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(54) **METHOD AND APPARATUS FOR DRIVING ELECTRO-LUMINESCENCE DISPLAY PANEL DESIGNED TO PERFORM EFFICIENT BOOTING**

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(52) **U.S. Cl.** 345/76; 345/82; 315/169.1;
315/169.3

(58) **Field of Classification Search** 345/60–100,
345/204; 315/169.1–169.4

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

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* cited by examiner

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(57) **ABSTRACT**

Provided are a method and apparatus for driving an electro-luminescence (EL) display panel having data electrode lines and scanning electrode lines intersecting each other at a predetermined distance and EL cells, formed at the intersections thereof. In the method and apparatus, a booting current corresponding to a magnitude change of a display data signal in the next horizontal drive time period with respect to a display data signal in the current horizontal drive time period is applied to each of the data electrode lines at the beginning of the next horizontal drive time period. Instantaneous values of the booting currents are kept constant, and the application time for the booting current is proportional to a magnitude change of each display data signal in the next horizontal drive time period with respect to the display data signal in the current horizontal drive time period.

8 Claims, 6 Drawing Sheets

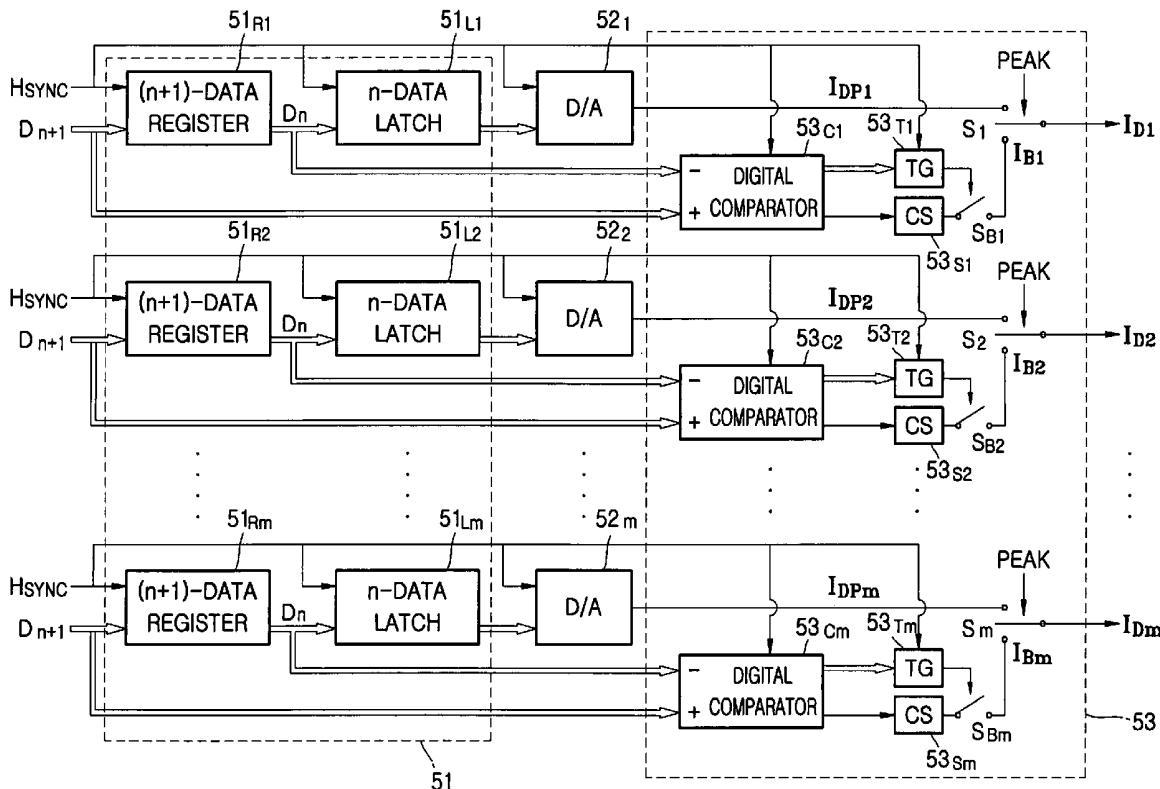


FIG. 1 (PRIOR ART)

