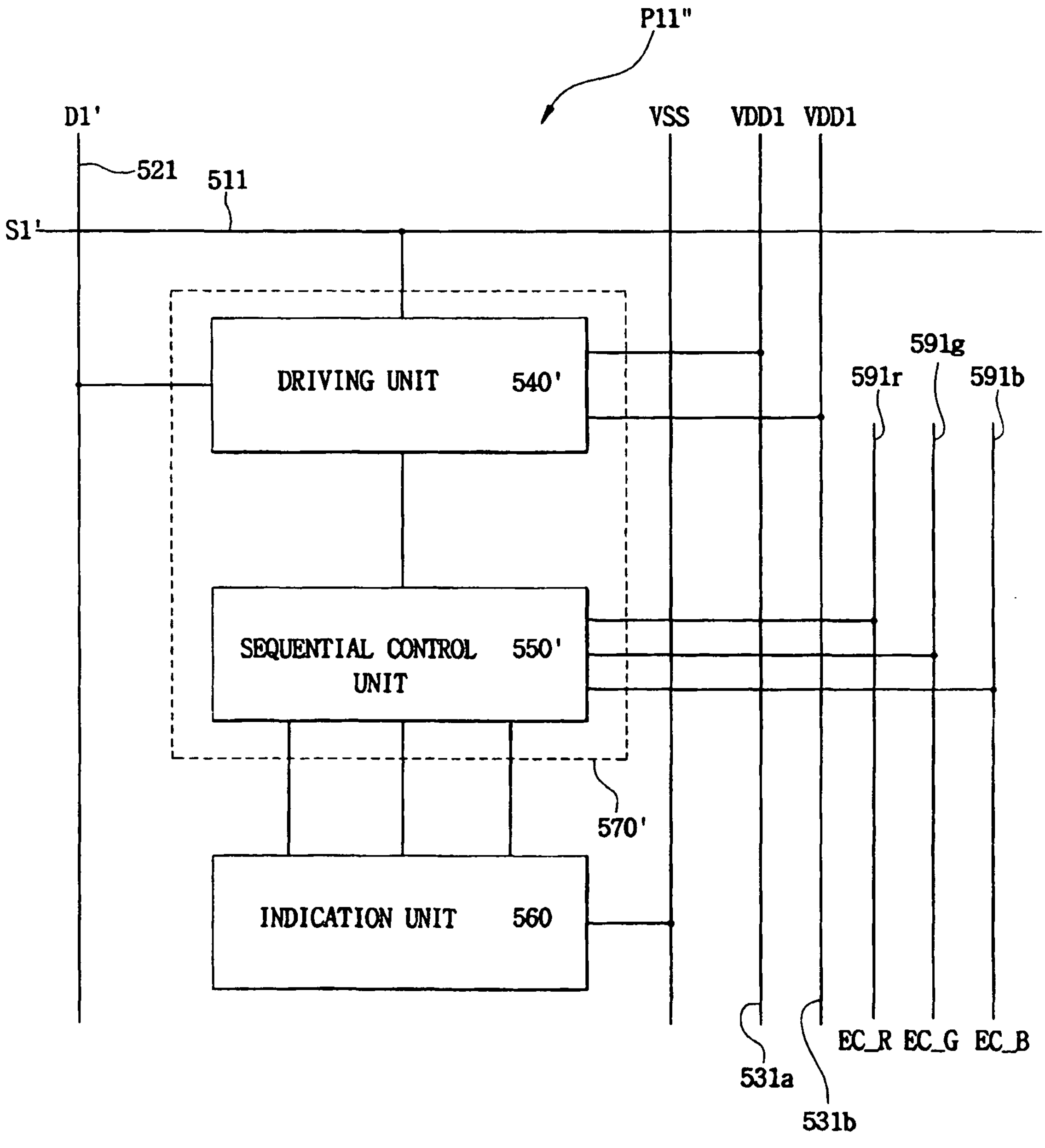

P11"
D1'
VSS
VDD1
VDD1
521
511
S1'
DRIVING UNIT
540'
591g
591r
591b
SEQUENTIAL CONTROL UNIT
550'
570'
INDICATION UNIT
560
EC_R
EC_G
EC_B
531a
531b

