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(54) LIQUID CRYSTAL DISPLAY DEVICE

(56) **References Cited**

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## U.S. PATENT DOCUMENTS

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(\*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 525 days.

5,363,424	A	11/1994	Fujisawa	
5,440,304	A *	8/1995	Hirai .....	341/100
5,787,273	A	7/1998	Runaldue	
7,071,928	B2 *	7/2006	Kwon et al. ....	345/204
7,167,153	B2 *	1/2007	Kimura et al. ....	345/100
7,289,095	B2 *	10/2007	Park et al. ....	345/98
7,492,343	B2 *	2/2009	Kang et al. ....	345/100
2001/0017607	A1	8/2001	Kwon et al.	
2003/0117362	A1 *	6/2003	An .....	345/98
2003/0189542	A1	10/2003	Lee et al.	

(Continued)

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(65) **Prior Publication Data**

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## FOREIGN PATENT DOCUMENTS

CN	1180418	4/1998
CN	1405745	3/2003
CN	1412736	4/2003

(Continued)

### Related U.S. Application Data

(63) Continuation of application No. 10/964,779, filed on Oct. 15, 2004, now Pat. No. 7,495,648.

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(30) **Foreign Application Priority Data**

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Apr. 28, 2004	(KR)	10-2004-0029611
Apr. 28, 2004	(KR)	10-2004-0029612

(57) **ABSTRACT**

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**G09G 3/20** (2006.01)

(52) U.S. Cl.

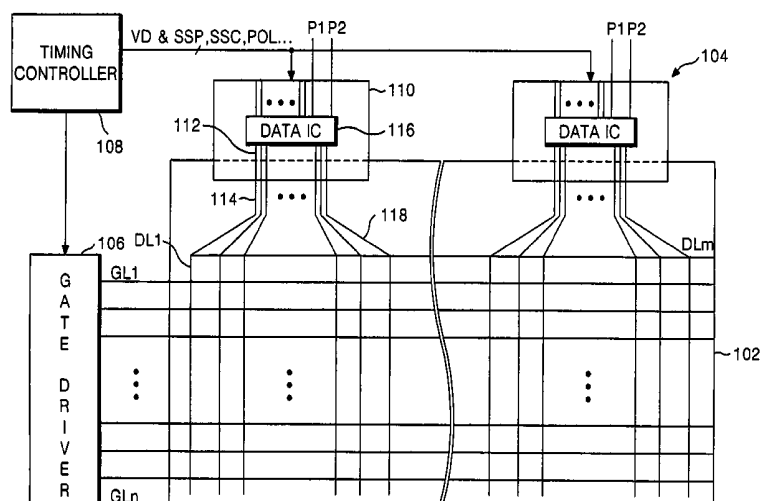
CPC ..... **G09G 3/20** (2013.01); **G09G 3/3688**  
(2013.01); **G09G 2300/0426** (2013.01); **G09G**  
**2310/027** (2013.01); **G09G 2340/0421**  
(2013.01)

(58) **Field of Classification Search**

CPC ..... G09G 3/36; G09G 3/20; G09G 3/3688  
USPC ..... 345/100, 204, 87; 349/149  
See application file for complete search history.

A display having a data driving integrated circuit includes N number of output channels (where N is an integer) having at least two regions including a first output channel and an Nth output channel, a data output channel group including M data output channels (where M is an integer less than N), the M data output channels supplying pixel data to a corresponding number of the data lines in accordance with a desired resolution of the display, wherein (N-M) output channels are not supplied with pixel data, and the (N-M) output channels are located between the first output channel and the Nth output channel, and a channel selector selecting the M data output channels.

**8 Claims, 18 Drawing Sheets**



(56)

**References Cited**

## U.S. PATENT DOCUMENTS

2003/0197826 A1\* 10/2003 Yun et al. .... 349/149  
 2005/0156850 A1\* 7/2005 Morita ..... 345/96

## FOREIGN PATENT DOCUMENTS

DE 19540146 A1 5/1996  
 DE 19716095 A1 6/2002  
 DE 10224564 A1 5/2003  
 EP 0519744 A2 12/1992  
 EP 0540294 A2 5/1993

EP 1069457 A1 1/2001  
 GB 2381645 A 5/2003  
 JP 61-292127 12/1986  
 JP 62-2076 A 1/1987  
 JP 64-084298 3/1989  
 JP 04-170515 6/1992  
 JP 06-043424 2/1994  
 JP 07-295522 A 11/1995  
 JP 10-149139 A 6/1998  
 JP 11-311763 11/1999  
 JP 2002-278492 9/2002  
 JP 2003-195836 7/2003

