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(54) Driving circuit for active matrix type display, drive method of electronic equipment and electronic apparatus

Steuerschaltung für eine Anzeige mit aktiver Matrix, Steuerverfahren für elektronische Apparatur und elektronisches Gerät

Circuit de commande pour un dispositif d'affichage à matrice active, méthode de commande d'un équipement et d'un appareil électronique

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EP 2 306 444 B1

Description

[0001] The present invention relates to a driving circuit for an active matrix type display using an electro-optical element such as an organic electroluminescence element (hereinafter referred to as "organic electroluminescence element "), and the like, to a driving method of electronic device and an electronic apparatus, and to the electronic device. More particularly, the present invention relates to a driving circuit having a function for applying reverse bias to an electro-optical element to suppress the deterioration thereof, to a driving method of electronic device and an electronic apparatus, and to the electronic device.

[0002] It has been known that a display can be realized by arranging a plurality of pixels in matrix that comprise an organic electroluminescence element which is one of electro-optical elements. The organic electroluminescence element is arranged such that a laminated organic thin film including a light emitting layer is interposed between a cathode formed of a metal electrode, for example, Mg, Ag, Al, Li, and the like and an anode formed of a transparent electrode composed of ITO (indium tin oxide).

[0003] FIG. 8 shows an ordinary arrangement of a driving circuit for an active matrix type display using an organic electroluminescence element. In this figure, the organic electroluminescence element is shown as a diode 10. Further, the driving circuit 1 is composed of two transistors Tr1 and Tr2 each composed of a thin film transistor (TFT) and a capacitance element 2 for accumulating electric charge.

[0004] Herein both the transistors Tr1 and Tr2 are p-channel type TFTs. The transistor Tr1 is controlled to be turned on and off according to the electric charge accumulated in the capacitance element 2 in the figure. The capacitance element 2 is charged by a data line V_{DATA} through the transistor Tr2 that is turned on by setting a selection potential V_{SEL} to a low level. When the transistor Tr1 is turned on, a current flows to the organic electroluminescence element 10 through the transistor Tr1. The continuous flow of the current to the organic electroluminescence element 10 permits the same to emit light continuously.

[0005] FIG. 9 shows a brief timing chart as to the circuit of FIG. 8. As shown in FIG. 9, when data is to be written, the transistor Tr2 is turned on by setting the selection potential V_{SEL} to the low level, whereby the capacitance element 2 is charged. This charge period is a writing period T_w in the figure. An actual display period follows the writing period T_w. In this period, the transistor Tr1 is turned on by the electric charge accumulated in the capacitance element 2. This period is shown as a display period T_H in the figure.

[0006] FIG. 10 shows another arrangement of the driving circuit for the organic electroluminescence element. The driving circuit shown in the figure is written in the literature "The Impact of Transient Response of Organic Light Organic Light Emitting Diodes on the Design of Active Matrix OLED Displays" (1998 IEEE IEDM 98-875) . In FIG. 10, reference numeral Tr1 denotes a driving transistor, reference numeral Tr2 denotes a charge controlling transistor, reference numeral Tr3 denotes a first selection transistor, and reference numeral Tr4 denotes a second selection transistor that is turned off during the charge period of a capacitance element 2.

[0007] As known well here, the characteristics of transistors are dispersed even if they have the same standard. Accordingly, even if the same voltage is applied to the gates of transistors, a current having a given value does not always flow through the transistors, which may cause irregular luminance and the like. In contrast, in this driving circuit, electric charge is accumulated in the capacitance element 2 based on an amount of current according to a data signal output from a current source 4. Thus, the emitting state of organic electroluminescence can be controlled based on the amount of current according to data.

[0008] Herein all the transistors Tr1 to Tr4 are P-channel type MOS transistors. The transistors Tr2 and TR3 are turned on by setting a selection potential V_{SEL} to a low level, which causes electric charge having a value according to the output from the current source 4 to be accumulated in the capacitance element 2. Then, after the selection potential V_{SEL} goes to a high level and the transistors Tr2 and Tr3 are turned off, the transistor Trl is turned on by the electric charge accumulated in the capacitance element 2 and the transistor Tr4 is turned on by a data holding control signal V_{gp} so that a current flows to the organic electroluminescence element 10.

[0009] FIG. 11 shows a brief timing chart as to the circuit of FIG. 10, As shown in FIG. 11, when data is to be written by the current source 4, the transistors Tr2 and Tr3 are turned on by setting the selection potential V_{SEL} to the a low level, thereby charging the capacitance element 2. This charging period is a writing period T_w in FIG. 11. An actual display period follows the write period T_w. During the period in which the data holding control signal V_{gp} is set to the low level, the transistor Trl is turned on, and this turned-on period is a display period T_H.

[0010] FIG. 12 shows still another arrangement of the driving circuit for the organic electroluminescence element. The driving circuit shown in the figure is the circuit disclosed in Japanese Unexamined Patent Application Publication No. 11-272233. In this figure, the driving circuit includes a transistor Tr1 for supplying a current from a power supply to an organic electroluminescence element 10 when it is turned on, a capacitance element 2 for accumulating electric charge for maintaining the transistor Tr1 in the turned-on state, and a charge controlling transistor Tr5 for controlling the charge of the capacitance element 2 according to an external signal. Note that when the organic electroluminescence element 10 is to emit, a potential V_{rscan} is maintained to a low level to turn off a charge controlling transistor Tr7. With this operation, no reset signal V_{rsig} is output. Note that reference numeral Tr6 denotes an adjustment transistor.

[0011] The transistor Tr5 is turned on, and the capacitance element 2 is charged by a data line V_{DATA} through a transistor Tr6. Then, the conductance between the source and the drain of the transistor Tr1 is controlled according the charged level of the capacitance element 2, and a current flows to the organic electroluminescence element 10. That is, as shown in FIG. 13, when a potential V_{scan} is set to a high level to turn on the transistor Tr5, the capacitance element 2 is charged through the transistor Tr6. The conductance between the source and the drain of the transistor Trl is controlled according the charged level of the capacitance element 2, and a current flows to the organic electroluminescence element 10. The organic electroluminescence element 10 emitts.

[Problems to be Solved by the Invention]

[0012] Incidentally, it is known that application of reverse bias to an organic electroluminescence element is an effective means to increase the life thereof. This increase of life is disclosed in, for example, Japanese Unexamined Patent Application Publication No. 11-8064.

[0013] However, in the method of the publication, additional power supplies such as a negative power source, and the like must be newly prepared to apply reverse bias to the organic electroluminescence element, and the organic electroluminescence element must be controlled so as to permit the reverse bias to be applied thereto.

[0014] EP 0942407 discloses a current-driven emissive display device, in which an AC voltage or an alternating current is applied between a source and a drain terminal of a switching element, and a DC voltage or a direct current is applied between a first and a second terminal of a luminescent element. This is realized by application of a voltage, which is inverted at predetermined intervals, to two luminescent elements heterogeneously arranged, to a luminescent element and a rectifier arranged in reverse orientation and in parallel, or to a full-wave rectification circuit. At this time, the rectifier is formed by a thin-film transistor, a PN junction, or a PIN junction, and is formed simultaneously with an existing switching element.

[0015] EP 1003150 discloses a transistor circuit for a display panel including a driving transistor where conductance between a source and a drain is controlled in response to voltage. The circuit also includes a compensating transistor where a gate is connected to one of a source and a drain and wherein the compensating transistor is connected so as to supply input signals to the gate of the driving transistor through the source and drain.

[0016] Accordingly, an object of the present invention is to provide a driving circuit for an active matrix type display capable of applying reverse bias to an electro-optical element such as an organic electroluminescence element, and the like without almost increasing power consumption and cost, to provide a driving method of electronic device and an electronic apparatus, and to provide electronic device.

[Means for Solving the Problems]

[0017] According to an aspect of the present invention, there is provided an active matrix display as defined in claim 1.

[0018] In short, since a connected state of the first power supply and the second power supply to the driving circuit is changed by switches, reverse bias can be applied to an organic electroluminescence element without almost increasing power consumption and cost. In this case, a first power supply is ordinarily set to Vcc and a second power supply is ordinarily set to the ground (GND), and potentials which are originally prepared are used. However, when a difference of potential that is sufficient for the organic electroluminescence element to emit can be secured, the power supplies are not limited thereto.

[0019] Embodiments of the present invention will now be described by way of further example only and with reference to the accompanying drawings, in which:-

Fig. 1 is a block diagram showing an embodiment of a driving circuit for an organic electroluminescence element according to the present invention.

FIG. 2 is a block diagram showing a first example of the driving circuit for the organic electroluminescence element according to the present invention.

FIG. 3 is a waveform view showing the operation of the driving circuit for the organic electroluminescence element of FIG. 2.