FIG.8A

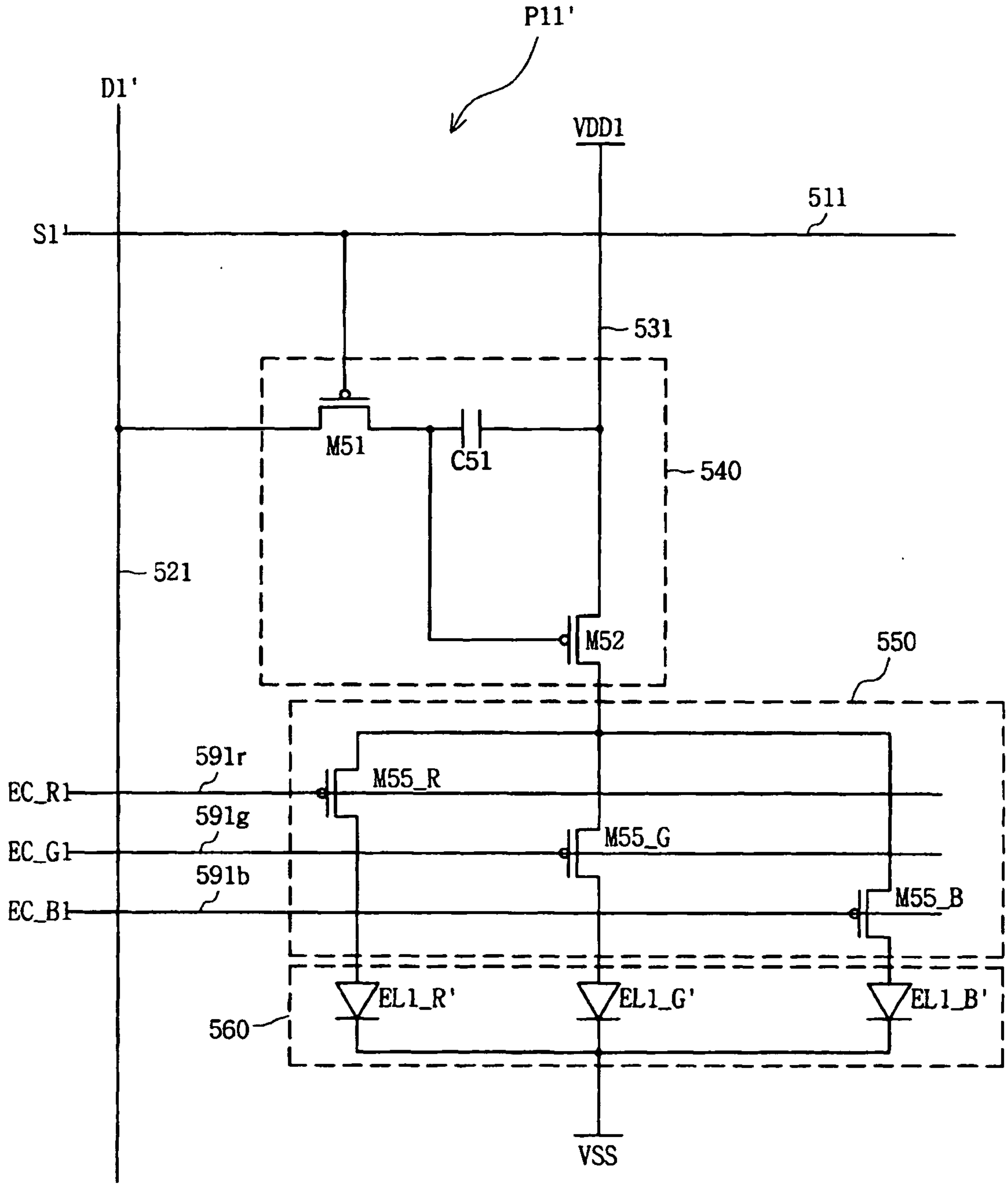

P11'
D1'
VDD1
511
S1'
531
M51
C51
540
521
M52
550
591r
EC_R1
M55_R
591g
EC_G1
M55_G
591b
EC_B1
M55_B
560
EL1_R'
EL1_G'
EL1_B'
VSS