\* cited by examiner

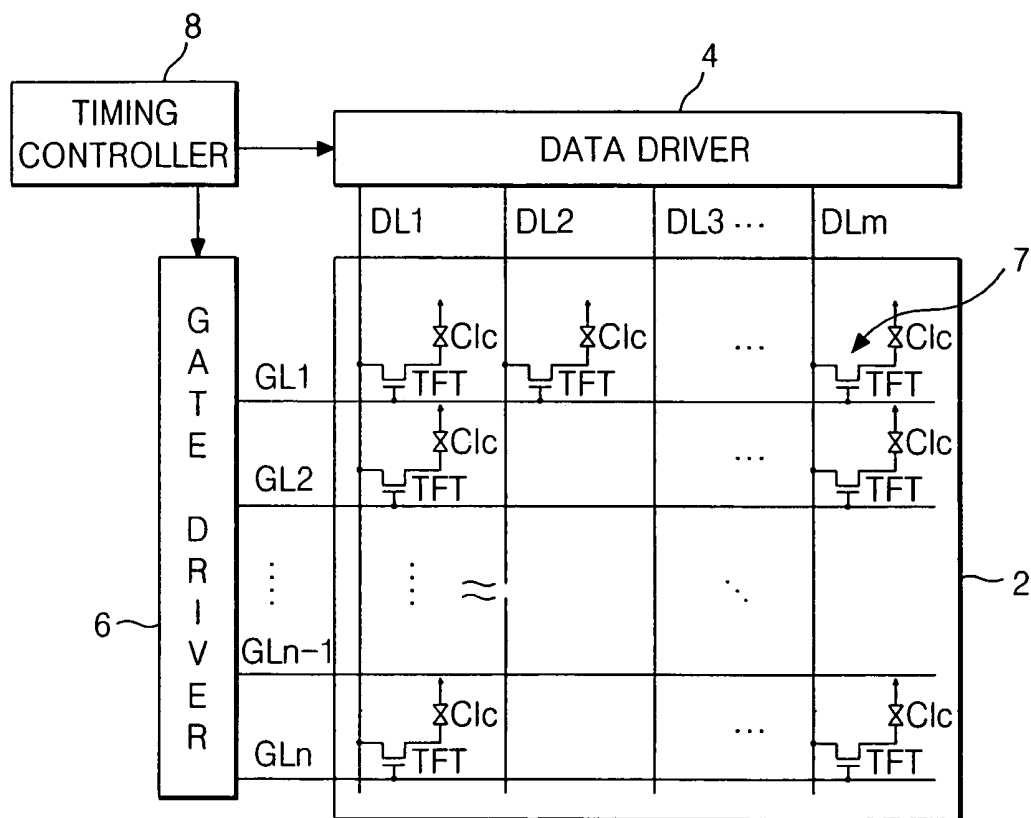
FIG. 1  
RELATED ART

FIG. 2A  
RELATED ART

