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(54) **EL DISPLAY DEVICE AND METHOD OF CONTROLLING THE SAME**

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(57) **ABSTRACT**

An EL display device controlling luminosity by a current value supplied to a light emitting element. The EL display device includes a power source supplying a current to the light emitting element and includes a first variable power source and a second variable power source outputting a lower potential than the first variable power source, and a control part changing an output potential of the first variable power source and an output potential of the second variable power source according to acquired maximum luminosity data. Furthermore, the EL display device includes a gate signal output part and a data signal output part, and the control part may change a power source potential of the gate signal output part or a power source potential of the data signal output part according to the maximum luminosity data.

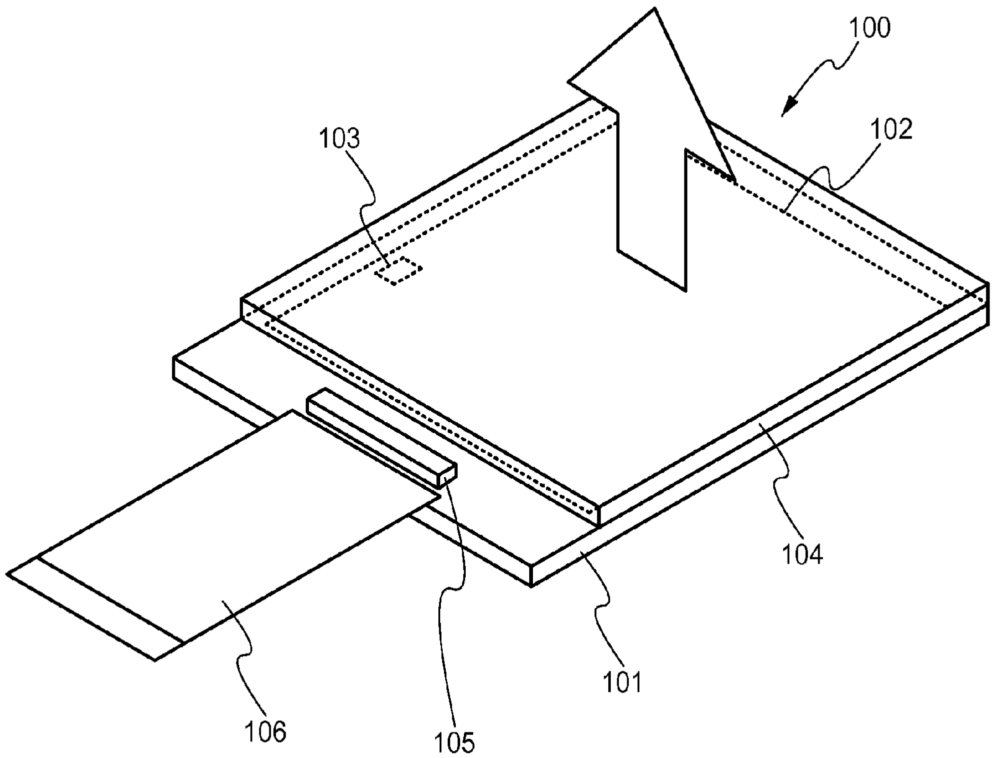


FIG.1

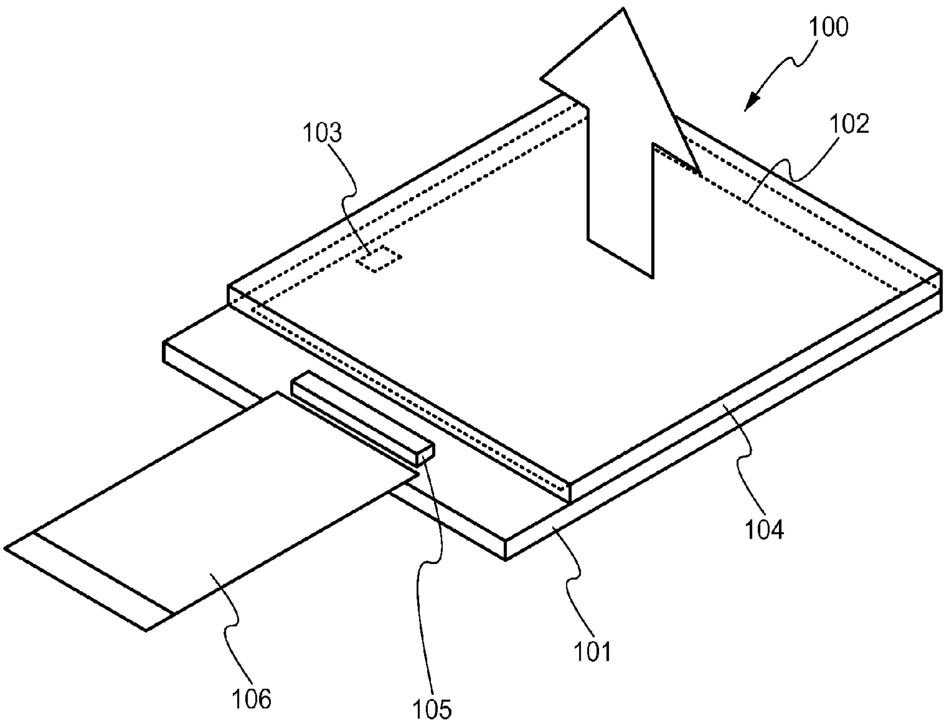


FIG.2

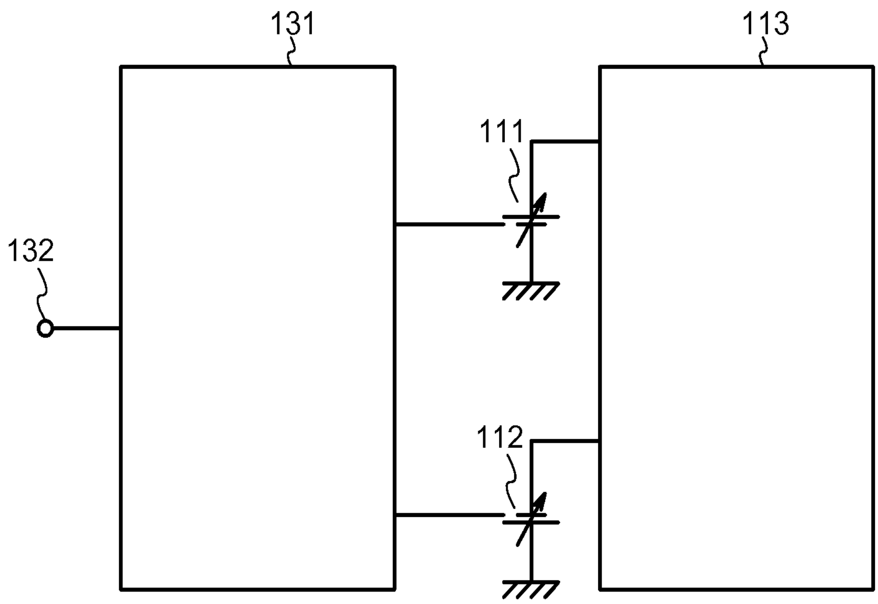


FIG.3

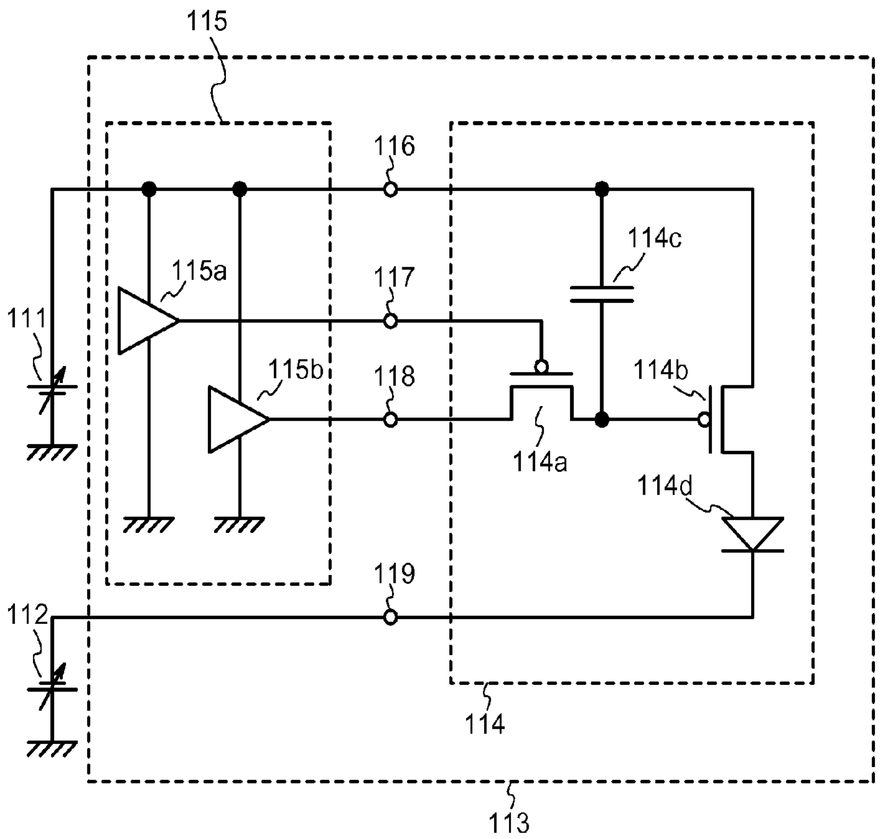

115
116
114c
115a
117
111
115b
118
114b
114a
114d
119
112
114
113

FIG.4

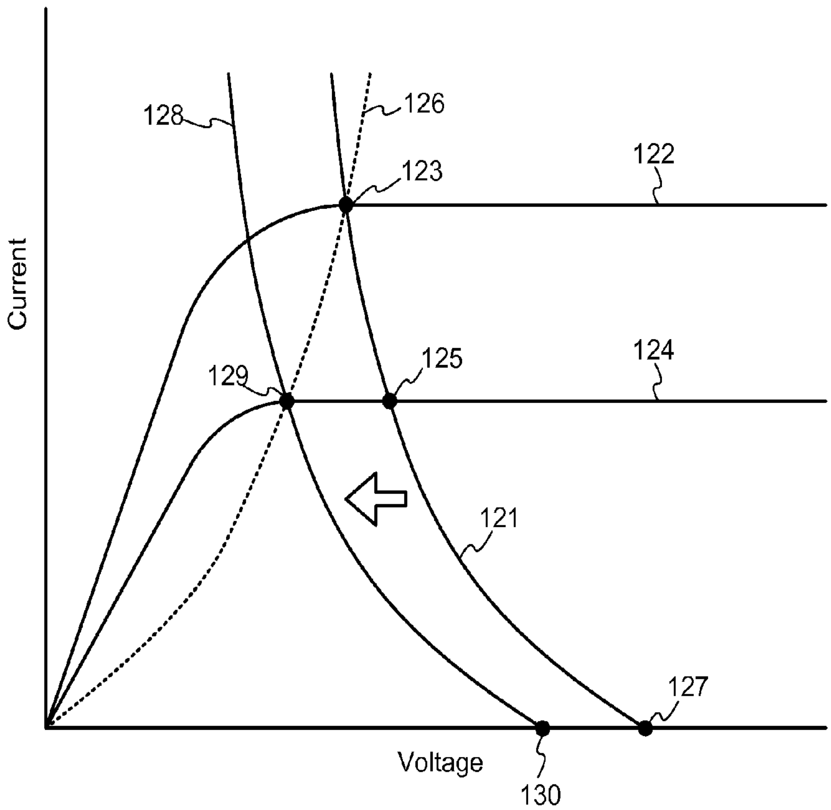


FIG.5

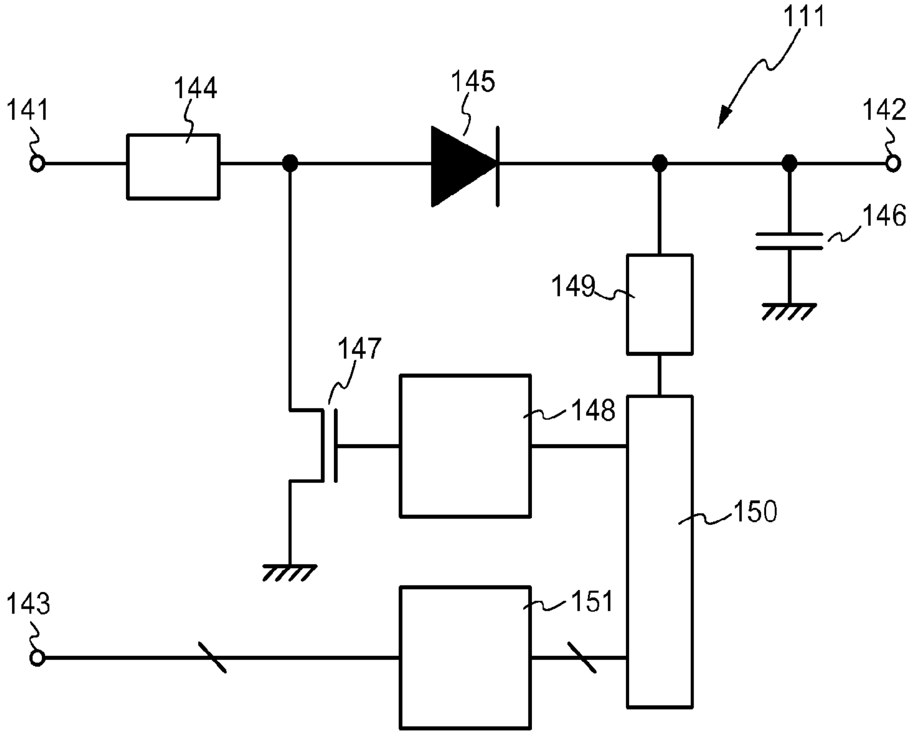


FIG.6

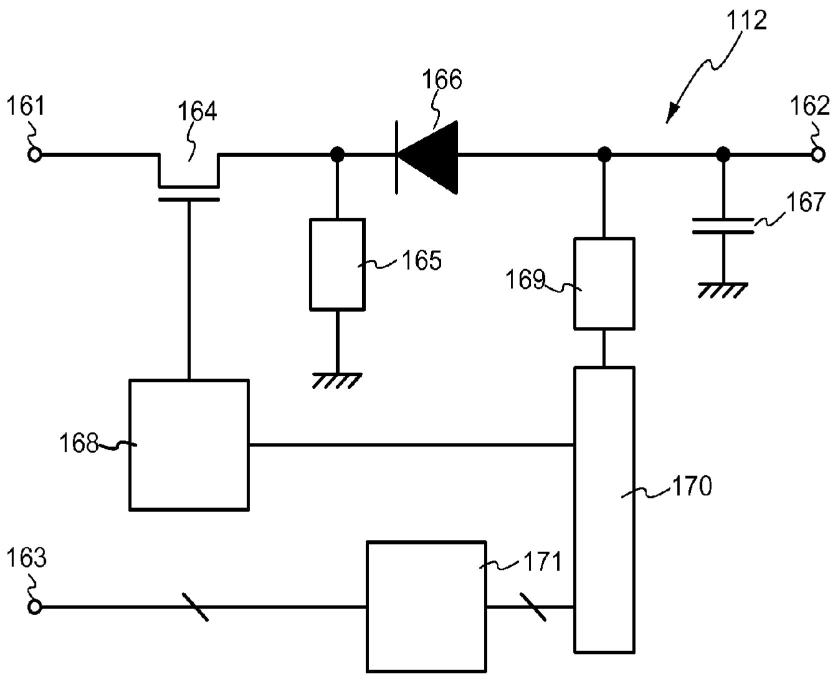


FIG.7

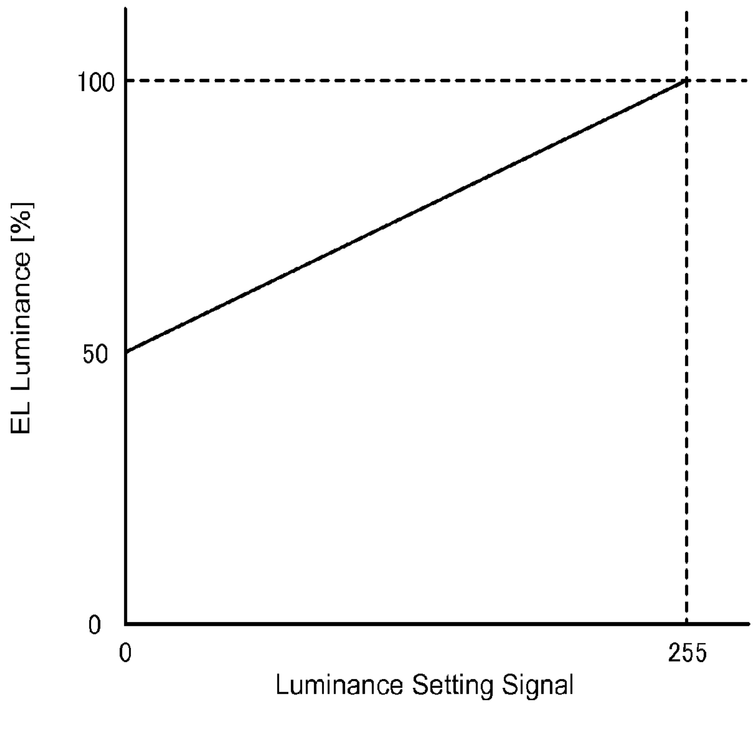


FIG.8

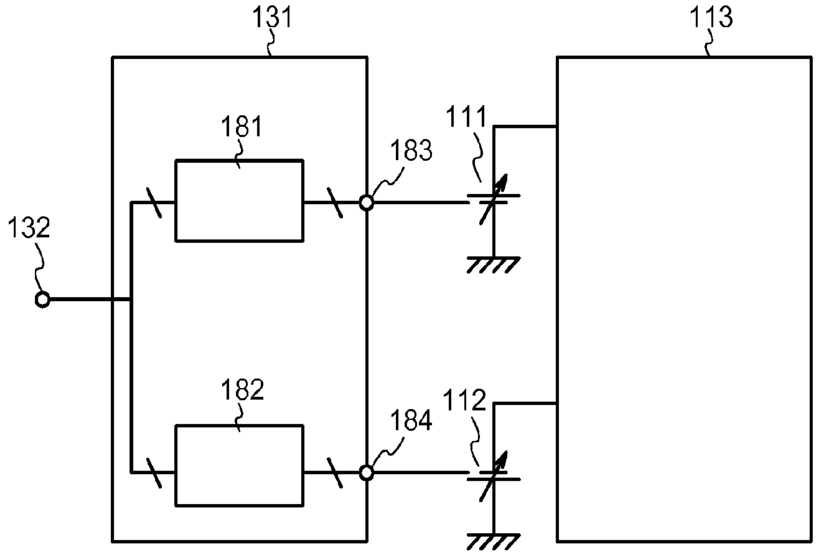


FIG.9

