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(54) **Liquid crystal display.**

(57) A liquid crystal display in accordance with the present invention is characterized in comprising the following devices; a display having a plurality of picture elements; a display control device which on one hand releases selection signals for selecting picture elements to be displayed and on the other hand releases color set data for displaying a region with a fixed width in an optionally presettable color different from the contents of a display along the circumference end of the screen of the display device, and; a display drive device for driving the picture elements according to the output of the above-mentioned display control device. In this composition, by setting a region having a fixed width and an optionally presettable color along the circumference end of the screen of the display, an enhanced discernability can be obtained with respect to characters, graphics or the like displayed near the edge of the screen.

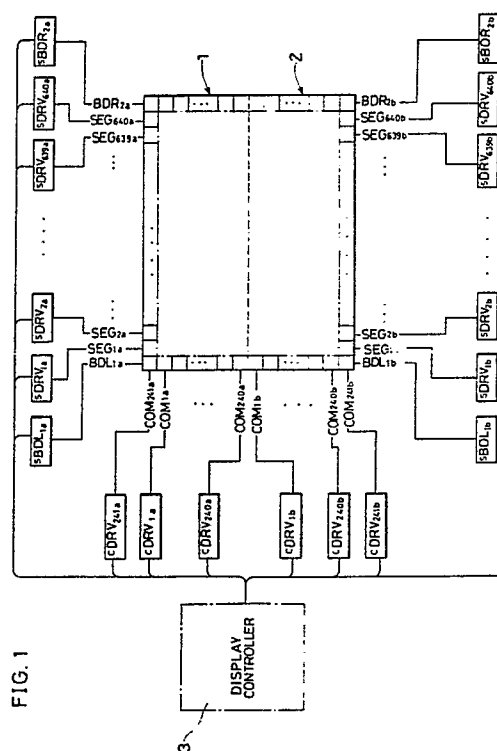


FIG. 1

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LIQUID CRYSTAL DISPLAY

FIELD OF THE INVENTION

The present invention relates to a liquid crystal display for displaying characters, graphics or the like by driving a plurality of picture elements.

BACKGROUND OF THE INVENTION

The conventional liquid crystal displays display characters, graphics or the like on the screen by properly selecting and driving a plurality of picture elements which are located in a matrix-like state.

However, in the above-mentioned conventional liquid crystal displays, when characters, graphics or the like are displayed by picture elements located at the circumference end of the screen such as the upper or lower end, or the right or left end, it is difficult to distinguish them from the end of the screen, and depending on the shape of them, those characters, graphics or the like sometimes are seen overlapped with the end of the screen. Consequently, there are conventional problems in that visual discernability is not enough near the border part between the characters, graphics or the like and the screen edge, and therefore it is very hard to discern the contents of display.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a liquid crystal display wherein an enhanced discernability can be obtained with respect to characters, graphics or the like displayed near the edge of a display screen, by setting a region with a fixed width along the circumference end of the display screen and displaying the region in an optional color different from those of characters, graphics or the like.

It is another object of the invention to provide a liquid crystal display; whose display control means installed therein may release selection signals for simultaneously selecting picture elements which are located within both the upper end region with a fixed width and the lower end region with same of the display screen to a display drive means for driving the picture elements, and therefore; which may reduce a burden for data transfer imposed on the display control means therein.

In order to achieve above-mentioned objects, a liquid crystal display in accordance with the

present invention is characterized in that it comprises the following means; a display means having a plurality of picture elements; a display control means which on one hand releases selection signals for selecting picture elements to be displayed among a plurality of picture elements and on the other hand releases color set data for displaying a region with a fixed width in an optionally presettable color different from those of the contents- (characters, graphics or the like) of a display along the circumference end of the screen of the display means, and; a display drive means for permitting the picture elements selected by the selection signals from the above-mentioned display control means to be displayed in an optionally presettable color according to the color set data.

