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(54) **Current sampling circuit for organic electroluminescent display**

Stromabtastschaltung für organische Elektrolumineszenzanzeige

Circuit d'échantillonnage de courant pour dispositif d'affichage électroluminescent organique

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Description

[0001] The present invention relates, inter alia, to a driver circuit. One particular application of such a driver circuit is for driving a pixel of an organic electroluminescent device.

[0002] An organic electro-luminescent (OEL) element comprises a light emitting material layer sandwiched between an anode layer and a cathode layer. Electrically, this element operates like a diode. Optically, it emits light when forward biased and the intensity of the emission increases with the forward bias current. It is possible to construct a display panel with a matrix of OEL elements fabricated on a transparent substrate and with at least one of the electrode layers being transparent. One can also integrate the driving circuit on the same panel by using low temperature polysilicon thin film transistor (TFT) technology.

[0003] In a basic analog driving scheme for an active matrix OEL display, a minimum of two transistors are required per pixel (Figure 1): T_1 is for addressing the pixel and T_2 is for converting the data voltage signal into current which drives the OEL element at a designated brightness; The data signal is stored by the storage capacitor $C_{storage}$ when the pixel is not addressed. Although p-channel TFTs are shown in the figures, the same principle can also be applied for a circuit with n-channel TFTs.

[0004] There are problems associated with TFT analog circuits and OEL elements do not act like perfect diodes. The light emitting material does, however, have relatively uniform characteristics. Due to the nature of the TFT fabrication technique, spatial variation of the TFT characteristics exists over the entire panel. One of the most important considerations in a TFT analog circuit is the variation of threshold voltage, ΔV_T, from device to device. The effect of such variation in an OEL display, exacerbated by the non perfect diode behaviour, is the non-uniform pixel brightness over the display panel, which seriously affects the image quality. Therefore, a built-in circuit for compensating a dispersion of transistor characteristics is required.

[0005] A circuit shown in figure 2 is proposed as one of built-in for compensating a variation of transistor characteristics. In this circuit, T_1 is for addressing the pixel. T_2 operates as an analog current control to provide the driving current. T_3 connects between the drain and gate of T_2 and toggles T_2 to be either a diode or in saturation. T_4 acts as a switch. Either T_1 or T_4 can be ON at any one time. Initially, T_1 and T_3 are OFF, and T_4 is ON. When T_4 is OFF, T_1 and T_3 are ON, and a current of known value is allowed to flow into the OEL element, through T_2. This is the programming stage because the threshold voltage of T_2 is measured with T_2 operating as a diode (with T_3 turned ON) while the programming current is allowed to flow through T_1, through T_2 and into the OEL element. T_3 shorts the drain and gate of T_2 and turns T_2 in to a diode. The detected threshold voltage of T_2 is stored by the capacitor C1 connected between the gate and source terminals of T_2 when T_3 and T_1 are switched OFF. Then T_4 is turned ON, the current is now provided by V_{DD}. If the slope of the output characteristics were flat, the reproduced current would be the same as the programmed current for any threshold voltage of T_2 detected. By turning ON T_4, the drain-source voltage of T_2 is pulled up, so a flat output characteristic will keep the reproduced current the same as the programmed current. Note that ΔV_{T2} shown in figure 2 is imaginary, not real.

[0006] A constant current is provided, in theory, during the active programming stage, which is t_2 to t_5 in the timing diagram shown in figure 2. The reproduction stage starts at t_6.

[0007] The circuit of figure 2 is advantageous but there is an on-going desire to reduce power consumption. In particular, implementation of the current-source in the circuit of figure 2 requires a bias voltage (V_{BIAS}) in addition to the supply voltage (V_{DD}). Although the supply voltage (V_{DD}) could be increased to cover the required bias voltage (V_{BIAS}) - which would have the advantage of reducing the component count, there is still an overall increase in system power consumption to program with any value of data current (I_{DAT}).

[0008] WO99/6501 discloses an active matrix electroluminescent display device which has an array of current-driven electroluminescent display elements, whose operations are each controlled by an associated switching means to which a drive signal for determining a desired light output is supplied in a respective address period and which is arranged to drive the display element according to the drive signal following the address period. Each switching means comprises a current mirror circuit in which the same transistor is used to both sense and produce the required drive current for the display element with the gate of the transistor being connected to a storage capacitance on which a voltage determined by the drive signal is stored.

[0009] Document WO98/48403 discloses an active matrix organic electroluminescent pixel structure comprising means for compensation of threshold variation of the driving transistor by storing of the correct value in an additional capacitor. WO98/48403 also discloses a method of operation of the pixel structure.

[0010] During a threshold voltage compensation step, the drive transistor is diode connected by switching on an auto zero transistor, and the threshold voltage of the drive transistor is charged on the capacitor. During the data write phase, the address transistor is switched on, and the data voltage is passed to the storage capacitor via a data transfer capacitor.

[0011] Attention is, by the present invention, drawn to the fact that all currents passing through the circuit of figure 2 pass through the OEL element. The significance of this to the present invention will be apparent from the description given hereinafter.

[0012] According to a first aspect of the present invention there is provided a circuit for driving a current driven element, according to that of claim 1.

[0013] The circuit may further comprise a third switching device, which is connected to bias the transistor to act as a diode during the programming stage. The third switching device may connect the first switching device to the gate of the transistor.

[0014] Preferably the transistor is a polysilicon thin film transistor.

[0015] The first switching means and the second switching means may be n-channel thin film transistors.

[0016] In a preferred embodiment, the first current path is connected to a current sink.

[0017] In one embodiment, the transistor may be a p-channel thin film transistor.

[0018] Advantageously, the current driven element may be an electroluminescent element.

[0019] According to a second aspect of the present invention, there is provided a method of controlling a current supply to a current driven element, according to that of claim 11.

[0020] Embodiments of the present invention will now be described by way of further example only and with reference to the accompanying drawings, in which:-

Figure 1 shows a conventional OEL element pixel driver circuit using two transistors,
Figure 2 shows a known current programmed OEL element driver with threshold voltage compensation,
Figure 3 shows a pixel driver circuit according to a first embodiment of the present invention,
Figure 4 shows a pixel driver circuit according to a second embodiment of the present invention,
Figure 5 shows several pixels in a matrix display wherein each pixel uses the circuit of figure 4,
Figure 6 is a schematic sectional view of a physical implementation of an OEL element and pixel driver according to an embodiment of the present invention,
Figure 7 is a simplified plan view of an OEL display panel incorporating the present invention,
Figure 8 shows another embodiment of a pixel driver circuit according to the present invention,
Figure 9 shows another embodiment of a pixel driver circuit according to the present invention,
Figure 10 is a schematic view of a mobile personal computer incorporating a display device having a pixel driver according to the present invention,
Figure 11 is a schematic view of a mobile telephone incorporating a display device having a pixel driver according to the present invention,
Figure 12 is a schematic view of a digital camera incorporating a display device having a pixel driver according to the present invention,
Figure 13 illustrates the application of the driver circuit of the present invention to a magnetic RAM,
Figure 14 illustrates the application of the driver circuit of the present invention to a magnetoresistive element,
Figure 15 illustrates the application of the driver circuit of the present invention to a capacitance sensor or a charge sensor,
Figure 16 illustrates the application of the driver circuit of the present invention to a night vision camera, and
Figure 17 is a brief outline of an alternative implementation of the circuit of figure 4.

[0021] A pixel driver circuit according to a first embodiment of the present invention is shown in figure 3. Transistor T_2 operates as an analog current control to provide the driving current to the OEL element. Also, the storage capacitor C_1 is connected between the gate and the source of transistor T_2. In the circuit of figure 2, a current source is operatively connected to the source of transistor T_2 by transistor T_1, during the programming stage, and current is thus applied to the OEL element. In the embodiment of the present invention, transistor T_1 operatively connects transistor T_2 to a current sink during the programming stage. That is, according to the present invention, during the programming stage no current is supplied through transistor T_2 to the OEL element. In the circuit of figure 3, the drain of transistor T_2 is connected to the source of transistor T_1 via the source/drain path of transistor T_3. The source of transistor T_1 is connected to the gate of transistor T_2 and the gates of transistors T_1 and T_3 are connected together. The programming voltage Vp is applied to the gates of T_1 and T_3. Transistor T_4, which is switched off during the programming stage, connects the drain of T_2 and the source of T_3 to the OEL element. During the programming stage, transistor T_1 operatively connects transistor T_2 to a current sink which is tied to ground or a reference voltage.