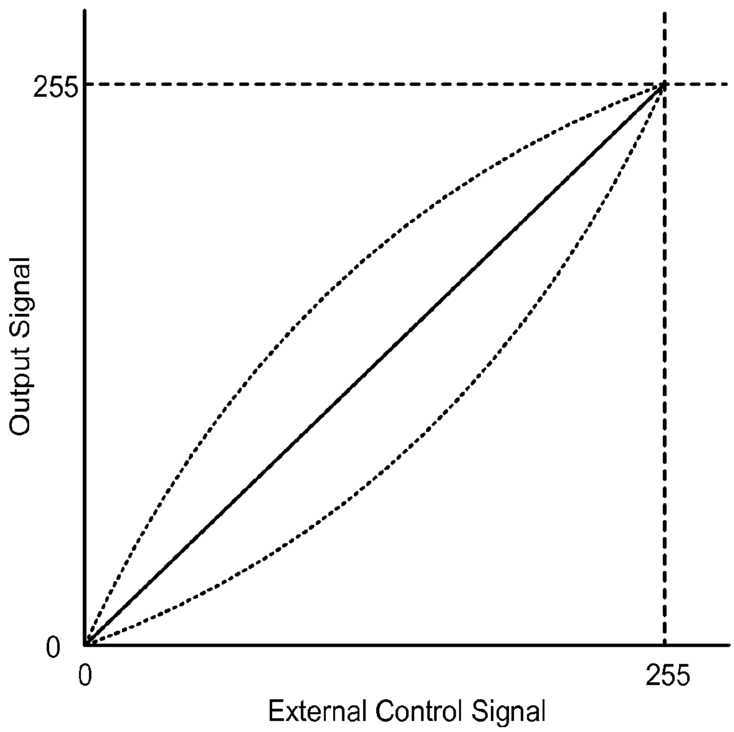


FIG.10

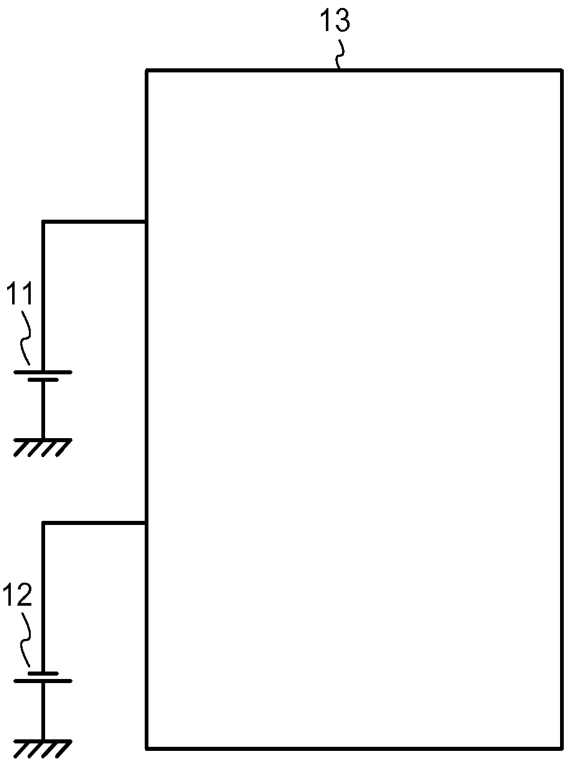


FIG.11

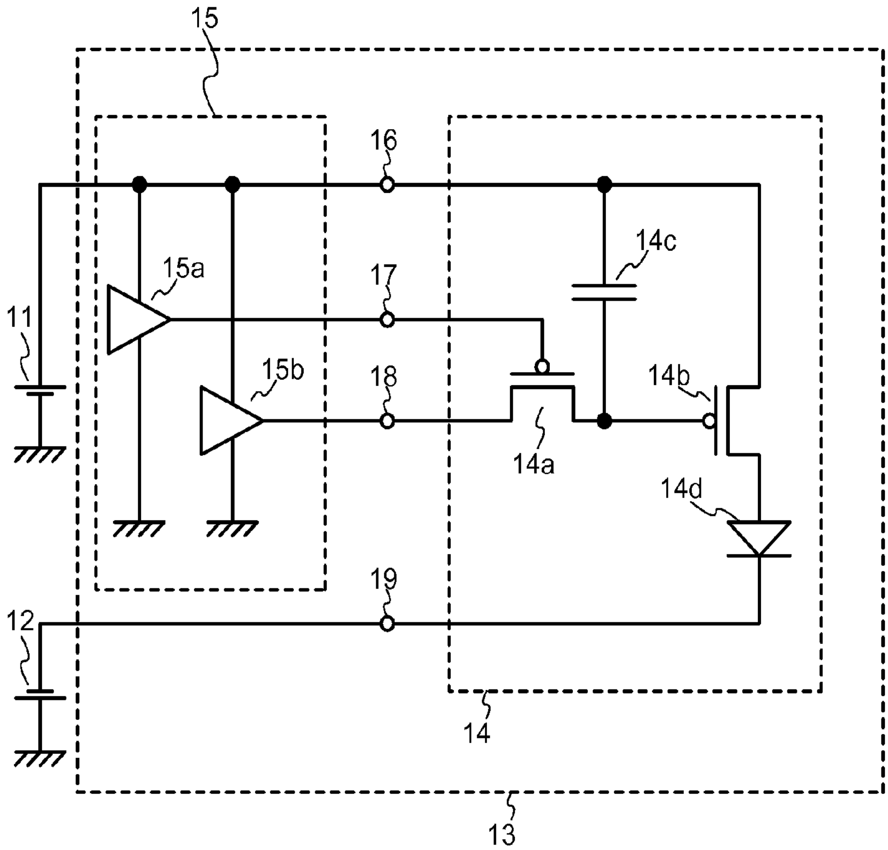
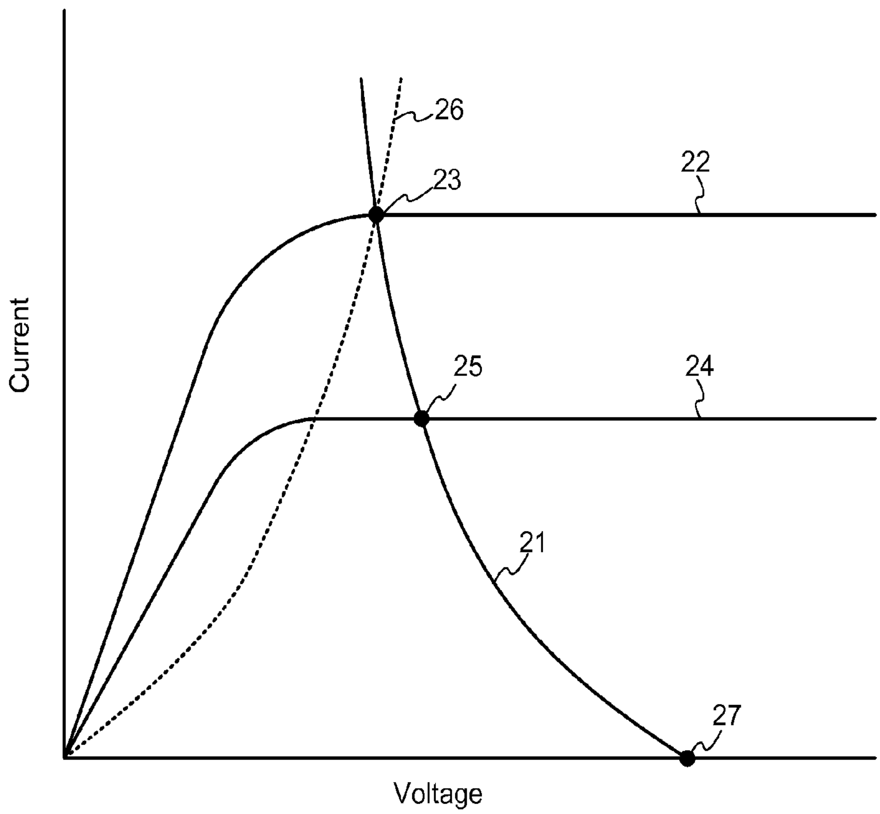


FIG.12



EL DISPLAY DEVICE AND METHOD OF CONTROLLING THE SAME

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application is based on and claims benefit of priority from the prior Japanese Patent Application No. 2014-227925, filed on Nov. 10, 2014, the entire contents of which are incorporated herein by reference.

FIELD

[0002] The present invention is related to an EL display device including a pixel formed from a light emitting element such as an electroluminescence element. In particular, the present invention is related to a power source circuit of an EL display device.

BACKGROUND

[0003] An electroluminescence element (referred to below as EL element) is known as a light emitting element utilizing an electroluminescence (EL) phenomenon. An EL element has a structure in which an EL material which serves as a light emitting material is sandwiched between an anode and a cathode and emits light at a wavelength depending on the type of EL material.

[0004] When a certain voltage is applied between the anode and cathode of an EL element, current flows between both and an EL material emits light with luminosity according to the value of the current. Therefore, it is possible to make an EL element emit light at a desired luminosity by controlling the current value supplied to the EL element.