FIG. 4 is a block diagram showing a second example of the driving circuit for the organic electroluminescence element according to the present invention.

FIG. 5 is a waveform view showing the operation of the circuit of FIG. 4.

FIG. 6 is a block diagram showing a third example of the driving circuit for the organic electroluminescence element.

FIG. 7 is a waveform view showing the operation of the circuit of FIG. 6.

FIG. 8 is a block diagram showing an example of the arrangement of a driving circuit for a conventional organic electroluminescence element.

FIG. 9 is a waveform view showing the operation of the circuit of FIG. 8.

FIG. 10 is a block diagram showing another example of the arrangement of the driving circuit for the conventional organic electroluminescence element.

FIG. 11 is a waveform view showing the operation of the circuit of FIG. 10.

FIG. 12 is a block diagram showing another example of the arrangement of the driving circuit for the conventional organic electroluminescence element.

FIG. 13 is a waveform view showing the operation of the circuit of FIG. 12.

FIG. 14 is a view showing an example when an active matrix type display including the driving circuit according to an example of the present invention is applied to a mobile type personal computer.

FIG. 15 is a view showing an example when an active matrix type display including the driving circuit according to an example of the present invention is applied to the display of a mobile phone.

FIG. 16 is a perspective view showing a digital still camera when an active matrix type display including the driving circuit according to an example of the present invention is applied to a finder portion.

[0020] Next, an embodiment of the present invention will be described with reference to the drawings. Note that, in the respective drawings referred to in the following description, the same components as those in other drawings are denoted by the same reference numerals.

[0021] FIG. 1 is a block diagram showing a driving circuit for an active matrix type display using an organic electroluminescence element according to the present invention. As shown in the figure, the driving circuit 1 for the organic electroluminescence element of the embodiment has a first terminal A. The first terminal A can be electrically connected to any one of a first power supply line for supplying a first potential (V_{cc}) and a second power supply line for supplying a second potential GND lower than the first potential by a switch 21.

[0022] Further, the driving circuit 1 for the organic electroluminescence element includes a second terminal B. The second terminal B is electrically connected to a switch 22 through an organic electroluminescence element 10. The second terminal B can be electrically connected to any one of the first power supply line for supplying the first potential (V_{cc}) and the second power supply line for supplying the second potential GND lower than the first potential by a switch 22 through the organic electroluminescence element 10. Note that the first potential (V_{cc}) is a potential higher than the second potential (GND) and, for example, about 10 V.

[0023] When the organic electroluminescence element 10 emits (first operating state), that is, when display is performed, it is sufficient that the switch 21 be set to the first power supply line for supplying the first potential (Vcc) and that the switch 22 be set to the second power supply line for supplying the second potential (GND). At this time, the first terminal A is electrically connected to the first power supply line, and the second terminal B is electrically connected to the second power supply line through the organic electroluminescence element 10.

[0024] In contrast, when the organic electroluminescence device 10 does not emit (second operating state), that is, when no display is performed, it is sufficient that the switch 21 be set to the second power supply line for supplying the second potential (GND) and that the switch 22 be set to the first power supply line for supplying the first potential (V_{cc}). At this time, the first terminal A is electrically connected to the second power supply line, and the second terminal B is electrically connected to the first power supply line through the organic electroluminescence element 10. Since the potential of the second terminal B does not exceed the first potential (V_{cc}) in the above electrically-connected relationship, reverse bias is applied to the organic electroluminescence element 10. However, it is not necessary to continue the above electrically-connected relationship over the entire period during which the organic electroluminescence element 10 is in the second operating state. That is, it is sufficient to maintain the electrically-connected relationship in at least a part of the above period during which the organic electroluminescence element 10 is in the second operating state.

[0025] As described above, reverse bias can be applied to the organic electroluminescence element 10 only by changing the setting of the first and second switches 21 and 22. Since a power supply and GND which are prepared from the beginning are utilized in this case, it is not necessary to newly prepare additional power supplies such as a negative power supply and the like. Thus, power consumption is not increased as well as an increase in cost does not occur. Note that each of these switches 21 and 22 can be easily realized by the combination of transistors.

[Examples]

[0026] FIG. 2 is a block diagram showing the internal arrangement of a driving circuit according to an embodiment of the present invention. In this figure, the circuit arrangement of FIG. 8 described above is employed in a driving circuit 1. That is, the driving circuit 1 includes a driving transistor Tr1 for controlling the operating state of an organic electroluminescence element 10, a capacitance element 2 for accumulating electric charge for maintaining the transistor Tr1 in a turned-on state, and a charging controlling transistor Tr2 for controlling the charge to the capacitance element 2 according to an external signal. In the driving circuit 1, one of the electrodes constituting the capacitance element 2 is electrically connected to a first terminal A, and the other electrode thereof constituting the capacitance element 2 is electrically connected to the gate electrode of the driving transistor Tr1. Further, one of the source and the drain constituting the driving transistor Tr1 is electrically connected to the first terminal A, and the other thereof constituting the driving transistor Tr1 is electrically connected to the second terminal B. As a result, the first terminal A is electrically connected to the second terminal B through the source and the drain of the driving transistor Tr1.

[0027] Then, an electrically-connected-state of the first terminal A and the second terminal B is changed by the switches 21 and 22. That is, when the organic electroluminescence element 10 emits (first operating state), the switch 21 is set to a power supply potential V_{cc}, and the switch 22 is set to the ground GND. It is sufficient in this state that the capacitance element 2 be charged, that the driving transistor Tr1 be turned on, and that a current flows to the organic electroluminescence element 10.

[0028] In contrast, when the organic electroluminescence element 10 does not emit (second operating state), it is sufficient that the switch 21 be set to the ground GND and that the switch 22 be set to the power supply potential V_{cc}. In this case, a selection potential V_{SEL} is maintained to the power supply potential Vcc. The potential (V_D) of the first terminal A is dropped from the power supply potential V_{cc} to the ground potential GND, and, after the drop thereof, the potential (V_B) of a third terminal C is risen from the ground potential GND to the power supply potential V_{cc}. Thus, the gate potential V_I of the driving transistor Tr1 drops following the change of the potential V_D. Ordinarily, a wiring capacitance (not shown) is added to the gate line of the driving transistor Tr1. However, if the magnitude of the capacitance is negligible with respect to the capacitance of the capacitance element 2, the gate potential V_1 drops by the power supply potential V_{cc} when the potential V_D of the first terminal A changes from the power supply potential V_{cc} to the ground potential GND. At this time, the potential of the second terminal B is equal to the threshold voltage (V_{th}) of the driving transistor Tr1 at the largest, whereby reverse bias is applied to the organic electroluminescence element 10 because the potential V_s of the third terminal C is set to the power supply potential V_{cc}.

[0029] As described above, reverse bias can be applied to the organic electroluminescence element 10 only by changing the setting of the first and second switches 21 and 22. Since it is not necessary to newly prepare additional power supplies such as a negative power supply and the like, power consumption is not increased as well as a great increase in cost does not happen.

[0030] FIG. 4 is a block diagram showing the internal arrangement of a drivin circuit according to a second example. In this figure, the circuit arrangement of FIG. 10 described above is employed in the driving circuit 1. That is, the driving circuit includes a driving transistor Tr1 for controlling the operating state of an organic electroluminescence element 10, a capacitance element 2 for accumulating electric charge for controlling the conductive state of the transistor Tr1, and a charge controlling transistor Tr2 for controlling the charge to the capacitance element 2 according to an external signal. In the driving circuit 1, one of the electrodes constituting the capacitance element 2 is electrically connected to a first terminal A through a second selection transistor Tr4, and the other electrode thereof constituting the capacitance element 2 is electrically connected to the gate electrode of the driving transistor Tr1. Further, one end of the driving transistor Tr1 is electrically connected to the first terminal A through the second selection transistor Tr4, and the other end thereof is electrically connected to the second terminal B. As a result, the first terminal A is electrically connected to the second terminal B through the sources and the drains of the driving transistor Tr1 and the selection transistor Tr4.

[0031] As known well here, the characteristics of transistors are dispersed even if they have the same standard. Accordingly, even if the same voltage is applied to the gates of transistors, a current having a given value does not always flow to the transistors, which may cause irregular luminance and the like. In contrast, in this driving circuit, electric charge is accumulated in the capacitance element 2 based on an amount of current according to a data signal output from a current source 4. Thus, the emitting state of organic electroluminescence can be controlled based on the amount of current according to data.

[0032] In this driving circuit, the electrically-connected relationship between the first terminal A and the second terminal B is changed to a power supply potential V_{cc} and the ground potential GND by switches 21 and 22. That is, when the organic electroluminescence element 10 is to emit, it is sufficient that the switch 21 be set to the power supply potential V_{cc}, that the switch 22 be set to the ground potential GND, that the transistor Tr1 be turned on, that the transistor Tr4 be turned on, and that a current flows to the organic electroluminescence element 10.