[0022] The circuit of figure 3 operates in the programming stage with T_4 switched off and T_1 and T_3 switched on. T_3 being switched on has the effect of making T_2 act as a diode and T_1 connects this diode to the data current sink. As a result, capacitor C_1 charges (or discharges, depending on the voltage stored during the previous frame). Capacitor C_1 charges to the gate/source voltage of transistor T_2 and thus stores the voltage (V_{GS2}, corresponding to the data current I_{DAT}) which will control the current supply to the OEL element during the reproduction stage. At the end of the programming stage, T_1 and T_3 are switched off. The voltage V_{GS2} is stored on C_1 for the remainder of the frame period. As will be readily apparent from the circuit diagram and this description, in accordance with the present invention there is no requirement for a bias voltage to provide a current source. That is, the supply voltage (V_{DD}) in figure 3 is determined by T_2 and by the OEL element and there is no requirement for a high voltage to power a current source. The maximum voltage required by the circuit is thus significantly less than that required by the circuit of figure 2.

[0023] At the start of the programming stage, with T_4 switched off, it is found that the OEL element exhibits a parasitic capacitance which discharges through the device. The rate of charging of C_1 determines the time taken for the programming stage. In accordance with circuits embodying the present invention, the capacitance of C_1 can be relatively small and thus the charging can be very rapid. As a consequence, the period for which no current is applied to the OEL element by T_2 is very short compared with the whole frame. These factors, together with the persistence of vision of the human eye means that there is no perceptible degradation of a displayed image.

[0024] The off resistance of T_3 can be important, because after C_1 has been charged and T_3 is switched off, the off resistance of T_3 can affect the voltage across C_1 for the rest of the frame period. Thus, the gate/source capacitance of T_3 should preferably be small compared with C_1.

[0025] The reproduction voltage V_R is applied to the gate of transistor T_4. At the beginning of the reproduction stage, in the circuit of figure 3, T_4 is switched on and T_1 and T_3 remain switched off. As a result, T_2 acts as a current source with V_{GS2} biased by C_1, thus supplying current to the OEL element. At the end of the reproduction stage T_4 is switched off, T_1 and T_3 remain switched off. This completes one cycle. The driving waveform is indicated in figure 3.

[0026] Figure 4 illustrates a second embodiment according to the present invention. The circuit of figure 4 differs from that of figure 3 in the connection of transistor T_3. In the circuit of figure 4. T_1 is connected to C_1 through the drain/source path of T_3. The circuit of figure 4 is preferred to that of figure 3 because T_3 is not in the current path during the programming stage. Otherwise the operation and effects of the second embodiment are similar to those of the first embodiment.

[0027] Figure 5 is a circuit diagram showing a number of pixels in an active matrix display, with each pixel implemented in accordance with the circuit of figure 4. To simplify the illustration, a monochrome display device is shown. Since the circuit is of an active matrix, pixels on the same row are addressed at the same time. Transistor T_3 is responsible for pixel addressing, so its source terminal is connected to the current data line shared by a column of pixels. Because of this the leakage current of T_3 should be kept to a minimum. This can be ensured by using a multi-gate structure for T_1. In addition to a multi-gate structure, a lightly doped drain (LDD) structure can also reduce the leakage current.

[0028] Figure 6 is a schematic cross-sectional view of the physical implementation of the pixel driver circuit in an OEL element structure. In figure 6, numeral 132 indicates a hole injection layer, numeral 133 indicates an organic EL layer, and numeral 151 indicates a resist or separating structure. The switching thin-film transistor 121 and the n-channel type current-thin-film transistor 122 adopt the structure and the process ordinarily used for a low-temperature polysilicon thin-film transistor, such as are used for example in known thin-film transistor liquid crystal display devices such as a top-gate structure and a fabrication process wherein the maximum temperature is 600°C or less. However, other structures and processes are applicable.

[0029] The forward oriented organic EL display element 131 is formed by: the pixel electrode 115 formed of Al, the opposite electrode 116 formed of ITO, the hole injection layer 132, and the organic EL layer 133. In the forward oriented organic EL display element 131, the direction of current of the organic EL display device can be set from the opposite electrode 116 formed of ITO to the pixel electrode 115 formed of Al.

[0030] The hole injection layer 132 and the organic EL layer 133 may be formed using an ink-jet printing method, employing the resist 151 as a separating structure between the pixels. The opposite electrode 116 formed of ITO may be formed using a sputtering method. However, other methods may also be used for forming all of these components.

[0031] The typical layout of a full display panel employing the present invention is shown schematically in figure 7. The panel comprises an active matrix OEL element 200 with analogue current program pixels, an integrated TFT scanning driver 210 with level shifter, a flexible TAB tape 220, and an external analogue driver LSI 230 with an integrated RAM/controller. Of course, this is only one example of the possible panel arrangements in which the present invention can be used.

[0032] The structure of the organic EL display device is not limited to the one described here. Other structures are also applicable.

[0033] With reference for example to the circuit of figure 3, it will be appreciated that the invention provides a data current source - in this case for the OEL element. The circuit is readily extended so as to provide an amplified and/or multiple level (current) output. The principle of such a circuit can be understood with reference to figure 8. the circuit of figure 8 comprises the circuit of figure 3 with an additional drive transistor T_5 and an additional switching transistor T_6 added. The source of T_5 is connected to V_{DD} and its gate receives the same drive voltage signal as is applied to the gate of transistor T_2. The drain of transistor T_5 is series connected to the drain of transistor T_6 and the source of T_6 is connected to the common point of connection of transistors T_2, T_3 and T_4. The gate of transistor T_6 is connected to the gate of transistor T_4. If it is assumed that the characteristic of transistor T_2 is W/L and that the characteristic of transistor T_5 is selected to be (N-1)W/L then a current amplification of:-

$$I_{out} = I_{in} \times N$$

is achieved. I_{in} is the current which flows through the current sink, i.e. I_{DAT} in figures 3 and 4. I_{out} is the current which flows through the OEL element. Thus the circuit of figure 8 can be used to reduce the value of I_{DAT} compared with the circuit of figures 3 and 4, while maintaining the same current through the OEL element. Lowering the value of I_{DAT} has the advantage of enabling the operating speed of the circuit to be increased. Lowering the value of I_{DAT} also has the advantage of lowering the transmission loss experienced across a matrix of pixels, which is particularly important with respect to large scale display panels.

[0034] Of course, additional stages - each adding their own circuit of additional transistors T_5 and T_6 - can be added. With the switching transistors T_6 series connected and each receiving its own gate drive signal - as shown in figure 9 (A,B etc) - different current values can be selected to pass through the OEL element, resulting in different intensities of light output.

[0035] Preferably the circuits shown in figures 3 to 9 are implemented using thin film transistor (TFT) technology, most preferably in polysilicon.

[0036] The present invention is particularly advantageous for use in small, mobile electronic products such as mobile phones, computers, CD players, DVD players and the like - although it is not limited thereto.

[0037] Several electronic apparatuses using the above organic electroluminescent display device will now be described.

<1: Mobile Computer>

[0038] An example in which the display device according to one of the above embodiments is applied to a mobile personal computer will now be described.

[0039] Figure 10 is an isometric view illustrating the configuration of this personal computer. In the drawing, the personal computer 1100 is provided with a body 1104 including a keyboard 1102 and a display unit 1106. The display unit 1106 is implemented using a display panel fabricated according to the present invention, as described above.

<2: Portable Phone>

[0040] Next, an example in which the display device is applied to a display section of a portable phone will be described. Fig. 11 is an isometric view illustrating the configuration of the portable phone. In the drawing, the portable phone 1200 is provided with a plurality of operation keys 1202, an earpiece 1204, a mouthpiece 1206, and a display panel 100. This display panel 100 is implemented using a display panel fabricated according to the present invention, as described above.

<3: Digital Still Camera>

[0041] Next, a digital still camera using an OEL display device as a finder will be described. Fig. 12 is an isometric view illustrating the configuration of the digital still camera and the connection to external devices in brief.

[0042] Typical cameras sensitize films based on optical images from objects, whereas the digital still camera 1300 generates imaging signals from the optical image of an object by photoelectric conversion using, for example, a charge coupled device (CCD). The digital still camera 1300 is provided with an OEL element 100 at the back face of a case 1302 to perform display based on the imaging signals from the CCD. Thus, the display panel 100 functions as a finder for displaying the object. A photo acceptance unit 1304 including optical lenses and the CCD is provided at the front side (behind in the drawing) of the case 1302.