[0005] FIG. **10** is a diagram for explaining an outline of an EL display device **13**. The EL display device **13** is arranged with two power sources for supplying a current to an EL element. Specifically, a first power source **11** which outputs a high potential and a second power source **12** which outputs a lower potential than the first power source **11** are arranged, and the EL display device **13** is controlled by supplying the potential from the two power sources.

[0006] FIG. **11** is a diagram showing a circuit structure of an outline of the EL display device **13**. A pixel circuit **14** and drive circuit **15** are arranged within the EL display device **13** and both electrically connected via a first power source line **16**, a gate signal (scanning signal) **17** and data signal line **18**. The first power source line **16** and second power source line **19** are connected to the first power source **11** and second power source **12** respectively. In this way, the first power source **11** and second power source **12** are electrically connected to the pixel circuit **14** respectively.

[0007] The pixel circuit **14** is respectively arranged in a plurality of pixels which form a pixel part (display region) of the EL display device **13** and performs control for making the EL element emit light according to image data. Basically, the pixel circuit **14** includes a first transistor **14***a*, second transistor **14***b*, capacitance element **14***c* and EL element **14***d*. The first transistor **14***a* and second transistor **14***b* typically are formed from thin film transistor (TFT).

[0008] The drive circuit **15** is a logic circuit which generates a gate signal or data signal supplied to the pixel circuit **14** and is typically arranged as drive IC (Integrated Circuit). Basically, the drive circuit **15** includes a logic buffer **15***a* which supplies a gate signal to the gate signal line **17** and an analog buffer **15***b* which supplies a data signal to the data signal line **18**.

[0009] In the EL display device **13** shown in FIG. **11**, the first power source **11** is connected to the logic buffer **15***a*, analog buffer **15***b*, capacitance element **14***c* and the source of the second transistor **14***b* via the first power source line **16**. The second power source **12** is connected to a cathode terminal of the EL element **14***d* via the second power source line **19**. In addition, the logic buffer **15***a* is connected to a gate terminal of the first transistor **14***a* via the gate signal line **17**, and the analog buffer **15***b* is connected to a source/drain terminal of the first transistor **14***a* via the data signal line **18**.

[0010] Actually, the pixel circuit **14** is arranged for each of the plurality of pixels arranged in the pixel part of the EL display device **13** and each pixel circuit **14** is connected to a corresponding gate signal line **17** and data signal line **18**. The first power source line **16** and second power source line **19** are commonly connected to all of the pixels.