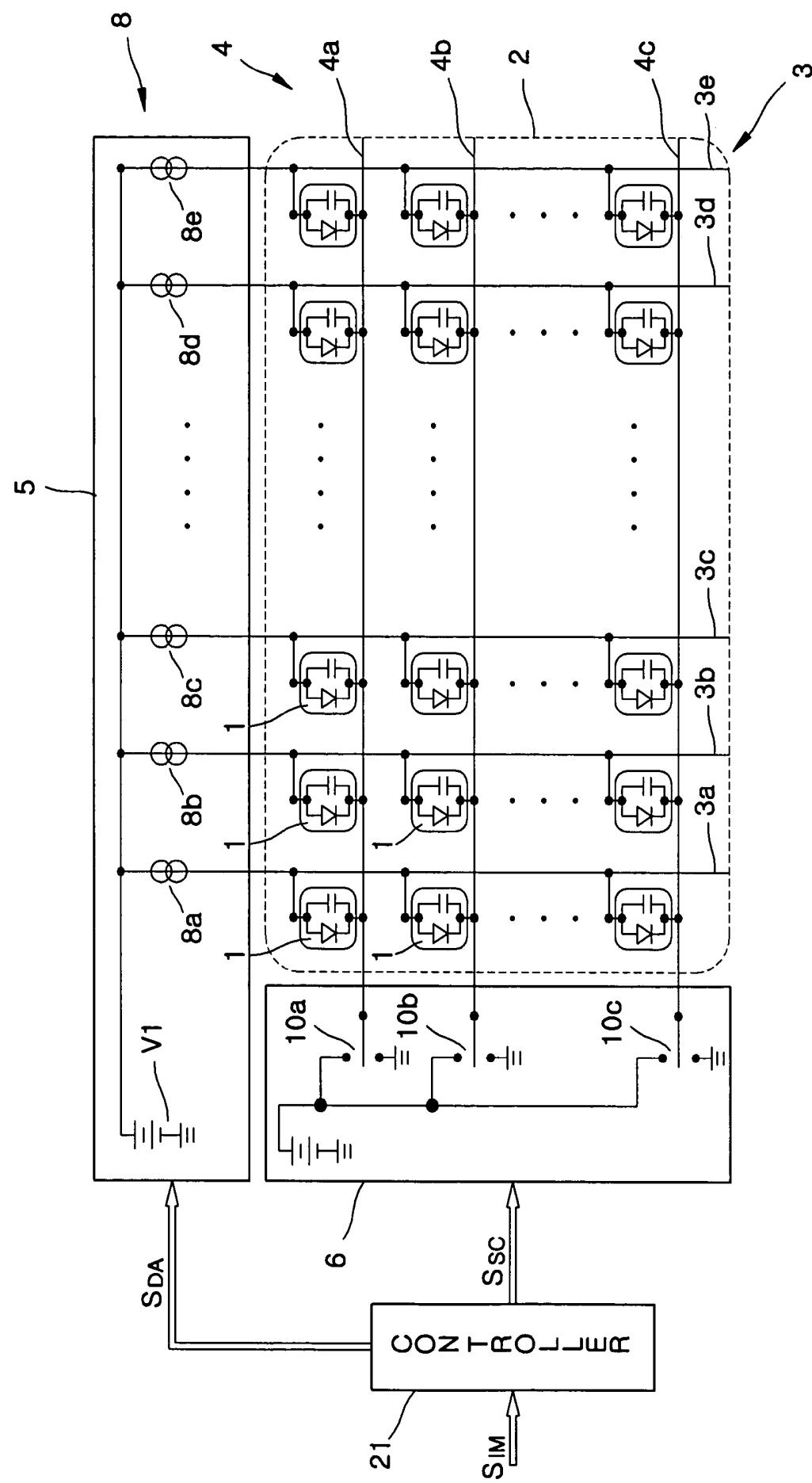


FIG. 2 (PRIOR ART)

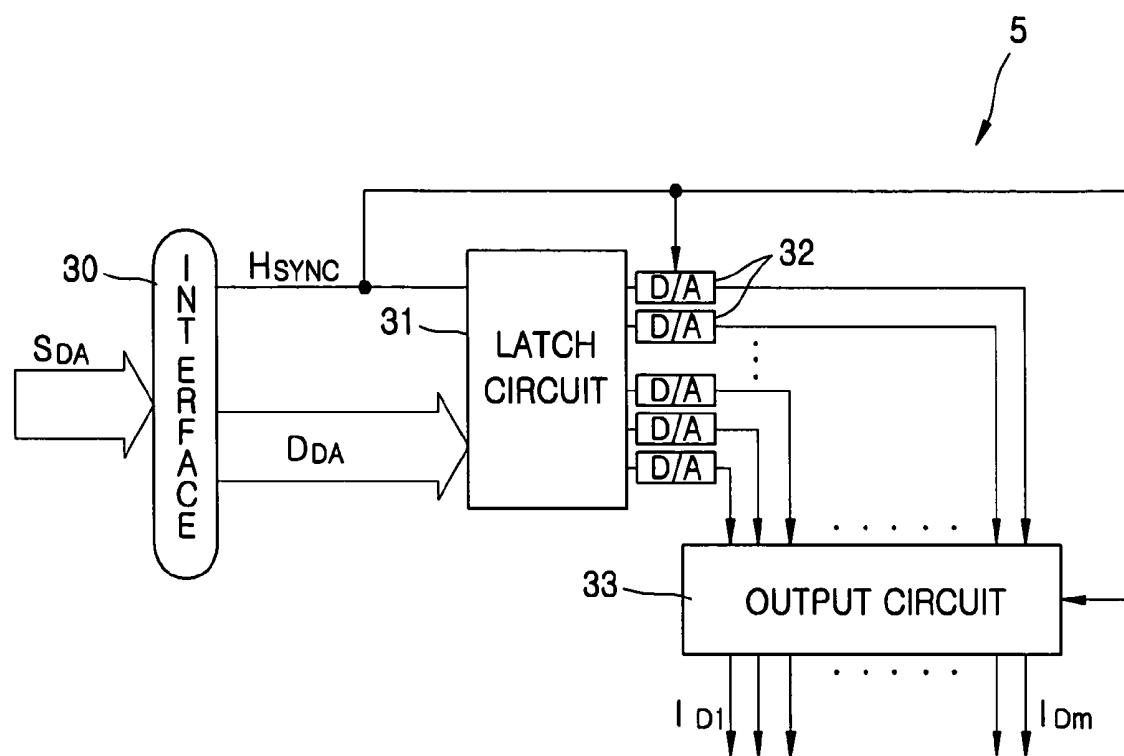


FIG. 3 (PRIOR ART)