[0043] When a cameraman determines the object image displayed in the OEL element panel 100 and releases the shutter, the image signals from the CCD are transmitted and stored to memories in a circuit board 1308. In the digital still camera 1300, video signal output terminals 1312 and input/output terminals 1314 for data communication are provided on a side of the case 1302. As shown in the drawing, a television monitor 1430 and a personal computer 1440 are connected to the video signal terminals 1312 and the input/output terminals 1314, respectively, if necessary. The imaging signals stored in the memories of the circuit board 1308 are output to the television monitor 1430 and the personal computer 1440, by a given operation.

[0044] Examples of electronic apparatuses, other than the personal computer shown in Fig. 10, the portable phone shown in Fig. 11, and the digital still camera shown in Fig. 12, include OEL element television sets, view-finder-type and monitoring-type video tape recorders, car navigation systems, pagers, electronic notebooks, portable calculators, word processors, workstations, TV telephones, point-of-sales system (POS) terminals, and devices provided with touch panels. Of course, the above OEL device can be applied to display sections of these electronic apparatuses.

[0045] The driver circuit of the present invention can be disposed not only in a pixel of a display unit but also in a driver disposed outside a display unit.

[0046] In the above, the driver circuit of the present invention has been described with reference to various display devices. The applications of the driver circuit of the present invention are much broader than just display devices and include, for example, its use with a magnetoresistive RAM, a capacitance sensor, a charge sensor, a DNA sensor, a night vision camera and many other devices.

[0047] Figure 13 illustrates the application of the driver circuit of the present invention to a magnetic RAM. In figure 13 a magnetic head is indicated by the reference MH.

[0048] Figure 14 illustrates the application of the driver circuit of the present invention to a magnetoresistive element. In figure 14 a magnetic head is indicated by the reference MH. and a magnetic resistor is indicated by the reference MR.

[0049] Figure 15 illustrates the application of the driver circuit of the present invention to a capacitance sensor or a charge sensor. In figure 15 a sense capacitor is indicated by the reference C_{sense}. The circuit of figure 15 is also applicable to other applications, such as a fingerprint sensor and a DNA sensor.

[0050] Figure 16 illustrates the application of the driver circuit of the present invention to a night vision camera. In figure 16 a photoconductor is indicated by refrenece R.

[0051] In the embodiments illustrated with reference to the above specific description the transistors have been shown as p-channel type transistors. This is not limiting of the invention. For example, figure 17 is a brief outline of an alternative implementation of the circuit of figure 4. In figure 17 n-channel transistors are used throughout the circuit, except for the drive transistor which is retained as a p-channel transistor.

[0052] It will be apparent to persons skilled in the art that other variations and modifications can be made to the arrangements described with respect to figures 3 to 16 without departing from the scope of the invention, as defined in the appended claims.

Claims

1. A driver circuit for driving a current driven element, the circuit comprising:

a data current source line to provide a data current (Idat);
a power supply line (Vdd);
a transistor (T_2) connected to said power supply line,
a capacitor (C1) connected to the gate of the transistor (T_2) for storing an operating voltage of said transistor (T_2) during said programming stage;
the transistor being adapted to be set in a conducting state so as to allow a data current to flow during a programming stage, the data current being for determining the operative voltage stored in said capacitor, thereby determining the level of a driving current to be supplied to the current driven element during a reproduction stage;
a first switching device (T_1) connected to said transistor (T_2) so as to establish a first current path through which said data current is arranged to flow during the programming stage, the data current flowing in said first current path from the power supply line (Vdd) through the transistor (T_2) and the first switching device (T_1) to the data current source line, such that no current is supplied from the transistor (T_2) to the current driven element during the programming stage while said capacitor (C1) is charged with said operative voltage; and
a second switching device (T_4) connected to said transistor (T_2) so as to establish a second current path through the transistor (T_2) and the current driven element during a reproduction stage, the current provided from the transistor (T2) to the current driven element during the reproduction stage being dependent on said operative voltage stored in said capacitor during the programming stage,
wherein the first and second switching devices are controllable by respective control signals (V_P, V_R) supplied from separate signal lines,
the second switching device is arranged to be switched off before the first switching device is switched on, and the first switching device is arranged to be switched off before the second switching device is switched on.

2. The driver circuit according to claim 1, further comprising a third switching device (T_3), the third switching device being connected to bias the transistor (T_2) to act as a diode during the programming stage.

3. The driver circuit according to claim 2, wherein the third switching device (T_3) connects the first switching device (T_1) to the gate of the transistor (T_2).

4. The driver circuit according to any one of the preceding claims, wherein the transistor (T_2) is a polysilicon thin film transistor.

5. The driver circuit according to any one of the preceding claims, wherein the first switching device (T_1) and the second switching device (T_4) are n-channel thin film transistors.

6. The driver circuit according to any one of the preceding claims, wherein the first current path is connected to a current sink.

7. The driver circuit according to any one of the preceding claims, wherein the transistor (T_2) is a p-channel transistor.

8. The driver circuit according to any one of the preceding claims, wherein the current driven element is an electroluminescent element.

9. An electroluminescent display device comprising the driver circuit according to any one of the preceding claims.

10. An electronic apparatus incorporating an electroluminescent display device as claimed in claim 9.

11. A method of controlling a current supply circuit to provide current to a current driven element, the circuit comprising:

a data current source line to provide a data current (Idat) ;

a power supply line (Vdd);
a transistor (T_2) connected to said power supply line,
a transistor (T_1) connected to said transistor (T_2),
a transistor (T_4) connected to said transistor (T_2),
a capacitor (C1) connected to the gate of the transistor (T_2) for storing an operating voltage of said transistor (T2) during said programming stage,
the method comprising:

controlling said first switching device (T_1) so as to establish a first current path through which said data current flows during a programming stage, the data current being for determining the operative voltage stored in said capacitor, thereby determining the level of a driving current to be supplied to the current driven element during a reproduction stage;
the data current flowing in said first current path from the power supply line (Vdd) through the transistor (T_2) and the first switching device (T_1) to the data current source line, such that no current is supplied from the transistor (T_2) to the current driven element during the programming stage while said capacitor (C1) is charged with said operative voltage; and
controlling a second switching device (T_4) to provide a second current path during a reproduction stage, the second current path including the transistor (T_2) and the current driven element the current provided from the transistor (T2) to the current driven element during the reproduction stage being dependent on said operative voltage stored in said capacitor during the programming stage,
wherein the first and second switching devices are controlled by respective signals from separate signal lines, and
controlling the second switching device so as to switch it off before the first switching device is switched on, and controlling the first switching device so as to switch it off before the second switching device is switched on.

12. A method according to claim 11, wherein the first current path is connected to a current sink.

13. A method according claim 11 or claim 12, wherein the current driven element is an electroluminescent element.

Patentansprüche

1. Treiberschaltung zum Antreiben eines strombetriebenen Elements, wobei die Schaltung umfasst:

eine Datenstromquellenleitung zum Bereitstellen eines Datenstroms (Idat);
eine Stromversorgungsleitung (Vdd);
einen Transistor (T_2), der an die Stromversorgungsleitung angeschlossen ist;
einen Kondensator (C1), der an das Gate des Transistors (T_2) zum Speichern einer Betriebsspannung des Transistors (T_2) während der Programmierungsstufe angeschlossen ist; -
wobei der Transistor dazu ausgebildet ist, in einen leitenden Zustand gebracht zu werden, so dass ein Datenstrom während einer Programmierungsstufe fließen kann, wobei der Datenstrom zum Bestimmen der Betriebsspannung dient, die in dem Kondensator gespeichert ist, wodurch der Pegel eines Antriebsstroms bestimmt wird, der dem strombetriebenen Element während einer Wiedergabestufe zugeführt wird;
eine erste Schaltvorrichtung (T_1), die an den Transistor (T_2) angeschlossen ist, um einen ersten Strompfad herzustellen, durch den der Datenstrom so angeordnet ist, dass er während der Programmierungsstufe fließt, wobei der Datenstrom in dem ersten Strompfad von der Stromversorgungsleitung (Vdd) durch den Transistor (T_2) und die erste Schaltvorrichtung (T_1) zu der Datenstromquellenleitung fließt, so dass kein Strom von dem Transistor (T_2) zu dem strombetriebenen Element während der Programmierungsstufe geleitet wird, während der Kondensator (C1) mit der Betriebsspannung geladen ist; und
eine zweite Schaltvorrichtung (T_4), die an den Transistor (T_2) angeschlossen ist, um einen zweiten Strompfad durch den Transistor (T_2) und das strombetriebene Element während einer Widergabestufe herzustellen, wobei der Strom der von dem Transistor (T_2) zu dem strombetriebenen Element während der Widergabestufe bereitgestellt wird, von der Betriebspannung abhängig ist, die in dem Kondensator während der Programmierungsstufe gespeichert ist;
wobei die erste und zweite Schaltvorrichtung durch entsprechende Kontrollsignale (V_P, V_R) kontrollierbar sind, die von separaten Signalleitungen zugeleitet werden,
wobei die zweite Schaltvorrichtung so angeordnet ist, dass sie abgeschaltet wird, bevor die erste Schaltvorrichtung eingeschaltet wird, und die erste Schaltvorrichtung so angeordnet ist, dass sie abgeschaltet wird, bevor die zweite Schaltvorrichtung eingeschaltet wird.