[0011] Next, the circuit operation in the EL display device **13** is explained. In the pixel circuit **14**, when an active potential (potential for opening the gate of a transistor) is supplied to the gate terminal of the first transistor **14***a* via the gate signal line **17**, the first transistor **14***a* is switched to an ON state. In this way, a data signal supplied via the data signal line **18** is stored in the capacitance element **14***c* via the first transistor **14***a*.

[0012] The potential stored in the capacitance element **14***c* is also supplied to the gate terminal of the second transistor **16***b*. The second transistor **14***b* flows a current (drain current) according to a potential level of a data signal supplied to a gate terminal and supplies the current to the EL element **14***d*. The EL element **14***d* emits light at a luminosity according to the value of the current supplied from the second transistor **14***b*. That is, when a maximum potential is supplied to the gate terminal of the second transistor **14***b*, the EL element **14***d* emits light at maximum luminosity and when a minimum potential is supplied to the gate terminal, the EL element **14***d* does not emit light.

[0013] FIG. **12** is a diagram showing the load characteristics of the second transistor **14***b* and EL element **14***d*. In FIG. **12**, the horizontal axis is the difference (power source voltage) between the first power source **11** and second power source **12**, and the vertical axis is the current (drain current) flowing between the source and drain of the second transistor **14***b*.

[0014] In FIG. **12**, the curved line **21** indicates the voltage-current characteristics of the EL element **14***d*, what is called diode characteristics. The EL element **14***d* emits light at a luminosity almost proportional to the value of a current flowing through the element. The curved line **22** indicates the relationship between the voltage between the source and drain of the second transistor **14***b* and a drain current, what is called MOS transistor characteristics. The second transistor **14***b* is arranged with a characteristic which does not flow a drain current in the case where a gate/source voltage (difference between a source potential and gate potential) is below a certain threshold and flows a drain voltage when it is above a certain threshold.

[0015] Here, a method of setting a power source voltage in the EL display device **13** is explained using FIG. **12**. First, a desired maximum luminosity in the EL display device **13** is determined and based on this the value of a current flowing to the EL element **14***d* is determined. As described above, since the value of a current flowing to the EL element **14***d* and the value of a current flowing to the second transistor **14***b* are the same, the intersection between the curved line **21** and the curved line **22** is an operating point in the case where a maximum luminosity is obtained. On the other hand, in the case of a minimum luminosity, since the EL element **14***d* does not flow a current, the intersection point **27** between the curved line **21** and the horizontal axis becomes the operating point in the case where a minimum luminosity is obtained. In addition, the space between the operating point **23** and the operating point **27** becomes an operating point when displaying at an arbitrary gradation.

[0016] In order to consecutively display a luminosity from a minimum luminosity through to a maximum luminosity, the operating point **23** for obtaining a maximum luminosity is required to be set within a saturation region of the second transistor **14***b*, and in order to reduce power consumption to a minimum, usually the operating point **23** when at maximum luminosity is set near a boundary between a saturation region and linear region of the second transistor **14***b*. In this way, it is possible to set the power source voltage to a minimum and minimize power consumption.

[0017] Here, in the case where a user lowers the luminosity of an EL display device, the potential of a data signal is lowered and the potential supplied to the gate terminal of the second transistor **14***b* is lowered. That is, the gate voltage of the second transistor **14***b* is lowered. In this case, the relationship between the voltage between the source and drain of the second transistor **14***b* and the drain current changes to the relationship shown in the curved line **24**. Therefore, the operating point of a maximum luminosity changes to the intersection point **25** from the intersection point **23**.

[0018] Here, the curved line **26** plots the boundary between the saturation region and linear region of the second transistor **14***b* with respect to the current characteristics (curved line **22**, **24** etc) under various gate voltages. As is clear from FIG. **12**, while a user uses an EL display device at a low luminosity, since the operating point **25** is misaligned from the boundary between the saturation region and linear region of the second transistor **14***b* (that is, intersection point between curved line **24** and curved line **26**), minimization of power consumption was not achieved.

[0019] In addition, in the EL display device **13**, since output potential of the first power source **11** and the output potential of the second power source **12** are constant values respectively, in the case where a user lowers luminosity, only a reduction in power equal to the reduction in the value of the current flowing through the EL element **14***d* is obtained and it could not be said that a sufficient reduction in power consumption was achieved.

[0020] In order to deal with such problems, a technology is disclosed in the patent document 1 in which an output potential of a powers source connected to the cathode of an EL element is lowered in the case where the gate voltage of a transistor connected in series is lowered with respect to the EL element, and the voltage (CV margin) applied to the EL element is decreased. In this way, in the EL display device described in patent document 1, in addition to the reduction in power due to a decrease in the value of a current flowing through the EL element, a reduction in power consumption is achieved by a reduction in power due to a decrease in a CV margin.

SUMMARY

[0021] An EL display device in one embodiment of the present invention is an EL display device controlling luminosity by a current value supplied to a light emitting element, the EL display device includes a power source supplying a] current to the light emitting element and including a first variable power source and a second variable power source outputting a lower potential than the first variable power source, and a control part changing an output potential of the first variable power source and an output potential of the second variable power source according to acquired maximum luminosity data.

[0022] The EL display device in another embodiment of the present invention further includes a gate signal output part, and a data signal output part, the control part changing a power source potential of the gate signal output part or a power source potential of the data signal output part according to the maximum luminosity data.

[0023] The control part may acquire the maximum luminosity data based on an acquired image signal and may acquire the maximum luminosity data based on acquired user luminosity operation data.

[0024] An EL display device in one embodiment of the present invention is a method of controlling an EL display device controlling luminosity by a current value supplied to a light emitting element and including a power source supplying a current to the light emitting element including a first variable power source and a second variable power source outputting a lower potential than the first variable power source, and a control part making an output potential of the power source variable, the method includes the control part changing an output potential of the first variable power source and an output potential of the second variable power source according to acquired maximum luminosity data.

[0025] The EL display device in another embodiment of the present invention further includes a gate signal output part, and a data signal output part, the control part changing a power source potential of the gate signal output part or a power source potential of the data signal output part according to the maximum luminosity data.

[0026] The control part may acquire the maximum luminosity data based on an acquired image signal and may acquire the maximum luminosity data based on acquired user luminosity operation data.

BRIEF EXPLANATION OF DRAWINGS

[0027] FIG. **1** is a diagram showing an external structure in an EL display device related to an embodiment of the present invention;

[0028] FIG. **2** is a diagram showing a circuit structure in an EL display device related to an embodiment of the present invention;

[0029] FIG. **3** is a diagram showing a circuit structure of a display control circuit in an EL display device related to an embodiment of the present invention;

[0030] FIG. **4** is a diagram showing load characteristics of a second transistor and an EL element in a display device related to an embodiment of the present invention;

[0031] FIG. **5** is a diagram showing a structure of a positive power source circuit in a display device related to an embodiment of the present invention;

[0032] FIG. **6** is a diagram showing a structure of a negative power source circuit in a display device related to an embodiment of the present invention;

[0033] FIG. **7** is a diagram showing a relationship between a luminosity setting signal and EL luminosity in a display device related to an embodiment of the present invention;

[0034] FIG. **8** is a diagram showing a structure of a power source control circuit in a display device related to an embodiment of the present invention;

[0035] FIG. **9** is a diagram showing a structure of a back-up table in a power source control circuit in a display device related to an embodiment of the present invention;

[0036] FIG. **10** is a diagram showing an external structure in an EL display device;

[0037] FIG. **11** is a diagram showing a circuit structure of a display control circuit in an EL display device; and

[0038] FIG. **12** is a diagram showing load characteristics of a second transistor and an EL element in an EL display device.

DESCRIPTION OF EMBODIMENTS

[0039] The technology described in the patent document 1 focuses only on reducing power consumed by an EL element and did not consider power consumed by other drive circuits. That is, the patent document 1 lacks the point of view of reducing power across the entire EL display device and there was no room for further improvement in low power consumption of an EL display device.