FIG.8B

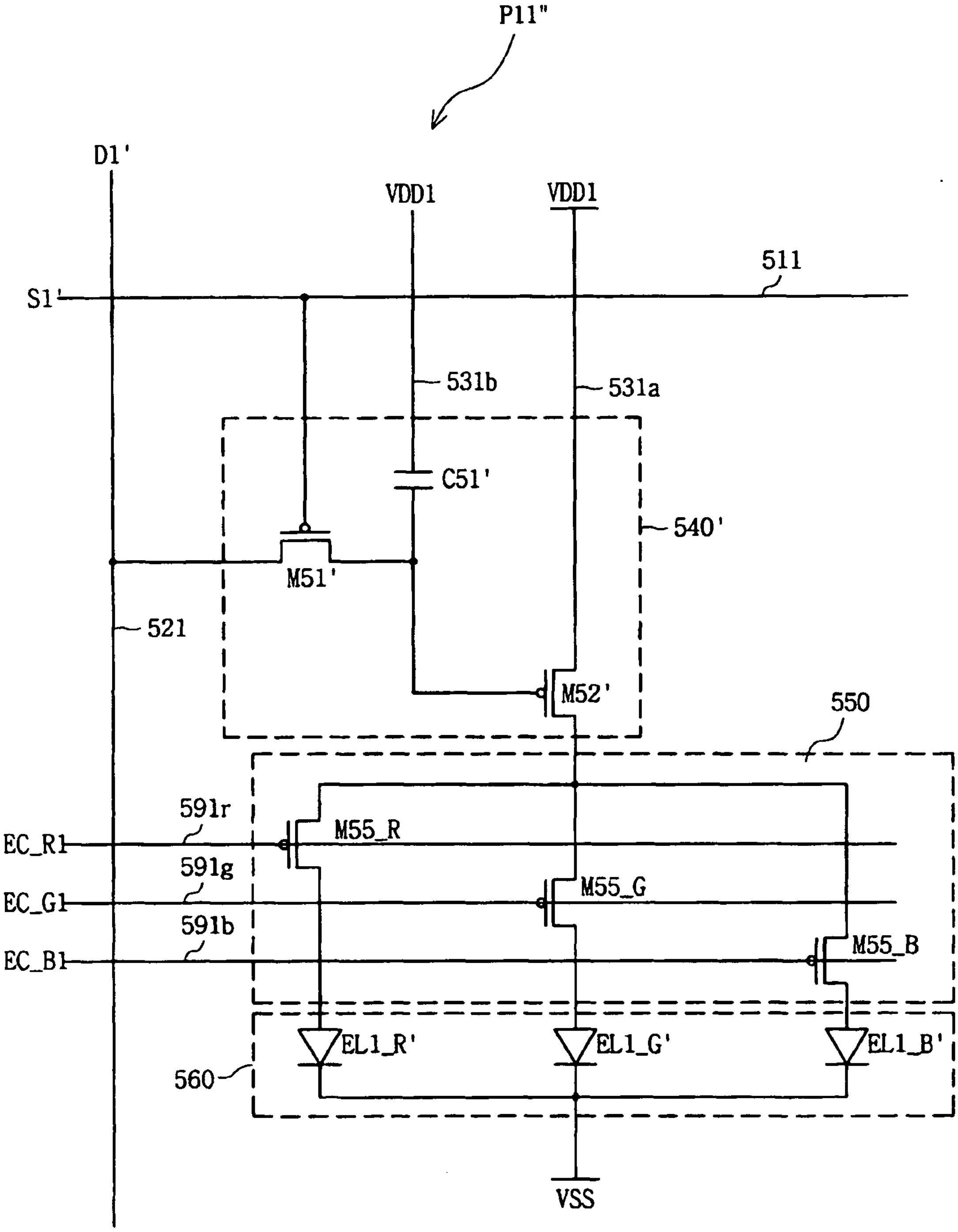

P11"
D1'
VDD1
VDD1
511
S1'
531b
531a
C51'
540'
M51'
521
M52'
550
591r
M55_R
EC_R1
591g
M55_G
EC_G1
591b
M55_B
EC_B1
EL1_R'
EL1_G'
EL1_B'
560
VSS