2. Treiberschaltung nach Anspruch 1, des Weiteren umfassend eine dritte Schaltvorrichtung (T_3), wobei die dritte Schaltvorrichtung (T_3) zum Vorspannen des Transistors (T_2) angeschlossen ist, um als Diode während der Programmierungsstufe zu dienen.

3. Treiberschaltung nach Anspruch 2, wobei die dritte Schaltvorrichtung (T_3) die erste Schaltvorrichtung (T_1) an das Gate des Transistors (T_2) anschließt.

4. Treiberschaltung nach einem der vorangehenden Ansprüche, wobei der Transistor (T_2) ein Polsilizium-Dünnfilmtransistor ist.

5. Treiberschaltung nach einem der vorangehenden Ansprüche, wobei die erste Schaltvorrichtung T_1) und die zweite Schaltvorrichtung (T_4) n-Kanal-Dünnfilmtransistoren sind.

6. Treiberschaltung nach einem der vorangehenden Ansprüche, wobei der erste Strompfad an eine Stromsenke angeschlossen ist.

7. Treiberschaltung nach einem der vorangehenden Ansprüche, wobei der Transistor (T_2) ein p-Kanal-Transistor ist.

8. Treiberschaltung nach einem der vorangehenden Ansprüche, wobei das strombetriebene Element ein Elektrolumineszenzelement ist.

9. Elektrolumineszenz-Anzeigevorrichtung, umfassend die Treiberschaltung nach einem der vorangehenden Ansprüche.

10. Elektronisches Gerät, das eine Elektrolumineszenz-Anzeigevorrichtung nach Anspruch 9 enthält.

11. Verfahren zum Steuern einer Stromversorgungsschaltung, um Strom für ein strombetriebenes Element bereitzustellen, wobei die Schaltung umfasst:

eine Datenstromquellenleitung zum Bereitstellen eines Datenstroms (Idat);
eine Stromversorgungsleitung (Vdd);
einen Transistor (T_2), der an die Stromversorgungsleitung angeschlossen ist;
einen Transistor (T_1) der an den Transistor (T_2) angeschlossen ist;
einen Transistor (T_4) der an den Transistor (T_2) angeschlossen ist;
einen Kondensator (C1), der an das Gate des Transistors (T_2) zum Speichern einer Betriebsspannung des Transistors (T_2) während der Programmierungsstufe angeschlossen ist;
wobei das Verfahren umfasst:

Steuern der ersten Schaltvorrichtung (T_1), so dass ein erster Strompfad hergestellt wird, durch den der Datenstrom während einer Programmierungsstufe fließt, wobei der Datenstrom zum Bestimmen der Betriebsspannung dient, die in dem Kondensator gespeichert ist, wodurch der Pegel eines Antriebsstroms bestimmt wird, der dem strombetriebenen Element während einer Wiedergabestufe zugeführt wird;
den Datenstrom, der in dem ersten Strompfad von der Stromversorgungsleitung (Vdd) durch den Transistor (T_2) und die erste Schaltvorrichtung (T_1) zu der Datenstromquellenleitung fließt, so dass von dem Transistor (T_2) kein Strom zu dem strombetriebenen Element während der Programmierungsstufe geleitet wird, während der Kondensator (C1) mit der Betriebsspannung geladen ist; und
Steuern einer zweiten Schaltvorrichtung (T_4), um einen zweiten Strompfad während einer Wiedergabestufe bereitzustellen, wobei der zweite Strompfad den Transistor (T_2) und das strombetriebene Element enthält,
wobei der Strom der von dem Transistor (T_2) zu dem strombetriebenen Element während der Widergabestufe bereitgestellt wird, von der Betriebspannung abhängig ist, die in dem Kondensator während der Programmierungsstufe gespeichert ist;
wobei die erste und zweite Schaltvorrichtung durch entsprechende Signale von separaten Signalleitungen kontrolliert werden, und
Steuern der zweiten Schaltvorrichtung derart, dass sie abgeschaltet wird, bevor die erste Schaltvorrichtung eingeschaltet wird, und Steuern der ersten Schaltvorrichtung derart, dass sie abgeschaltet wird, bevor die zweite Schaltvorrichtung eingeschaltet wird.

12. Verfahren nach Anspruch 11, wobei der erste Strompfad an eine Stromsenke angeschlossen ist.

13. Verfahren nach Anspruch 11 oder Anspruch 12, wobei das strombetriebene Element ein Elektrolumineszenzelement ist.

Revendications

1. Circuit d'attaque pour commander un élément à commande par courant, le circuit comprenant :

une ligne de source de courant des données afin de fournir un courant des données (Idat);

une ligne d'alimentation (Vdd) ;
un transistor (T_2) connecté à ladite ligne d'alimentation ;
un condensateur (C1) connecté à la grille du transistor (T_2) pour accumuler une tension d'exploitation dudit transistor (T_2) pendant ladite étape de programmation ;
le transistor étant adapté pour passer dans un état de conduction de manière à permettre à un courant des données de circuler pendant une étape de programmation, le courant des données servant à déterminer la tension d'exploitation accumulée dans ledit condensateur, en déterminant de la sorte le niveau d'un courant d'attaque à fournir à l'élément à commande par courant pendant une étape de reproduction ;
un premier dispositif de commutation (T_1) connecté audit transistor (T_2) de manière à établir un premier trajet du courant à travers lequel ledit courant des données circule pendant l'étape de programmation, le courant des données circulant dans ledit premier trajet du courant à partir de la ligne d'alimentation (Vdd), en passant par le transistor (T_2) et le premier dispositif de commutation (T_1), jusqu'à la ligne de source de courant des données, de manière à ce que aucun courant n'est fourni par le transistor (T_2) à l'élément à commande par courant pendant l'étape de programmation alors que ledit condensateur (C1) est chargé avec ladite tension d'exploitation ; et
un deuxième circuit de commutation (T_4) connecté audit transistor (T_2) de manière à établir un deuxième trajet du courant à travers le transistor (T_2) et l'élément à commande par courant pendant une étape de reproduction, le courant fourni par le transistor (T_2) à l'élément à commande par courant pendant l'étape de reproduction dépendant de ladite tension d'exploitation accumulée dans ledit condensateur pendant l'étape de programmation ;
les premier et deuxième éléments de commutation pouvant être contrôlés par des signaux de commande respectifs (V_P, V_R) fournis par des lignes de transfert de signaux distinctes ;
le deuxième dispositif de commutation étant étudié pour être éteint avant d'allumer le premier dispositif de commutation, et le premier dispositif de commutation étant étudie pour être éteint avant d'allumer le deuxième dispositif de commutation.

2. Circuit d'attaque selon la revendication 1, comprenant par ailleurs un troisième dispositif de commutation (T_3), le troisième dispositif de commutation étant connecté afin de polariser le transistor (T_2) afin qu'il agisse en tant que diode pendant l'étape de programmation .

3. Circuit d'attaque selon la revendication 2, le troisième dispositif de commutation (T_3) connectant le premier dispositif de commutation (T_1) à la grille du transistor (T_2).

4. Circuit d'attaque selon l'une quelconque des revendications précédentes, le transistor (T_2) étant un transistor à couche mince en polysilicium.

5. Circuit d'attaque selon l'une quelconque des revendications précédentes, le premier dispositif de commutation (T_1) et le deuxième dispositif de commutation (T_4) étant des transistors à couche-mince à canal n.