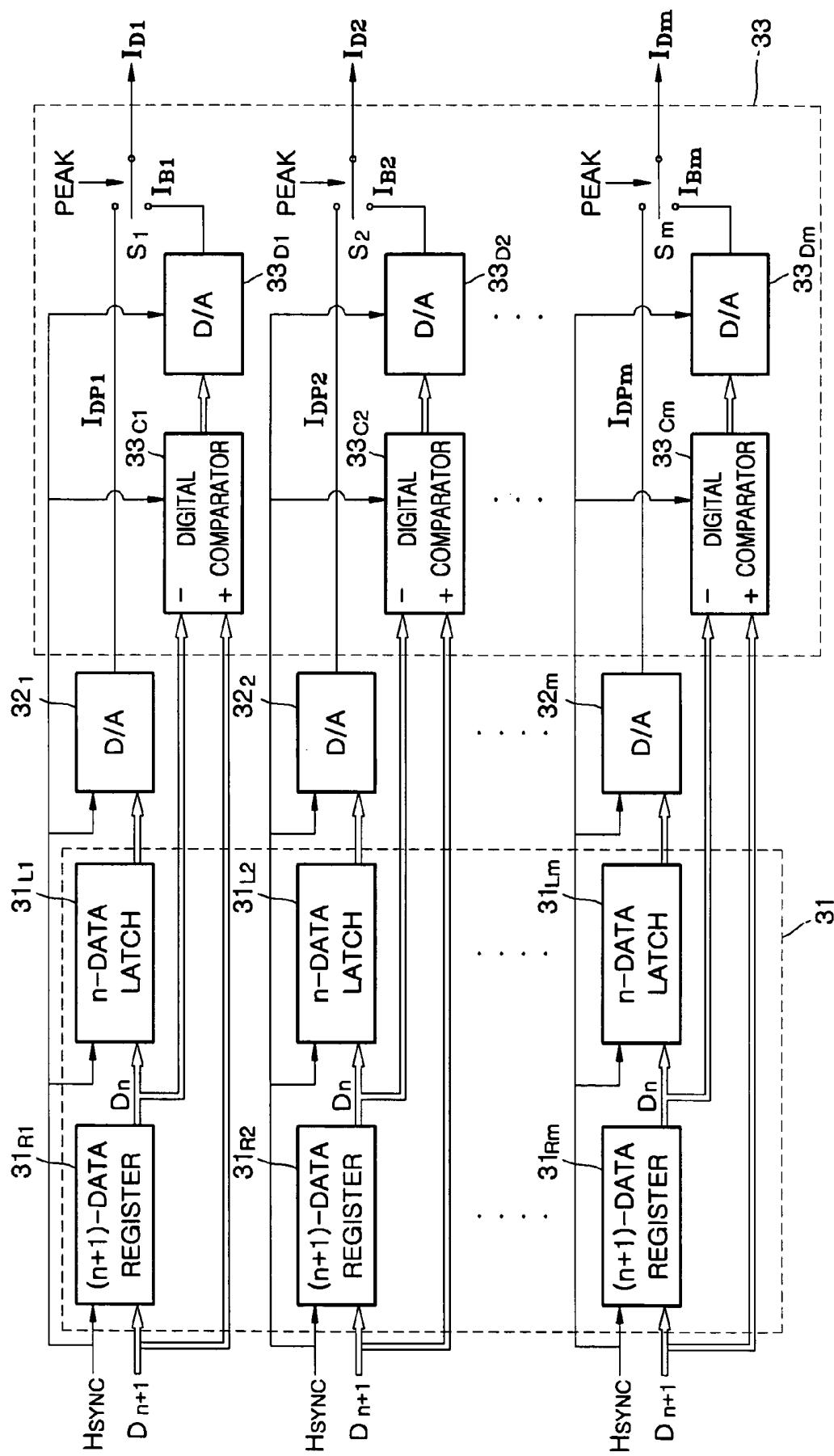


FIG. 4 (PRIOR ART)