[0033] In contrast, when reverse bias is to be applied to the organic electroluminescence element 10, it is sufficient that the switch 21 be set to the ground potential GND and that the switch 22 is set to the power supply potential V_{cc}. In this case, as shown in FIG. 5, a selection potential V_{SEL} is maintained to the power supply potential V_{cc}, and a data maintaining control signal V_{gp} is maintained to the ground potential GND. Then, the potential V_D of the first terminal A is dropped from the power supply potential V_{cc} to the ground GND. After the drop of the potential V_D, the potential V_s of the third terminal C is risen from the ground potential GND to the power supply potential V_{cc}. FIG. 5 shows only the operation after a current has been written in the driving circuit.

[0034] The potential V_1 of a node D drops from the power supply potential V_{cc} to the threshold voltage V_{th} of the transistor Tr4 following the drop of the potential V_D of the first terminal A from the power supply potential V_{cc} to the ground GND because the transistor Tr4 is turned on at all times. At this time, a wiring capacitance (not shown) is ordinarily added to the gate line of the transistor Tr1. However, if the magnitude of the capacitance is negligible with respect to the capacitance of the capacitance element 2, the potential V_2 of a node E changes to v_2 - (V_{cc} - V_{th}). Further, when the potential V_2 is V_2 - (V_{cc} - V_{th}), the potential V_3 of the second terminal B drops to the threshold voltage V_{th}. Note that the above description assumes that the threshold voltage of the transistor Tr1 is equal to that of the transistor Tr4. Reverse bias is applied to the organic electroluminescence element 10 as described above.

[0035] Application of reverse bias to the organic electroluminescence element 10 can be realized only by changing the setting of the switches as described above. since it is not necessary to newly prepare additional power supplies such as a negative power supply, and the like, power consumption is not increased as well as a great increase in cost does not occur.

[0036] FIG. 6 is a block diagram showing the internal arrangement of a driving circuit according to a third example. In this figure, the circuit disclosed in Japanese Unexamined Patent Application Publication No. 11-272233 is employed in the driving circuit 1. That is, the driving circuit 1 includes a driving transistor Tr1 for controlling the operating state of an organic electroluminescence element 10, a capacitance element 2 for accumulating electric charge for maintaining the transistor Tr1 in a turned-on state, and a charge controlling transistor Tr5 for controlling the accumulated state of electric charge of the capacitance element 2 according to an external signal. In the driving circuit 1, one of the electrodes constituting the capacitance element 2 is electrically connected to the gate electrode of the transistor Tr1, and the other electrode thereof constituting the capacitance element 2 is electrically connected to the ground GND. Further, one of the source and the drain constituting the driving transistor Tr1 is electrically connected to a first terminal A, and the other thereof constituting the driving transistor Tr1 is electrically connected to a second terminal B. As a result, the first terminal A is electrically connected to the second terminal B through the source and the drain of the driving transistor Tr1. Note that, in the figure, the transistor Tr1 and a transistor Tr6 are P-channel type transistors, and the transistor Tr5 and a transistor Tr7 are N-channel type transistors. Further, the transistor Tr6 connected to a diode has an effect for compensating the dispersion of the threshold value of the transistor Tr1.

[0037] In this driving circuit, the electrically-connected relationship between the first terminal A and the second terminal B is changed to a power supply potential V_{cc} and to the ground potential GND by switches 21 and 22. That is, when an organic electroluminescence element 10 is to be emitted, the switch 21 is set to the power supply potential V_{cc}, and the switch 22 is set to the ground potential GND. In this state, the transistor Tr5 is turned on and the capacitance element 2 is charged through the transistor Tr6. Then, it is sufficient that the conductance between the source and the drain of the transistor Tr1 be controlled according the charged level and that a current flows to the organic electroluminescence element 10.

[0038] In contrast, when reverse bias is to be applied to the organic electroluminescence element 10, it is sufficient that the switch 21 be set to the ground potential GND and that the switch 22 be set to the power supply potential V_{cc}. In this case, first, the potential V_{SCAN} that is to be applied to the gate electrode of the transistor Tr5 is set to the power supply potential V_{cc}, and then the capacitance element 2 is charged, as shown in FIG. 7. At this time, the potential V_{SCAN} is set to the power supply potential V_{cc} for a period during which the capacitance element 2 maintains (charges) electric charge which is sufficient to turn on the transistor Tr1. A data line V_{DATA} must be set to a potential that permits the transistor Tr1 to be turned on. After the capacitance element 2 has been charged, the switch 21 is manipulated to drop the potential V_D of the first terminal A from the power supply potential V_{cc} to the ground potential GND. Thereafter, the switch 22 is manipulated to rise the potential V_s of a third terminal C from the ground potential GND to the power supply potential V_{cc}. Note that the transistor Tr7 is a reset transistor. When reverse bias is to be applied to the organic electroluminescence element 10, a potential V_{RSCAN} is maintained to the ground potential GND to turn off the transistor Tr7.

[0039] As described above, reverse bias can be applied to the organic electroluminescence element 10 only by changing the setting of the switches. Since it is not necessary to newly prepare additional power supplies such as a negative power supply, and the like, power consumption is not increased as well as a great increase in cost does not happen.

[0040] Note that while these two switches 21 and 22 are manipulated at shift timing in the above respective examples, it is apparent that they may be manipulated at the same time. When a change control signal is input to each of these switches at the shift timing, they can be manipulated at different timing. In this case, it is sufficient to input the respective control signals of the two switches through buffers each having a different number of stages.

[0041] While the driving circuits for the active matrix type display using the organic electroluminescence element have been described above, the scope of application of the present invention is not limited thereto, and the present invention also can be applied to an active matrix type display using electro-optical elements other than the organic electroluminescence element , for example, a TFT-LCD, a FED (field emission display), an electrophoresis element, a field inversion device, a laser diode, a LED, and the like.

[0042] Next, some examples of electronic apparatus to which the active matrix type display including a driving circuit 1 described above. FIG. 14 is a perspective view showing the arrangement of a mobile type personal computer to which this active matrix type display is applied.

In this figure, the personal computer 1100 is composed of a main body 1104 having a key board 1102 and a display unit 1106 which includes the active matrix type display 100.

[0043] Further, FIG. 15 is a perspective view showing the arrangement of a mobile phone having a display to which the active matrix type display 100 including the aforementioned driving circuit is applied.

[0044] In this figure, the mobile phone 1200 includes the aforementioned active matrix type display 100 together with a voice receiving port 1204 and a voice transmission port 1206, in addition to a plurality of manipulation buttons 1202.

[0045] Further, FIG. 16 is a perspective view showing the arrangement of a digital still camera having a finder to which the active matrix type display 100 including the aforementioned driving circuit is applied. Note that this figure also simply shows connection to an external unit. The digital still camera 1300 creates an imaging signal by photoelectrically converting the light image of a subject by an imaging device such as a CCD (charge coupled device) or the like, while an ordinary camera exposes a film using the light image of the subject. The active matrix type display 100 is disposed on the back surface of the case 1302 of the digital still camera 1300 so as to make display based on the imaging signal created by the CCD, and the active matrix type display 100 acts as a finder for displaying the subject. Further, a light receiving unit 1304 including an optical lens, the CCD, and the like is disposed on the observing side (back surface side in the figure) of the case 1302.

[0046] When a photographer confirms the image of the subject displayed in the driving circuit and depresses a shutter button 1306, the imaging signal of the CCD at that time is transferred to and stored in the memory of a circuit substrate 1308. Further, in this digital still camera 1300, video signal output terminals 1312 and a data communication input/output terminal 1314 are disposed on a side of the case 1302. Then, as shown in the figure, a TV monitor 1430 is connected to the former video signal output terminals 1312 and a personal computer 1440 is connected to the latter data communication input/output terminal 1314, respectively when necessary. Further, the imaging signal stored in the memory of a circuit substrate 1308 is output to the TV monitor 1430 and the personal computer 1440.

[0047] Note that exemplified as the electronic apparatus to which the active matrix type display 100 of the present invention is applied are a liquid crystal TV, view finder type and monitor-directly-observing type video tape recorders, a car navigator, a pager, an electronic note book, a pocket calculator, a word processor, a workstation, a TV phone, a POS terminal, equipment provide with a touch panel, and the like, in addition to the personal computer of FIG. 14, the mobile phone of FIG. 15, and the digital still camera of FIG. 16. It is needless to say that the aforementioned active matrix type display 100 can be applied as the display of these various types of electronic equipment.

[Advantages]

[0048] As described above, the present invention has an advantage that application of reverse bias can be realized by changing a connected state of a first power supply having a first potential and that of a second power supply having a second potential by switches without the need of newly preparing additional power supplies such as a negative power supply, and the like and without almost increasing power consumption and cost.