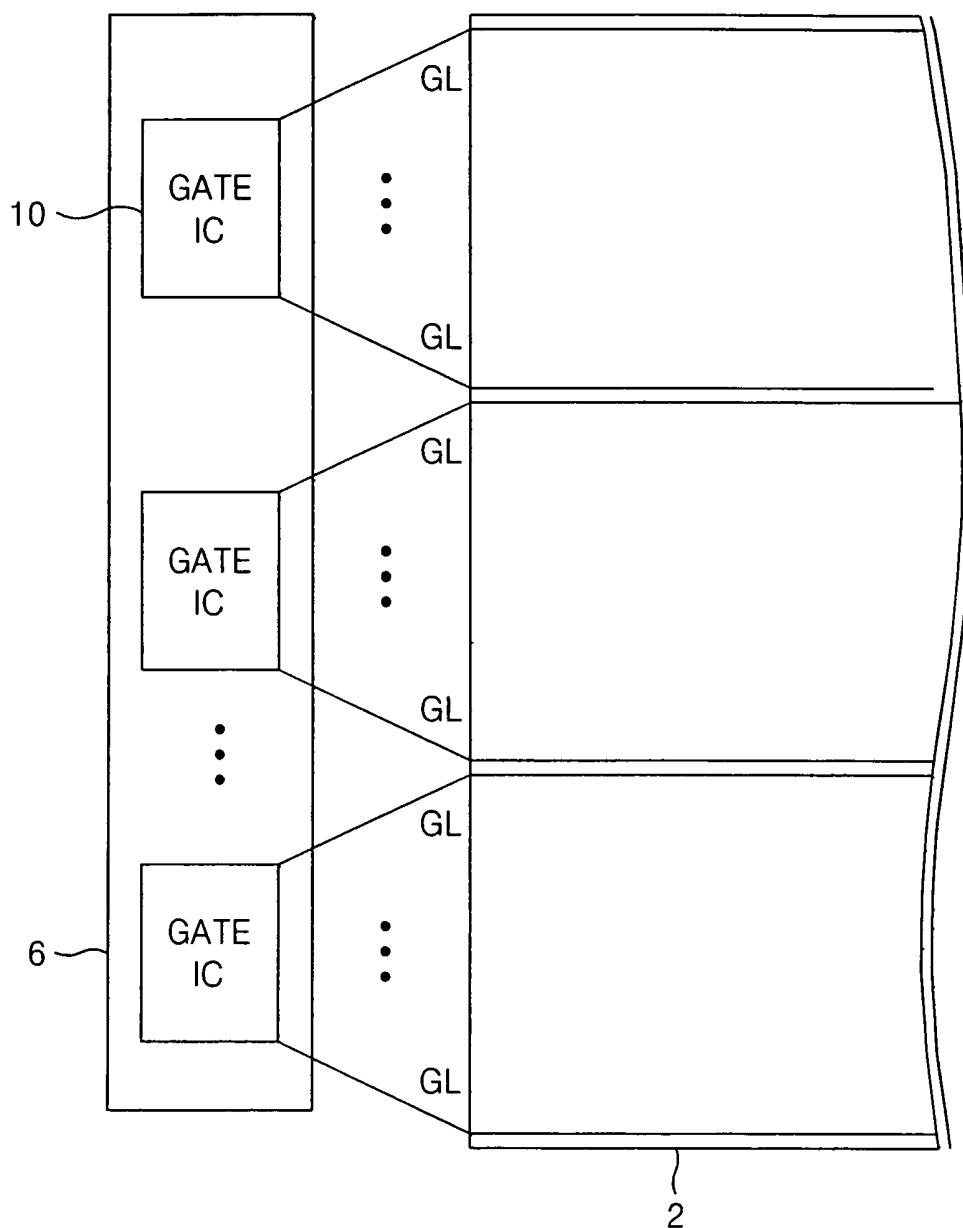


FIG. 2B  
RELATED ART

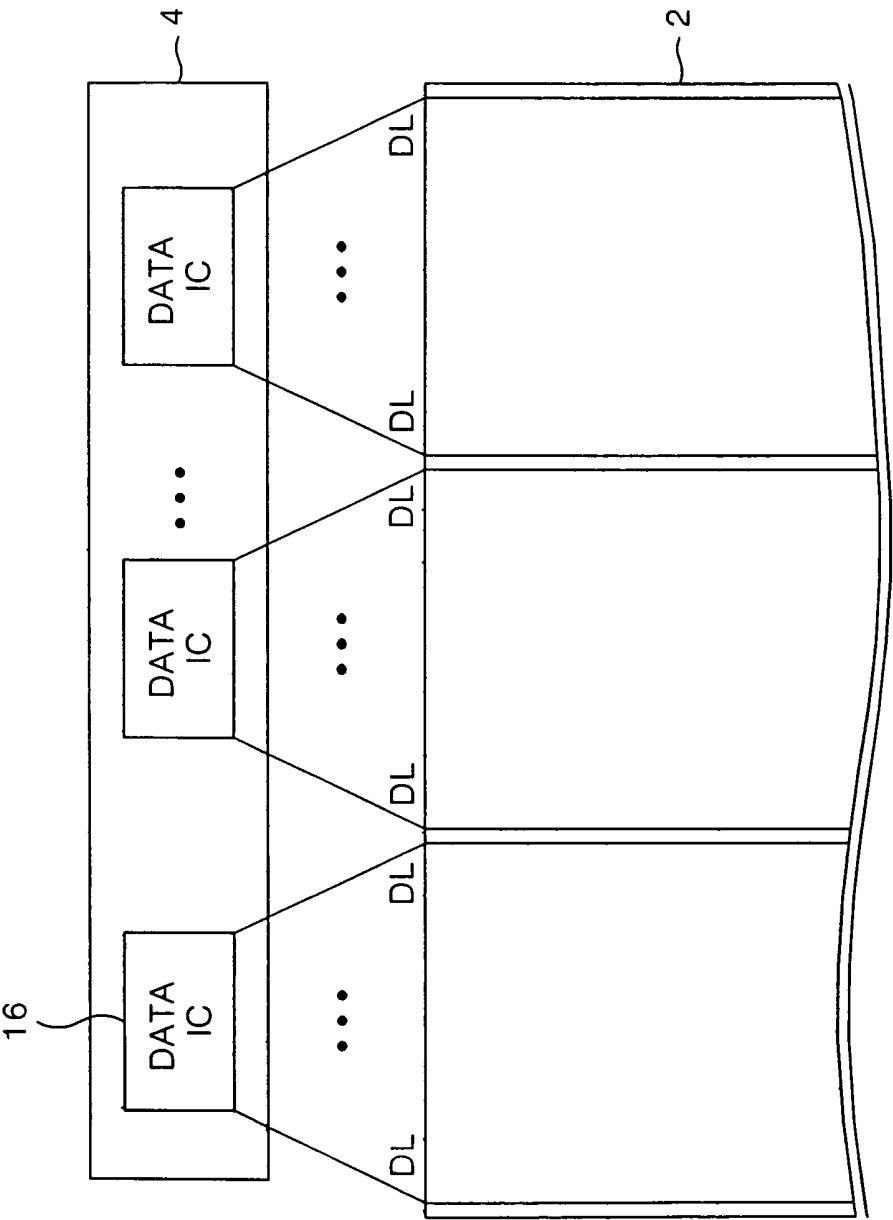


FIG. 3  