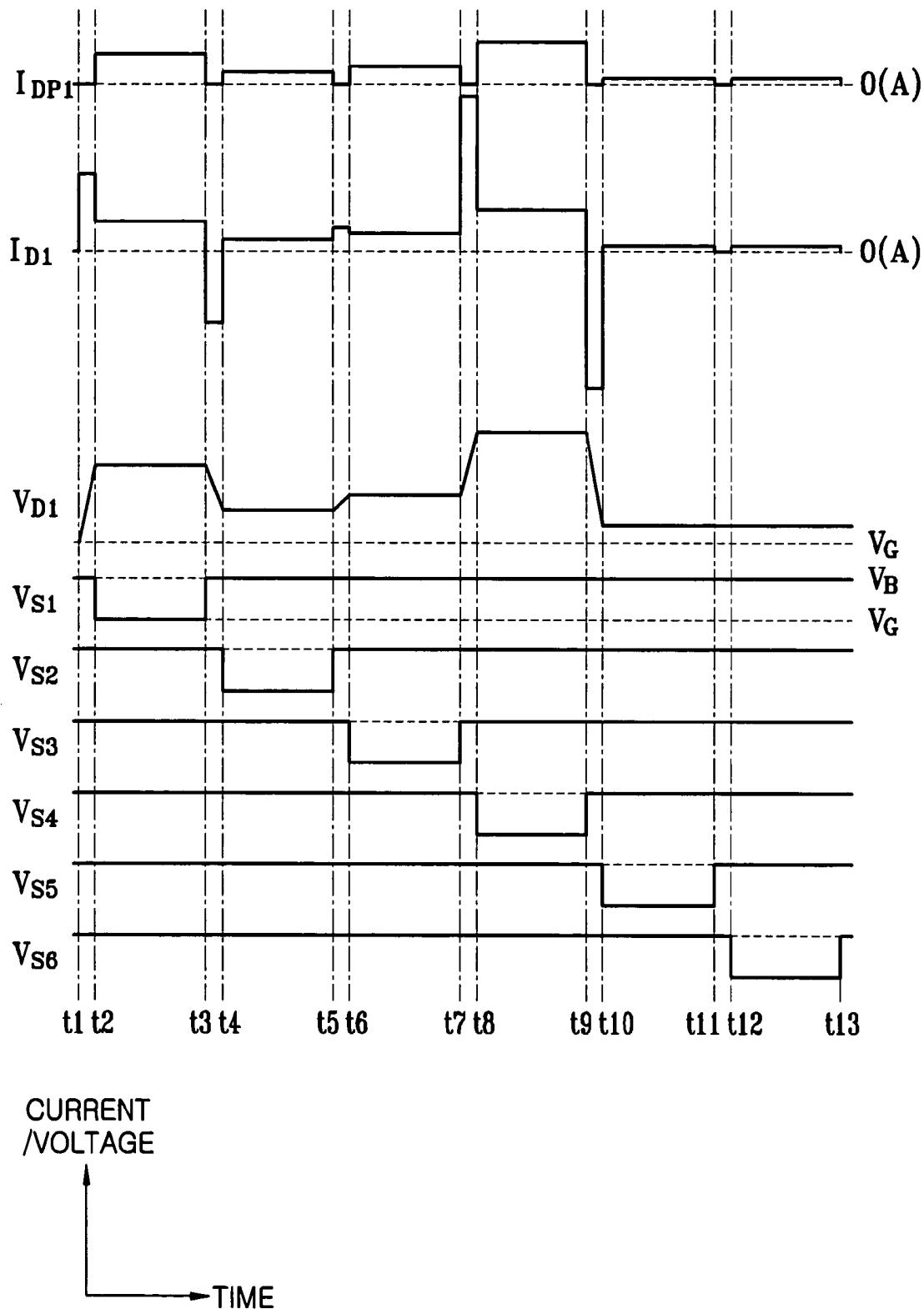


FIG. 5

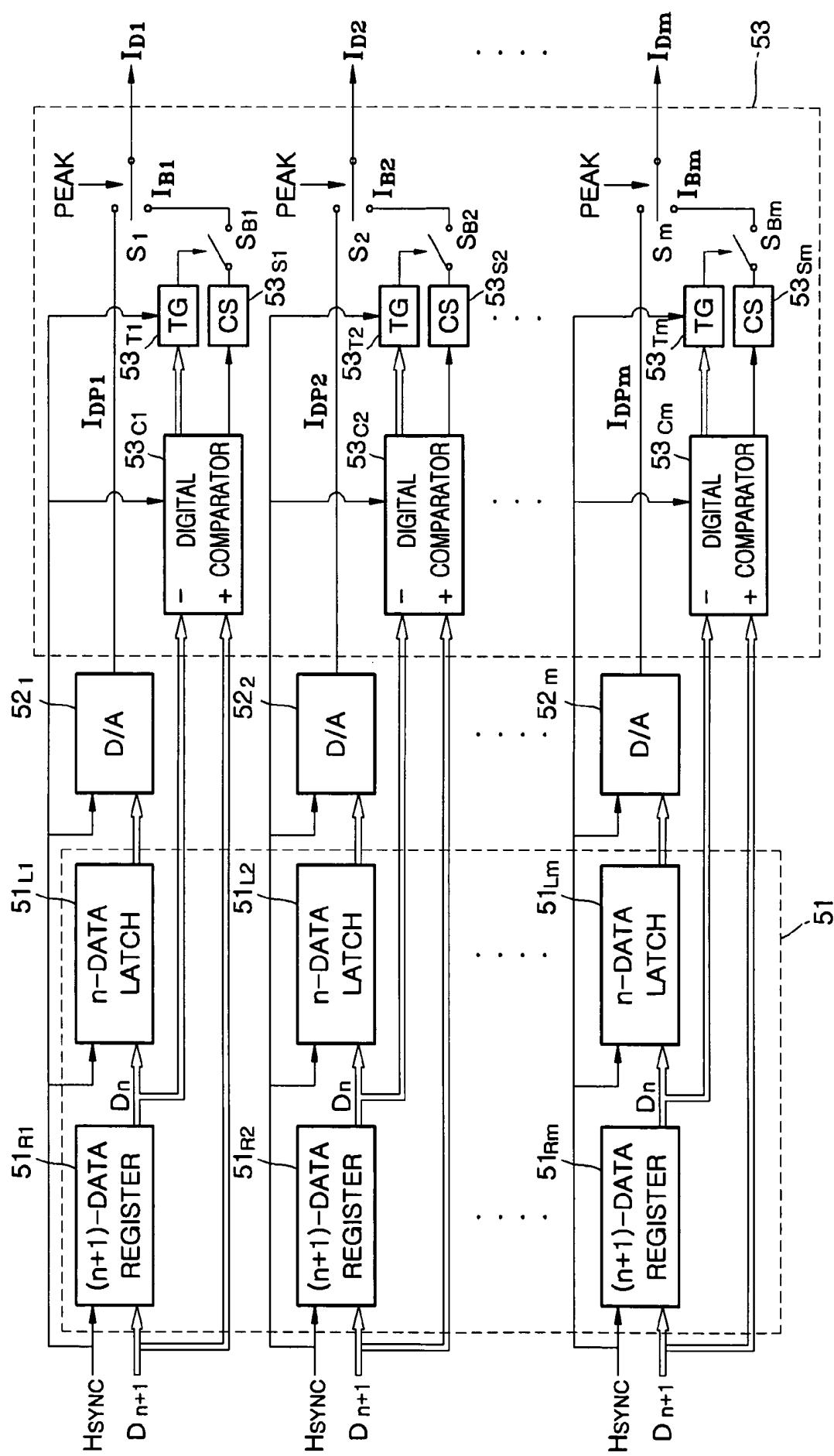
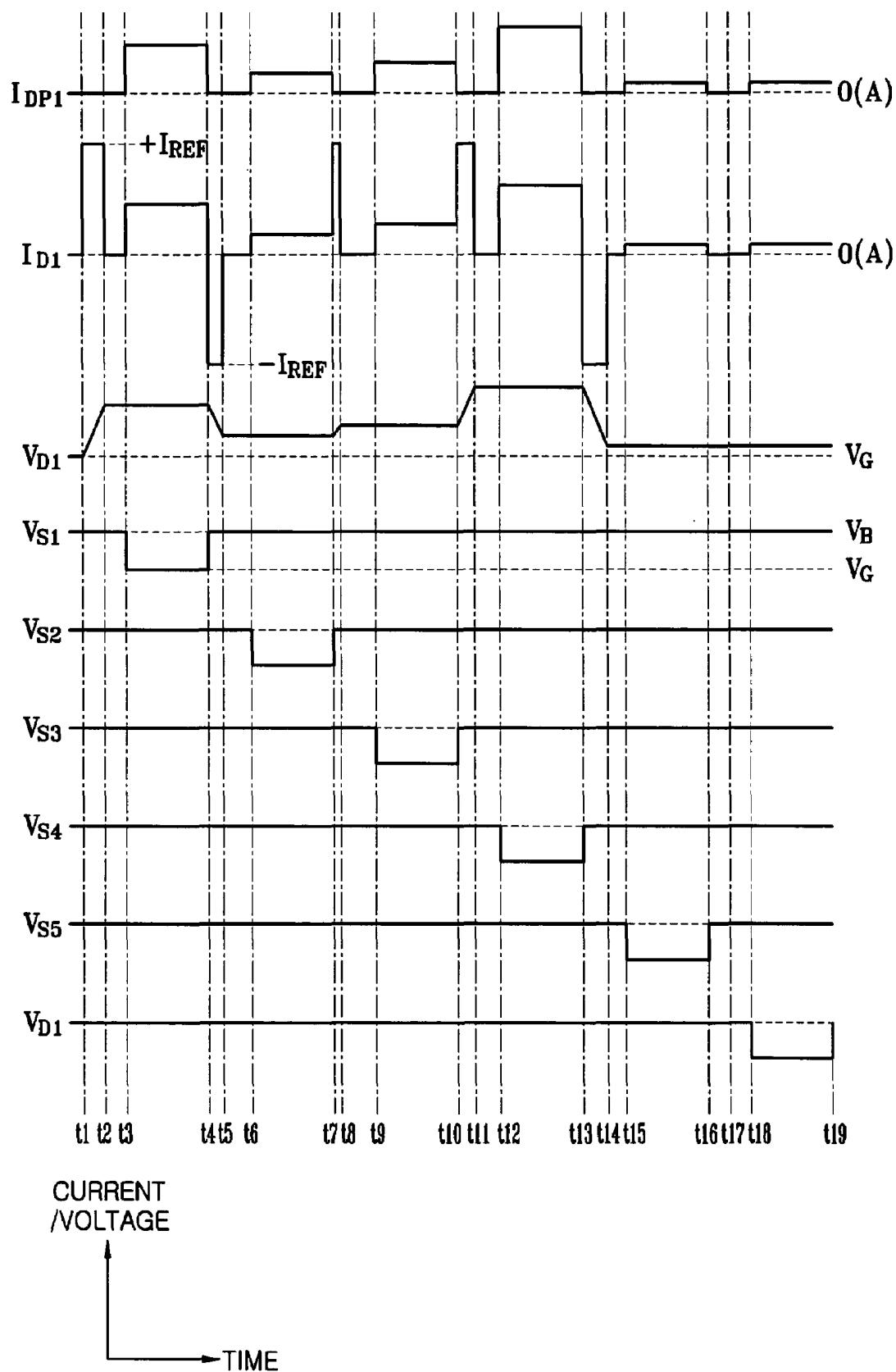


