PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 :
G09G 3/10

A1

(11) International Publication Number: WO 98/48403

(43) International Publication Date: 29 October 1998 (29.10.98)

(21) International Application Number: PCT/US98/08367

(22) International Filing Date: 23 April 1998 (23.04.98)

(30) Priority Data:

60/044,174	23 April 1997 (23.04.97)	US
09/064,696	22 April 1998 (22.04.98)	US
09/064,697	22 April 1998 (22.04.98)	US

(71) Applicant: SARNOFF CORPORATION [US/US]; 201 Washington Road, CN–5300, Princeton, NJ 08543–5300 (US).

(72) Inventors: DAWSON, Robin, Mark, Adrian; 184 Coppermine Road, Princeton, NJ 08540 (US). KANE, Michael, Gillis; 44 Robin Drive, Skillman, NJ 08558 (US). HSU, James, Ya–Kong; 7107 Hana Road, Edison, NJ 08817 (US). HSUEH, Fu–Lung; 14 Kinglet Drive South, Cranbury, NJ 08512 (US). IPRI, Alfred, Charles; 7 Cotswold Lane, Princeton, NJ 08540 (US). STEWART, Roger, Green; 3 Ski Drive, Neshanic Station, NJ 08853 (US).

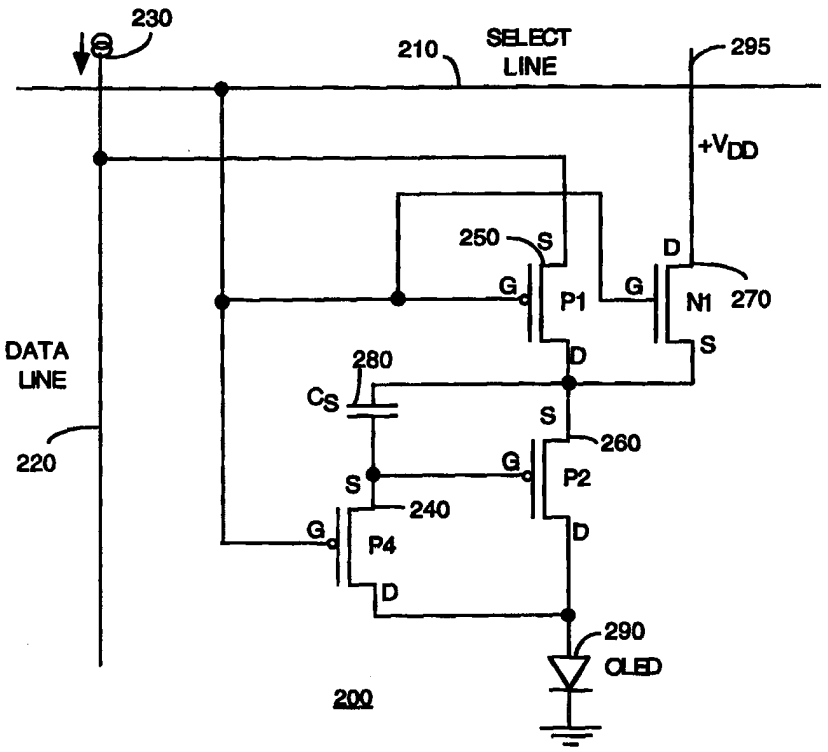
(81) Designated States: JP, KR, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: ACTIVE MATRIX LIGHT EMITTING DIODE PIXEL STRUCTURE AND METHOD

(57) Abstract

A LED pixel structure (200, 300, 400, 600, 700) that reduces current nonuformities and threshold voltage variations in a "drive transistor" of the pixel structure is disclosed. The LED pixel structure incorporates a current source for loading data into the pixel via a data line. Alternatively, an auto zero voltage is determined for the drive transistor prior to the loading of data.



FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	**ES**	Spain	**LS**	Lesotho	**SI**	Slovenia
AM	Armenia	**FI**	Finland	**LT**	Lithuania	**SK**	Slovakia
AT	Austria	**FR**	France	**LU**	Luxembourg	**SN**	Senegal
AU	Australia	**GA**	Gabon	**LV**	Latvia	**SZ**	Swaziland
AZ	Azerbaijan	**GB**	United Kingdom	**MC**	Monaco	**TD**	Chad
BA	Bosnia and Herzegovina	**GE**	Georgia	**MD**	Republic of Moldova	**TG**	Togo
BB	Barbados	**GH**	Ghana	**MG**	Madagascar	**TJ**	Tajikistan
BE	Belgium	**GN**	Guinea	**MK**	The former Yugoslav Republic of Macedonia	**TM**	Turkmenistan
BF	Burkina Faso	**GR**	Greece			**TR**	Turkey
BG	Bulgaria	**HU**	Hungary	**ML**	Mali	**TT**	Trinidad and Tobago
BJ	Benin	**IE**	Ireland	**MN**	Mongolia	**UA**	Ukraine
BR	Brazil	**IL**	Israel	**MR**	Mauritania	**UG**	Uganda
BY	Belarus	**IS**	Iceland	**MW**	Malawi	**US**	United States of America
CA	Canada	**IT**	Italy	**MX**	Mexico	**UZ**	Uzbekistan
CF	Central African Republic	**JP**	Japan	**NE**	Niger	**VN**	Viet Nam
CG	Congo	**KE**	Kenya	**NL**	Netherlands	**YU**	Yugoslavia
CH	Switzerland	**KG**	Kyrgyzstan	**NO**	Norway	**ZW**	Zimbabwe
CI	Côte d'Ivoire	**KP**	Democratic People's Republic of Korea	**NZ**	New Zealand		
CM	Cameroon			**PL**	Poland		
CN	China	**KR**	Republic of Korea	**PT**	Portugal		
CU	Cuba	**KZ**	Kazakstan	**RO**	Romania		
CZ	Czech Republic	**LC**	Saint Lucia	**RU**	Russian Federation		
DE	Germany	**LI**	Liechtenstein	**SD**	Sudan		
DK	Denmark	**LK**	Sri Lanka	**SE**	Sweden		
EE	Estonia	**LR**	Liberia	**SG**	Singapore		

