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(54) **DRIVING CIRCUIT FOR CURRENT PROGRAMMED ORGANIC LIGHT-EMITTING DIODE DISPLAYS**

ANSTEUERSCHALTUNG FÜR STROMPROGRAMMIERTE ORGANISCHE LEUCHTDIODEN-DISPLAYS

CIRCUIT DE COMMANDE POUR AFFICHAGES A DEL ORGANIQUES PROGRAMMEES EN INTENSITE

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Description

FIELD OF INVENTION

[0001] The present invention relates to methods and apparatus for driving a current line with a parasitic capacitance. In particular, the present invention relates to methods and apparatus for driving organic light-emitting diode (OLED) displays that are current programmed.

BACKGROUND OF THE INVENTION

[0002] Maturing of Flat Panel Display (FPD) technologies has provided larger and lower cost laptop monitors, small area/low power panels for cell phones and other portable devices, HDTV and widescreen formats for home television, and high reliability daylight readable displays for "glass cockpits" for aircraft.

[0003] Emerging technologies such as organic LEDs (OLED) promise to deliver higher quality emissive flat displays, allowing the removal of the backlight. When compared to LCDs, a thinner form-factor with almost perfect viewing angle and much faster response speed would be provided by OLEDs. Thus the intrinsic characteristics of OLEDs give visual and form factor advantages over LCDs.

[0004] A typical array structure of an active matrix organic light-emitting diode (AMOLED) is shown in Figure 1. The display 100 includes an array of pixels 102 that are arranged in rows and columns. The pixels 102 are connected to the data line 106 via a select transistor 104. The transistor 104 is a thin film transistor (TFT). The data line 106 is driven by a current source 108. The overlap capacitance of the transistors 104 connected to data line 106 and the line capacitance of the data line 106 itself leads to a high parasitic capacitance.

[0005] The basic OLED structure for a given pixel 102 consists of a stack of thin organic layers between a transparent anode and a metallic cathode. The organic layers include a hole-injection layer, a hole-transport layer, an emissive layer, and an electron transport layer. When an appropriate voltage is applied to the structure the injected positive and negative charges combine in the emissive layer to product light. OLEDs are therefore self-emissive displays and thus do not require a backlight as is required by LCDs. Also the charge combination process causes very little time delay providing for a fast response time.

[0006] OLED displays are current-controlled display devices. LCDs, on the other hand, are voltage-controlled. Current programming provides the OLED with a current that is independent of the characteristics of any other components such as thin film transistors (TFT) or the OLED itself, and compensates for Vt shift, spatial mismatch, and OLED degradation. However, the parasitic capacitance contributed from the line and select transistors connected to the line results in a large settling time. The settling time is a function of the initial line voltage and threshold voltage of the drive TFT. Although, the settling time can be improved partially by pre-charging, the improvement is not sufficient for medium and large area displays.

[0007] The parasitic capacitance of the drive transistor and the data line to which it is connected is schematically shown in Figure 2. In particular Figure 2 schematically shows the equivalent circuit for a current programmed pixel 202, having a current source 203 and a transistor 204, during a programming cycle. Capacitance C_P 210 and resistance R_P 208 are the parasitic components while capacitance C_S 206 is the capacitance of the storage capacitor. If C_S 206 « C_P 210 and R_P 208 is small, the timing constant, or settling time, of the circuit shown in Figure 2 is:

[0008]

$$\tau \propto 2\frac{C_p}{\sqrt{i * \beta}} \qquad (1)$$

[0009] where β is the coefficient in current-voltage (I-V) characteristics of the transistor 204 given by $I_{ds} = \beta (V_{gs} - V_{th})^2$. Here, I_{ds} is the drain-source current, V_{gs} the gate-source voltage, and V_{th} the threshold voltage.

[0010] If the capacitance C_p 210 is a large capacitance, around 40pf, and β is small for the transistor 204, which is fabricated with amorphous silicon (a-Si), τ is of the order of millisecond. However, the timing budget of the programming cycle is less than 100μs for large area displays. Since the efficiency of the OLED has been increased, the amount of current required to achieve the maximum brightness is very small; therefore, τ, which is also a function of current, increases dramatically.

[0011] This parasitic capacitance thus contributes to a high settling time for current programmed pixels, limiting the timing budget of the programming cycle. This can cause considerable error due to imperfect settling. In order to remove this error, a simple and fast solution for driving the current programmed pixels that is suitable for applications in OLED

displays is needed.

[0012] United States patent application No. 20040095297A1 to Libsch et al. describes a programming method in which the programming current is controlled by a current sensor. A schematic diagram of the circuit of Figure 1 of Libsch et al. is shown in Figure 3. During the programming cycle a current sensor 302 monitors the voltage across resistor R 304 through the feedback 308. The current sensor 302 controls the programming current. After the pixel settles, the current flowing through the resistor R 304 and the OLED 306 is the same as wanted current. Because of the use of feedback 308, this driving method has a fast settling time. However, the drawback of this circuit is that it has a high power consumption resulting from resistor R 304. The resistor R 304 should quite large such that the circuit is able to sense a low current level accurately. Therefore, the power dissipated in resistor R 304 is considerable. The other drawback of this circuit is that it suffers from mismatch. The spatial mismatch changes the value of resistor R 304 causing non-uniformity in the display. It also has the addition feedback 308.

[0013] United States Patent 6,433,488 to Bu discloses an OLED driver circuit that implements a current comparator in a feedback loop. The circuit presented in Figure 2 of Bu is schematically presented in Figure 4. In a programming cycle, SCAN is high so the transistor T2 402 is off and the transistor T4 404 is on. Therefore, the current flows through the transistor T3 406, the OLED 408, and the transistor T1 410. A current comparator 412 defines the reference voltage 414 based on comparison result of the pixel current, via feedback line 416, and reference current 418. After the pixel settles, the pixel current 416 is the same as reference current 418. This circuit provides a fast settling time for the pixel because of the use of feedback. However, the circuit has a high power compensation because of the two transistors (T1 410 and T2 402) in the path of current during the driving cycle, further this method uses four transistors and extra feedback line 416.

[0014] US Patent 6,356,029 discloses a pixel driver that includes a storage capacitor, an OLED, a feedback transistor and a highpass filter coupled to the OLED for operating the feedback transistor. US Patent 6,356,029 monitors the voltage of the OLED to compensate for the aging of pixel by complementarily charging the storage capacitor.

[0015] US Patent Application Publication 2004/0257313A1 discloses a system for driving an EL display, which includes a D/A converter and a digital comparator.

[0016] UK Patent Application GB2389951 discloses driving a pixel circuit, which includes an A/D converter, a D/A converter and a controller that receives output from the AID converter and provides data to the D/A converter.

[0017] US Patent 5723950 discloses a driver for OLED pixel, which includes a highpass filter.

[0018] US2003/0156101 A1 describes an apparatus for adapting and applying current boost levels to precharge current driven elements in a matrix.

[0019] Therefore there is a need for a circuit that improves the settling time of the current driven circuit that does not encounter the high power consumption of the known circuits.

SUMMARY OF THE INVENTION

[0020] The present invention relates to a circuit for driving an OLED pixel. The invention further relates to a circuit that enables the use of current programmed pixel circuits in large area displays by improving the settling time.