In the above-mentioned composition, the display control means transfers the selection signals and the color set data to the display drive means which drives picture elements located within the region with a fixed width along the circumference end of the screen of the display means. When the selection signals and color set data are entered to it, the display drive means permits the display means to display a circumference region with a fixed width having an optionally preset color according to the color set data by driving the corresponding picture elements.

More specifically, the selection signals are simultaneously transferred to the display drive means, which drives picture elements located in regions with a fixed width in the upper and lower ends of the screen. Accordingly, the picture elements in the regions with a fixed width in the upper and lower ends of the screen are simultaneously driven. Then, picture elements located in the regions with a fixed width in the right and left ends of the screen are scanned and driven successively from the top. In this way, the above-mentioned circumference region with a fixed width on the screen is displayed in an optionally preset color, an enhanced visual discernability for characters, graphics or the like near the edge of the screen can be obtained.

For a fuller understanding of the nature and advantages of the invention, reference should be made to the ensuing detailed description taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 and Fig. 2 show one way of preferred embodiment of the present invention.

Fig. 1 is a schematic block diagram showing a composition of a liquid crystal display.

Fig. 2(a) to (f) show schematic illustrations showing display conditions in a circumference end of a screen of a display means.

DESCRIPTION OF THE EMBODIMENTS

One embodiment of the present invention is described in detail below with reference to drawings, Fig. 1 and Fig. 2.

Fig. 1 shows a liquid crystal display which has picture elements of 640 x 480 which is driven using the dual-panel single-drive method. This liquid crystal display is composed of two liquid crystal panels, 1 and 2, combined together as a display means. Each liquid crystal panel, 1 or 2, has picture elements of 640 x 240.

The liquid crystal panel 1 has a plurality of terminals for scan electrodes, COM_{1a} to COM_{240a} (hereinafter called common electrode terminal group) as well as a plurality of terminals for display electrodes, SEG_{1a} to SEG_{640a} (hereinafter called segment electrode terminal group). Similarly, the liquid crystal panel 2 has a common electrode terminal group, COM_{1b} to COM_{240b} , as well as a segment electrode terminal group, SEG_{1b} to SEG_{640b} . These common electrode terminal group and segment electrode terminal group are formed on respective different substrates (not shown) in thin film state. The two substrates are disposed opposite to each other so that they may hold liquid crystal in between, and one electrode group may intersect the other at right angles.

As to the liquid crystal panel 1, the common electrode terminal group, COM_{1a} to COM_{240a} , which apply scan voltage to picture elements in the line direction among a plurality of picture elements located in a matrix-like state, are respectively connected to a common electrode driver group, $cDRV_{1a}$ to $cDRV_{240a}$ as a display drive means. On the other hand, the segment electrode terminal group, SEG_{1a} to SEG_{640a} , which apply signal voltage to picture elements in the column direction, are respectively connected to a segment electrode driver group, $sDRV_{1a}$ to $sDRV_{640a}$ as a display drive means.

Similarly, in the liquid crystal panel 2, the common electrode terminal group, COM_{1b} to COM_{240b} , and the segment electrode terminal group, SEG_{1b} to SEG_{640b} , are respectively connected to a common electrode driver group, $cDRV_{1b}$ to $cDRV_{240b}$, and a segment electrode driver group, $sDRV_{1b}$ to $sDRV_{640b}$.

In this embodiment, it is defined to call a region with a fixed width along the circumference end of a display screen "border". In the liquid

crystal panel 1, a common electrode terminal for the border, COM_{241a} , is additionally installed to the above-mentioned common electrode terminal group, and applies scan voltage to picture elements of one line located in the upper end border. This terminal COM_{241a} is connected to a common electrode driver for the border, $cDRV_{241a}$, serving as a display drive means. Moreover, a segment electrode terminal for the left border, BDL_{1a} , and a segment electrode terminal for the right border, BDR_{2a} , are additionally installed to the above-mentioned segment electrode terminal group, and respectively apply signal voltage to picture elements of each one column located in the left border and the right one. These terminals, BDL_{1a} and BDR_{2a} , are respectively connected to segment electrode drivers for the border, $sBDL_{1a}$ and $sBDR_{2a}$.