FIG.9

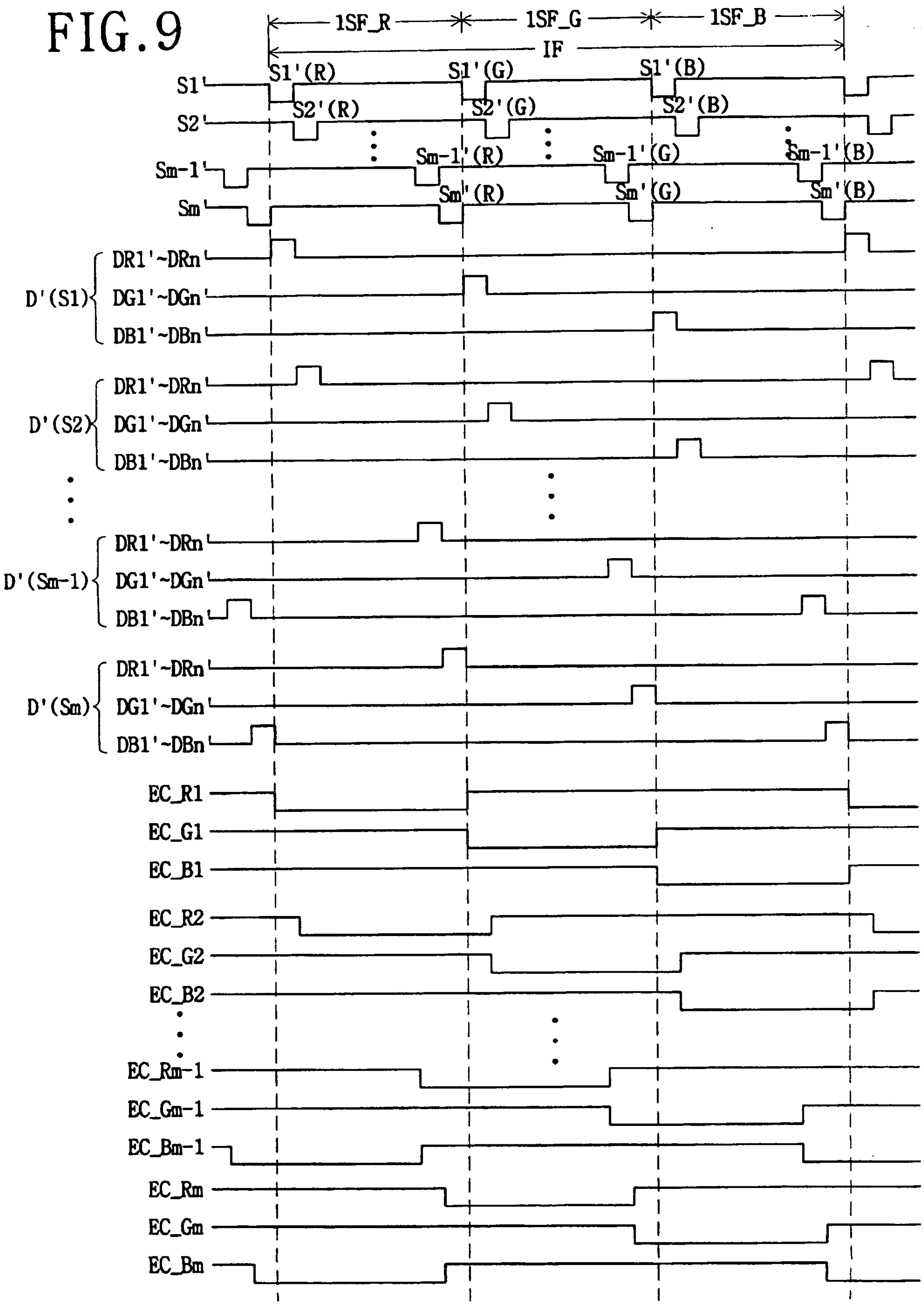

1SF_R
1SF_G
1SF_B
IF
S1'(R)
S1'(G)
S1'(B)
S2'(R)
S2'(G)
S2'(B)
Sm-1'(R)
Sm-1'(G)
Sm-1'(B)
Sm'(R)
Sm'(G)
Sm'(B)
S1
S2
Sm-1
Sm
D'(S1)
D'(S2)
D'(Sm-1)
D'(Sm)
DR1'~DRn
DG1'~DGn
DB1'~DBn
EC_R1
EC_G1
EC_B1
EC_R2
EC_G2
EC_B2
EC_Rm-1
EC_Gm-1
EC_Bm-1
EC_Rm
EC_Gm
EC_Bm