[0021] It is an object of the invention to obviate or mitigate at least one shortcoming of circuits for improving time sensitivity of the prior art.

[0022] In accordance with one aspect of the invention a load driving circuit for a load having a parasitic capacitance associated therewith and being current programmed is provided. The driving circuit having a data line having a voltage controlling the load, a feedback loop having a lowpass filter for monitoring the voltage of the data line, and a current source for providing a current to the data line; the current source being controlled by a signal line and an output from the lowpass filter.

[0023] In accordance with another aspect of the invention a driving circuit for a light emitting diode that is current programmed and having a parasitic capacitance is provided. The driving circuit having a data line controlling the light emitting diode, a low pass filter monitoring the voltage of the data line, and a current source for providing a current to the data line; the current source being controlled by a signal line and an output from the lowpass filter.

[0024] In accordance with another aspect of the invention a driving circuit for a light emitting diode that is current programmed and having a parasitic capacitance is provided. The driving circuit comprising a data line controlling the light emitting diode, a feedback loop comprising, an analogue to digital converter, and a controller running an algorithm that provides low pass filter functionality to the feedback loop, and a current source for providing a current to the data line; the current source receiving input from a digital to analogue converter that receives input from the controller.

[0025] In accordance with another aspect of the invention a method of driving a light emitting diode in a display, the light emitting diode having a parasitic capacitance and being current programmed is provided. The method comprising the steps of providing a current to the light emitting diode, the current being provided by a current source, monitoring a voltage of a data line providing the current to the light emitting diode with a low pass filter, and mixing the voltage and a data line signal to form an input, providing the input to the current source.

[0026] This summary of the invention does not necessarily describe all features of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027] These and other features of the invention will become more apparent from the following description in which reference is made to the appended drawings wherein:

[0028] FIGURE 1 presents a schematic diagram of a pixel array according of the prior art;

[0029] FIGURE 2 presents a schematic diagram of parasitics associated with a pixel of an OLED based display of the prior art;

[0030] FIGURE 3 presents a schematic diagram of pixel programming circuit of the prior art;

[0031] FIGURE 4 presents a schematic diagram of another pixel programming circuit of the prior art;

[0032] FIGURE 5 presents a schematic diagram of a display drive circuit having a feedback circuit in accordance with an embodiment of the invention;

[0033] FIGURE 6 presents a schematic diagram of a display drive circuit having a feedback circuit in accordance with another embodiment of the invention;

[0034] FIGURE 7 presents a schematic diagram of a display drive circuit having a bandpass filter in accordance with another embodiment of the invention;

[0035] FIGURE 8a presents a schematic diagram of a bandpass filter in accordance with another embodiment of the invention;

[0036] FIGURE 8b presents a schematic diagram of a bandpass filter in accordance with another embodiment of the invention;

[0037] FIGURE 9 presents curves of settling time in accordance with another embodiment of the invention.

[0038] FIGURE 10a presents calculated noise when a high-pass filter is used in accordance with an embodiment of the invention; and

[0039] FIGURE 10b presents calculated noise when a low-pass filter is used in accordance with an embodiment of the invention.

DETAILED DESCRIPTION

[0040] As outlined in the discussion of Figure 2 the settling of the time of the current can be larger than that allowed because of the parasitic capacitance. Embodiments of the invention consider the use of a feedback circuit to provide positive feedback to a current source. This feedback allows for an improvement in the settling time of the current allowing current driven displays to have the necessary response times.

[0041] A basic feedback circuit according to one embodiment of the invention is shown in Figure 5. A display drive circuit 502 is used to drive a light-emitting pixel 503. The drive circuit 502 includes a voltage controlled current source (VCCS) 506 and a feedback loop. Within this feedback loop is a filter 504 and a voltage adder 512. The current source 506 is controlled by V_{DATA} 508 and the output of the filter 504, which monitors the voltage of data line 510. The current source 506, filter 504, and voltage adder 512 are part of the display driver 502 that can be implemented as a separate chip using CMOS technology or as part of a display using on-display TFT technology.

[0042] In another embodiment of the invention, shown in Figure 6, the filter is implemented as a differentiator 602. If the parasitic resistances R_P 604 are small enough and the VCCS 606 is a linear current source, the timing constant for the circuit shown in FIG. 6 is:

[0043]

$$\tau \propto 2\frac{(C_p - K)}{\sqrt{i * \beta}} \qquad (3)$$

[0044] Here 'i' is the current related to V_{DATA} 608. K is the coefficient of the differentiator 602 and should be selected close to the parasitic capacitance C_P 610 in order to achieve the desirable results. However, a reasonable difference between K and C_P has no significant effect on the settling time.

[0045] The circuit of Figure 6 can remove the effect of parasitic capacitance 610 and as a result can be used for fast programming of current programmed pixel 612, which is a general schematic that represent functionality of current programmed pixels. It will be apparent to one of skill in the art that the circuit of Figure 6 can be used with any current-programmed pixel circuits.

[0046] A filter circuit according to the currently preferred embodiment is shown in Figure 7. In this embodiment the

display drive circuit 702 uses a bandpass (BP) filter 704 for the feedback function. The drive circuit 702 drives the pixel 703 and manages the effect of parasitic capacitance C_P 706 through the use of positive feedback. At the beginning of the programming cycle, the voltage of the line 708 changes rapidly, and so the VCCS 710 pumps more current into current line 708. As the voltage of the current line 708 settles, the current supplied by the current source 710 goes to a programming current. Also, the band-pass filter 704 mitigates high-frequency noise of the current line 708, which would otherwise influence the output current of the current source 710.

[0047] Figure 8a presents further detail of the bandpass filter used in display drive circuit 702. A simple filter circuit has been used such that the circuit fits within the pixel pitch of approximately 100 μm. The bandpass filter of Figure 8A is generally indicated as 803 is implemented as a one-pole lowpass Butterworth filter and a differentiator. In the circuit of Figure 8a a current conveyer type II (CCII) is used for realization of the driver. The Z terminal 808 is connected directly to the Y terminal 806. Therefore, the voltage of node X 804 follows the voltage of the Z terminal 808 due to a feedback between the Y terminal 806 and the X terminal 804. Also, the capacitor C_{PL} 810 acts as a low pass filter and mitigates any high frequency noise. The capacitor C_F 812, on the other hand, differentiates the voltage at the X terminal 804, which is equal to the voltage of the line and converts it to a current. The current mirror duplicates this current and adds it to the programming current.

[0048] Another implementation of the lowpass filter that uses a digital implementation is presented in Figure 8b. In this Figure the drive circuit 819 is used to drive pixel 825. The voltage of the line 820 is read back by an ADC 822. The controller 824 block runs an algorithm and changes the current of the current source 826 using the DAC 828. An important aspect of the algorithm run by the controller 824 is the calculation of the difference between the current sample V[n] and the previous sample V[n-1]. With a consideration to this difference the algorithm adjusts the current provided by the current source 826 to speed up the programming.