6. Circuit d'attaque selon l'une quelconque des revendications précédentes, le premier trajet du courant étant connecté à un collecteur de courant.

7. Circuit d'attaque selon l'une quelconque des revendications précédentes, le transistor (T_2) étant un transistor à canal p.

8. Circuit d'attaque selon l'une quelconque des revendications précédentes, l'élément à commande par courant étant un élément électroluminescent.

9. Dispositif d'affichage électroluminescent comprenant le circuit d'attaque selon l'une quelconque des revendications précédentes.

10. Appareil électronique dans lequel est intégré un dispositif d'affichage électroluminescent tel que revendiqué dans la revendication 9.

11. Méthode de contrôle d'un circuit d'alimentation en courant afin de fournir du courant à un élément à commande par courant, le circuit comprenant :

une ligne de source de courant des données afin de fournir un courant des données (Idat) ;
une ligne d'alimentation (Vdd) ;
un transistor (T_2) connecté à ladite ligne d'alimentation ;
un transistor (T_1) connecté audit transistor (T_2) ;
un transistor (T_4) connecté audit transistor (T_2) ;
un condensateur (C1) connecté à la grille du transistor (T_2) pour accumuler une tension d'exploitation dudit transistor (T_2) pendant ladite étape de programmation ; la méthode comprenant :

le contrôle dudit premier dispositif de commutation (T_1) de manière à établir un premier trajet du courant à travers lequel circule ledit courant des données pendant une étape de programmation, le courant des données servant à déterminer la tension d'ex-

ploitation accumulée dans ledit condensateur, en déterminant de la sorte le niveau d'un courant d'attaque à fournir à l'élément à commande par courant pendant une étape de reproduction ;
le courant de données circulant dans ledit premier trajet du courant à partir de la ligne d'alimentation (Vdd) en passant par le transistor (T_2) et le premier dispositif de commutation (T_1) jusqu'à la ligne de source de courant des données, de manière à ce que aucun courant n'est fourni par le transistor (T_2) à l'élément à commande par courant pendant l'étape de programmation alors que ledit condensateur (C1) est chargé avec ladite tension d'exploitation ; et
le contrôle d'un deuxième dispositif de commutation (T_4) afin de fournir un deuxième trajet du courant pendant une étape de reproduction, le deuxième trajet du courant incluant le transistor (T_2) et l'élément à commande par courant, le courant fourni par le transistor (T_2) à l'élément à commande par courant pendant l'étape de reproduction dépendant de ladite tension d'exploitation accumulée dans ledit condensateur pendant l'étape de programmation;
les premier et deuxième dispositifs de commutation étant contrôlés par des signaux respectifs provenant de lignes de transfert de signaux distinctes ; et
le contrôle du deuxième dispositif de commutation de manière à l'éteindre avant d'allumer le premier dispositif de commutation, et le contrôle du premier dispositif de commutation de manière à l'éteindre avant d'allumer le deuxième dispositif de commutation.

12. Méthode selon la revendication 11, le premier trajet du courant étant connecté à un collecteur de courant.

13. Méthode selon la revendication 11 ou la revendication 12, l'élément à commande par courant étant un élément électroluminescent.

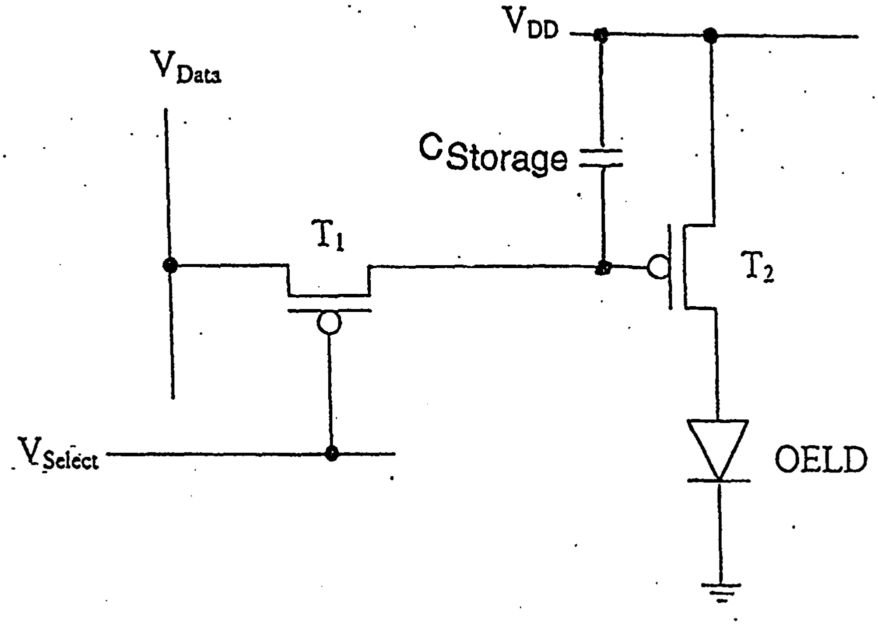


Figure 1

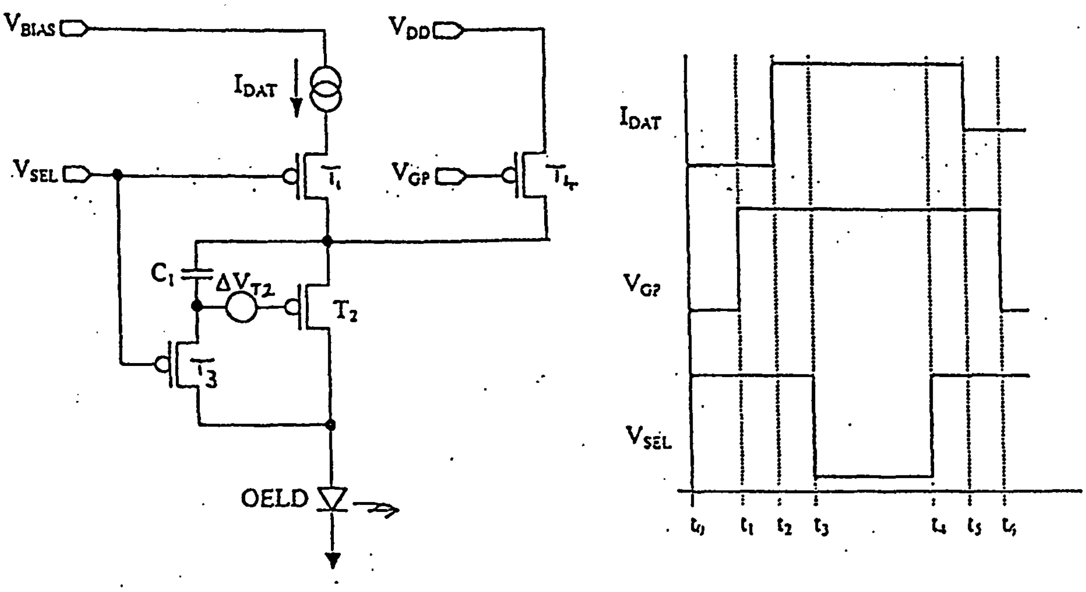
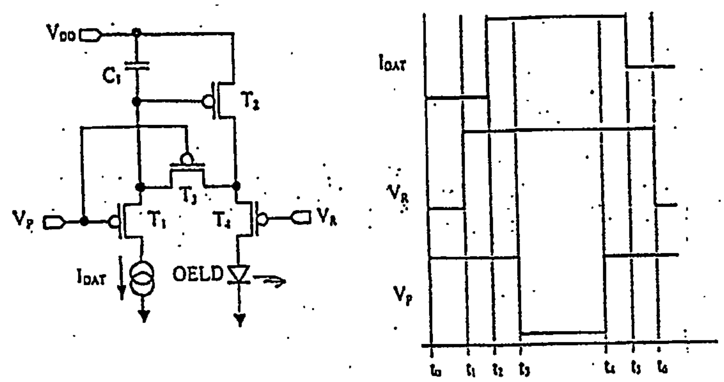