Similarly, in the liquid crystal panel 2, a common electrode terminal for the border, COM_{241b} , is additionally installed to the above-mentioned common electrode terminal group, and applies scan voltage to picture elements of one line located in the lower end border. This terminal COM_{241b} is connected to a common electrode driver for the border, $cDRV_{241b}$. Moreover, segment electrode terminals for the borders, BDL_{1b} and BDR_{2b} , are additionally installed to the above-mentioned segment electrode terminal group, and respectively apply signal voltage to picture elements of each one column located in the left border and the right one. These terminals, BDL_{1b} and BDR_{2b} , are respectively connected to segment electrode drivers for the borders, $sBDL_{1b}$ and $sBDR_{2b}$.

Moreover, these drivers are respectively connected to a liquid crystal display controller 3 as a display control means. This controller 3 transfers selection signals for selecting picture elements to be displayed among a plurality of picture elements located in a matrix-like state as well as color set data concerning the color of the border (hereinafter called color data for the border) to a display drive means. The color set data is presettable in an optional color different from those of characters, graphics or the like by the controller 3.

In the above-mentioned composition, synchronizing to vertical synchronous signals, Y_b , generated by the liquid crystal display controller 3, the selection signals for selecting picture elements to be displayed and the color data for the border predeterminedly set by the controller 3 are released to respective above-mentioned common electrode drivers as well as to segment electrode drivers from the liquid crystal display controller 3.

More specifically, at first the segment electrode driver group and the segment electrode drivers, $sBDL_{1a}$, $sBDR_{2a}$, $sBDL_{1b}$, $sBDR_{2b}$, of the liquid crystal panels 1 and 2 are simultaneously selected. Then, they apply signal voltage to the respective

segment electrode terminals according to the pre-determined color data for the border. At the same time, as is shown in Fig. 1, the common electrode drivers, $cDRV_{241a}$ and $cDRV_{241b}$, of the liquid crystal panels 1 and 2 are selected to apply scan voltage to the common electrode terminals for the borders, COM_{241a} and COM_{241b} . Consequently, picture elements of the selected upper end one line as well as lower end one line are displayed in an optionally preset color as borders.

Hereupon, a more concrete explanation is given on a process in which the picture elements groups in the borders are driven, and displayed in an optionally presettable color. However, the coordinates of a plurality of picture elements located in a matrix-like state are expressed as $(cDRV_i, sDRV_j)$ by using the signs of the common electrode drivers and the segment electrode drivers. The subscript i stands for a mark each electrode driver has.

For example, when the common electrode driver $cDRV_{241a}$ and the segment electrode driver $sBDL_{1a}$ are simultaneously selected, signal voltage and scan voltage are applied to picture elements within regions corresponding to a line and a column shown with slanting lines, as is shown in Fig. 2(a). However, as shown in the figure, the picture elements within a region with slanting lines intersected one another, that is to say, only the picture element within a selected point $(cDRV_{241a}, sBDL_{1a})$, wherein the signal voltage and the scan voltage are simultaneously applied, is displayed in an optionally presettable color as the border. The other picture elements within non-selected points are not displayed. Similarly, when the common electrode driver $cDRV_{241a}$ and the segment electrode driver $sBDR_{2a}$ are simultaneously selected, as is shown in Fig. 2(b), the picture element within a selected point $(cDRV_{241a}, sBDR_{2a})$ is displayed in an optionally preset color as the border, and the other picture elements within non-selected points are not displayed.

In the same way as the above, when the common electrode driver $cDRV_{241a}$ and all the segment electrode group of the liquid crystal panel 1 are simultaneously selected, the selected points consist of one entire line including the above-mentioned BDL_{1a} , as is shown in Fig. 2(c), and therefore all the picture elements corresponding to the one line of the upper end of the liquid crystal panel 1 are displayed in the optionally preset color as the border.