[0049] An analysis of the settling time associated with the circuit of Figure 8a is shown in Figure 9. A MATLAB™ model was used to investigate the characteristics of the new current source. To simplify the analysis, the cut-off frequency of the LP filter is considered to be high. Thus, the overdrive voltage of T1 can be written as:

[0050]

$$I_P = (C_P - C_F)\frac{d}{dt}V - V^2 \qquad (3)$$

[0051] where, V is the overdrive voltage of T1, and CF the gain of differentiator. It is evident that CF can compensate for the parasitic capacitance.

[0052] In Figure 9 the settling time of the current source 702 that implements a LP filter is less than 40 μs whereas it is 400 μs for the conventional case i.e. the current is provided by the current source with no feedback. It is also evident that increasing the cut-off frequency of the low pass filter makes the driver more sensitive to the noise of the current line. There is however an increase in the speed as the cut-off frequency increases.

[0053] Figure 10a presents a graph of pixel current over time during the programming cycle when a differentiator or high-pass filter is used. The noise of the line is fed back to the current through the differentiator. This causes the noise to be amplified. Moreover, it can make the driver unstable since the differentiator is highly sensitive to high frequency signals. As is apparent from this graph the noise of the line is amplified and destroys the signal. Figure 10b presents a graph of pixel current over time during the programming cycle when a low-pass filter is used. The reduced noise is readily apparent when Figure 10b is compared to Figure 10a.

[0054] The present invention has been described with regard to one or more embodiments. However, it will be apparent to persons skilled in the art that a number of variations and modifications can be made without departing from the scope of the invention as defined in the claims.

Claims

1. A current-programmed active-matrix OLED display device comprising:

   an array of pixels arranged in rows and in columns, each pixel comprising a current-programmed pixel circuit (202) adapted to supply a current to an organic light-emitting diode; said pixel circuit being current programmed through a data line, during a programming cycle;
   a display driver (502) adapted to provide a programming current to each data line of the display device, **characterized by** the display driver comprising a current source controlled by a programming data signal and by the output of either a differentiator, a high-pass filter or a band-pass filter;

the input of said differentiator, high-pass filter or band-pass filter being connected to the data line;
said differentiator, high-pass filter or band-pass filter being adapted to differentiate the voltage of the data line with respect to time, throughout the programming cycle of each pixel circuit, so as to improve the settling time of the current programmed in each pixel circuit.

2. The display device according to claim 1, wherein the band pass filter comprises a Butterworth filter and a differentiator.

3. The display device according to claim 1, wherein said differentiator, high-pass filter or band-pass filter comprises a differentiator and a band-pass filter arranged as a feedback loop, with the differentiator arranged to differentiate the voltage on the data line throughout the programming cycle and the band-pass filter arranged to mitigate high frequency noise on the data line.

4. The display device according to one of claims 1-3, further comprising:

a voltage adder (512) for mixing a signal on the data line and the output of said differentiator, high-pass filter or band-pass filter and wherein the current source is a voltage controlled current source (506) controlled according to the output of the voltage adder (512).

5. A display driver for a current-programmed active-matrix OLED display device comprising an array of pixels arranged in rows and in columns, each pixel comprising a current-programmed pixel circuit (202) adapted to supply a current to an organic light-emitting diode, said pixel circuit being current programmed through a data line, during a programming cycle;
wherein the display driver (502) is adapted to provide a programming current to each data line of the display device, the display driver comprising a current source controlled by a programming data signal and by the output of either a differentiator, a high-pass filter or a band-pass filter;
the input of said differentiator, high-pass filter or band-pass filter being connected to the data line;
said differentiator, high-pass filter or band-pass filter being adapted to differentiate the voltage of the data line with respect to time, throughout the programming cycle of each pixel circuit, so as to improve the settling time of the current programmed in each pixel circuit.

6. The display driver according to claim 5, wherein the band pass filter comprises a Butterworth filter and a differentiator.

7. The display driver according to claim 5, wherein said differentiator, high-pass filter or band-pass filter comprises a differentiator and a band-pass filter arranged as a feedback loop, with the differentiator arranged to differentiate the voltage on the data line throughout the programming cycle and the band-pass filter arranged to mitigate high frequency noise on the data line.

8. The display driver according to claim 5, wherein the display driver (502) further comprises:

a voltage adder (512) for mixing a signal on the data line and the output of said differentiator, high-pass filter or band-pass filter and wherein the current source is a voltage controlled current source (506) controlled according to the output of the voltage adder (512).

9. A method for driving a current-programmed active-matrix OLED display device comprising an array of pixels arranged in rows and in columns, each pixel comprising a current-programmed pixel circuit (202) adapted to supply a current to an organic light-emitting diode, said pixel circuit being current programmed through a data line, during a programming cycle, the method comprising the following steps:

providing a programming current to each data line of the display device;
controlling a current source by a programming data signal and by the output of either a differentiator, a high-pass filter or a band-pass filter;
providing the input of said differentiator, high-pass filter or band-pass filter to the data line; and
differentiating the voltage of the data line with respect to time, throughout the programming cycle of each pixel circuit, so as to improve the settling time of the current programmed in each pixel circuit.

10. The method according to claim 9, wherein the controlling is carried out by mixing the output of said differentiator, high-pass filter or band-pass filter with said programming current.

11. The method according to claim 9, further comprising:

adding an output from said differentiator, high-pass filter or band-pass filter to a data voltage, via a voltage adder (512), and wherein the current source is a voltage controlled current source (506) controlled according to the output of the voltage adder (512).

12. The method according to claim 9, wherein said differentiator, high-pass filter or band-pass filter comprises a differentiator and a band-pass filter arranged as a feedback loop, and wherein the differentiating the voltage on the data line throughout the programming cycle is carried out via the differentiator, the method further comprising mitigating high frequency noise on the data line from influencing the output of the current source, via the band-pass filter.

Patentansprüche

1. Stromprogrammierte Aktivmatrix-OLED-Anzeigevorrichtung, umfassend:

eine Feldanordnung von Pixeln, die in Reihen und in Spalten angeordnet sind, wobei jedes Pixel eine stromprogrammierte Pixelschaltung (202) umfasst, die dafür ausgelegt ist, einer organischen lichtemittierenden Diode einen Strom zuzuführen; wobei die Pixelschaltung durch eine Datenleitung während eines Programmierzyklus stromprogrammiert wird;
einen Anzeigetreiber (502), der dafür ausgelegt ist, einen Programmierstrom für jede Datenleitung der Anzeigevorrichtung bereitzustellen,
dadurch gekennzeichnet, dass
der Anzeigetreiber eine Stromquelle umfasst, die von einem Programmierdatensignal und durch die Ausgabe entweder eines Differenzierers, eines Hochpassfilters oder eines Bandpassfilters gesteuert wird;
die Eingabe des Differenzierers, Hochpassfilters oder Bandpassfilters mit der Datenleitung verbunden ist;
der Differenzierer, das Hochpassfilter oder Bandpassfilter dafür ausgelegt ist, die Spannung der Datenleitung in Bezug auf die Zeit während des Programmierzyklus einer jeden Pixelschaltung zu differenzieren, um so die Einschwingzeit (settling time) des in jeder Pixelschaltung programmierten Stromes zu verbessern.