Figure 2

Figure 3



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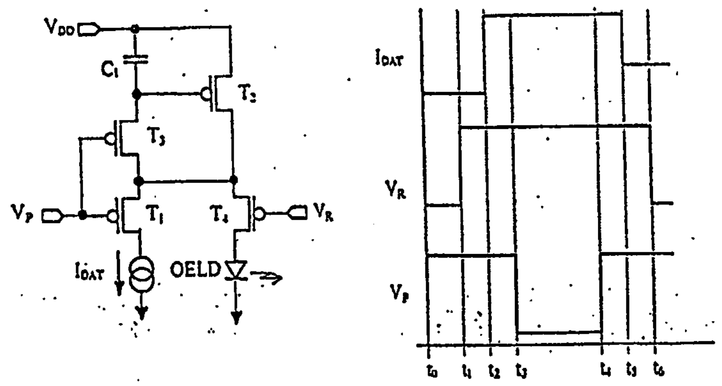
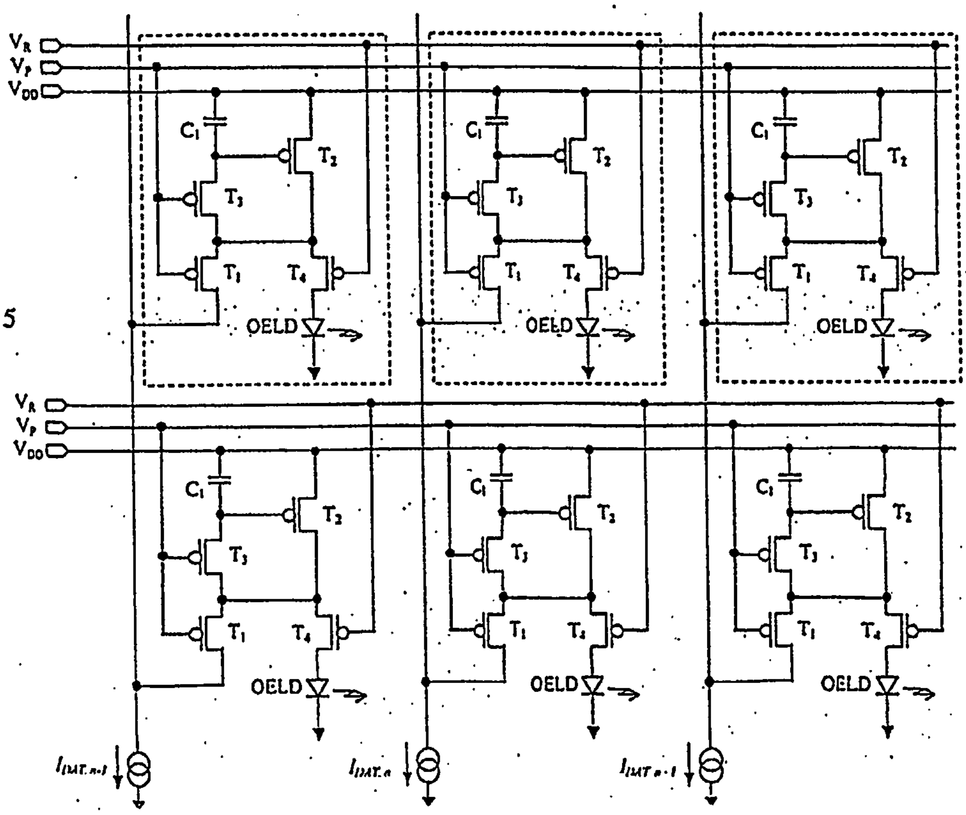


Figure 5



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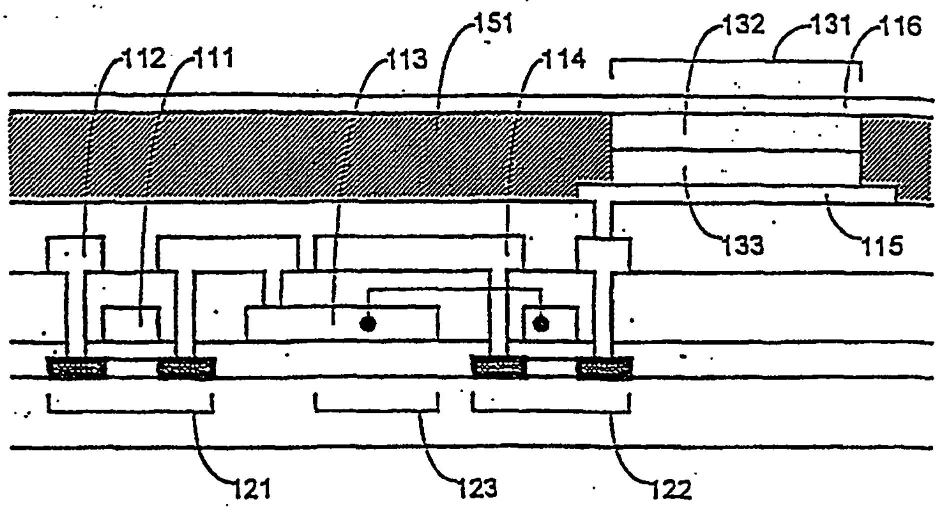
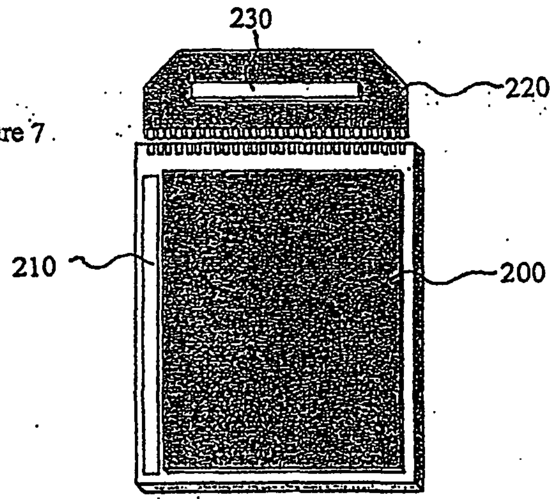


Figure 7



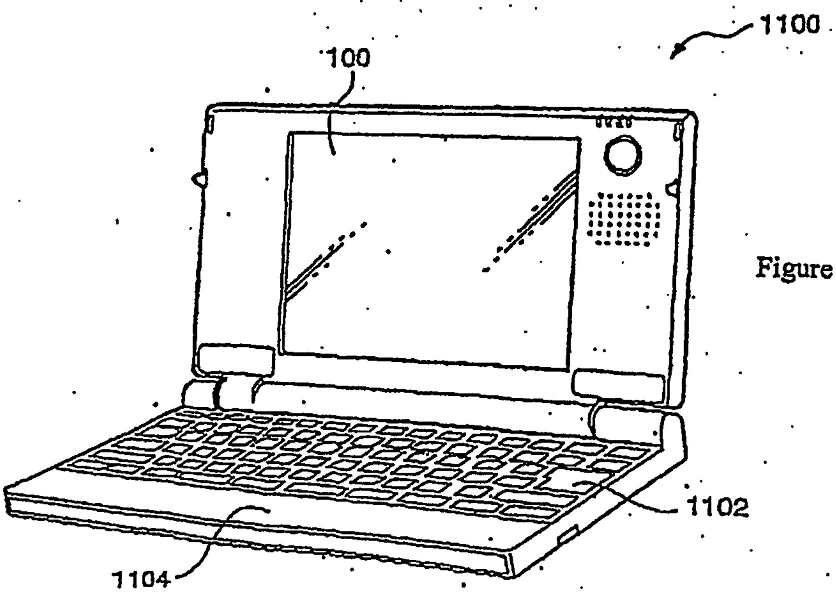
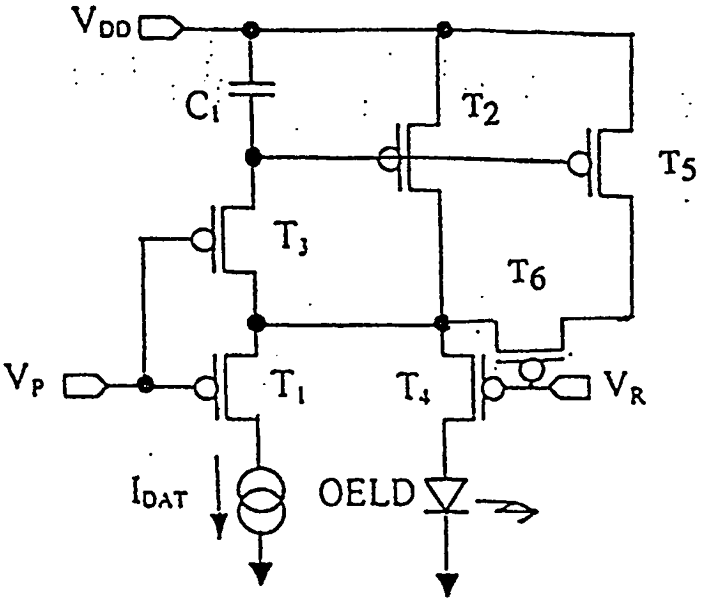