Moreover, when the common electrode driver $cDRV_{241b}$ and all the segment electrode group of the liquid crystal panel 2 are simultaneously selected, all the picture elements corresponding to the one line of the lower end of the liquid crystal panel 2 are displayed in the optionally preset color

as the border, as is shown in Fig. 2(d). As is shown in the above, the upper border and the lower border of the respective panels 1 and 2 are simultaneously displayed in the optionally preset color.

However, since the common electrode drivers, $cDRV_{241a}$ as well as $cDRV_{241b}$, and all the segment electrode driver group are selected in a fixed cycle, the picture element groups located in each one line of the upper and lower borders are also driven in the fixed cycle. The borders, however, can be always seen displayed by the afterimage effect of the eyes.

Next, in accordance with selection signals and color data for the border from the liquid crystal display controller 3, when segment electrode drivers for the borders, $sBDL_{1a}$, $sBDR_{2a}$, $sBDL_{1b}$, and $sBDR_{2b}$ are selected and common electrode driver groups, $(cDRV_{1a}$ to $cDRV_{240a}$ as well as $cDRV_{1b}$ to $cDRV_{240b})$ are successively scanned from the $cDRV_{1a}$ side, the right border and left one of the liquid crystal panels 1 and 2 begin to be successively displayed in the optionally preset color according to the scan, as is shown in Fig. 2(e). On finishing scanning the common electrode driver, $cDRV_{240b}$, both the right border and left one are displayed in the optionally preset color, as shown in Fig. 2(f). These picture element groups located in each one line of the right and left borders are also driven in a fixed cycle, but the borders can be always seen displayed by the afterimage effect of the eyes, as was mentioned before.

In this way, the upper and lower borders as well as the right and left ones of the liquid crystal displays 1 and 2 are displayed in the optionally preset color by performing the above-mentioned procedures repeatedly.

As is mentioned the above, a liquid crystal display in accordance with the present invention is characterized in that it comprises the following means; a display means such as liquid crystal panels having a plurality of picture elements; a display control means, for example a liquid crystal display controller, which on one hand releases selection signals for selecting picture elements to be displayed among a plurality of picture elements and on the other hand releases color set data for displaying a region with a fixed width in an optionally presettable color different from those of the contents of a display along the circumference end of the screen of the display means, and; a display drive means, for example segment electrode drivers and common electrode drivers, which permits the picture elements, which are selected according to the selection signals from the above-mentioned display control means, to be displayed in an optionally presettable color according to the color set data.

In this composition, by setting a region having a fixed width and an optionally presettable color along the circumference end of the screen of the display means of the liquid crystal display, an enhanced discernability can be obtained with respect to characters, graphics or the like displayed near the edge of a display screen.

Furthermore, since the region with the fixed width along the circumference end of the screen may be optionally set in a color which stands in contrast with those of characters, graphs or the like, it is certain that the contents of display are more easily discernable.

In addition, the display control means may release selection signals for simultaneously selecting picture elements which are located within both the upper end region with a fixed width and the lower end region with same to the display drive means for driving the picture elements, and therefore a burden for data transfer imposed on the display control means may be greatly reduced.

The invention being thus described, it may be obvious that the same way be varied in many ways. Such variations are not to be regarded as a departure from the scope of the invention.

There are described above novel features which the skilled man will appreciate give rise to advantages. These are each independent aspects of the invention to be covered by the present application, irrespective of whether or not they are included within the scope of the following claims.

Claims

1. A liquid crystal display comprising a display means having a plurality of picture elements, and the display being composed so that a region with a fixed width along the circumference end of the screen of the display means therein may be displayed in an optional color.

2. A liquid crystal display comprising:
a display means having a plurality of picture elements;
a display control means which on the one hand releases selection signals for selecting picture elements to be displayed among a plurality of picture elements and on the other hand releases color set data for displaying a region with a fixed width in an optionally presettable color different from those of the contents of a display along the circumference end of the screen of the display means; and
a display drive means for permitting the picture elements selected by the selection signals from the display control means to be displayed in an optionally preset color according to the color set data.