Claims

1. An active matrix display comprising a plurality of pixels and a switching means (21, 22), a pixel of the plurality of pixels including an electroluminescent element (10) and a driving circuit,
   wherein the driving circuit includes a p-channel type first transistor (Tr1) controlling a current which flows through the electroluminescent element (10), the first transistor being coupled to a first terminal (A) through one of a source and a drain of the first transistor, the first transistor (Tr1) being coupled to a second terminal (B) through the other of the source and the drain of the first transistor, the second terminal (B) being coupled to a third terminal (C) through the electroluminescent element;
   a capacitance element (2) for accumulating an electric charge for maintaining the first transistor (Tr1) in a turned-on state, a first electrode of the capacitor (2) being coupled to a gate of the first transistor (Tr1) and a second electrode of the capacitor (2) being coupled to the first terminal; and
   a p-channel type charge controlling transistor (Tr2) for controlling an accumulated state of the electric charge of the capacitance element according to a signal, one of the source or drain of the charge controlling transistor (Tr2) being connected to the first electrode of the capacitance element (2),
   the active matrix display being **characterized** that:

   in a first period, the switching means is arranged to set a first potential of the first terminal at a first value and a second potential of the third terminal at a second value lower than the first value such that a forward bias voltage is applied to the electroluminescent element (10) and the electroluminescent element (10) emits a light based on the current, and
   in a second period, the switching means is arranged to set the first potential of the first terminal at the second value such that, with the change in the first potential of the first terminal, the gate potential of the first transistor drops by the potential difference between the first value

and the second value, and subsequently to set the second potential of the third terminal at the first value such that a reverse bias voltage is applied to the electroluminescent element (10).

2. An active matrix type display according to claim 1, the second value being a value of a ground potential, and the first value being a value of a power supply potential.

3. An electronic apparatus including the active matrix display according to claim 1 or claim 2.

4. A method for driving an active matrix display comprising a plurality of pixels and a switching means (21, 22), a pixel of the plurality of pixels including an electroluminescent element (10) and a driving circuit, wherein the driving circuit comprises a p-channel type first transistor (Tr1) controlling a current which flows through the electroluminescent element (10), the first transistor being coupled to a first terminal (A) through one of a source and a drain of the first transistor, the first transistor (Tr1) being coupled to a second terminal (B) through the other of the source and the drain of the first transistor, the second terminal (B) being coupled to a third terminal (C) through the electroluminescent element;
a capacitance element (2) for accumulating an electric charge for maintaining the first transistor (Tr1) in a turned-on state, a first electrode of the capacitor (2) being coupled to a gate of the first transistor (Tr1) and a second electrode of the capacitor (2) being coupled to the first terminal; and
a p-channel type charge controlling transistor (Tr2) for controlling an accumulated state of the electric charge of the capacitance element according to a signal, one of the source or drain of the charge controlling transistor (Tr2) being connected to the first electrode of the capacitance element (2),
the method comprising:

setting a first potential of the first terminal at a first value and a second potential of the third terminal at a second value lower than the first value with the switching means such that a forward bias voltage is applied to the electroluminescent element (10) and the electroluminescent element (10) emits a light based on the current in a first period,
setting the first potential of the first terminal at the second value with the switching means such that, with the change in the first potential of the first terminal, the gate potential of the first transistor drops by the potential difference between the first value and the second value, and subsequently setting the second potential of the third terminal at the first value with the switching means such that a reverse bias voltage is applied to the electroluminescent element (10).

Patentansprüche

1. Anzeige mit aktiver Matrix, umfassend mehrere Pixel und ein Schaltmittel (21, 22), wobei ein Pixel der mehreren Pixel ein elektrolumineszierendes Element (10) und eine Steuerschaltung enthält,
wobei die Steuerschaltung einen ersten Transistor (Tr1) vom p-Kanaltyp enthält, der einen Strom kontrolliert, der durch das elektrolumineszierende Element (10) fließt, wobei der erste Transistor durch eines von Source und Drain des ersten Transistors an eine erste Anschlussklemme (A) gekoppelt ist, wobei der erste Transistor (Tr1) durch das andere von Source und Drain des ersten Transistors an eine zweite Anschlussklemme (B) gekoppelt ist, wobei die zweite Anschlussklemme (B) durch das elektrolumineszierende Element an eine dritte Anschlussklemme (C) gekoppelt ist;
ein Kapazitätselement (2) zum Speichern einer elektrischen Ladung zum Halten des ersten Transistors (Tr1) in einem eingeschalteten Zustand, wobei eine erste Elektrode des Kondensators (2) an ein Gate des ersten Transistors (Tr1) gekoppelt ist und eine zweite Elektrode des Kondensators (2) an die erste Anschlussklemme gekoppelt ist; und
einen Ladungskontrolltransistor (Tr2) vom p-Kanaltyp zum Kontrollieren eines Speicherzustandes der elektrischen Ladung des Kapazitätselements gemäß einem Signal, wobei eines von Source oder Drain des Ladungskontrolltransistors (Tr2) an die erste Elektrode des Kapazitätselements (2) angeschlossen ist,
wobei die Anzeige mit aktiver Matrix **dadurch gekennzeichnet** ist, dass:

in einer ersten Periode das Schaltmittel dazu angeordnet ist, ein erstes Potential der ersten Anschlussklemme bei einem ersten Wert und ein zweites Potential der dritten Anschlussklemme bei einem zweiten Wert, der geringer ist als der erste Wert, einzustellen, so dass eine Vorwärtsvorspannung an das elektrolumineszierende Element (10) angelegt wird und das elektrolumineszierende Element (10) ein Licht basierend auf dem Strom ausgibt, und
in einer zweiten Periode das Schaltmittel dazu angeordnet ist, das erste Potential der ersten Anschlussklemme bei dem zweiten Wert einzustellen, so dass bei der Änderung im ersten Potential der ersten Anschlussklemme das Gate-Potential des ersten Transistors um die Potentialdifferenz zwischen dem ersten Wert und dem zweiten Wert fällt, und anschließend das zweite Potential der dritten Anschlussklemme bei dem ersten Wert einzustellen, so dass eine Rück-

wärtsvorspannung an das elektrolumineszierende Element (10) angelegt wird.

2. Anzeige mit aktiver Matrix nach Anspruch 1, wobei der zweite Wert ein Wert eines Massepotentials ist und der erste Wert ein Wert eines Energieversorgungspotentials ist.

3. Elektronische Apparatur, die die Anzeige mit aktiver Matrix nach Anspruch 1 oder Anspruch 2 enthält.

4. Verfahren zum Steuern einer Anzeige mit aktiver Matrix, umfassend mehrere Pixel und ein Schaltmittel (21, 22), wobei ein Pixel der mehreren Pixel ein elektrolumineszierendes Element (10) und eine Steuerschaltung enthält, wobei die Steuerschaltung einen ersten Transistor (Tr1) vom p-Kanaltyp enthält, der einen Strom kontrolliert, der durch das elektrolumineszierende Element (10) fließt, wobei der erste Transistor durch eines von Source und Drain des ersten Transistors an eine erste Anschlussklemme (A) gekoppelt ist, wobei der erste Transistor (Tr1) durch das andere von Source und Drain des ersten Transistors an eine zweite Anschlussklemme (B) gekoppelt ist, wobei die zweite Anschlussklemme (B) durch das elektrolumineszierende Element an eine dritte Anschlussklemme (C) gekoppelt ist;
ein Kapazitätselement (2) zum Speichern einer elektrischen Ladung zum Halten des ersten Transistors (Tr1) in einem eingeschalteten Zustand, wobei eine erste Elektrode des Kondensators (2) an ein Gate des ersten Transistors (Tr1) gekoppelt ist und eine zweite Elektrode des Kondensators (2) an die erste Anschlussklemme gekoppelt ist; und
einen Ladungskontrolltransistor (Tr2) vom p-Kanaltyp zum Kontrollieren eines Speicherzustandes der elektrischen Ladung des Kapazitätselements gemäß einem Signal, wobei eines von Source oder Drain des Ladungskontrolltransistors (Tr2) an die erste Elektrode des Kapazitätselements (2) angeschlossen ist,
wobei das Verfahren umfasst:

Einstellen eines ersten Potentials der ersten Anschlussklemme bei einem ersten Wert und eines zweiten Potentials der dritten Anschlussklemme bei einem zweiten Wert, der geringer ist als der erste Wert, mit dem Schaltmittel, so dass eine Vorwärtsvorspannung an das elektrolumineszierende Element (10) angelegt wird und das elektrolumineszierende Element (10) ein Licht basierend auf dem Strom in einer ersten Periode ausgibt,
Einstellen des ersten Potentials der ersten Anschlussklemme bei dem zweiten Wert mit dem Schaltmittel, so dass bei der Änderung im ersten Potential der ersten Anschlussklemme das Gate-Potential des ersten Transistors um die Potentialdifferenz zwischen dem ersten Wert und dem zweiten Wert fällt, und anschließendes Einstellen des zweiten Potentials der dritten Anschlussklemme bei dem ersten Wert mit dem Schaltmittel, so dass eine Rückwärtsvorspannung an das elektrolumineszierende Element (10) angelegt wird.