RELATED ART

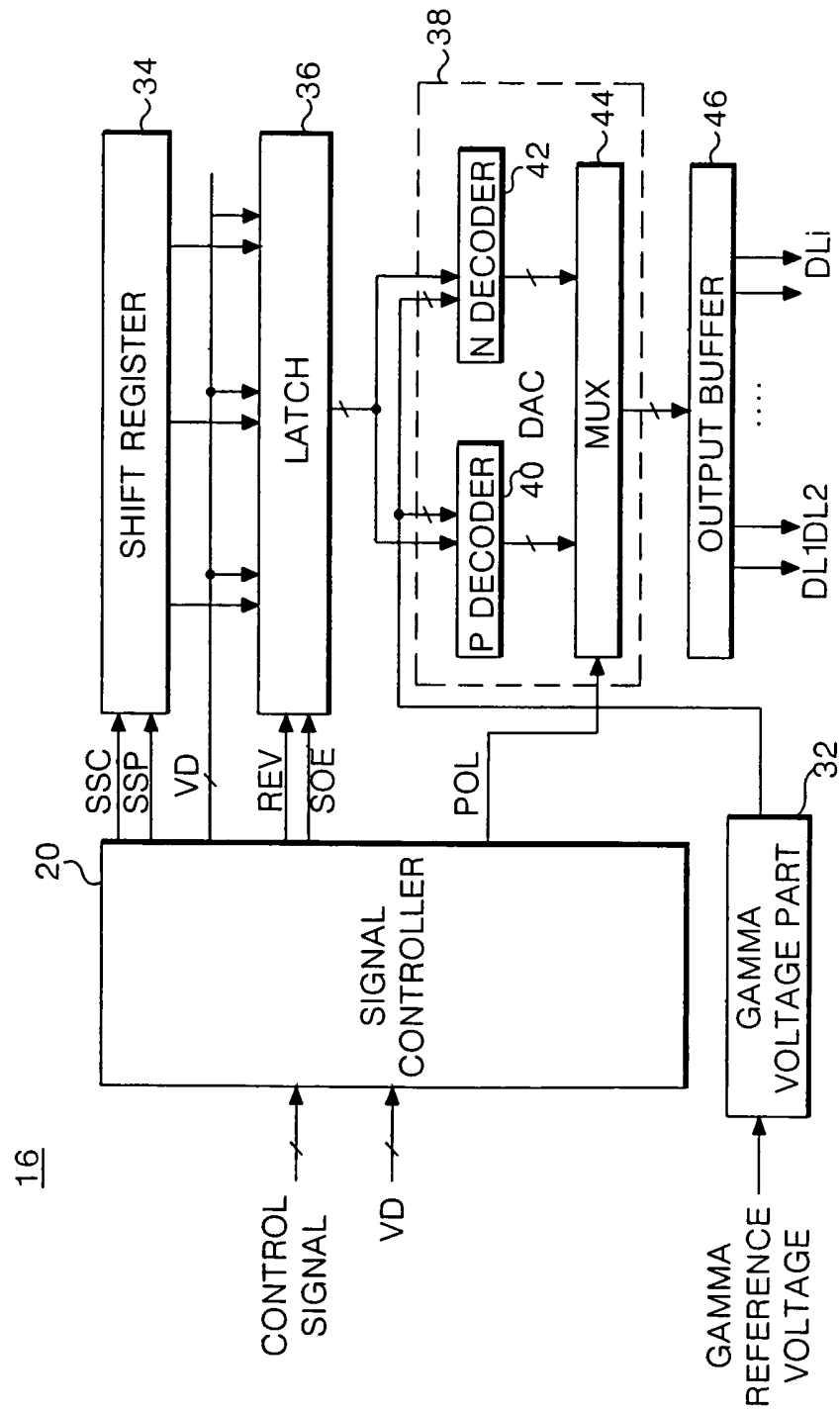


FIG. 4

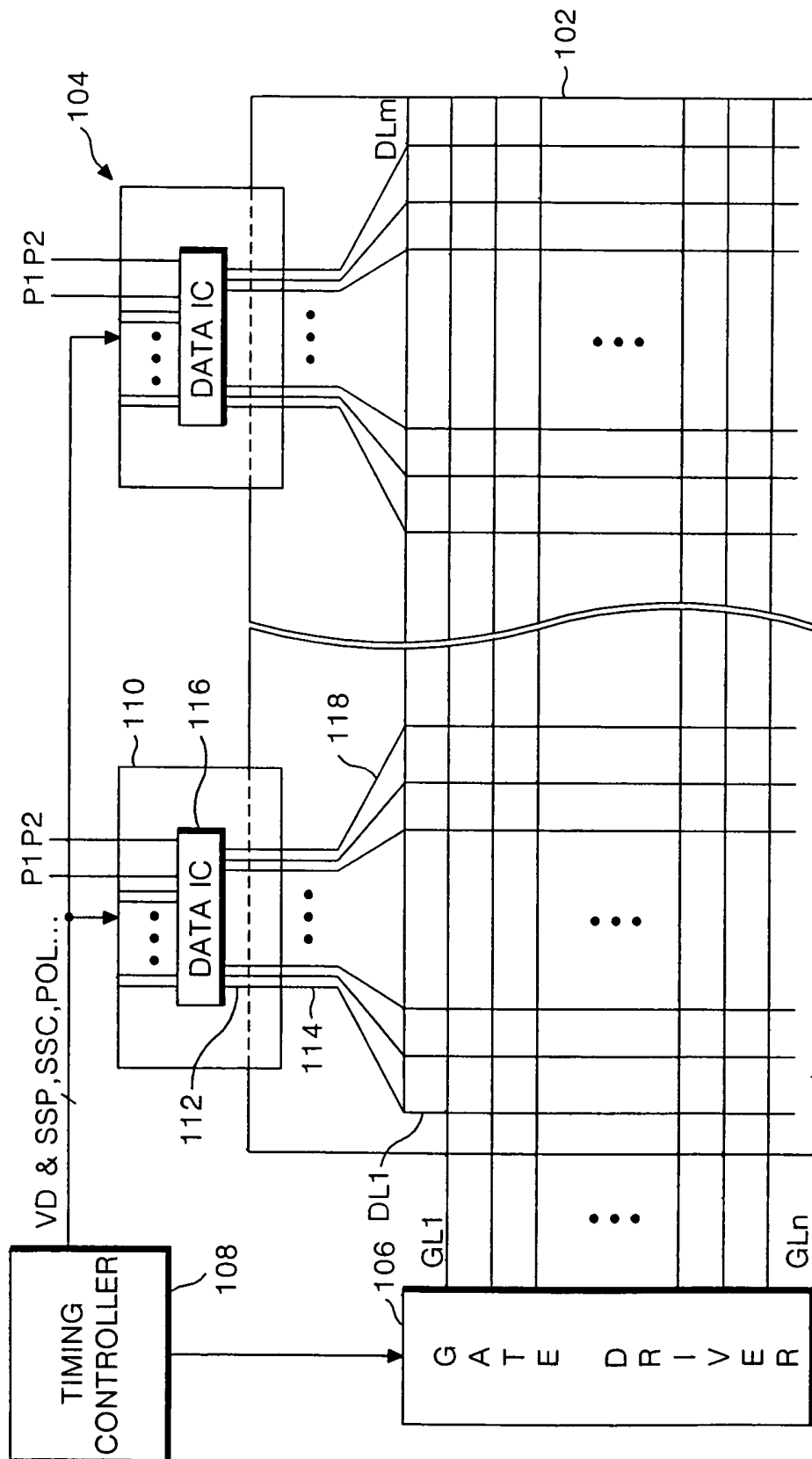


FIG. 5