2. Anzeigevorrichtung nach Anspruch 1, wobei das Bandpassfilter ein Butterworth-Filter und einen Differenzierer umfasst.

3. Anzeigevorrichtung nach Anspruch 1, wobei der Differenzierer, das Hochpassfilter oder Bandpassfilter einen Differenzier und ein Bandpassfilter mit einer Anordnung als Rückkopplungsschleife umfasst, in der der Differenzierer dafür angeordnet ist, die Spannung auf der Datenleitung während des Programmierzyklus zu differenzieren, und das Bandpassfilter dafür angeordnet ist, hochfrequentes Rauschen auf der Datenleitung abzuschwächen.

4. Anzeigevorrichtung nach einem der Ansprüche 1 bis 3, des Weiteren umfassend:

einen Spannungsaddierer (512) zum Mischen eines Signals auf der Datenleitung und
der Ausgabe des Differenzierers, Hochpassfilters oder Bandpassfilters, wobei die Stromquelle eine spannungsgesteuerte Stromquelle (506) ist, die entsprechend der Ausgabe des Spannungsaddierers (512) gesteuert wird.

5. Anzeigetreiber für eine stromprogrammierte Aktivmatrix-OLED-Anzeigevorrichtung, die eine Feldanordnung von Pixeln umfasst, die in Reihen und in Spalten angeordnet sind, wobei jedes Pixel eine stromprogrammierte Pixelschaltung (202) umfasst, die dafür ausgelegt ist, einer organischen lichtemittierenden Diode einen Strom zuzuführen, wobei die Pixelschaltung durch eine Datenleitung während eines Programmierzyklus stromprogrammiert wird;
wobei der Anzeigetreiber (502) dafür ausgelegt ist, einen Programmierstrom für jede Datenleitung der Anzeigevorrichtung bereitzustellen, wobei der Anzeigetreiber eine Stromquelle umfasst, die durch ein Programmierdatensignal und durch die Ausgabe entweder eines Differenzierers, eines Hochpassfilters oder eines Bandpassfilters gesteuert wird;
die Eingabe des Differenzierers, Hochpassfilters oder Bandpassfilters mit der Datenleitung verbunden ist;
der Differenzierer, das Hochpassfilter oder Bandpassfilter dafür ausgelegt ist, die Spannung der Datenleitung in Bezug auf die Zeit während des Programmierzyklus einer jeden Pixelschaltung zu differenzieren, um so die Einschwingzeit (settling time) des in jeder Pixelschaltung programmierten Stromes zu verbessern.

6. Anzeigetreiber nach Anspruch 5, wobei das Bandpassfilter ein Butterworth-Filter und einen Differenzierer umfasst.

7. Anzeigetreiber nach Anspruch 5, wobei der Differenzierer, das Hochpassfilter oder Bandpassfilter einen Differenzierer und ein Bandpassfilter mit einer Anordnung als Rückkopplungsschleife umfasst, in der der Differenzierer dafür angeordnet ist, die Spannung auf der Datenleitung während des Programmierzyklus zu differenzieren, und das Bandpassfilter dafür angeordnet ist, hochfrequentes Rauschen auf der Datenleitung abzuschwächen.

8. Anzeigetreiber nach Anspruch 5, wobei der Anzeigetreiber (502) des Weiteren umfasst:

einen Spannungsaddierer (512) zum Mischen eines Signals auf der Datenleitung und der Ausgabe des Differenzierers, Hochpassfilters oder Bandpassfilters, wobei die Stromquelle eine spannungsgesteuerte Stromquelle (506) ist, die entsprechend der Ausgabe des Spannungsaddierers (512) gesteuert wird.

9. Verfahren zum Betreiben einer stromprogrammierten Aktivmatrix-OLED-Anzeigevorrichtung, die eine Feldanordnung von Pixeln umfasst, die in Reihen und in Spalten angeordnet sind, wobei jedes Pixel eine stromprogrammierte Pixelschaltung (202) umfasst, die dafür ausgelegt ist, einer organischen lichtemittierenden Diode einen Strom zuzuführen, wobei die Pixelschaltung durch eine Datenleitung während eines Programmierzyklus stromprogrammiert wird, wobei das Verfahren die nachfolgenden Schritte umfasst:

Bereitstellen eines Programmierstromes für jede Datenleitung der Anzeigevorrichtung; Steuern einer Stromquelle durch ein Programmierdatensignal und durch die Ausgabe entweder eines Differenzierers, eines Hochpassfilters oder eines Bandpassfilters;
Bereitstellen der Eingabe des Differenzierers, Hochpassfilters oder Bandpassfilters für die Datenleitung; und
Differenzieren der Spannung der Datenleitung in Bezug auf die Zeit während des Programmierzyklus einer jeden Pixelschaltung, um so die Einschwingzeit (settling time) des in jeder Pixelschaltung programmierten Stromes zu verbessern.

10. Verfahren nach Anspruch 9, wobei das Steuern durch Mischen der Ausgabe des Differenzierers, Hochpassfilters oder Bandpassfilters mit dem Programmierstrom ausgeführt wird.

11. Verfahren nach Anspruch 9, des Weiteren umfassend:

Addieren einer Ausgabe aus dem Differenzierer, Hochpassfilter oder Bandpassfilter zu einer Datenspannung mittels eines Spannungsaddierers (512), wobei die Stromquelle eine spannungsgesteuerte Stromquelle (506) ist, die entsprechend der Ausgabe des Spannungsaddierers (512) gesteuert wird.

12. Verfahren nach Anspruch 9, wobei der Differenzierer, das Hochpassfilter oder Bandpassfilter einen Differenzierer und ein Bandpassfilter mit einer Anordnung als Rückkopplungsschleife umfasst, wobei das Differenzieren der Spannung auf der Datenleitung während des Programmierzyklus mittels des Differenzierers ausgeführt wird, wobei das Verfahren des Weiteren ein weg von einem Beeinflussen der Ausgabe der Stromquelle erfolgendes Abschwächen von hochfrequentem Rauschen auf der Datenleitung mittels des Bandpassfilters umfasst.

Revendications

1. Dispositif d'affichage OLED à matrice active programmée en intensité comprenant :

un réseau de pixels agencés selon des lignes et des colonnes, chaque pixel comprenant un circuit de pixel (202) programmé en intensité et adapté pour fournir un courant à une diode électroluminescente organique ; ledit circuit de pixel étant programmé par intensité par le biais d'une ligne de données, durant un cycle de programmation ;
un circuit de commande d'affichage (502) adapté pour fournir un courant de programmation à chaque ligne de données du dispositif d'affichage, **caractérisé en ce que** le circuit de commande d'affichage comprend une source de courant commandée par un signal de données de programmation et par la sortie soit d'un différentiateur, soit d'un filtre passe-haut, soit d'un filtre passe-bande ;
l'entrée dudit différentiateur, filtre passe-haut ou filtre passe-bande étant connectée à la ligne de données ;
ledit différentiateur, filtre passe-haut ou filtre passe-bande étant adapté pour différencier la tension de la ligne de données en fonction du temps, durant le cycle de programmation de chaque circuit de pixel, afin d'améliorer le temps d'établissement du courant programmé par intensité dans chaque circuit de pixel.