Revendications

1. Dispositif d'affichage à matrice active comprenant une pluralité de pixels et un moyen de commutation (21, 22), un pixel de la pluralité des pixels comprenant un élément électroluminescent (10) et un circuit de commande,
dans lequel le circuit de commande comprend un premier transistor de type à canal p (Tr1) contrôlant un courant qui circule à travers l'élément électroluminescent (10), le premier transistor étant couplé à une première borne (A) par l'intermédiaire d'un/une d'entre une source et un drain du premier transistor, le premier transistor (Tr1) étant couplé à une deuxième borne (B) par l'intermédiaire de l'autre d'entre la source et le drain du premier transistor, la deuxième borne (B) étant couplée à une troisième borne (C) par l'intermédiaire de l'élément électroluminescent ;
un élément capacitif (2) pour accumuler une charge électrique afin de maintenir le premier transistor (Tr1) dans un état allumé, une première électrode du capaciteur (2) étant couplée à une grille du premier transistor (Tr1) et une deuxième électrode du capaciteur (2) étant couplée à la première borne ; et
un transistor de contrôle de charge de type à canal p (Tr2) pour contrôler un état accumulé de la charge électrique de l'élément capacitif en fonction d'un signal, l'un/une d'entre la source ou le drain du transistor de contrôle de charge (Tr2) étant connecté(e) à la première électrode de l'élément capacitif (2),
le dispositif d'affichage à matrice active **se caractérisant en ce que** :

au cours d'une première période, le moyen de commutation est étudié pour régler un premier potentiel de la première borne à une première valeur et un deuxième potentiel de la troisième borne à une deuxième valeur inférieure à la première valeur de manière à ce qu'une tension de polarisation en sens direct soit appliquée à l'élément électroluminescent (10) et que l'élément électroluminescent (10) émet une lumière sur la base du courant, et
au cours d'une deuxième période, le moyen de commutation étant étudié pour régler le premier potentiel de la première borne à la deuxième valeur de manière à ce que, avec le changement du premier potentiel de la première borne, le potentiel de grille du premier transistor chute de

l'ordre de la différence de potentiel entre la première valeur et la deuxième valeur, et pour ensuite régler le deuxième potentiel de la troisième borne à la première valeur de manière à ce qu'une tension de polarisation en sens inverse soit appliquée à l'élément électroluminescent (10).

2. Dispositif d'affichage à matrice active selon la revendication 1, la deuxième valeur étant une valeur d'un potentiel de terre, et la première valeur étant une valeur d'un potentiel d'alimentation en énergie.

3. Appareil électronique comprenant le dispositif d'affichage à matrice active selon la revendication 1 ou la revendication 2.

4. Procédé pour commander un dispositif d'affichage à matrice active comprenant une pluralité de pixels et un moyen de commutation (21, 22), un pixel de la pluralité des pixels comprenant un élément électroluminescent (10) et un circuit de commande, dans lequel le circuit de commande comprend un premier transistor de type à canal p (Tr1) contrôlant un courant qui circule à travers l'élément électroluminescent (10), le premier transistor étant couplé à une première borne (A) par l'intermédiaire de l'un/une d'entre une source et un drain du premier transistor, le premier transistor (Tr1) étant couplé à une deuxième borne (B) par l'intermédiaire de l'autre d'entre la source et le drain du premier transistor, la deuxième borne (B) étant couplée à une troisième borne (C) par l'intermédiaire de l'élément électroluminescent ; un élément capacitif (2) pour accumuler une charge électrique afin de maintenir le premier transistor (Tr1) dans un état allumé, une première électrode du capaciteur (2) étant couplée à une grille du premier transistor (Tr1) et une deuxième électrode du capaciteur (2) étant couplée à la première borne ; et un transistor de contrôle de charge de type à canal p (Tr2) pour contrôler un état accumulé de la charge électrique de l'élément capacitif en fonction d'un signal, l'un/une d'entre la source ou le drain du transistor de contrôle de charge (Tr2) étant connecté(e) à la première électrode de l'élément capacitif (2), le procédé comprenant :

le réglage d'un premier potentiel de la première borne à une première valeur et d'un deuxième potentiel de la troisième borne à une deuxième valeur inférieure à la première valeur avec le moyen de commutation de manière à ce qu'une tension de polarisation en sens direct soit appliquée à l'élément électroluminescent (10) et que l'élément électroluminescent (10) émet une lumière sur la base du courant dans la première période,

le réglage du premier potentiel de la première borne à la deuxième valeur avec le moyen de commutation de manière à ce que, avec le changement du premier potentiel de la première borne, le potentiel de grille du premier transistor chute de l'ordre de la différence de potentiel entre la première valeur et la deuxième valeur, et ensuite le réglage du deuxième potentiel de la troisième borne à la première valeur avec le moyen de commutation de manière à ce qu'une tension de polarisation en sens inverse soit appliquée à l'élément électroluminescent (10).