Figure 10

Figure 8



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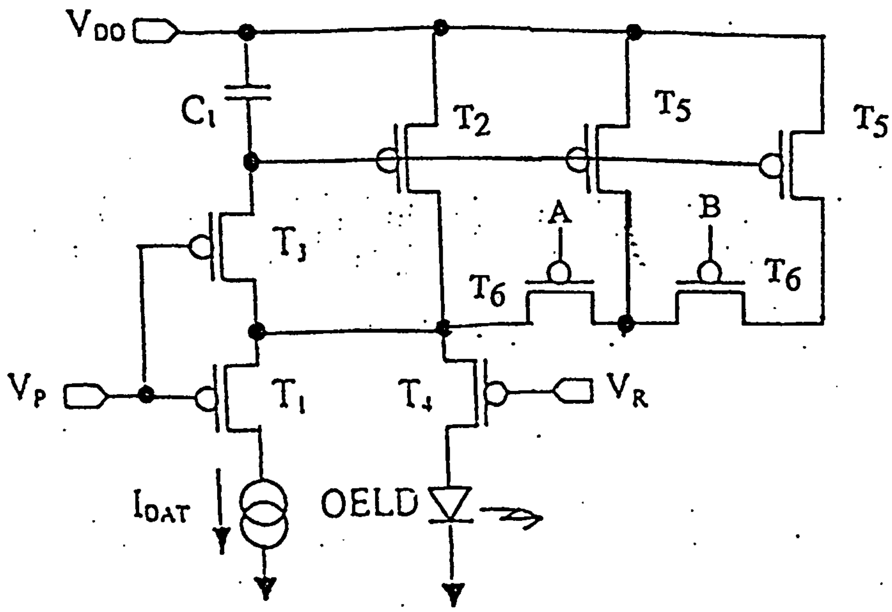


Figure 11

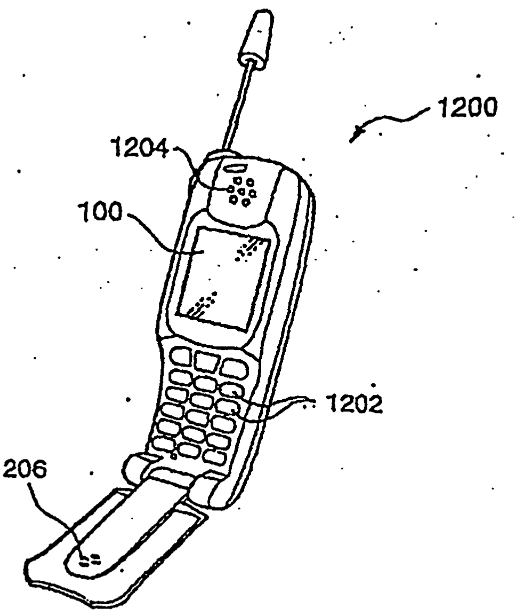


Figure 12

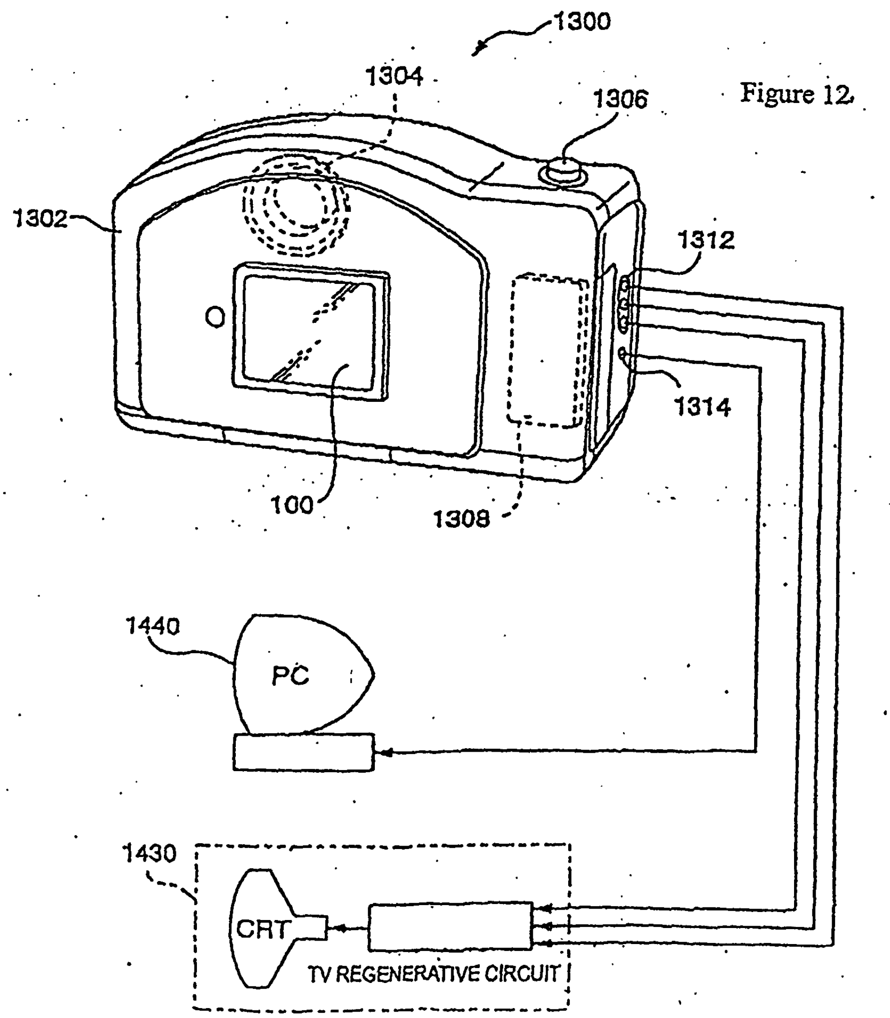


Figure 13

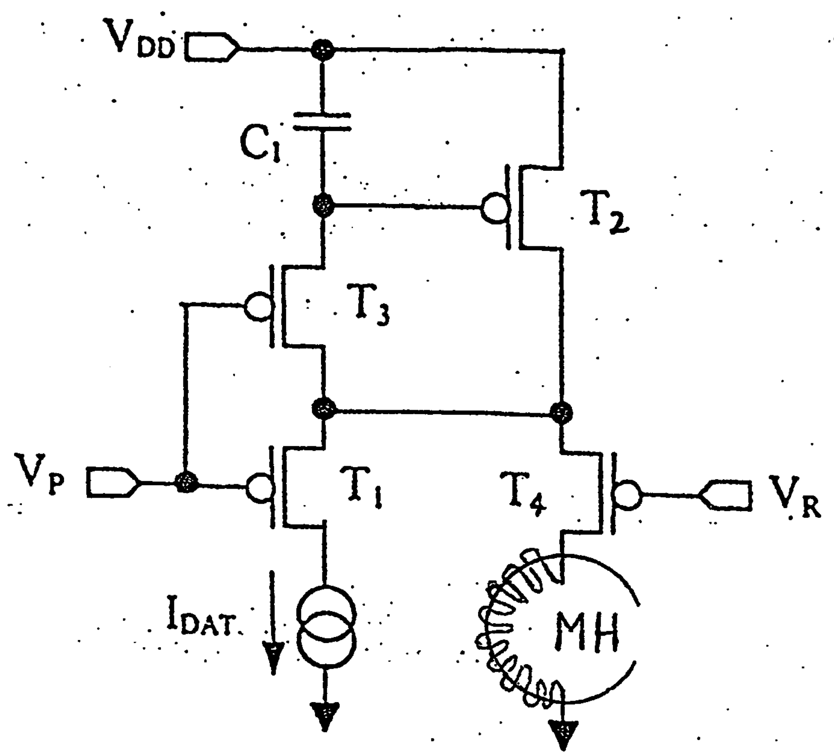
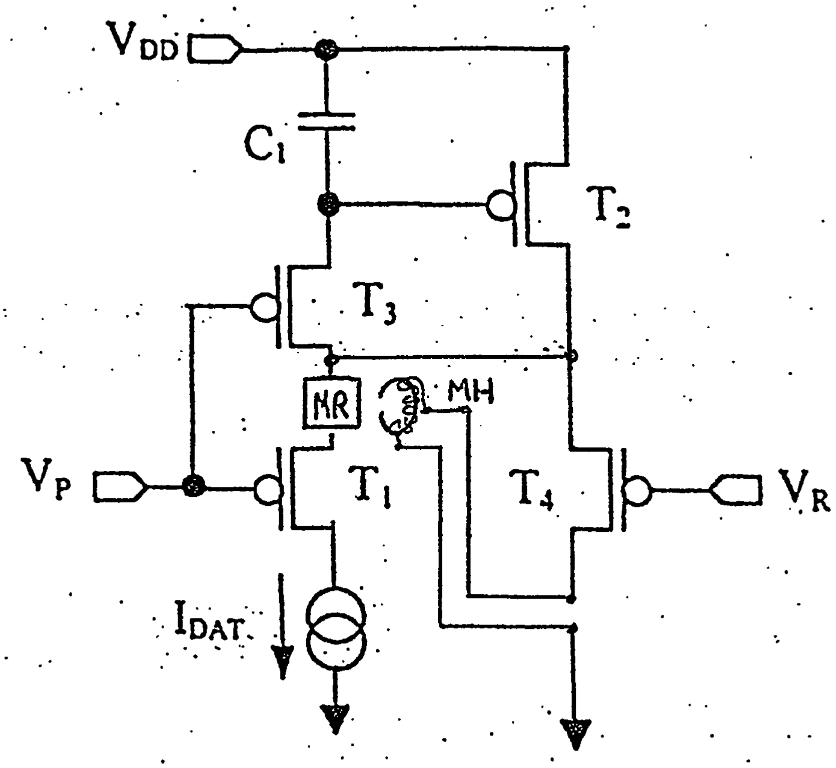