ACTVE MATRIX LIGHT EMITTING DIODE PIXEL STRUCTURE AND METHOD

This application claims the benefit of U.S. Provisional Application No. 60/ 044, 174 filed April 23, 1997, which is herein incorporated by reference.

This invention was made with U.S. government support under contract number F33615-96-2-1944. The U.S. government has certain rights in this invention.

The invention relates to an active matrix light emitting diode pixel structure. More particularly, the invention relates to a pixel structure that reduces current nonuniformities and threshold voltage variations in a "drive transistor" of the pixel structure and method of operating said active matrix light emitting diode pixel structure.

BACKGROUND OF THE DISCLOSURE

Matrix displays are well known in the art, where pixels are illuminated using matrix addressing as illustrated in FIG. 1. A typical display 100 comprises a plurality of picture or display elements (pixels) 160 that are arranged in rows and columns. The display incorporates a column data generator 110 and a row select generator 120. In operation, each row is sequentially activated via row line 130, where the corresponding pixels are activated using the corresponding column lines 140. In a passive matrix display, each row of pixels is illuminated sequentially one by one, whereas in an active matrix display, each row of pixels is first loaded with data sequentially.

With the proliferation in the use of portable displays, e.g., in a laptop computer, various display technologies have been employed, e.g., liquid crystal display (LCD) and light-emitting diode (LED) display. An important distinction between these two technologies is that a LED is an emissive device which has power efficiency advantage over non-emissive devices such as (LCD). In a LCD, a fluorescent backlight is on for the entire duration in which the display is in use, thereby dissipating power

even for "off" pixels. In contrast, a LED (or OLED) display only illuminates those pixels that are activated, thereby conserving power by not having to illuminate "off" pixels.

Although a display that employs an OLED pixel structure can reduce power consumption, such pixel structure may exhibit nonuniformity in intensity, which is attributable to two sources, threshold voltage drift of the drive transistor and transistor nonuniformity due to manufacturing. However, it has been observed that the brightness of the OLED is proportional to the current passing through the OLED.

Therefore, a need exists in the art for a pixel structure and concomitant method that reduces current nonuniformities and threshold voltage variations in a "drive transistor" of the pixel structure.

SUMMARY OF THE INVENTION

In one embodiment of the present invention, a current source is incorporated in a LED (OLED) pixel structure that reduces current nonuniformities and threshold voltage variations in a "drive transistor" of the pixel structure. The current source is coupled to the data line, where a constant current is initially programmed and then captured.

In an alternate embodiment, the constant current is achieved by initially applying a reference voltage in an auto-zero phase that determines and stores an auto zero voltage. The auto zero voltage effectively accounts for the threshold voltage of the drive transistor. Next, a data voltage which is referenced to the same reference voltage is now applied to illuminate the pixel.

In an another alternate embodiment, a resistor is incorporated in a LED (OLED) pixel structure to desensitize the dependence of the current passing through the OLED to the threshold voltage of the drive transistor.

BRIEF DESCRIPTION OF THE DRAWINGS

The teachings of the present invention can be readily understood by considering the following detailed description in conjunction with the accompanying drawings, in which:

FIG. 1 depicts a block diagram of a matrix addressing interface;

FIG. 2 depicts a schematic diagram of an active matrix LED pixel structure of the present invention;

FIG. 3 depicts a schematic diagram of an alternate embodiment of the present active matrix LED pixel structure;

FIG. 4 depicts a schematic diagram of another alternate embodiment of the present active matrix LED pixel structure;

FIG. 5 depicts a block diagram of a system employing a display having a plurality of active matrix LED pixel structures of the present invention;

FIG. 6 depicts a schematic diagram of an alternate embodiment of the active matrix LED pixel structure of FIG. 2; and

FIG. 7 depicts a schematic diagram of an alternate embodiment of an active matrix LED pixel structure of the present invention.

To facilitate understanding, identical reference numerals have been used, where possible, to designate identical elements that are common to the figures.

DETAILED DESCRIPTION

FIG. 2 depicts a schematic diagram of an active matrix LED pixel structure 200 of the present invention. In the preferred embodiment, the active matrix LED pixel structure is implemented using thin film transistors (TFTs), e.g., transistors manufactured using amorphous or poly-silicon. Similarly, in the preferred embodiment, the active matrix LED pixel structure incorporates an organic light-emitting diode (OLED). Although the present pixel structure is implemented using thin film transistors and an organic light-emitting diode, it should be understood that the present invention can be implemented using other types of transistors and light emitting diodes. For example, if transistors that are manufactured using other materials exhibit the threshold nonuniformity as discussed above, then the present invention can be employed to provide a constant current through the lighting element.

Although the present invention is illustrated below as a single pixel or pixel structure, it should be understood that the pixel can be employed with other pixels, e.g., in an array, to form a display. Furthermore,

DOCKET ALARM

Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts

Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research

With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips

Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS
Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS
Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS
Sync your system to PACER to automate legal marketing.