Fig. 1

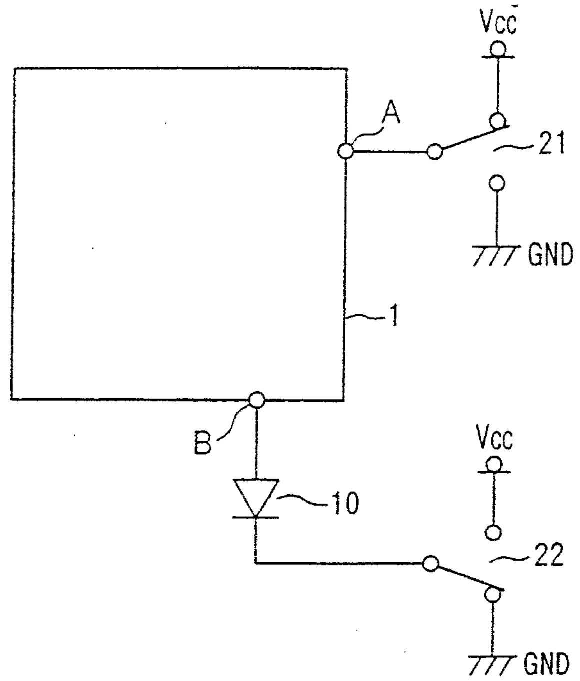

VCC
A
21
GND
1
B
VCC
10
22
GND

Fig. 2

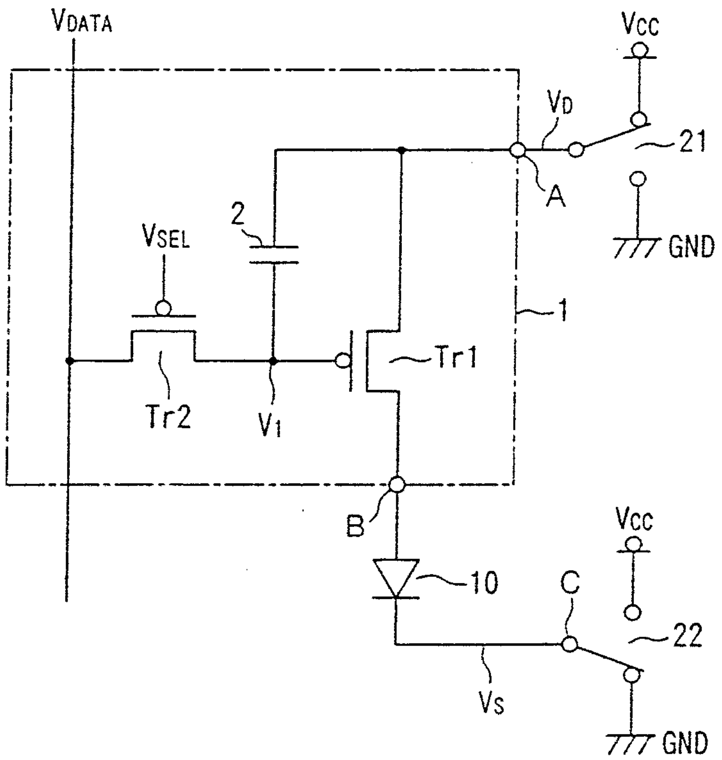

VDATA
VCC
VD
21
A
GND
2
VSEL
1
Tr1
Tr2
V1
B
VCC
10
C
22
VS
GND

Fig. 3

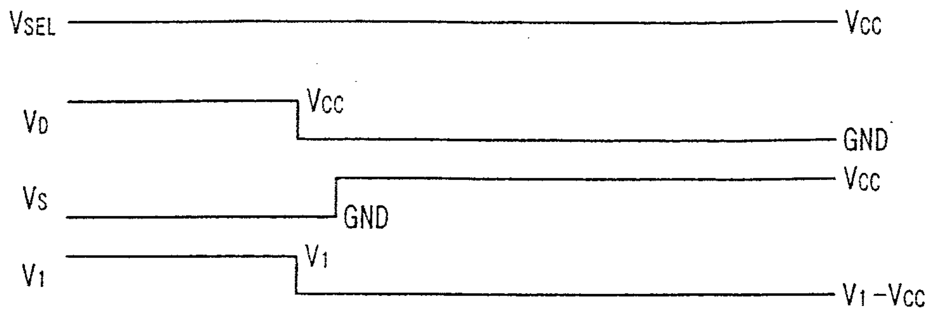

VSEL
Vcc
VD
Vcc
GND
Vs
GND
Vcc
V1
V1
V1 -Vcc

Fig. 4

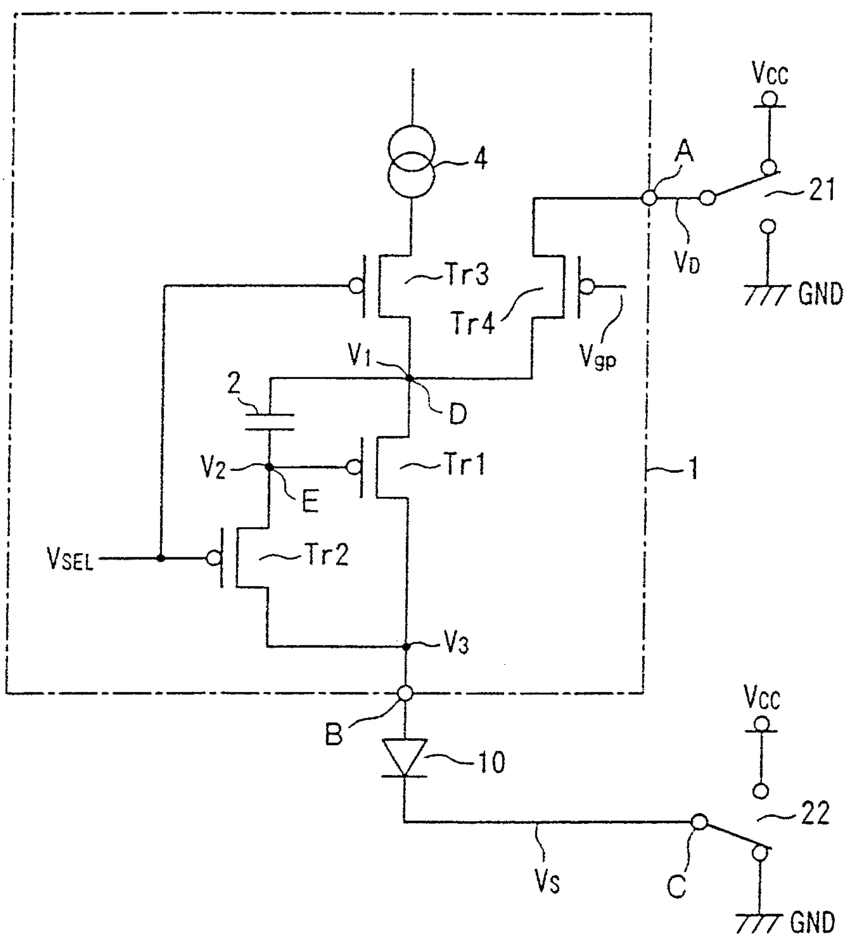

4
Tr3
Tr4
Vgp
A
VD
21
Vcc
GND
V1
D
2
V2
E
Tr1
1
VSEL
Tr2
V3
B
10
Vcc
22
Vs
C
GND

Fig. 5

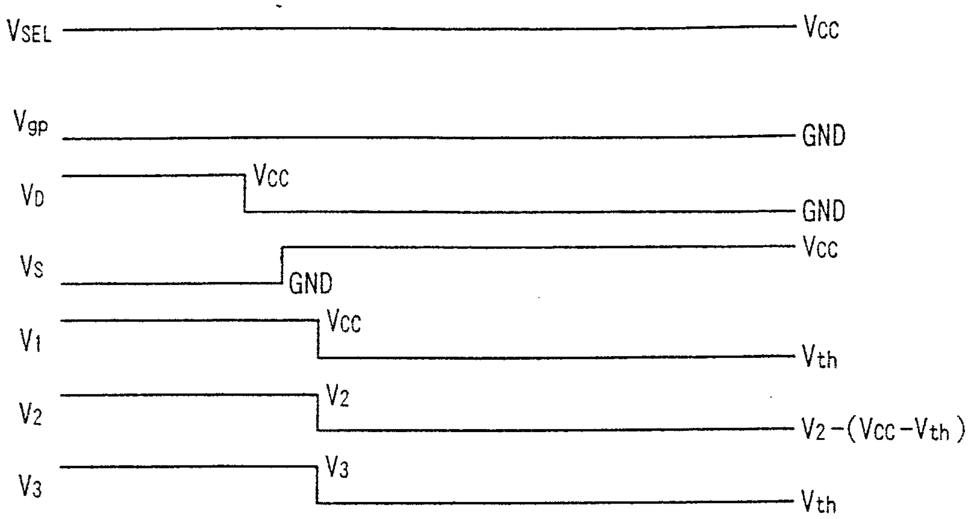

VSEL
Vcc
Vgp
GND
VD
Vcc
GND
VS
Vcc
GND
V1
Vcc
Vth
V2
V2
V2-(Vcc-Vth)
V3
V3
Vth

Fig. 6

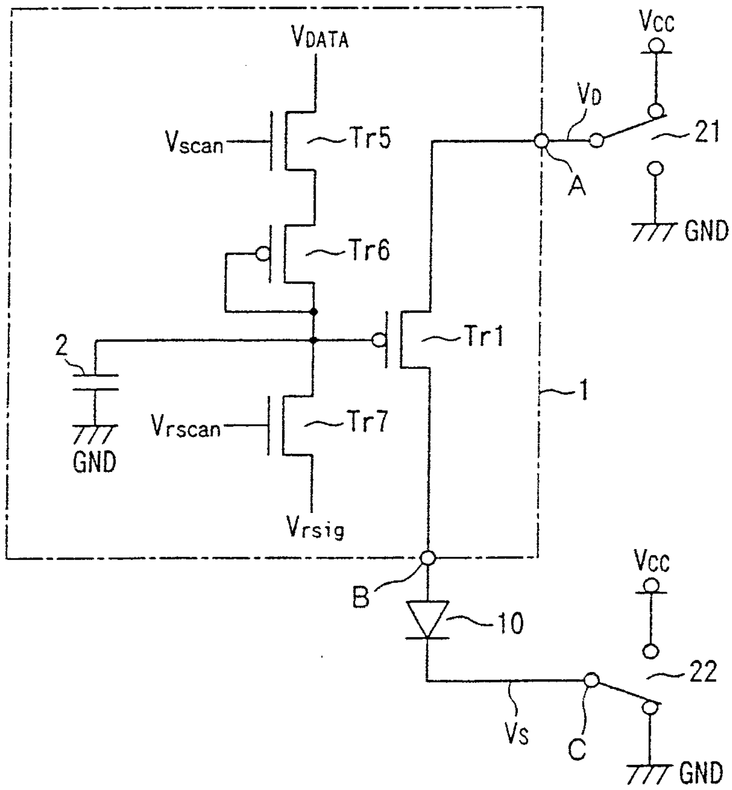

VDATA
Vscan
Tr5
Tr6
Tr1
Tr7
Vrscan
Vrsig
2
GND
1
Vcc
VD
A
21
GND
B
10
Vcc
22
Vs
C
GND