FIG. 10

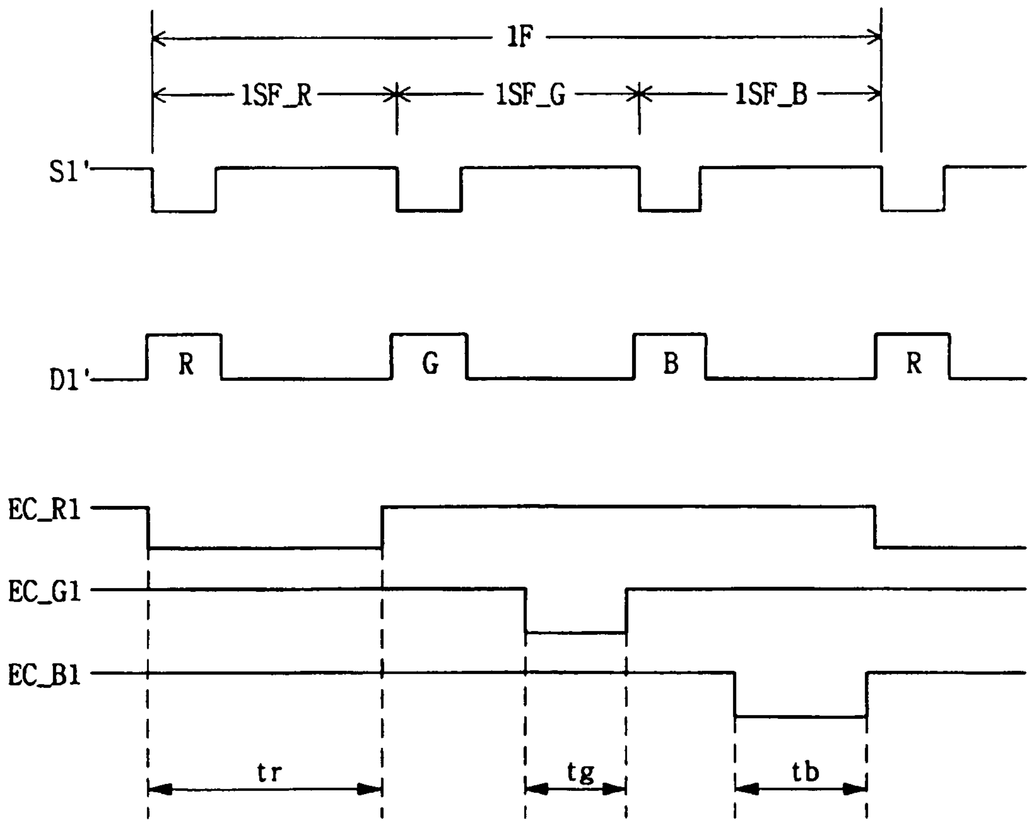