3. A liquid crystal display as defined in claim 2, which comprises two combined liquid crystal pan-

els having, for example the total picture elements of 640 x 480 as a display means, each of which is composed of a multitude of picture elements of 640 x 240, and is driven using the dual-panel single-drive method.

4. A liquid crystal display as defined in claim 3, wherein the above-mentioned display control means comprises a liquid crystal display controller for producing vertical synchronous signals.

5. A liquid crystal display as defined in claim 4, wherein the above-mentioned liquid crystal display controller on the one hand releases;
selection signals for selecting picture elements to be displayed among a plurality of picture elements belonging to the display means to the display drive means by synchronizing the output of selection signals to vertical synchronous signals, and on the other hand releases;

color set data for displaying a region with a fixed width along the circumference end of the screen of the display means in an optionally preset color which stands in contrast with those of the contents of display, characters, graphics or the like to the display drive means by synchronizing the output of color set data to the vertical synchronous signals.

6. A liquid crystal display as defined in claim 5, wherein the above-mentioned liquid crystal display controller releases selection signals to the display drive means in order to simultaneously select both the upper end region with a fixed width and the lower end region with same of the screen of the display means.

7. A liquid crystal display as defined in claim 6, wherein the above-mentioned display drive means comprises:

common electrode driver groups connected to common electrode terminal groups for applying scanning voltage to picture elements in the line direction of the display means;

common electrode drivers for the border each of which is connected to respective common electrode terminals for the border for applying scan voltage to picture elements located in each one line of the upper end and lower end of the circumference end region of the display means;

segment electrode driver groups which are connected to segment electrode terminal groups for applying signal voltage to picture elements in the column direction of the display means;

segment electrode drivers each of which is connected to respective segment electrode terminals for the border for applying signal voltage to picture elements located in each one column of the right end and left end in the borders of the circumference end region of the display means.

8. A liquid crystal display as defined in claim 7, wherein the above-mentioned liquid crystal panel is composed so that the common electrode terminal

group and the segment electrode terminal group, which are formed on respective different substrates in thin film state, are disposed opposite to each other so as to intersect each other at right angles and to hold liquid crystal in between.

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9. A liquid crystal display as defined in claim 8, wherein, when at least one or more common electrode drivers and two or more segment electrode drivers are simultaneously selected, only the picture elements located in the selected points in which both of the signal voltage and the scan voltage are simultaneously applied are displayed in an optionally preset color as the border, and picture elements located in the other non-selected points are not displayed.

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10. A liquid crystal display as defined in claim 9, wherein, when each common electrode driver for the border for driving picture elements located in each one line of the upper end and lower end of the liquid crystal panel and all the segment electrode group are simultaneously selected, all the picture elements located in each one line of the upper end and lower end of the liquid crystal panel are simultaneously displayed in an optionally preset color as the borders.

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11. A liquid crystal display as defined in claim 10, wherein in accordance with selection signals as well as color set data for the border from the liquid crystal display controller, when each segment electrode driver for the border for driving picture elements located in each one column of the right end and left end of the liquid crystal panel is selected and the common electrode driver group are successively scanned, the right and left borders of the liquid crystal panel are successively displayed in an optionally preset color in the scan.

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12. A display device which comprises a display panel or screen having an array of picture elements, and control means for controlling the state of the picture elements in accordance with an image to be displayed, characterised in that said control means is operable to cause the picture elements within a peripheral portion of the panel or screen to display a selected colour for displaying a colour border of predetermined width.