Fig. 7

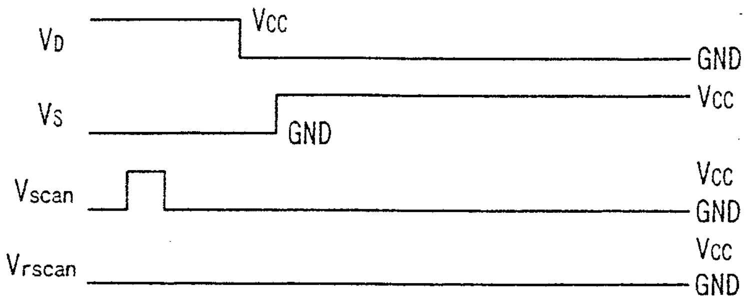


Fig. 8

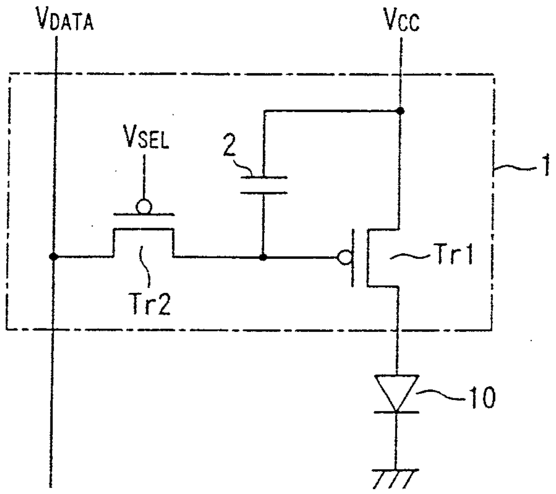


Fig. 9

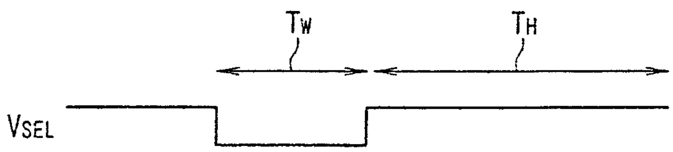


Fig. 10

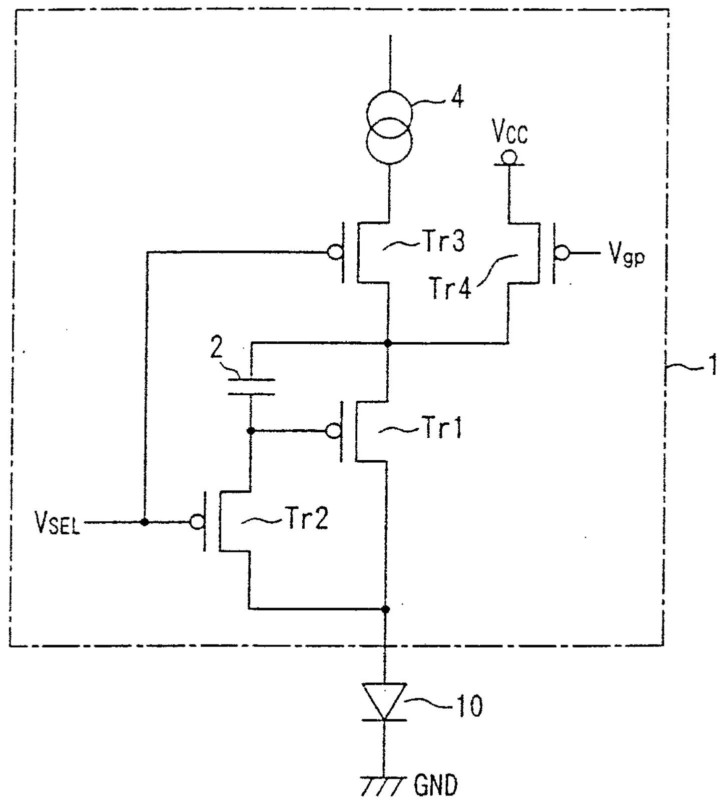


Fig. 11

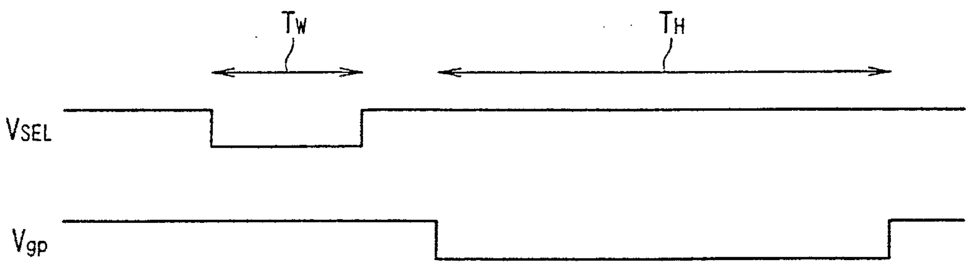


Fig. 12

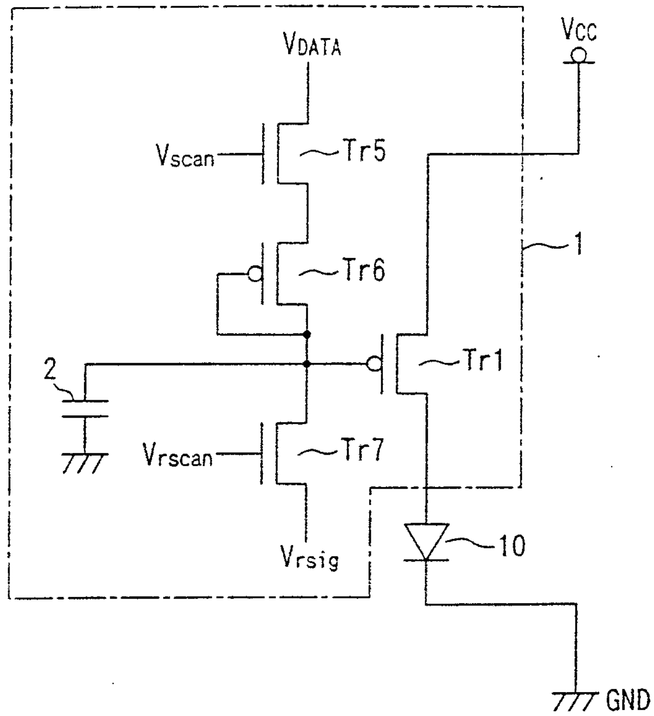

VDATA
Vcc
Vscan
Tr5
Tr6
1
2
Tr1
Vrscan
Tr7
Vrsig
10
GND

Fig. 13

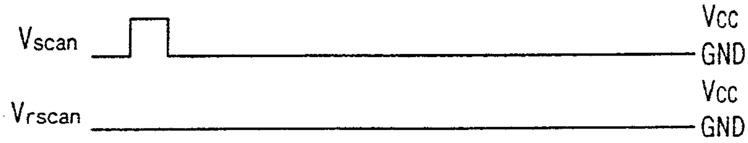

Vscan
Vcc
GND
Vrscan
Vcc
GND

Fig. 14

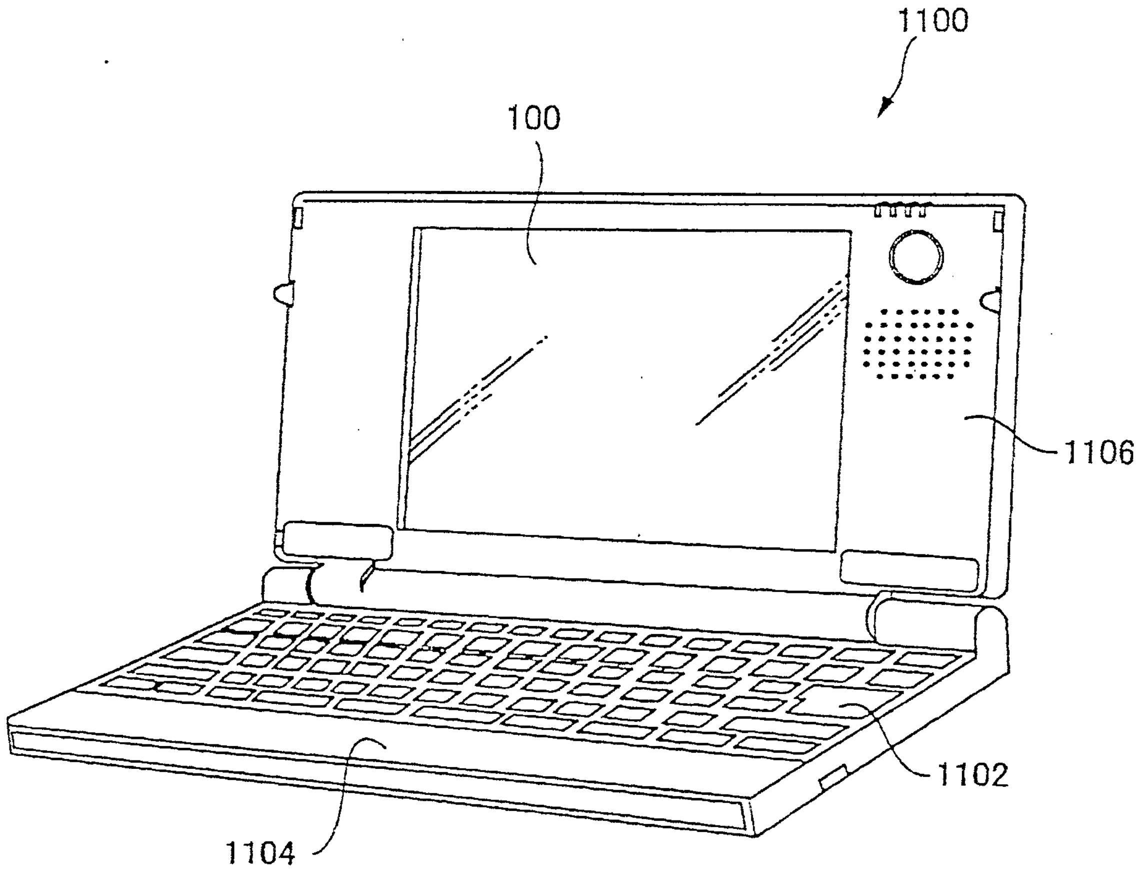


Fig.15

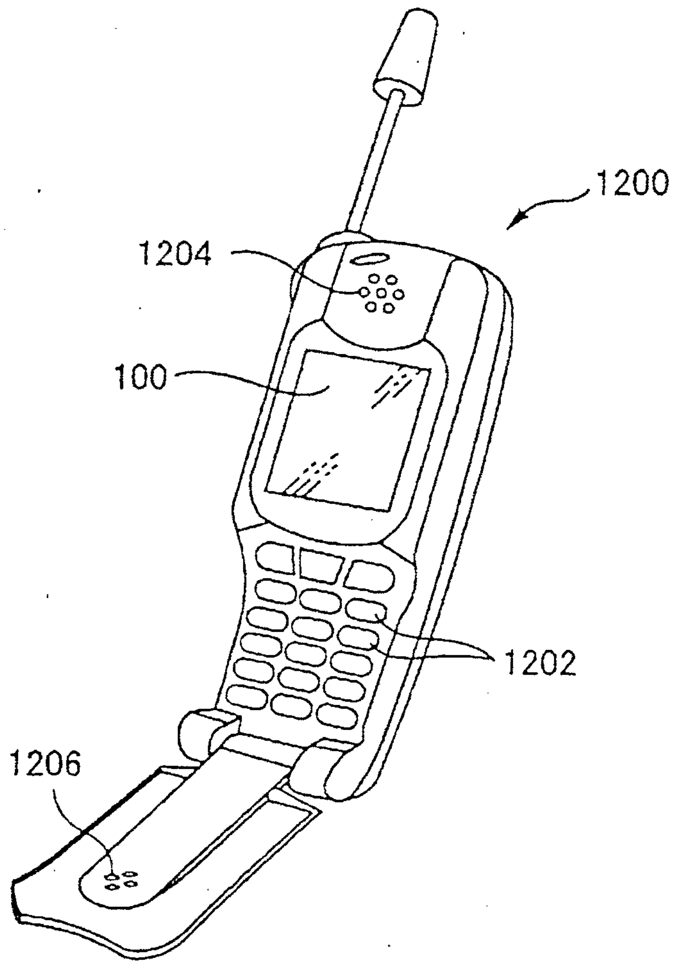
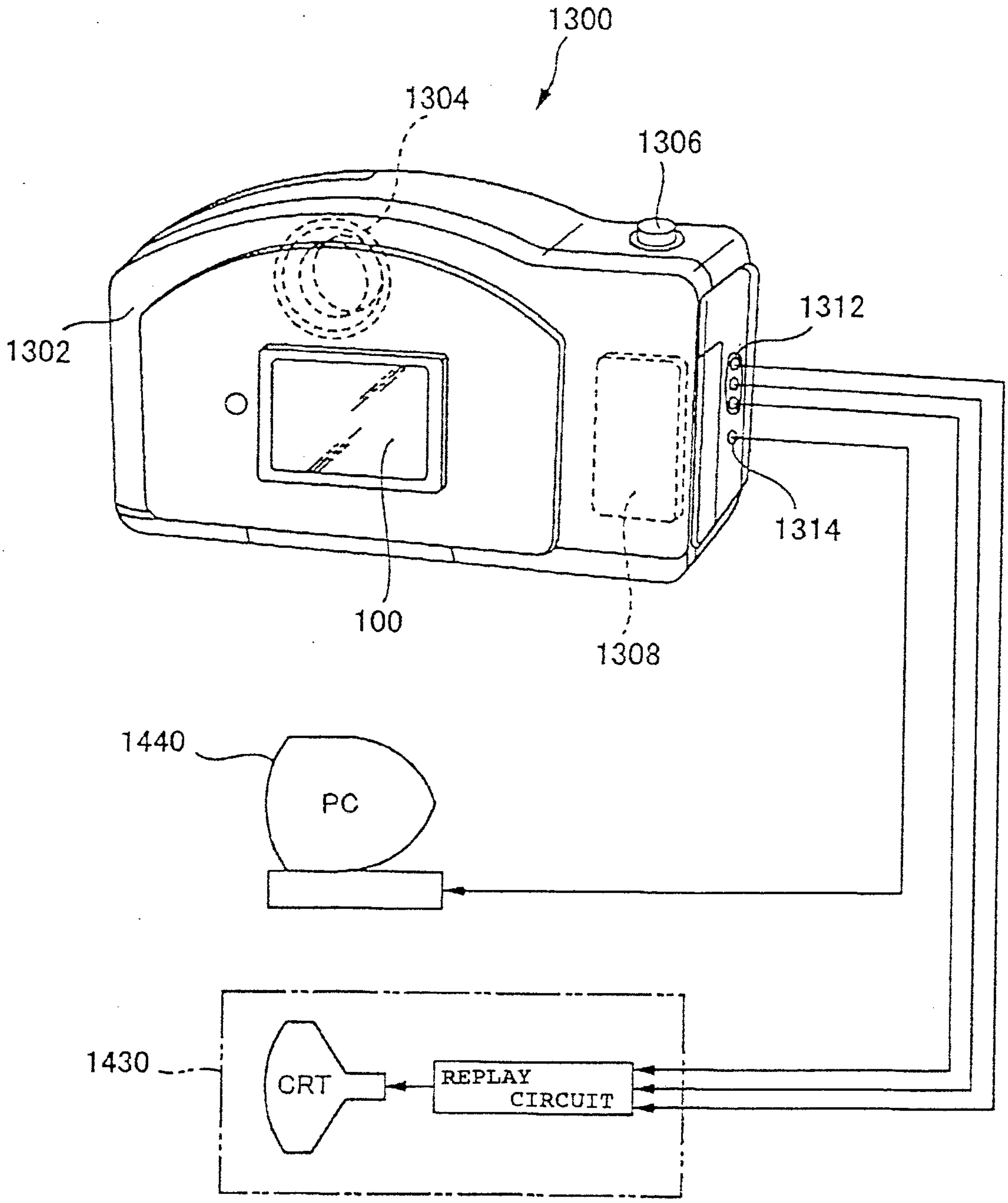


Fig.16


1300
1304
1306
1312
1302
1314
100
1308
1440
PC
1430
CRT
REPLAY CIRCUIT

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 11272233 A **[0010] [0036]**
- JP 11008064 A **[0012]**
- EP 0942407 A **[0014]**
- EP 1003150 A **[0015]**

Non-patent literature cited in the description