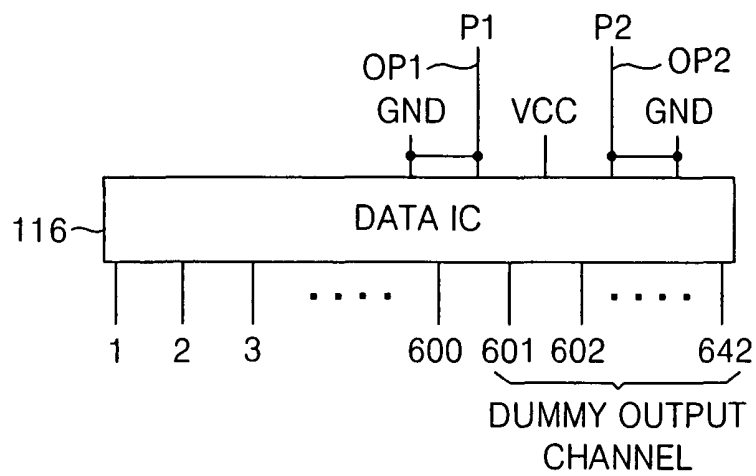


FIG. 6

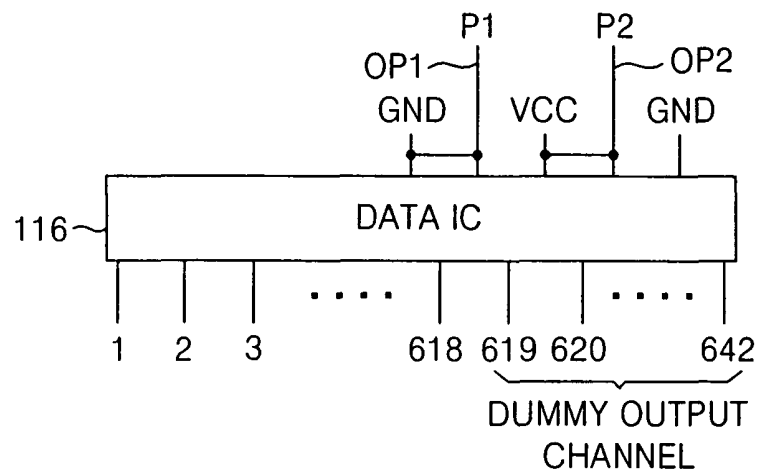


FIG. 7