[0040] Therefore, one aim of the present invention is to provide a technology to reduce power consumption of an EL display device. In particular, it is an aim of the present invention to provide an EL display device which reduces power consumption not just of an EL display element but also of other drive circuits.

[0041] Each embodiment of the present invention is explained below while referring to the diagrams. However, the present invention can be realized by various forms that does not depart from the scope of the present invention and should not be interpreted as being limited to the content described in the embodiments exemplified herein. In addition, in each diagram of the present specification, the same reference symbols are attached to elements that have been explained in relation to previous diagrams and elements with the same function and therefore overlapping explanations are sometimes omitted.

[0042] FIG. **1** is a diagram showing an entire structure of an organic EL display device **100** in an embodiment of the present invention. The organic EL display device **100** of the present embodiment includes a pixel part **102** above a first substrate **101** for forming elements. The pixel part **102** is arranged with a pixel **103** in a matrix shape and a pixel circuit described below is incorporated into each pixel **103**. A second substrate **104** is arranged as a sealing material above the first substrate **101** and has a structure for preventing the infiltration of water from the exterior. Light output from the pixel part **102** is emitted in the direction of the arrow and is observed by a user.

[0043] A drive IC **105** is arranged by a mounting method such as flip chip and the like as an external IC above the first substrate **101**. The drive IC **105** is a logic circuit which outputs a signal for driving an active element such as a thin film transistor arranged in the pixel part **102** and mainly functions as a gate line drive circuit and data line drive circuit. Input and output of a signal to and from the drive IC **105** is performed via a FPC (Flexible Print Circuit) **106**.

[0044] Furthermore, although an example is shown in the present embodiment in which the drive IC **105** is provide with a gate line drive circuit and data line drive circuit function, it is also possible to form a gate line drive circuit and data line drive circuit using a thin film transistor above the first substrate **101**. It is possible to form a gate line drive circuit above the first substrate **101** and the function of a data line drive circuit can be incorporated into the drive IC **105**.

[0045] In the EL display device **100** of the present embodiment, although a power source drive circuit described herein may be incorporated into the drive IC **105**, a separate IC (a power management IC for example) from the drive IC **105** may also be arranged.

[0046] A data signal is applied according to image data from the drive IC **105** and a gate signal matching a certain timing is applied to each pixel which forms the pixel part **102** shown in FIG. **1**. By applying the data signal and gate signal to a transistor arranged in each pixel, it is possible to perform a screen display according to the image data. Typically it is possible to use a thin film transistor using thin film formation technology as the transistor. However, the transistor is not limited to a thin film transistor and any element may be used as long as the element can control a current amount.

[0047] FIG. **2** is a diagram showing an approximate pixel structure in the EL display device **100** in the present embodiment. The EL display device **100** in the present embodiment is arranged with two variable power sources for use as power sources of an EL element and drive IC. Specifically, a first variable power source **111** which outputs a high potential and a second variable power source **112** which outputs a lower potential than the first variable power source are arranged, and a display control circuit **113** is controlled by the output potential of these two power sources. Here, the display control circuit **113** is a generic name for a circuit group including a pixel circuit included in the pixel part **112** described above and a drive circuit included in the drive IC **105**.

[0048] In addition, the EL display device **100** in the present embodiment includes a power source control circuit **131** for controlling the first variable power source **111** and second variable power source **112**. The power source control circuit **131** is a control circuit for adjusting the output potential of the first variable power source **111** and second variable power source **112** according to a luminosity setting signal input from an external input terminal **132**. In the present embodiment, a signal based on maximum luminosity data is used as the luminosity setting signal. Maximum luminosity data is data which expresses maximum luminosity which the EL display device attempts to output, and may be acquired based on an image signal or based on luminosity operation data of a user.

[0049] Furthermore, although the display control circuit **113** and power source control circuit **131** are described as separated circuits, it is possible to incorporate the function of the power source control circuit **131** into the display control circuit **113**. In this case, the power source control circuit **131** may be incorporated into the drive IC **105** shown in FIG. **1** for example.

[0050] FIG. **3** is a diagram showing a circuit structure within the display control circuit **113**. A pixel circuit **114** and drive circuit **115** are arranged within the display control circuit **113** shown in FIG. **3** and both are electrically connected via a first power source line **114**, gate signal (scanning signal) line **117** and data signal (image signal) line **118**. The first power source line **116** and second power source line **119** are connected to the first variable power source **111** and second variable power source **112** respectively. In this way, the first variable power source **111** and second variable power source **112** are electrically connected to the pixel circuit **114** respectively.

[0051] The pixel circuit **114** is a circuit in which each of a plurality of pixels **103** which form the pixel part **102** of the EL display device **100** shown in FIG. **1** is arranged and performs control for causing an EL element to emit light according to image data. Basically, the pixel circuit **114** has a structure including a first transistor **114***a*, second transistor **114***b*, capacitance element **114***c* and EL element **114***d*. The first transistor **114***a* functions as a switch when a data signal is input to each pixel. The second transistor **114***b* is used for adjusting the value of a current supplied to the EL element **114***d*. The capacitance element **114***c* includes a function for storing a potential supplied to a gate terminal of the second transistor **114***b* when each pixel is in an OFF state.

[0052] The first transistor **114***a* and the second transistor **114***b* typically can be formed using a thin film transistor. In the present embodiment, although the first transistor **114***a* and second transistor **114***b* are formed using a P channel type transistor, the first and second transistors may also be formed using a N channel type transistor. However, in this case, since the direction of a flowing current is reversed, the relationship of the output potential of the first variable power source **111** and second variable power source **112** and the direction of the EL element **114** are reversed.

[0053] The drive circuit **115** is a logic circuit which generates a gate signal and data signal supplied to the pixel circuit **114**. Basically, the drive circuit **115** has a structure including a logic buffer (gate signal output part) **115***a* which supplies a gate signal to the gate signal line **117**, and an analog buffer (data signal output part) **115***b* which supplies a data signal to the data signal line **118**. Furthermore, although a pixel structure is simplified in FIG. **3**, actually, since a pixel circuit **114** is arranged in each pixel, a plurality of first power source lines **116**, a plurality of gate signal lines **117** and plurality of data signal lines **118** are arranged in a matrix shape in the pixel part **102**.

[0054] In the display control circuit **113** having the structure described above, the first variable power source **111** is connected to the logic buffer **115***a*, analog buffer **115***b*, capacitance element **114***c* and source terminal of the second transistor **114***b* via the first power source line **116**. The second variable power source **112** is connected to the cathode terminal of the EL element **114***d* via the second power source line **119**. In addition, the logic buffer **115***a* is connected to the gate terminal of the first transistor **114***a* via the gate signal line **117** and the analog buffer **115***b* is connected to the source/drain terminal of the first transistor **114***a* via the data signal line **118**. In addition, the first power source line **116** and second power source line **119** are commonly connected to all of the pixels.

[0055] Next, a circuit operation in the EL display device **100** of the present embodiment is explained. In the pixel circuit **114**, when a gate signal of an active potential output from the logic buffer **115***a* is supplied to the gate terminal of the first transistor **114***a* via the gate signal line **117**, the first transistor **114***a* is switched to an ON state. In this way, a data signal output from the analog buffer **115***b* is stored in the capacitance element **114***c* via the data signal line **118** and first transistor **114***a*.

[0056] The data signal stored in the capacitance **114***c* is also supplied to the gate terminal of the second transistor **114***b*. The second transistor **114***b* flows a current (drain current) according to the potential level of the data signal supplied to the gate terminal and the voltage difference between the first variable power source **111** and second variable power source **112** (voltage supplied between the source and drain of the second transistor **114***b*) and supplied the current to the EL element **114***d*. The EL element **114***d* emits light at a luminosity according to the value of the current supplied from the second transistor **114***b*.