FIG. 11

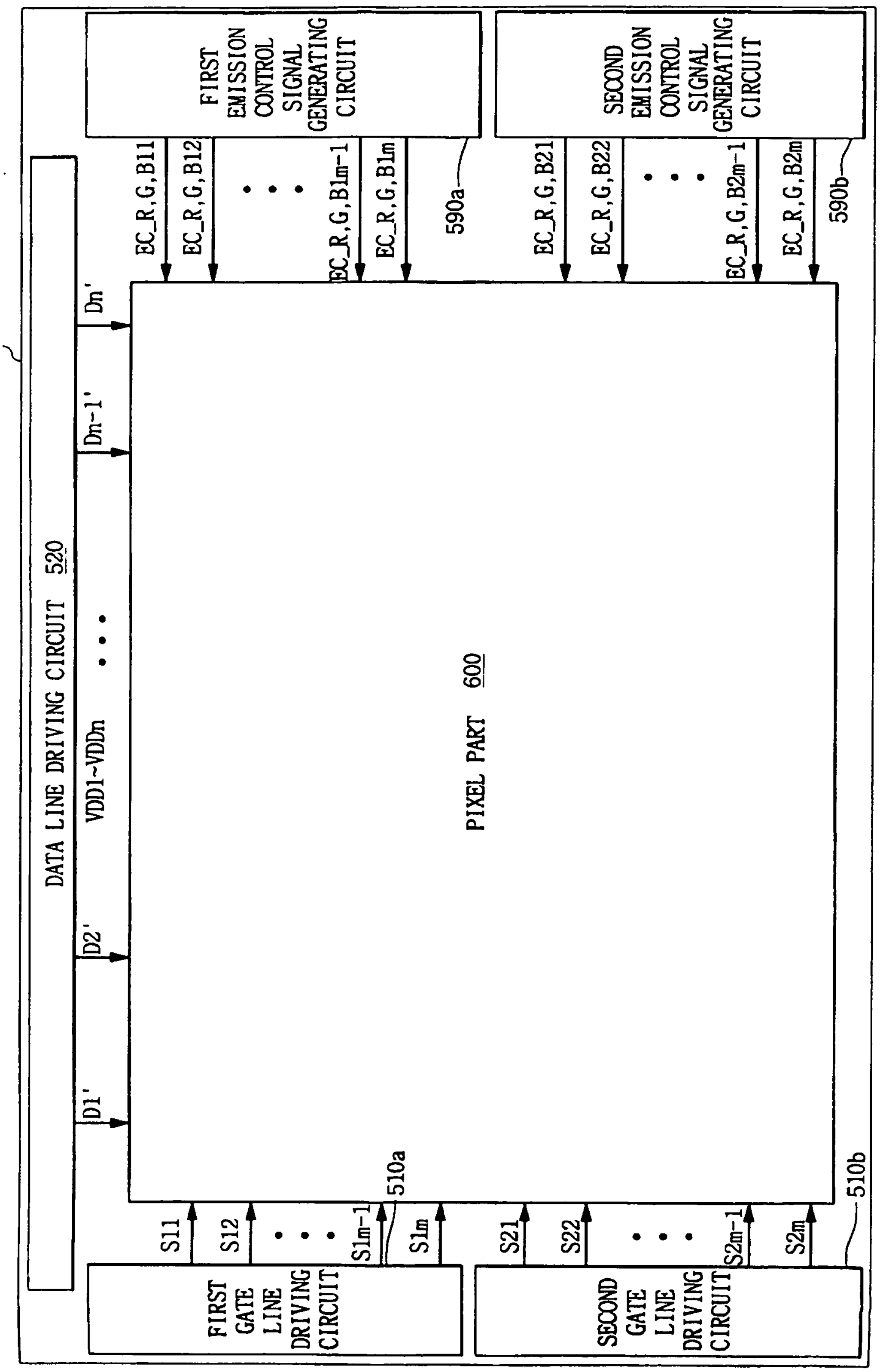