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FIG. 1

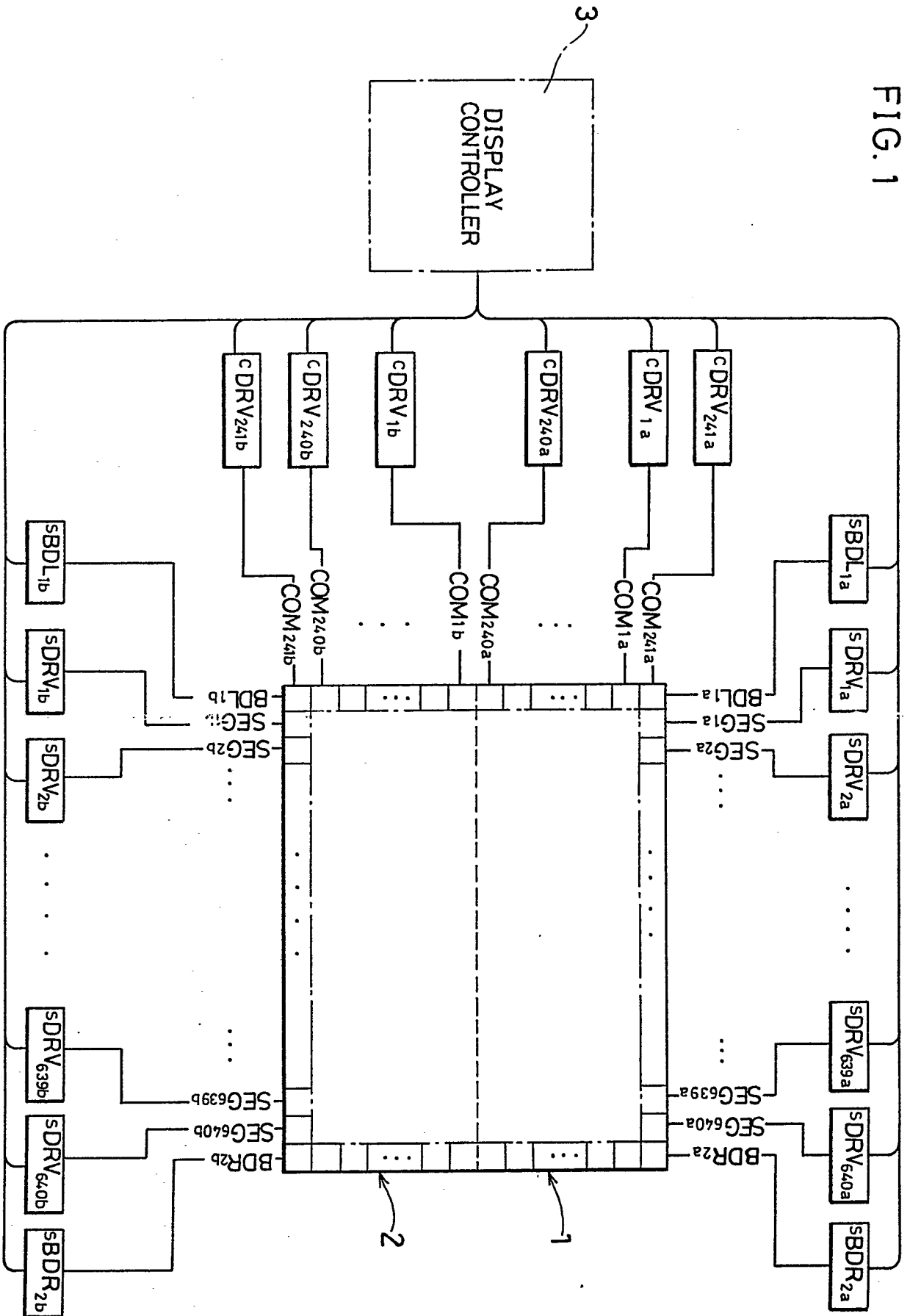


FIG. 2 (a)