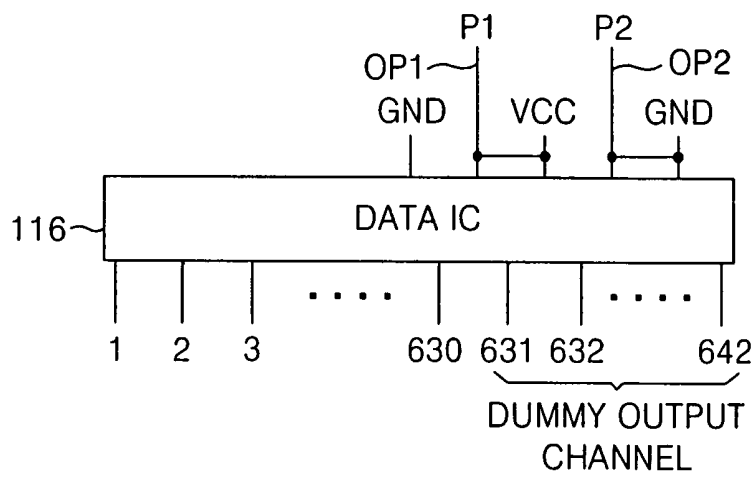


FIG. 8

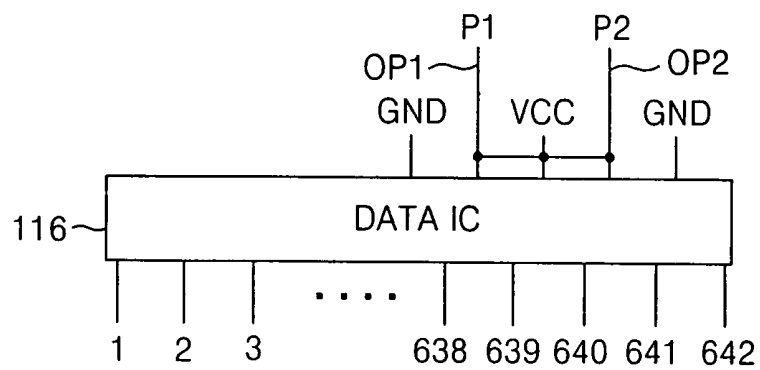


FIG. 9

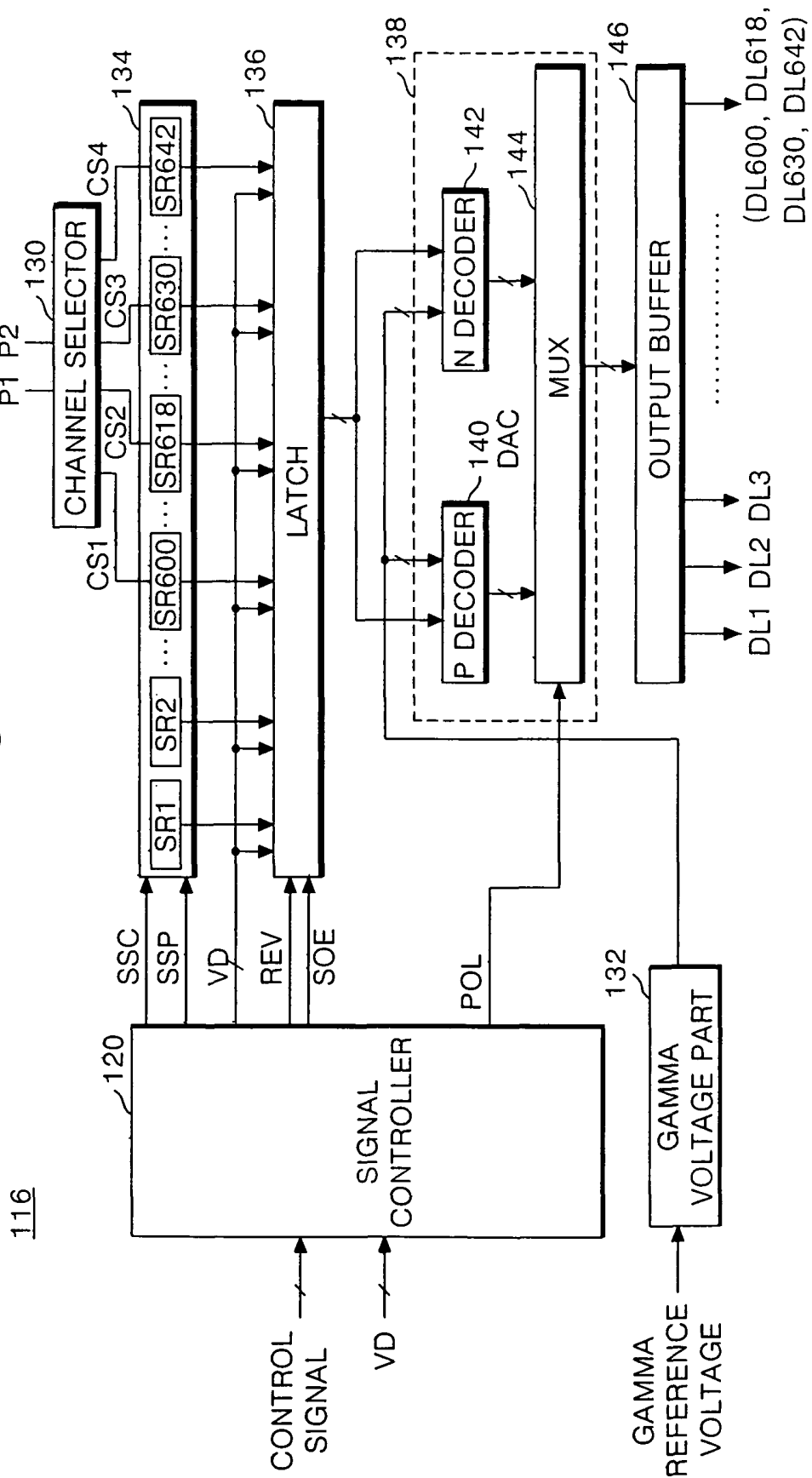