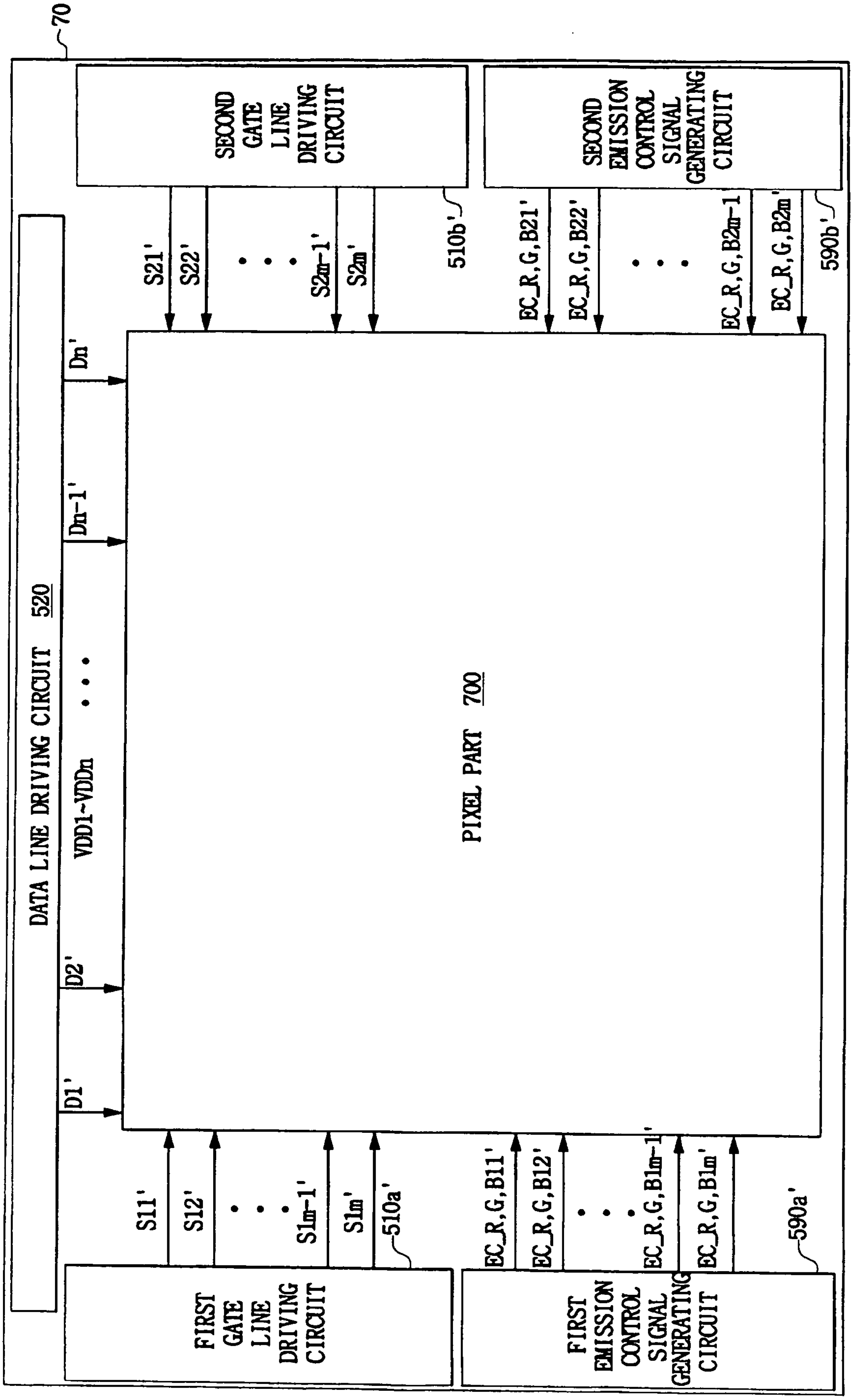