2. Dispositif d'affichage selon la revendication 1, dans lequel le filtre passe-bande comprend un filtre de Butterworth et un différentiateur.

3. Dispositif d'affichage selon la revendication 1, dans lequel ledit différentiateur, filtre passe-haut ou filtre passe-bande comprend un différentiateur et un filtre passe-bande agencés pour former une boucle de contre-réaction, le différentiateur étant agencé pour différencier la tension sur la ligne de données durant le cycle de programmation et le filtre passe-bande étant agencé pour atténuer le bruit haute fréquence sur la ligne de données.

4. Dispositif d'affichage selon l'une quelconque des revendications 1 à 3, comprenant en outre :

un sommateur de tension (512) destiné à mélanger un signal sur la ligne de données et la sortie dudit différentiateur, filtre passe-haut ou filtre passe-bande et dans lequel la source de courant est une source de courant commandée en tension (506) qui est commandée selon la sortie du sommateur de tension (512).

5. Circuit de commande d'affichage destiné à un dispositif d'affichage OLED à matrice active programmée en intensité comprenant un réseau de pixels agencés selon des lignes et des colonnes, chaque pixel comprenant un circuit de pixel (202) programmé en intensité et adapté pour fournir un courant à une diode électroluminescente organique, ledit circuit de pixel étant programmé par intensité par le biais d'une ligne de données durant un cycle de programmation ;
le circuit de commande d'affichage (502) étant adapté pour fournir un courant de programmation à chaque ligne de données du dispositif d'affichage, le circuit de commande d'affichage comprenant une source de courant commandée par un signal de données de programmation et par la sortie soit d'un différentiateur, soit d'un filtre passe-haut soit d'un filtre passe-bande ;
l'entrée dudit différentiateur, du filtre passe-haut ou du filtre passe-bande étant connectée à la ligne de données,
ledit différentiateur, filtre passe-haut ou filtre passe-bande étant adapté pour différencier la tension de la ligne de données en fonction du temps, durant le cycle de programmation de chaque circuit de pixel, afin d'améliorer le temps d'établissement du courant programmé par intensité dans chaque circuit de pixel.

6. Circuit de commande d'affichage selon la revendication 5, dans lequel le filtre passe-bande comprend un filtre de Butterworth et un différentiateur.

7. Circuit de commande d'affichage selon la revendication 5, dans lequel ledit différentiateur, filtre passe-haut ou filtre passe-bande comprend un différentiateur et un filtre passe-bande agencés pour former une boucle de contre-réaction, le différentiateur étant agencé pour différencier la tension sur la ligne de données durant le cycle de programmation et le filtre passe-bande étant agencé pour atténuer le bruit haute fréquence sur la ligne de données.

8. Circuit de commande d'affichage selon la revendication 5, dans lequel le circuit de commande d'affichage (502) comprend en outre :

un sommateur de tension (512) destiné à mélanger un signal sur la ligne de données et la sortie dudit différentiateur, filtre passe-haut ou filtre passe-bande et la source de courant étant une source de courant commandée en tension (506) qui est commandée selon la sortie du sommateur de tension (512).

9. Procédé de commander d'un dispositif d'affichage OLED à matrice active programmée en intensité comprenant un réseau de pixels agencés selon des lignes et des colonnes, chaque pixel comprenant un circuit de pixel (202) programmé en intensité et adapté pour fournir un courant à une diode électroluminescente organique, ledit circuit de pixel étant programmé par intensité par le biais d'une ligne de données, durant un cycle de programmation, le procédé comprenant les étapes suivantes :

la fourniture d'un courant de programmation à chaque ligne de données du dispositif d'affichage ;
la commande d'une source de courant par un signal de données de programmation et par la sortie soit d'un différentiateur, soit d'un filtre passe-haut, soit d'un filtre passe-bande ;
la fourniture de l'entrée dudit différentiateur, filtre passe-haut ou filtre passe-bande à la ligne de données ; et
la différenciation de la tension de la ligne de données en fonction du temps, durant le cycle de programmation de chaque circuit de pixel, afin d'améliorer le temps d'établissement du courant programmé par intensité dans chaque circuit de pixel.

10. Procédé selon la revendication 9, selon lequel la commande est exécutée en mélangeant la sortie dudit différenti-

ateur, filtre passe-haut ou filtre passe-bande au dit courant de programmation.

11. Procédé selon la revendication 9, comprenant en outre :

la sommation d'une sortie dudit différentiateur, filtre passe-haut ou filtre passe-bande à une tension de données, via un sommateur de tension (512) et selon lequel la source de courant est une source de courant commandée en tension (506) qui est commandée selon la sortie du sommateur de tension (512).

12. Procédé selon la revendication 9, selon lequel ledit différentiateur, filtre passe-haut ou filtre passe-bande comprend un différentiateur et un filtre passe-bande agencés pour former une boucle de contre-réaction, et selon lequel la différenciation de la tension sur la ligne de données durant le cycle de programmation est exécutée via le différentiateur, le procédé comprenant en outre l'atténuation du bruit haute fréquence sur la ligne de données dû à l'influence de la sortie de la source de courant, via le filtre passe-bande.