FIG. 10

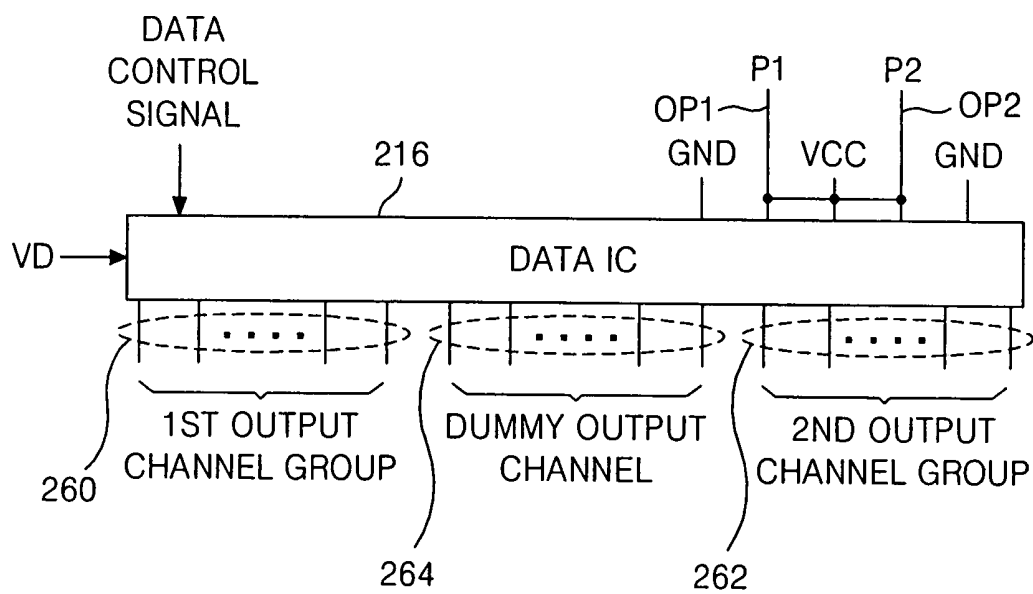


FIG. 11

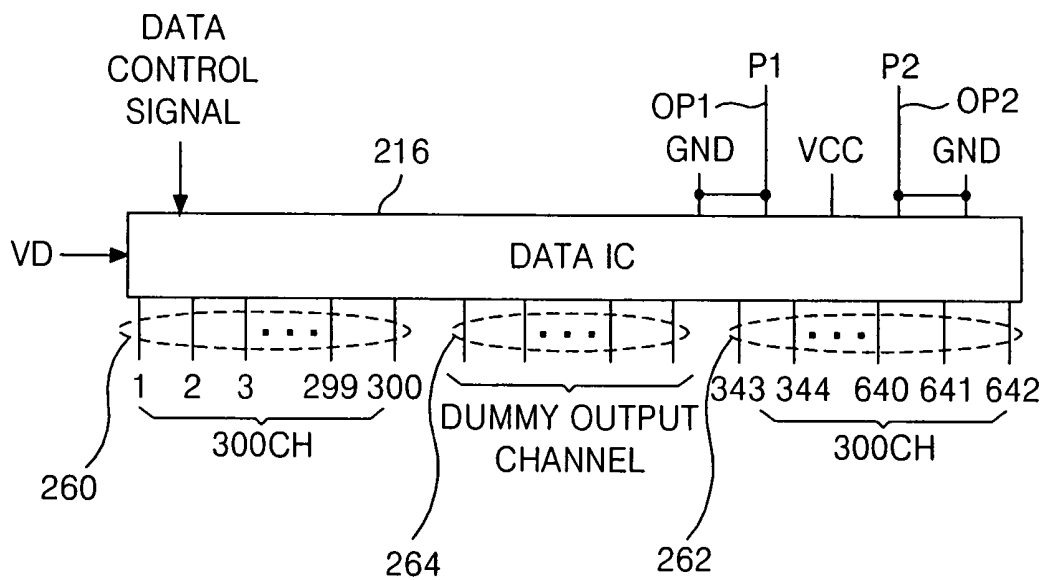