[0057] That is, when a maximum potential is supplied to the gate terminal of the second transistor **114***b*, a maximum current flows to the EL element **114***d* and the EL element **114***d* emits light at maximum luminosity. Reversely, since a current does not flow to the EL element **114***d* when a minimum potential is supplied to the gate terminal, the EL element **114***d* does not emit light.

[0058] FIG. **4** is a diagram showing the load characteristics of the second transistor **114***b* and EL element **114***d*. In FIG. **4**, the horizontal axis is a voltage difference between the first variable power source **111** and second variable power source **112** and the vertical axis is a current (drain current) which flows between the source and drain of the second transistor **114***b*. In this case, the drain current can be considered to be a current which flows to the EL element **114***d*.

[0059] In FIG. **4**, the curved line **121** is the voltage-current characteristics of the EL element **114***d*, what is called diode characteristics. The EL element **114***d* emits light at a luminosity almost in proportion to the value of a current flowing through the element. The curved line **122** shows the relationship between a voltage between the source and drain of the second transistor **114***b* and a drain current and here illustrates the characteristics of a MOS transistor. That is, the second transistor **114***b* is arranged with a characteristic for not flowing a drain current when the voltage between the source and drain (difference between the source potential and gate potential) is below a certain threshold and flows a drain current when the voltage is above the threshold.

[0060] Here, a setting method of a power source voltage of the EL display device **100** in the present embodiment is explained using FIG. **4**. First, a maximum luminosity is determined as the EL display device and depending on this, the value of a current which should flow to the EL element **114***d* is determined. As described above, since the value of a current which flows to the EL element **114***d* and the value of a current which flows to the second transistor **114***b* are equal, the intersection point **123** between the curved line **121** and curved line **122** serves as an operating point in the case where a maximum luminosity is obtained. On the other hand, in the case of a minimum luminosity, since the EL element **114***d* does not flow a current, the intersection point **127** between the curved line **121** and the horizontal axis become an operating point in the case where a minimum luminosity is obtained. In addition, the space between the operating point **123** and operating point **127** is an operating point when expressing an arbitrary gradation.

[0061] In order to be able to consecutively display luminosity from a minimum luminosity to a maximum luminosity, the operating point **123** for obtaining a maximum luminosity is required to be set in a saturation region of the second transistor **114***b*. In order to minimize power consumption in the EL display device **100** of the present embodiment, the operating point **123** at maximum luminosity is set near the boundary of a saturation region and linear region of the second transistor **114***b*. In this way, a voltage difference between the first variable power source **111** and second variable power source **112** can be set to a minimum and it is possible to minimize power consumption.

[0062] Here, in the case where the luminosity of the EL display device **100** is set low by a user, the potential of a data signal output from the analog buffer **115***b* is lowered according to maximum luminosity data based on the set luminosity and the potential supplied to the gate terminal of the second transistor **114***b* is lowered. That is, the gate voltage of the second transistor **114***b* is lowered. In this case, the relationship between the voltage between the source and drain of the second transistor **114***b* and the drain current changes to the relationship shown in the curved line **124**. Therefore, the operating point at maximum luminosity also changes to the operating point **125** from the operating point **123**.

[0063] Furthermore, in the EL display device **100** of the present embodiment, the power source control circuit **131** shown in FIG. **2** changes the output potential of both the first variable power source **111** and the second variable power source **112** according to maximum luminosity data input as a luminosity setting signal, and the position of the curved line **121** becomes misaligned to the position of the curved line **128** as is shown by the arrow. That is, the output potential of the first variable power source **111** is lowered so that the operating point **125** above the curved line **124** shifts to the point **129** above the curved line **126** which shows the boundary between the saturation region and linear region of the second transistor **114***b* and the output potential of the second variable power source **112** is increased.

[0064] In this case, the EL element **114***b* emits light at maximum luminosity when operating at the operating point **129** and as well as emitting light at minimum luminosity when operating at the operating point **130**, operates at an operating point between the operating point **129** and **130** and thereby expresses an arbitrary gradation.

[0065] In this way, in the EL display device **100** of the present embodiment, it is possible to reduce the voltage difference (that is, power source voltage) between the first variable power source **111** and the second variable power source **112** from the operating point **127** to the operating point **130**. Therefore, compared to a conventional EL display device, in addition to the effect of reducing power due to a reduction in the value of a current that flows to an EL element, it is possible to obtain a power reduction effects due to a reduction in a power source voltage.

[0066] In addition, by lowering the output potential of the first variable power source **111**, the power source potential supplied to the logic buffer **115***a* and analog buffer **115***b* is lowered. Therefore, it is also possible to reduce the power consumed by the logic buffer **115***a* and analog buffer **115***b*. In this way, in the EL display device **100** of the present embodiment, it is possible to obtain the effect of a reduction in power in proportion to the square of a power source voltage if the load of the drive IC is a capacitance load and also obtain the effect of a reduction in power in proportion to a power source voltage if the load is a current load.

[0067] Next, the structure of a power source circuit and the structure of a power source control circuit of the EL display device **100** in the present embodiment are explained.

[0068] FIG. **5** is a diagram showing an example of a circuit structure of the first variable power source (positive power source) **111**. The first variable power source **111** in the present embodiment is a rise type switching regulator in which a voltage from 3.0 to 3.3V is input from an input terminal **141** and a voltage from 4.0 to 5.0V is output from an output terminal. In order to make an output voltage variable, an input control signal is input to a control terminal **143**. Of course, the structure is not limited to this and an output voltage may be made variable by an input control signal.

[0069] As is shown in FIG. **5**, the first variable power source **111** is arranged with an inductor **144**, a diode **145**, an output smoothing condenser **146**, a switching transistor **147**, a control circuit **148**, a resistor **149**, a variable resistor **150** and a DA converter **151**. An output voltage is split between the resistor **149** and variable resistor **150** and the output of the variable resistor **150** is input to the control circuit **148**. In addition, the output of the control circuit **148** is input to a gate terminal of the switching transistor **147** and ON/OFF control of the switching transistor **147** is performed. In this way, feedback control of an output voltage is performed and it is possible to stabilize fluctuation in an output voltage due to a load fluctuation.

[0070] The value of a voltage output from the output terminal **142** can be changed by changing the resistance value of the variable resistor **150**. An input control signal input to the control terminal **143** is decoded by the DA converter **151** and the variable resistor **150** is controlled based on the decoded data, thereby it is possible to turn the resistance value of the variable resistor **150** into a required resistance value. Specifically, the output voltage of the first variable power source **111** when an input control signal has a reference symbol of 0 is a minimum and is set to become a maximum when the reference symbol is 255.

[0071] For example, in the case where the EL element is made to emit light at maximum luminosity (100% luminosity), the resistance value of the variable resistor **150** is set so that the second transistor **114***b* operates at the characteristics shown in the curved line **122** shown in FIG. **4**. In addition, in the case where the EL element is made to emit light at medium luminosity (50% luminosity), the resistance value of the variable resistor **150** is set so that the second transistor **114***b* operates at the characteristics shown in the curved line **124** shown in FIG. **4**.

[0072] FIG. **6** is a diagram showing an example of a circuit structure of the second variable power source (negative power source) **112**. The second variable power source **112** in the present embodiment is an inverting type switching regulator in which a voltage from 3.0 to 3.3V is input from an input terminal **161** and a voltage from -5.0 to 15V is output from an output terminal **162**. In order to make an output voltage variable, an input control signal is input to a control terminal **163**. Of course, the structure is not limited to this and an output voltage may be made variable by an input control signal.