FIG. 6



**METHOD AND APPARATUS FOR DRIVING
ELECTRO-LUMINESCENCE DISPLAY
PANEL DESIGNED TO PERFORM
EFFICIENT BOOTING**

CROSS REFERENCE TO RELATED
APPLICATION

This application claims the priority of Korean Patent Application No. 2003-23713, filed on Apr. 15, 2003, in the Korean Intellectual Property Office, the disclosure of which is incorporated herein by reference in its entirety.

FIELD OF THE INVENTION

The present invention relates to a method and apparatus for driving an electro-luminescence (EL) display panel, and more particularly, to a method and apparatus for driving an EL display panel having electro-luminescence cells formed at intersections between data and scanning electrode lines crossing each other at a predetermined distance.

BACKGROUND OF THE INVENTION

Referring to FIG. 1, a conventional EL display device includes an EL display panel 2 and a driving circuit. The driving circuit comprises a controller 21, a scanning driving unit 6, and a data driving unit 5. The EL display panel 2 has a plurality of data electrode lines 3 and scanning electrode lines 4 intersecting each other at a predetermined distance. The EL display panel 2 further has electro-luminescence cells 1, each being formed at the intersections between the data electrode lines 3 and the scanning electrode lines 4.

The controller 21 receives and processes image signals S_{IM} . The processing includes applying data control signals S_{DA} and scanning control signals S_{SC} to the data driving unit 5 and the scanning driving unit 6, respectively. The data control signals S_{DA} include the display data signals and the switching control signals, while the scanning control signals S_{SC} are the switching control signals.

The data driving unit 5 connected to the signal-input terminals of the data electrode lines 3 produces data current signals, corresponding to the display data signals from the controller 21 in response to the switching control signals received from the controller 21, and applies the data current signals to the data electrode lines 3. Here, reference number 8 denotes current sources.

The scanning driving unit 6 connected to the signal-input terminals of the scanning electrode lines 4 sequentially applies scanning driving signals, in response to the switching control signals received from the controller 21, to the scanning electrode lines 4.

Referring to FIG. 1 and FIG. 2, the data driving unit 5 of the EL display device of FIG. 1 includes an interface 30, a latch circuit 31, digital-to-analog (D/A) converters 32, and an output circuit 33.

The latch circuit 31, operating according to a horizontal synchronization signal H_{SYNC} received from the controller 21 through the interface 30, periodically stores the display data signals D_{DA} received from the controller 21 through the interface 30 while periodically outputting display data signals in the current and next horizontal drive time periods, respectively. Each of the D/A converters 32 converts each of the display data signals in the current horizontal drive time period received from the latch circuit 31 into a data current signal. The output circuit 33 then applies data output signals $I_{D1}-I_{Dm}$, corresponding to the display data signals received

from the D/A converters 32, to the corresponding data electrode lines 3, respectively.

As an example of a conventional EL display device configured as above, U.S. Pat. No. 6,531,827 discloses a technology for improving driving speed by applying booting current at the beginning of each horizontal drive time period. European Laid-open Patent Publication No. 1,091,340 proposes a technology for reducing power consumption by controlling the booting current according to a change in the amount of data. A conventional driving apparatus and method using the above-cited technologies will now be described.

Referring to FIGS. 1, 2 and 3, the latch circuit 31 of the data driving unit 5 of FIG. 2 generally comprises (n+1)-data registers $31_{R1}-31_{Rm}$ and n-data latches $31_{L1}-31_{Lm}$. The output circuit 33 of the data driving unit 5 includes digital comparators $33_{C1}-33_{Cm}$, D/A converters $33_{D1}-33_{Dm}$, and output current switches S_1-S_m .

Each of the (n+1)-data registers $31_{R1}-31_{Rm}$ outputs a display data signal stored therein according to the horizontal synchronization signal H_{SYNC} and stores a display data signal D_{n+1} received from the controller 21 through the interface 30. The n-data latches $31_{L1}-31_{Lm}$ output display data signals stored therein in response to the horizontal synchronization signal H_{SYNC} and store the display data signals D_n received from the (n+1)-data registers $31_{R1}-31_{Rm}$, respectively. The D/A converters 32_1-32_m then convert the display data signals D_n in the current horizontal drive time period received from the n-data latches $31_{L1}-31_{Lm}$ into data current signals $I_{DP1}-I_{DPm}$, respectively.

The digital comparators $33_{C1}-33_{Cm}$ of the output circuit 33 compare the display data signals D_n in the current horizontal drive time period received from n-data latches $31_{L1}-31_{Lm}$ with the display data signals D_{n+1} in the next horizontal drive time period received from (n+1)-data registers $31_{R1}-31_{Rm}$, respectively. The digital comparators $33_{C1}-33_{Cm}$ generate booting data signals according to the comparison results. The D/A converters $33_{D1}-33_{Dm}$ convert the booting data signals received from the digital comparators $33_{C1}-33_{Cm}$ into analog signals and output booting current signals $I_{B1}-I_{Bm}$, respectively. The output current switches S_1-S_m apply data output signals $I_{D1}-I_{Dm}$ to the data electrode lines 3, respectively. The data output signals $I_{D1}-I_{Dm}$ are generated by alternately selecting the output signals $I_{B1}-I_{Bm}$ of the D/A converters $33_{D1}-33_{Dm}$ of the output circuit 33 or output signals $I_{DP1}-I_{DPm}$ of the D/A converters 32_1-32_m , respectively.