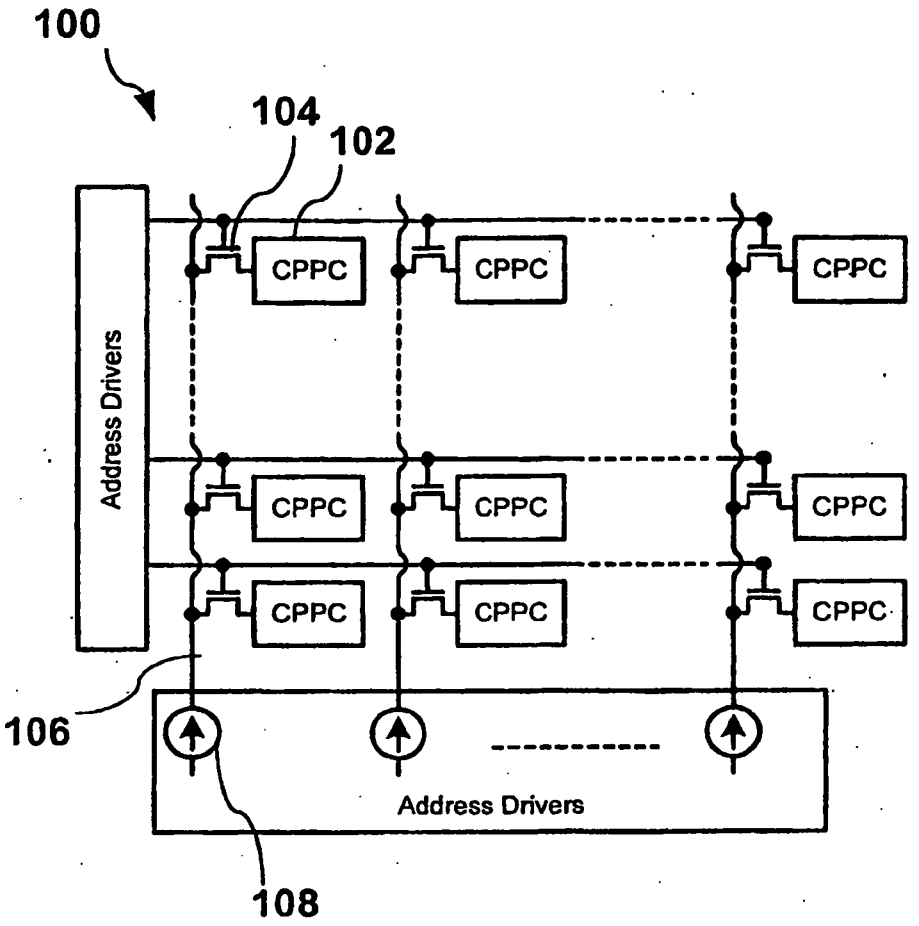

Figure 1

Prior Art

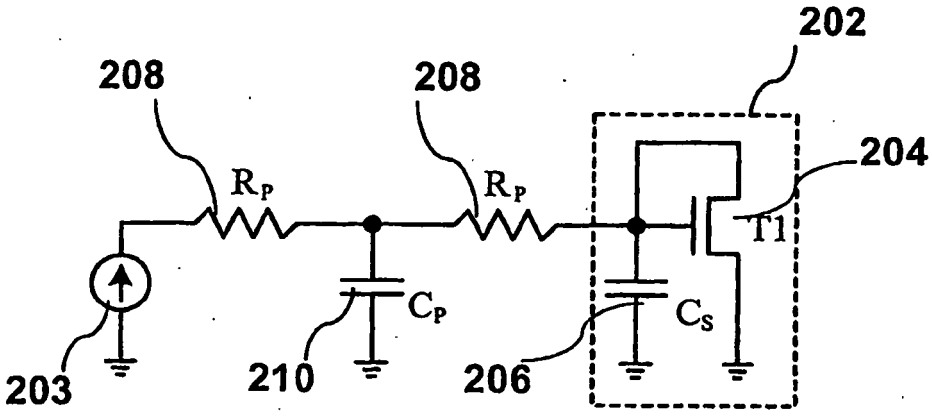

Figure 2

Prior Art

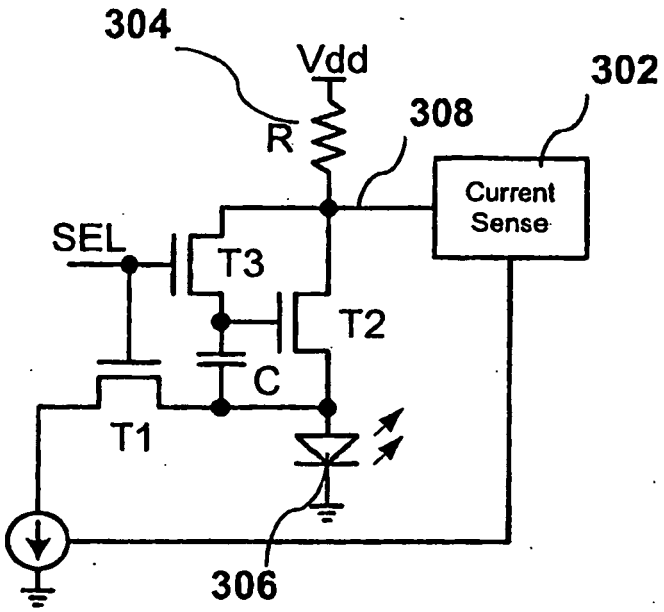

Figure 3

Prior Art

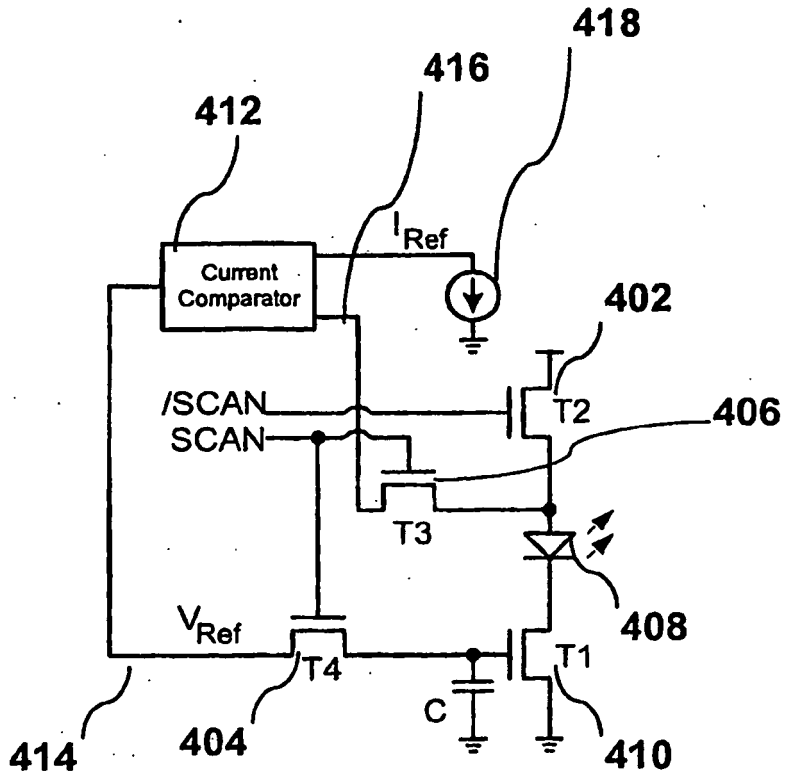

Figure 4

Prior Art

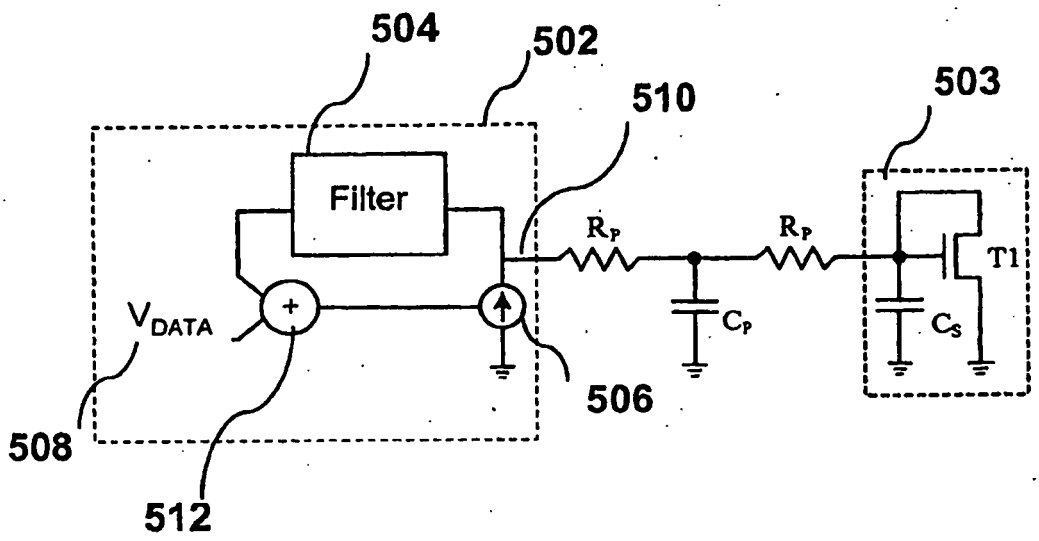

Figure 5

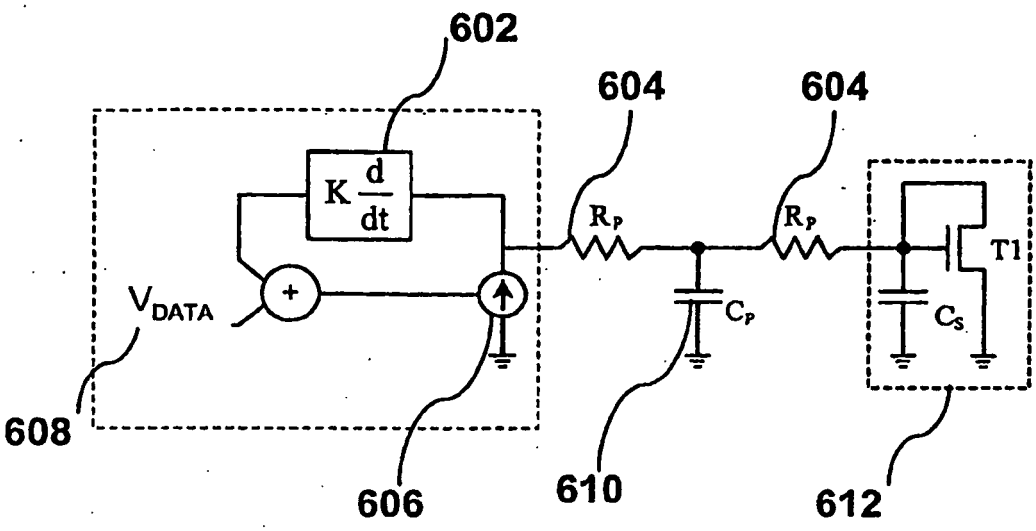

Figure 6

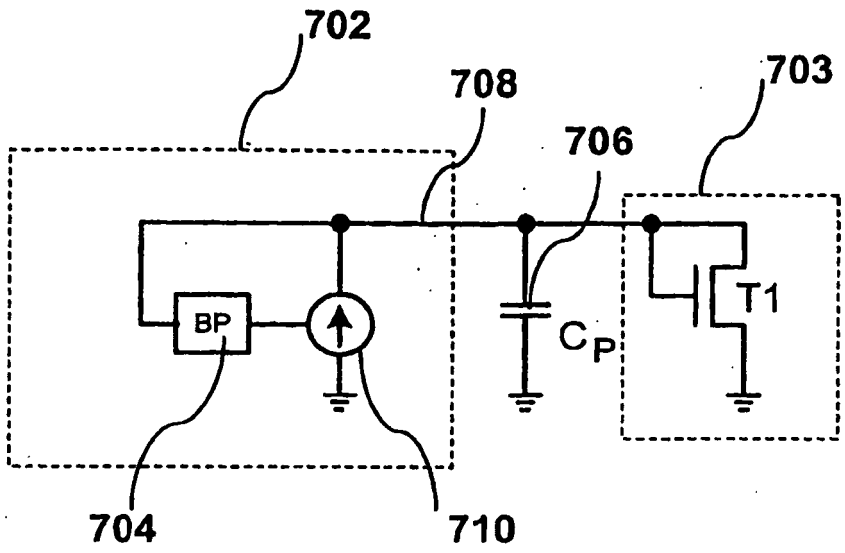

Figure 7

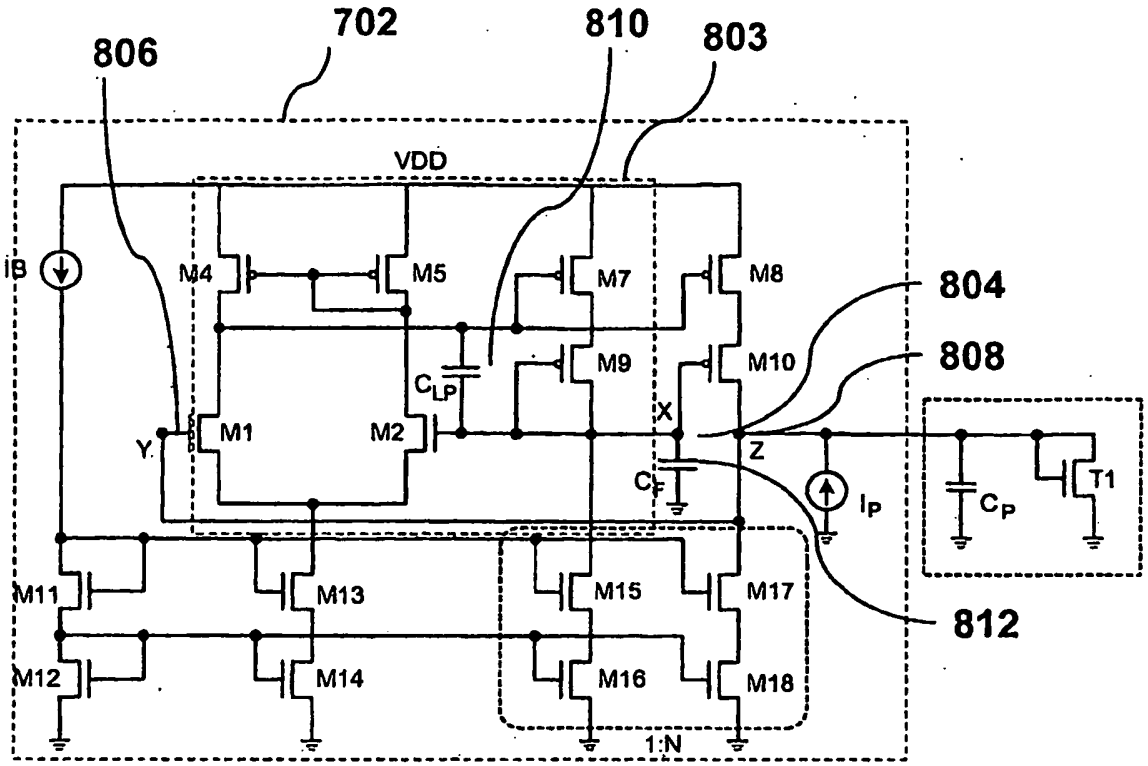

Figure 8a

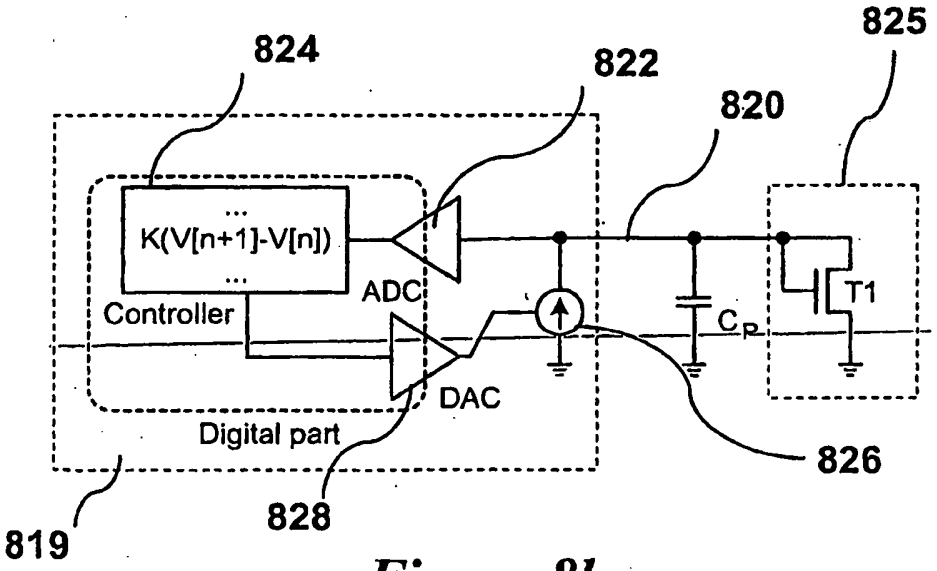

Figure 8b