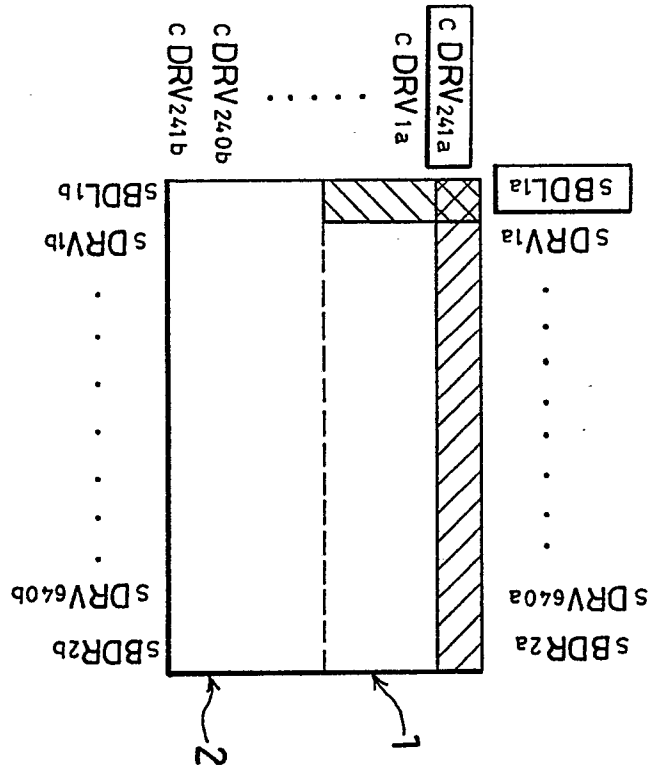


FIG. 2 (b)

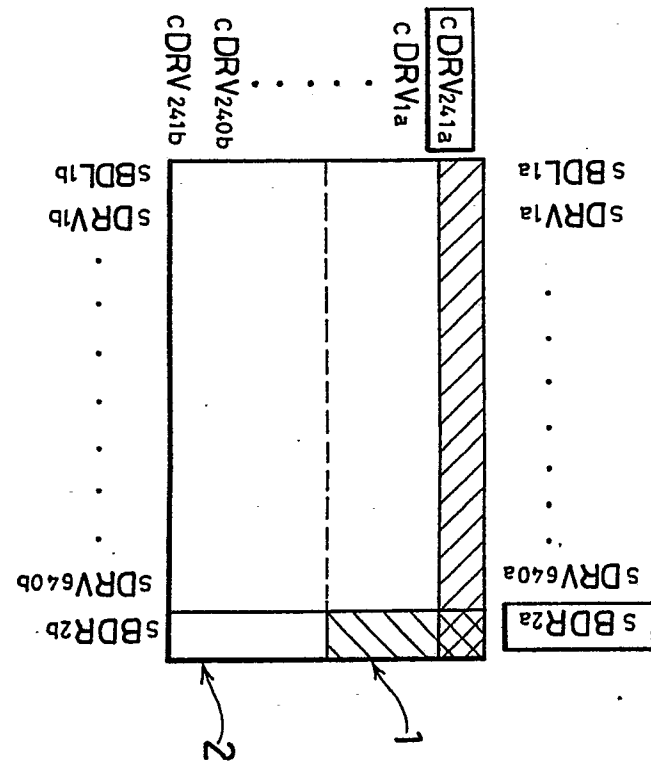


FIG. 2 (c)