A method for driving a conventional EL display device having a data driving unit 5 as shown in FIG. 3 will now be described with reference to FIGS. 3 and 4. In FIG. 4, reference character I_{DP1} is a data current signal from D/A converter 32_1 , I_{D1} is a data output signal applied to the data electrode line (3a of FIG. 1) from the output current switch S_1 corresponding to the D/A converter 32_1 , V_{D1} is a data voltage signal applied to the data electrode line 3a, and $V_{S1}-V_{S6}$ are scanning voltage signals applied to the scanning electrode lines (4 of FIG. 1).

With reference to the data output signal I_{D1} , a booting current corresponds to a magnitude change of a display data signal D_{n+1} in a next horizontal drive time period with respect to a display data signal D_n in a current horizontal drive time period. The booting current is applied to the data electrode line 3a at the beginning of the next horizontal drive time period. An instantaneous value of the booting current is proportional to a magnitude change of the data current signal I_{DP1} . In connection therewith, first and second drive periods t1-t3 and t3-t5 will now be representatively described.

The magnitude of the data current signal I_{DP1} at the scanning time interval $t2 \sim t3$ increases over that of the data current signal I_{DP1} at the previous scanning time interval (not shown) during booting time interval $t1 \sim t2$ of the first horizontal drive period $t1 \sim t3$. A positive polarity booting current, proportional to the amount by which the magnitude of the data current signal I_{DP1} at the scanning time interval $t2 \sim t3$ increases from the previous scanning time interval, is applied to the data electrode line 3a.

Conversely, the magnitude of the data current signal I_{DP1} at scanning time interval $t4 \sim t5$ decreases over that of the data current signal I_{DP1} at the previous scanning time interval $t2 \sim t3$ during booting time interval $t3 \sim t4$ of the second horizontal drive period $t3 \sim t5$. A negative polarity booting current, proportional to the amount by which the magnitude of the data current signal I_{DP1} at the scanning time interval $t4 \sim t5$ decreases from the previous scanning time interval $t2 \sim t3$, is applied to the data electrode line 3a.

Thus, the typical driving apparatus and method can improve the driving speed using the booting current. However, since the instantaneous value of booting current are proportional to the magnitude change of the data current signal I_{DP1} , the instantaneous value of booting current may increase significantly when the change becomes very large. This may cause crosstalk such that EL cells that are not scanned glow, as well as increase power consumption.

SUMMARY OF THE INVENTION

The present invention provides a method and apparatus for driving an electro-luminescence (EL) display panel designed to prevent occurrences of crosstalk, that is, when EL cells not scanned emit light, and reduce power dissipation, by efficiently applying a booting current for high speed operation at the beginning of a horizontal drive period.

According to an aspect of the present invention, there are provided a method and apparatus for driving an electro-luminescence (EL) display panel having data electrode lines and scanning electrode lines intersecting each other at a predetermined distance and EL cells, where each EL cell is formed at the intersections thereof. In the method and apparatus, a booting current, corresponding to a magnitude change of a display data signal in the next horizontal drive time period with respect to a display data signal in the current horizontal drive time period, is applied to each of the data electrode lines at the beginning of the next horizontal drive time period. Instantaneous values of the booting currents are kept constant, and the application time for the booting current is proportional to a magnitude change of each display data signal in the next horizontal drive time period with respect to the display data signal in the current horizontal drive time period.

The method and apparatus for driving the EL display panel make the instantaneous values of the booting currents constant by adjusting the power required for the booting currents according to the application time. Thus, since it is possible to limit excessive increases in instantaneous values of the booting currents, this invention may prevent occurrences of crosstalk caused by unscanned EL cells emitting light, while reducing power consumption.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other features and advantages of the present invention will become more apparent by describing in detail exemplary embodiments thereof with reference to the attached drawings.

FIG. 1 shows the configuration of a conventional electro-luminescence (EL) display device.

FIG. 2 is a block diagram showing the configuration of the data driving unit shown in FIG. 1.

FIG. 3 is a detailed block diagram showing a conventional interior configuration of the data driving unit of FIG. 2.

FIG. 4 is a timing diagram for explaining a method for driving a conventional EL display device having the data driving unit of FIG. 3.

FIG. 5 is a detailed block diagram showing an interior configuration of the data driving unit of FIG. 2 according to the present invention.

FIG. 6 is a timing diagram for explaining a method for driving an EL display device having the data driving unit of FIG. 5 according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

20 Since the basic configuration and operation of the conventional driving circuit described earlier with reference to FIGS. 1 and 2 also apply to a driving apparatus of this invention, a detailed description thereof will not be given.

Referring to FIGS. 1, 2, and 5, a latch circuit 51 of the data driving unit 5 of FIG. 2, according to the present invention, comprises (n+1)-data registers $51_{R1} \sim 51_{Rm}$ and n-data latches $51_{L1} \sim 51_{Lm}$. An output circuit 53 of the data driving unit according to the invention includes digital comparators $53_{C1} \sim 53_{Cm}$, current sources $53_{S1} \sim 53_{Sm}$, booting-current switches $S_{B1} \sim S_{Bm}$, timing signal generators $53_{T1} \sim 53_{Tm}$, and output current switches $S_1 \sim S_m$.

Each of the (n+1)-data registers $51_{R1} \sim 51_{Rm}$ outputs a display data signal stored therein according to horizontal synchronization signal H_{SYNC} , and stores a display data signal D_{n+1} received from the controller (21 of FIG. 1) through the interface (30 of FIG. 2). The n-data latches $51_{L1} \sim 51_{Lm}$ output display data signals stored therein in response to horizontal synchronization signal H_{SYNC} , and store the display data signals D_n received from the (n+1)-data registers $51_{R1} \sim 51_{Rm}$, respectively. Digital-to-analog (D/A) converters $52_1 \sim 52_m$ then convert the display data signals D_n in the current horizontal drive time period received from the n-data latches $51_{L1} \sim 51_{Lm}$ into data current signals $I_{DP1} \sim I_{DPm}$, respectively.