- The Impact of Transient Response of Organic Light Organic Light Emitting Diodes on the Design of Active Matrix OLED Displays. *IEEE IEDM 98-875,* 1998 **[0006]**

专利名称(译)	有源矩阵型显示器的驱动电路，电子设备的驱动方法和电子设备		
公开(公告)号	EP2306444B1	公开(公告)日	2015-04-01
申请号	EP2010181739	申请日	2001-09-20
[标]申请(专利权)人(译)	精工爱普生株式会社		
申请(专利权)人(译)	SEIKO EPSON CORPORATION		
当前申请(专利权)人(译)	SEIKO EPSON CORPORATION		
[标]发明人	KASAI TOSHIYUKI		
发明人	KASAI, TOSHIYUKI		
IPC分类号	G09G3/32 H05B33/08 G09G3/20 G09G3/30 H01L51/50		
CPC分类号	G09G3/3233 G09G3/325 G09G2300/0819 G09G2300/0842 G09G2300/0861 G09G2300/0866 G09G2310/0251 G09G2310/0256 G09G2310/0262 G09G2320/043		
优先权	2000285329 2000-09-20 JP 2001254850 2001-08-24 JP		
其他公开文献	EP2306444A1		
外部链接	Espacenet		

摘要(译)

为了实现能够实现反向偏压的应用而不会几乎增加功耗和成本的有机电致发光元件驱动电路。通过操作开关21和22来改变电源电位Vcc和GRD之间的连接关系。利用这种布置，实现了向有机电致发光元件10施加反向偏压而无需新准备诸如负电源的附加电源，等等，由此可以提高有机电致发光元件10的寿命。

Fig. 1

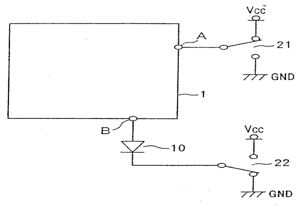

Fig. 2