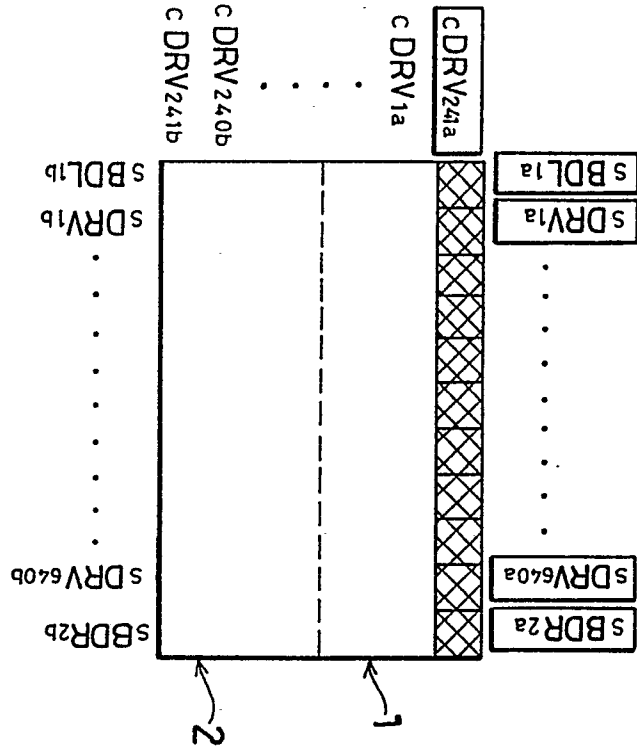


FIG. 2 (d)

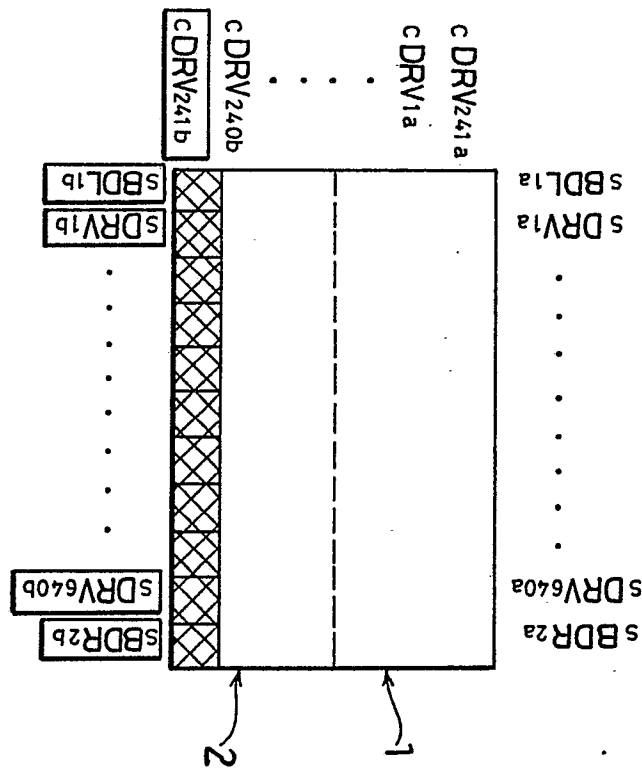


FIG. 2 (e)

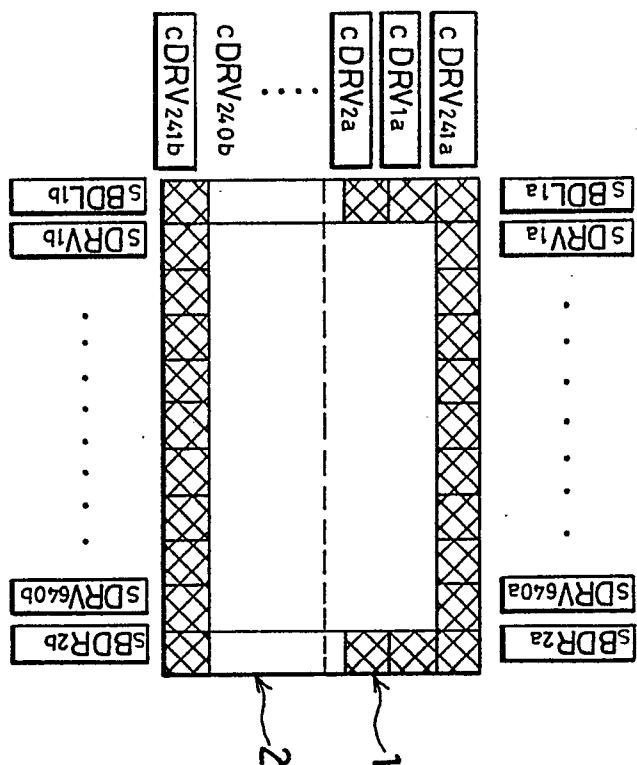


FIG. 2 (f)