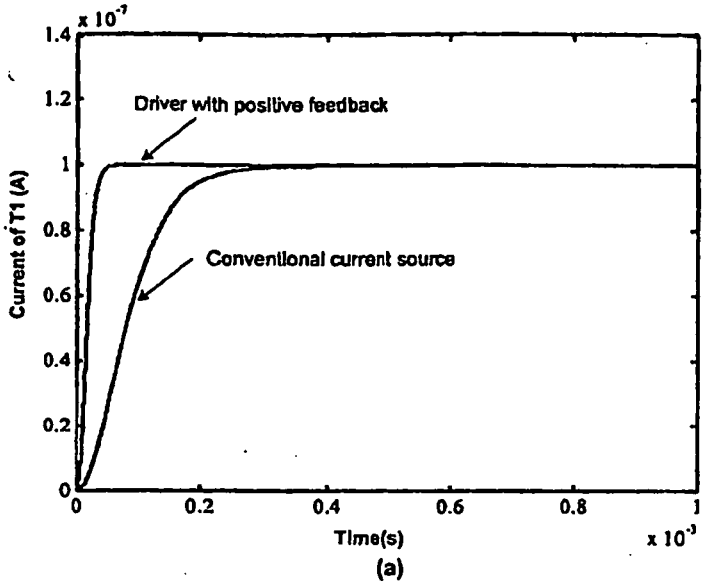
x 10^-7
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Current of T1 (A)
Driver with positive feedback
Conventional current source
0
0.2
0.4
0.6
0.8
1
Time(s)
x 10^-3
(a)

Figure 9

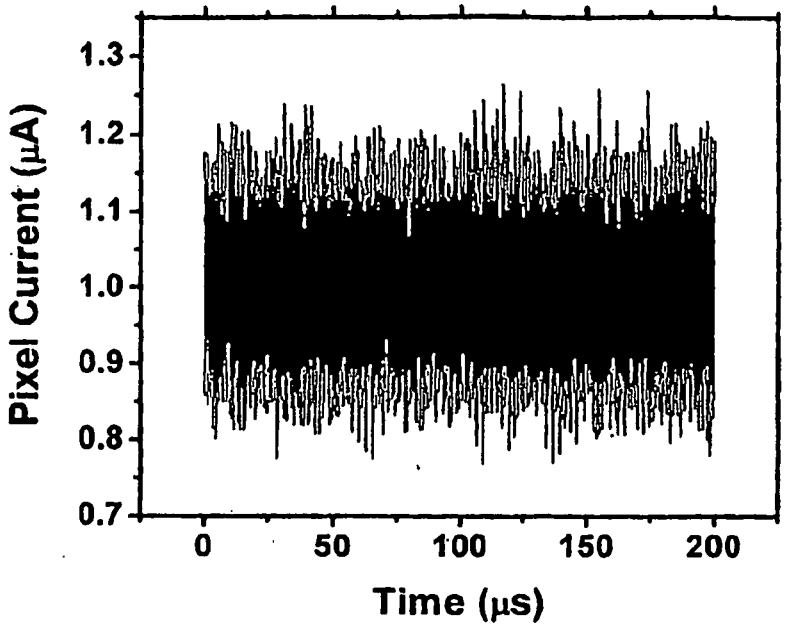

Figure 10a

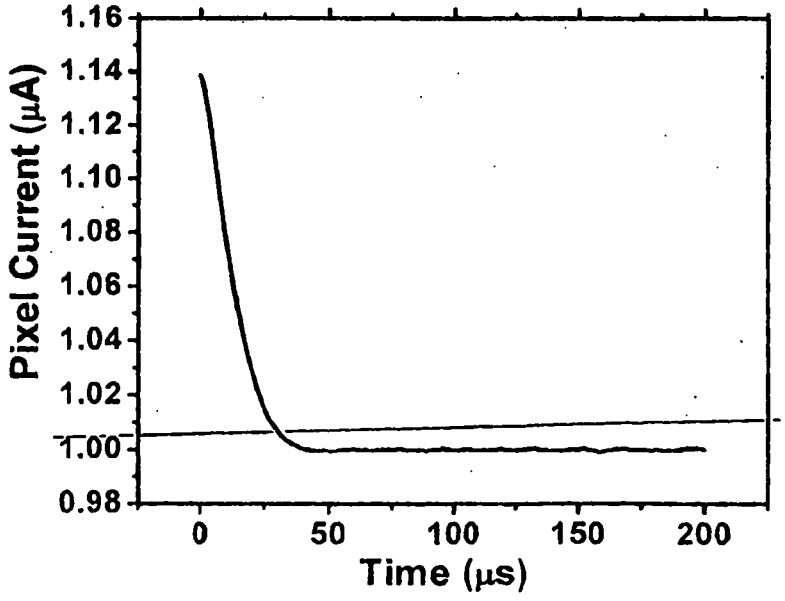

Figure 10b

REFERENCES CITED IN THE DESCRIPTION

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专利名称(译)	用于电流编程的有机发光二极管显示器的驱动电路		
公开(公告)号	EP1854338B1	公开(公告)日	2013-04-10
申请号	EP2006705133	申请日	2006-02-09
[标]申请(专利权)人(译)	伊格尼斯创新公司		
申请(专利权)人(译)	IGNIS创新INC.		
当前申请(专利权)人(译)	IGNIS创新INC.		
[标]发明人	NATHAN AROKIA CHAJI REZA G		
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IPC分类号	G09G3/32 H05B33/08 G09G3/3208		
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代理机构(译)	GRÜNECKER，KINKELDEY，STOCKMAIR & SCHWANHÄUSSER		
优先权	2496642 2005-02-10 CA		
其他公开文献	EP1854338A4 EP1854338A1		
外部链接	Espacenet		

摘要(译)

提供了一种用于具有与之相关的寄生电容的负载的负载驱动电路。 正在编程的负载。 该驱动电路具有：具有控制负载的电压的数据线；以及具有用于监视数据线的电压的低通滤波器的反馈回路；以及 电流源，用于向数据线提供电流； 电流源由信号线和低通滤波器的输出控制。