Figure 14



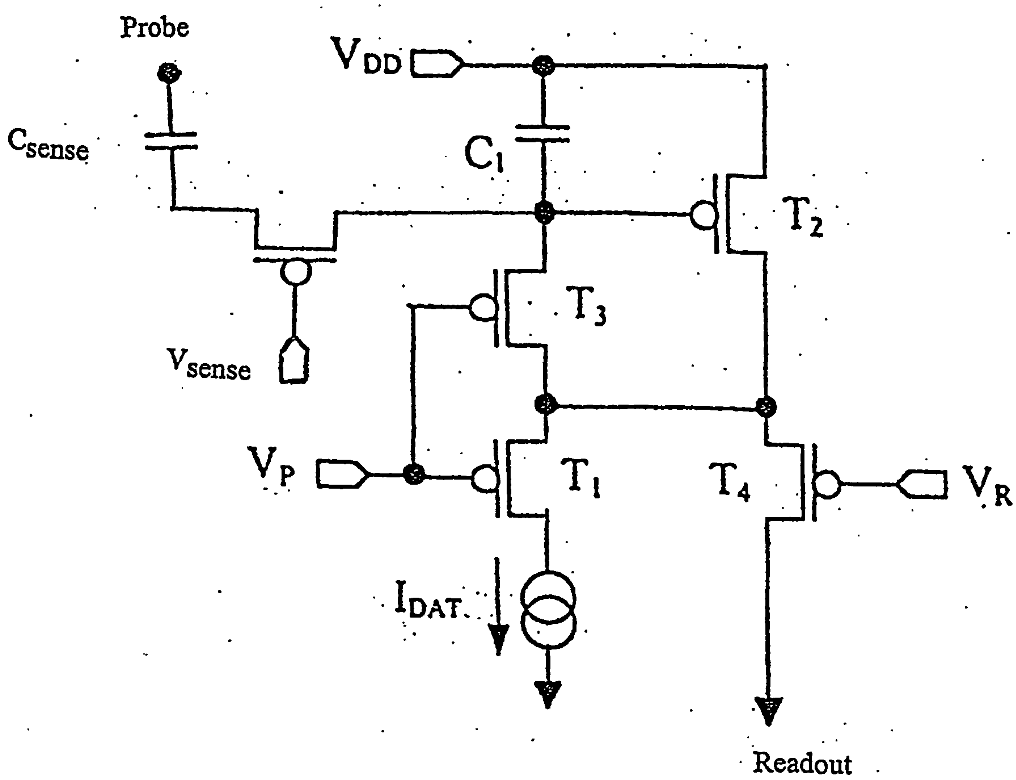


Figure 15

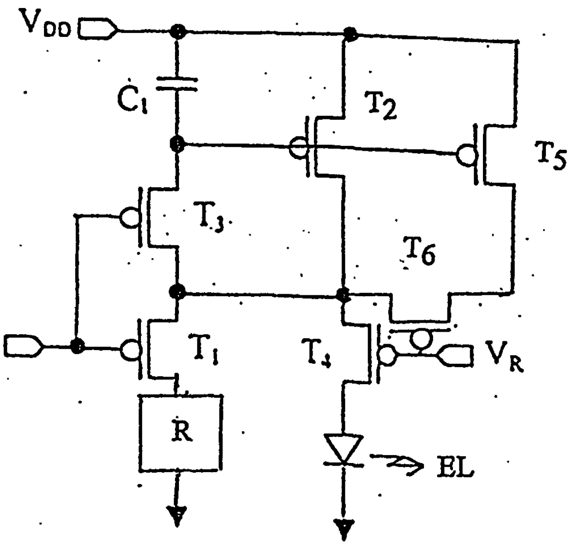


Figure 16

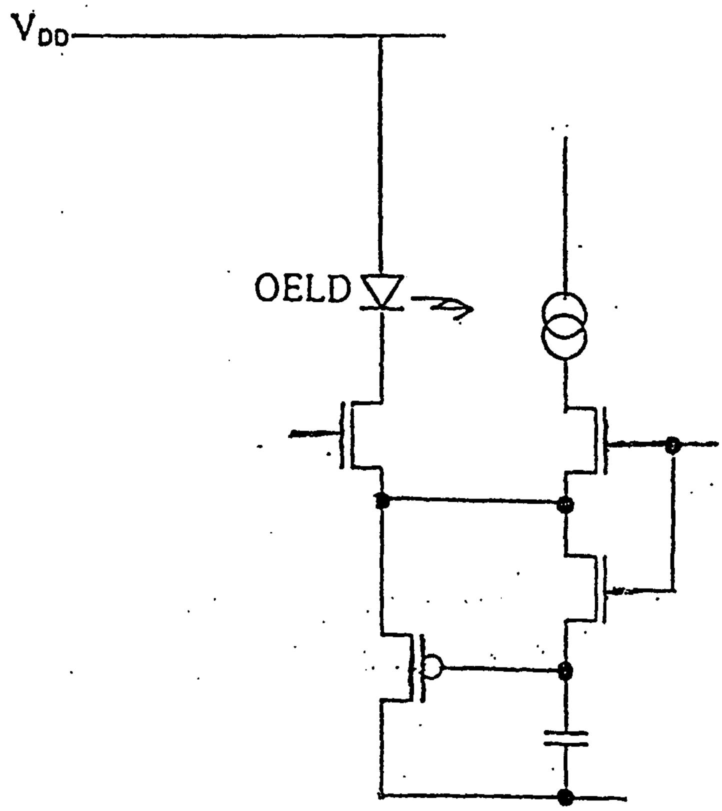


Figure 17

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- WO 996501 A **[0008]**
- WO 9848403 A **[0009]**

专利名称(译)	用于有机电致发光显示器的电流采样电路		
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[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	TAM SIMON		
发明人	TAM, SIMON		
IPC分类号	G09G3/32 G11C27/02		
CPC分类号	G09G3/325 G09G2300/0842 G09G2300/0861 G09G2320/0252 G11C27/024		
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外部链接	Espacenet		

摘要(译)

1。一种驱动电路，其包括编程级和再现级，所述电路包括：多个电流路径，每个电流路径穿过所述电路;电流驱动元件;晶体管，其连接成可操作地控制提供给所述电流源的电流;所述元件，连接用于在编程阶段期间存储晶体管的工作电压的电容器，以及控制电流路径的开关装置，其中一个电流路径不包括所述元件。在编程阶段期间没有电流由电流控制晶体管施加到电流驱动元件，因此降低了总功耗。此外，电路可以从正常电源电压操作，而不需要高偏置电压。在编程阶段期间，电路使用电流阱而不是电流源。优选地，电流驱动元件是电致发光元件。

$$I_{out} = I_{in} \times N$$