35 The digital comparators $53_{C1} \sim 53_{Cm}$ of the output circuit 53 compare the display data signals D_n in the current horizontal drive time period received from n-data latches $51_{L1} \sim 51_{Lm}$ with the display data signals D_{n+1} in the next horizontal drive time period received from (n+1)-data registers $51_{R1} \sim 51_{Rm}$, respectively. The digital comparators $53_{C1} \sim 53_{Cm}$ generate signals indicating a magnitude change of the display data signals D_{n+1} with respect to display data signals D_n and generate signals indicating the amount of the change.

40 The current sources $53_{S1} \sim 53_{Sm}$ output booting currents having constant instantaneous values and varying polarities depending on the magnitude change in the signals. Taking a data electrode line as an example, if the magnitude of display data signal D_{n+1} in the next horizontal drive time period increases over that of display data signal D_n in the current horizontal drive time period, a current source corresponding to the data electrode line outputs a positive polarity booting current during the next horizontal drive time period. Conversely, if the magnitude of display data signal D_{n+1} in the next horizontal drive time period decreases over that of display data signal D_n in the current horizontal drive time period, the current source corresponding to the data electrode line outputs a negative polarity booting current during the next horizontal drive time period.

booting current during the next horizontal drive time period. Since the booting currents are applied to the data electrode lines (3 of FIG. 1) at the beginning of each horizontal drive time period, it is possible to increase the speed at which the voltage is applied, i.e., driving speed for the EL cells (1 of FIG. 1), despite the presence of parasitic capacitance at the EL cells 1.

The booting-current switches S_{B1} - S_{Bm} switch the booting currents I_{B1} - I_{Bm} output from the current sources 53_{S1} - 53_{Sm} , respectively. The timing signal generators 53_{T1} - 53_{Tm} control timing for operation of the booting-current switches S_{B1} - S_{Bm} according to the signals indicating the amount of change received from the digital comparators 53_{C1} - 53_{Cm} . Specifically, the timing signal generators 53_{T1} - 53_{Tm} allow the booting-current switches S_{B1} - S_{Bm} to remain ON for a period proportional to the amount of magnitude change of display data signals at the beginning (t1~t3, t4~t6, t7~t9, t10~t12, t13~t15, or t16~t18 of FIG. 6) of each horizontal drive time period, respectively.

The power required for booting currents is adjusted by the amount of application time, which causes instantaneous values of the booting currents I_{B1} - I_{Bm} to be kept constant. Thus, it is possible to limit excessive increases in the instantaneous values of the booting currents I_{B1} - I_{Bm} , which prevents occurrences of crosstalk, that is, unscanned EL cells emitting light, while reducing power consumption.

The output current switches S_1 - S_m apply data output signals I_{D1} - I_{Dm} to the data electrode lines 3, respectively. The data output signals I_{D1} - I_{Dm} are generated by alternately selecting from the output signals I_{B1} - I_{Bm} of the booting-current switches S_{B1} - S_{Bm} and the output signals I_{DP1} - I_{DPm} of the D/A converters 52_1 - 52_m , respectively.

A method for driving an EL display device having the data driving unit of FIG. 5 according to the present invention, will now be described with reference to FIGS. 5 and 6. In FIG. 6, reference character I_{DP1} is a data current signal from a D/A converter 52_1 , I_{D1} is a data output signal applied to the data electrode line (3a of FIG. 1) from the output current switch S_1 corresponding to the D/A converter 52_1 , V_{D1} is a data voltage signal applied to the data electrode line 3a, and V_{S1} - V_{S6} are scanning voltage signals applied to the scanning electrode lines (4 of FIG. 1).

With reference to the data output signal I_{D1} , a booting current, corresponding to a magnitude change of a display data signal D_{n+1} in the next horizontal drive time period with respect to a display data signal D_n in the current horizontal drive time period, is applied to the data electrode line 3a at the beginning t1~t3, t4~t6, t7~t9, t10~t12, t13~t15 or t16~t18 of the next horizontal drive time period. This makes it possible to increase speed in which of voltage is applied, i.e., a driving speed for the EL cells (1 of FIG. 1), despite the presence of parasitic capacitance at the EL cells 1.

While an instantaneous value I_{REF} of booting current is kept constant, the amount of application time t1~t2, t4~t5, t7~t8, t10~t11, t13~t14 or t16~t17 for the booting current is proportional to the amount of magnitude change of the data current signal I_{DP1} . Thus, the power required for booting current I_{B1} is adjusted by the amount of application time to keep an instantaneous value of the booting current I_{B1} constant. It is possible to limit excessive increases in the instantaneous value of the booting current I_{B1} , which prevents occurrences of crosstalk, that is, unscanned EL cells emitting light, while reducing power consumption. In connection therewith, first and second drive periods t1~t3 and t4~t7 will now be representatively described.

The magnitude of the data current signal I_{DP1} during scanning time interval t3~t4 increases over that of the data current signal I_{DP1} during the previous scanning time interval (not shown) at the beginning t1-t3 of the first horizontal drive period t1~t4. An instantaneous value $+I_{REF}$ of positive polarity booting current is applied to the data electrode line 3a. Here, the application time interval t1~t2 is proportional to the amount by which the magnitude of the data current signal I_{DP1} at the scanning time interval t3~t4 increases from previous scanning time interval.

Conversely, the magnitude of the data current signal I_{DP1} during scanning time interval t6~t7 decreases over that of the data current signal I_{DP1} during the previous scanning time interval t3~t4 at the beginning of the second horizontal drive period t4~t7. An instantaneous value $-I_{REF}$ of negative polarity booting current is applied to the data electrode line 3a. Here, the application time interval t4~t5 is proportional to the amount by which the magnitude of the data current signal I_{DP1} during the scanning time interval t6~t7 decreases from the previous scanning time interval t3~t4.

As described above, the method and apparatus for driving an EL display panel according to the present invention make it possible to keep instantaneous values of booting currents constant by adjusting the power required for the booting currents, depending on the amount of application time. Since it is possible to limit excessive increases in instantaneous values of booting currents, this invention may prevent occurrences of crosstalk, that is, when unscanned EL cells emit light, while reducing power consumption.