60
DATA LINE DRIVING CIRCUIT 520
VDD1~VDDn
D1'
D2'
Dn-1'
Dn'
FIRST EMISSION CONTROL SIGNAL GENERATING CIRCUIT
SECOND EMISSION CONTROL SIGNAL GENERATING CIRCUIT
EC_R,G,B11
EC_R,G,B12
EC_R,G,B1m-1
EC_R,G,B1m
590a
EC_R,G,B21
EC_R,G,B22
EC_R,G,B2m-1
EC_R,G,B2m
590b
PIXEL PART 600
FIRST GATE LINE DRIVING CIRCUIT
SECOND GATE LINE DRIVING CIRCUIT
S11
S12
S1m-1
S1m
510a
S21
S22
S2m-1
S2m
510b

FIG. 12


70
SECOND GATE LINE DRIVING CIRCUIT
510b'
SECOND EMISSION CONTROL SIGNAL GENERATING CIRCUIT
590b'
S21'
S22'
S2m-1'
S2m'
EC_R,G,B21'
EC_R,G,B22'
EC_R,G,B2m-1'
EC_R,G,B2m'
DATA LINE DRIVING CIRCUIT 520
VDD1~VDDn
D1'
D2'
Dn-1'
Dn'
PIXEL PART 700
S11'
S12'
S1m-1'
S1m'
510a'
EC_R,G,B11'
EC_R,G,B12'
EC_R,G,B1m-1'
EC_R,G,B1m'
590a'
FIRST GATE LINE DRIVING CIRCUIT
FIRST EMISSION CONTROL SIGNAL GENERATING CIRCUIT

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 0762374 A1 **[0002]**

patsnap

专利名称(译)	用于OLED显示器中的时分驱动子像素的像素电路		
公开(公告)号	EP1531452B1	公开(公告)日	2007-07-25
申请号	EP2004090400	申请日	2004-10-18
[标]申请(专利权)人(译)	三星斯笛爱股份有限公司		
申请(专利权)人(译)	三星SDI CO.，LTD.		
当前申请(专利权)人(译)	三星SDI CO.，LTD.		
[标]发明人	KWAK WON KYU LEE KWAN HEE KIM KEUM NAM		
发明人	KWAK, WON-KYU LEE, KWAN-HEE KIM, KEUM-NAM		
IPC分类号	G09G3/32 H01L51/50 G09G3/20 G09G3/22 G09G3/28 G09G3/296 G09G3/30 H04N5/66		
CPC分类号	G09G3/3233 G09G2300/0452 G09G2300/0804 G09G2300/0814 G09G2300/0842 G09G2300/0861 G09G2310/0235 G09G2320/0606 G09G2320/0666		
代理机构(译)	hengelhaupt，Jürgen		
优先权	1020030080737 2003-11-14 KR		
其他公开文献	EP1531452A8 EP1531452A1		
外部链接	Espacenet		

摘要(译)

一种用于在显示时间段期间实现特定颜色的显示装置的像素电路。像素电路包括至少两个发光元件，每个所述发光元件用于在显示时间段期间发射对应的一种颜色。有源元件通常连接到所述至少两个发光元件以驱动所述至少两个发光元件。有源元件在显示时间段期间时分地驱动所述至少两个发光元件，使得每个所述发光元件在每个子显示时间段内发射相应的颜色。所述至少两个发光元件通过分时发射对应的颜色来在显示时间段中实现特定颜色，每个对应的一个颜色在每个子显示时间段内发出。

FIG.1