[0073] As is shown in FIG. **6**, the second variable power source **112** is arranged with a switching transistor **164**, an inductor **165**, a diode **166**, an output smoothing condenser **167**, a control circuit **168**, a resistor **169**, a variable resistor **170** and a DA converter **171**. An output voltage is split between the resistor **169** and variable resistor **170** and the output of the variable resistor **170** is input to the control circuit **168**. In addition, the output of the control circuit **168** is input to a gate terminal of the switching transistor **164** and ON/OFF control of the switching transistor **164** is performed. In this way, feedback control of an output voltage is performed and it is possible to stabilize fluctuation in an output voltage due to a load fluctuation.

[0074] The value of a voltage output from the output terminal **162** can be changed by changing the resistance value of the variable resistor **170**. An input control signal input to the control terminal **163** is decoded by the DA converter **171** and the variable resistor **170** is controlled based on the decoded data, thereby it is possible to turn the resistance value of the variable resistor **170** into a required resistance value. Specifically, the output voltage of the second variable power source **112** when an input control signal has a reference symbol of 0 is a minimum and is set to become a maximum when the reference symbol is 255.

[0075] For example, in the case where the EL element is made to emit light at maximum luminosity (100% luminosity), the resistance value of the variable resistor **170** is set so that the voltage difference between the first variable power source **111** and second variable power source **112** satisfies the voltage of the operating point **127** in FIG. **4**. That is, the resistance value of the variable resistor **170** is set so that the voltage-current characteristics of the EL element **114***d* becomes the curved line **121**. In addition, in the case where the EL element is made to emit light at medium luminosity (50% luminosity), the resistance value of the variable resistor **150** is set so that the voltage difference between the first variable power source **111** and second variable power source **112** satisfies the voltage of the operating point **130** in FIG. **4**. That is, the resistance value of the variable resistor **170** may be set so that the voltage-current characteristics of the EL element **114***d* becomes the curved line **128**.

[0076] FIG. **7** is a diagram showing the relationship between a luminosity setting signal input to the power source control circuit **131** and the luminosity of the EL display device **100**. In the present embodiment, a luminosity setting signal is set as an 8 bit digital signal and is minimum luminosity when at 0 and maximum luminosity when at 255. As is shown in FIG. **7**, a value from 0~255 is allocated as a luminosity setting signal between a minimum luminosity (50%) and maximum luminosity (100%).

[0077] Furthermore, in the present embodiment, although luminosity of a maximum luminosity was set as a minimum luminosity when considering actual usage, usually it may be set between 20% or more and 50% or less. Of course, it is also possible to set the luminosity between 0% or more and 100% or less. In addition, although the luminosity setting signal was set as an 8 bit digital signal, the signal is not limited to this format.

[0078] FIG. **8** is a diagram showing an example of a circuit structure of the power source control circuit **131**. The luminosity setting signal input to the external input terminal **132** is input to a first LUT (look up table) **181** and second LUT (look up table) **182**. Data for each output conversion is stored in the first LUT **181** and second LUT **182**. A conversion result by the first LUT **181** is output from an output terminal **183** and input to the control terminal **143** of the first variable power source **111** shown in FIG. **5**. In addition, a conversion result by the second LUT **182** is output from an output terminal **184** and input to the control terminal **163** of the second variable power source **112** shown in FIG. **6**.

[0079] The data stored in the first LUT **181** and second LUT **182** outputs a control signal to the first variable power source **111** and second variable power source **112** so that the EL display device **100** emits light at an appropriate luminosity according to the input luminosity setting signal. For example, the EL display device **100** emits light at maximum luminosity when the luminosity setting signal formed from an 8 bit digital signal is 255 and a control signal is output so that the EL display device **100** emits light at minimum luminosity when the luminosity setting signal is 0.

[0080] FIG. **9** is a diagram showing the input output relationship of the first LUT **181** and the second LUT **182**. By using a look up table as the power source control circuit **131**, it is possible to realize no only a linear relationship but also various other input output relationships such as a non-linear relationship. That is, if a look up table is used, since it is possible to output various conversion outputs as control signals of a variable power source according to a luminosity setting signal, it is possible to improve luminosity correction and adjustment freedom.

[0081] Furthermore, in the present embodiment, an example was shown in which a luminosity setting signal input to the power source control circuit **131** is converted using the look up table and output as a control signal for controlling the first variable power source **111** and second variable power source **112**. However, the present invention is not limited to this, it is also possible to form the power source control circuit **131** using an analog logic circuit or digital logic circuit, perform calculations with respect to the input luminosity setting signal and output as a control signal for controlling the first variable power source **111** and second variable power source **112**.

[0082] Using the EL display device explained as an embodiment of the present invention, a person ordinarily skilled in the art could appropriately perform an addition or removal of structural components or design modification or an addition of processes or an omission or change in conditions which are included in the scope of the present invention as long as they do not depart from the subject matter of the present invention.

[0083] In addition, even if the effects are different to the effects brought about by the embodiments described above, those effects which are clear from the descriptions in the present specification or could be easily foreseen by a person ordinarily skilled in the art should also be interpreted as being brought about by the present invention.

What is claimed is:

1. An EL display device controlling luminosity by a current value supplied to a light emitting element comprising:
- a power source supplying a current to the light emitting element and including a first variable power source and a second variable power source outputting a lower potential than the first variable power source; and
- a control part changing an output potential of the first variable power source and an output potential of the second variable power source according to acquired maximum luminosity data.

2. The EL display device according to claim **1** further comprising:
- a gate signal output part; and
- a data signal output part:
- the control part changing a power source potential of the gate signal output part or a power source potential of the data signal output part according to the maximum luminosity data.

3. The EL display device according to claim **1**, wherein the control part acquires the maximum luminosity data based on an acquired image signal.

4. The EL display device according to claim **1**, wherein the control part acquires the maximum luminosity data based on acquired user luminosity operation data.

5. The EL display device according to claim **1**, wherein the first variable power source is connected to an anode side of the light emitting element and the second variable power source is connected to a cathode side of the light emitting element.

6. The EL display device according to claim **1**, wherein the control part is arranged within an external IC.

7. The EL display device according to claim **1**, wherein the control part is arranged with a look up table correlating a control signal controlling the first variable power source and the second variable power source and a luminosity setting signal according to the maximum luminosity data.

8. A method of controlling an EL display device controlling luminosity by a current value supplied to a light emitting element and including a power source supplying a current to the light emitting element including a first variable power source and a second variable power source outputting a lower potential than the first variable power source, and a control part making an output potential of the power source variable, the method comprising:

the control part changing an output potential of the first variable power source and an output potential of the second variable power source according to acquired maximum luminosity data.

9. The method of controlling an EL display device according to claim **8** further comprising:

the EL display device including a gate signal output part and a data signal output part;

the control part changing a power source potential of the gate signal output part or a power source potential of the data signal output part according to the maximum luminosity data.

10. The method of controlling an EL display device according to claim **8**, wherein the control part acquires the maximum luminosity data based on an acquired image signal.

11. The method of controlling an EL display device according to claim **8**, wherein the control part acquires the maximum luminosity data based on acquired user luminosity operation data.

12. The method of controlling an EL display device according to claim **8**, wherein the control part changes an output potential of the power source based on a look up table correlating a control signal controlling the first variable power source and the second variable power source and a luminosity setting signal according to the maximum luminosity data.

* * * * *

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摘要(译)

EL显示装置通过提供给发光元件的电流值来控制亮度。 EL显示装置包括向发光元件提供电流的电源，并且包括输出比第一可变电源低的电位的第一可变电源和第二可变电源，以及改变输出电位的控制部分。第一可变电源和第二可变电源的输出电位根据获取的最大发光度数据。此外，EL显示装置包括栅极信号输出部分和数据信号输出部分，并且控制部分可以根据最大值改变栅极信号输出部分的电源电位或数据信号输出部分的电源电位。光度数据。