While the present invention has been particularly shown and described with reference to exemplary embodiments thereof, it will be understood by those of ordinary skill in the art that various changes in form and details may be made therein without departing from the spirit and scope of the present invention as defined by the following claims.

What is claimed is:

1. A method for driving an electro-luminescence display panel having electro-luminescence cells and data electrode lines and scanning electrode lines intersecting each other at a predetermined distance, each of the electro-luminescence cells being formed at the intersections thereof, comprising the step of:

applying a booting current to each of the data electrode lines at the beginning of the next horizontal drive time period,

wherein the booting current:

corresponds to a magnitude change of a display data signal in the next horizontal drive time period with respect to a display data signal in the current horizontal drive time period;

has instantaneous values which are kept constant; and has an application time amount that for the booting current is proportional to a magnitude change of each display data signal in the next horizontal drive time period with respect to the display data signal in the current horizontal drive time period.

2. The method of claim 1, wherein the booting current is applied in a forward direction with respect to the EL cells when the magnitude of the display data signal in the next horizontal drive time period is larger than that of the display data signal in the current horizontal drive time period, and

wherein the booting current is applied in a reverse direction with respect to the EL cells, when the magnitude of the display data signal in the next horizontal drive time period is smaller than that of the display data signal in the current horizontal drive time period.

3. The method of claim 2, wherein no booting current is applied when the magnitudes of the display data signals in the current and next horizontal drive time periods are equal to each other.

4. An apparatus for driving an electro-luminescence display panel, comprising:

data electrode lines and scanning electrode lines intersecting each other at predetermined distances; and a plurality of electro-luminescence cells, each of the plurality of electro-luminescence cells being formed at the intersections thereof, wherein:

a booting current is applied to each of the data electrode lines at the beginning of the next horizontal drive time period;

the booting current corresponds to a magnitude change of a display data signal in the next horizontal drive time period with respect to a display data signal in the current horizontal drive time period;

instantaneous values of the booting currents are kept constant; and

the application time for the booting current is proportional to a magnitude change of each display data signal in the next horizontal drive time period with respect to the display data signal in the current horizontal drive time period.

5. The apparatus of claim 4, comprising:

a data driving unit connected to signal-input terminals of the data electrode lines for producing data current signals, corresponding to display data signals, in response to input switching control signals in order to apply the data current signals to the data electrode lines, respectively, and applying the booting currents to the data electrode lines at the beginning of each horizontal drive time period, respectively;

a scanning driving unit connected to signal-input terminals of the scanning electrode lines for sequentially applying scanning driving signals in response to input switching control signals to the scanning electrode lines, respectively; and

a controller that inputs the display data signals and the switching control signals to the data driving unit and inputs the switching control signals to the scanning driving unit, respectively.

6. The apparatus of claim 5, wherein the data driving unit comprises:

a latch circuit that periodically stores the display data signals received from the controller and periodically outputs display data signals in the current and next horizontal drive time periods;

a plurality of digital-to-analog converters that convert the display data signals in the current horizontal drive time period received from the latch circuit into data current signals, respectively; and

an output circuit that compares the display data signals in the current and next horizontal drive time periods received from the latch circuit with each other, applies the booting currents to the data electrode lines, respectively, and applies the data current signals received from the plurality of digital-to-analog converters to the data electrode lines, respectively.

7. The apparatus of claim 6, wherein the latch circuit comprises:

a plurality of (n+1)-data registers that output display data signals stored therein according to a horizontal synchronization signal and store the display data signals received from the controller; and

a plurality of n-data latches that output display data signals stored therein in response to the horizontal synchronization signal and store the display data signals received from the plurality of (n+1)-data registers, respectively.

8. The apparatus of claim 6, wherein the output circuit comprises:

a plurality of digital comparators that compare the display data signals in the current and next horizontal drive time periods received from the latch circuit with each other, and generate signals indicating a magnitude difference between the display data signals in the current and next horizontal drive time periods and signals corresponding to the magnitude difference;

a plurality of current sources that output booting currents having constant instantaneous values and varying polarities depending on the signals indicating the magnitude change;

a plurality of booting-current switches that switch booting currents output from the plurality of current sources, respectively;

a plurality of timing signal generators that control timing for operation of the plurality of booting-current switches according to the signals indicating the amount of change received from the plurality of digital comparators, respectively; and

a plurality of output current switches that alternately select the output signals of the plurality of booting-current switches or output signals of the plurality of digital-to-analog converters and apply the selected signals to the data electrode lines, respectively.

专利名称(译)	用于驱动电致发光显示板的方法和设备，设计用于执行有效的启动		
公开(公告)号	US7265738	公开(公告)日	2007-09-04
申请号	US10/823722	申请日	2004-04-14
[标]申请(专利权)人(译)	三星LED		
申请(专利权)人(译)	三星的OLED CO. , LTD.		
当前申请(专利权)人(译)	三星DISPLAY CO. , LTD.		
[标]发明人	KAWASHIMA SHINGO YAMAGUCHI SHUJI		
发明人	KAWASHIMA, SHINGO YAMAGUCHI, SHUJI		
IPC分类号	G09G3/30 H01L51/50 G09G3/20 G09G3/32		
CPC分类号	G09G3/3283 G09G3/3216 G09G2300/06 G09G2310/0248 G09G2310/027 G09G2320/0209 G09G2320/0223 G09G2330/021		
审查员(译)	LEWIS , DAVID L.		
优先权	1020030023713 2003-04-15 KR		
其他公开文献	US20040257313A1		
外部链接	Espacenet USPTO		

摘要(译)

本发明提供一种用于驱动电致发光(EL)显示板的方法和设备，所述电致发光(EL)显示板具有在预定距离处彼此交叉的数据电极线和扫描电极线，以及形成在其交叉点处的EL单元。在该方法和装置中，对应于下一水平驱动时间段中的显示数据信号相对于当前水平驱动时间段中的显示数据信号的幅度变化的启动电流被施加到每个数据电极线。下一个水平驱动时间段的开始。引导电流的瞬时值保持恒定，并且引导电流的施加时间与下一水平驱动时间段中每个显示数据信号相对于当前水平驱动时间段中的显示数据信号的幅度变化成比例。