FIG. 12

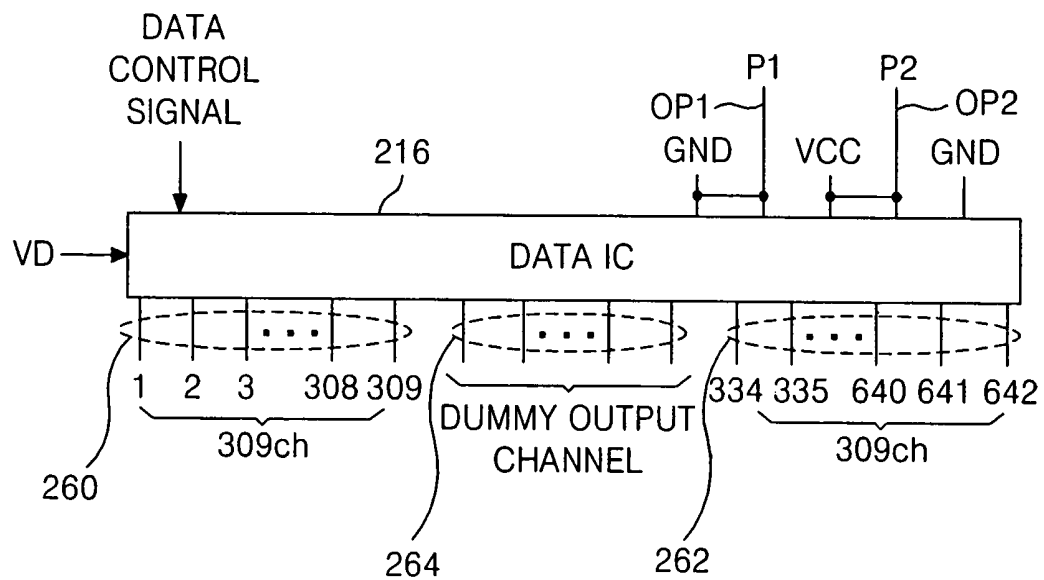


FIG. 13

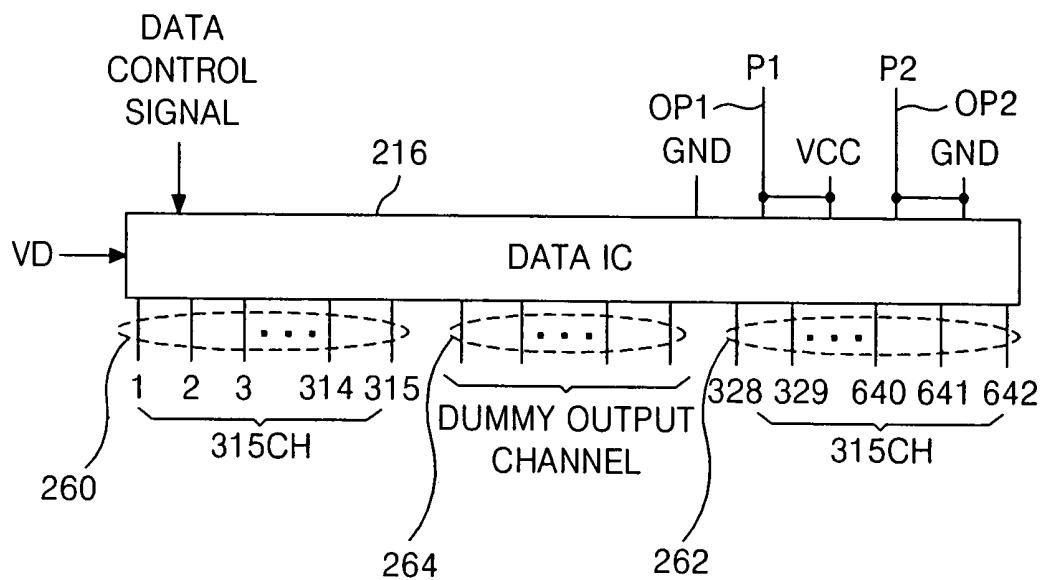


FIG. 14

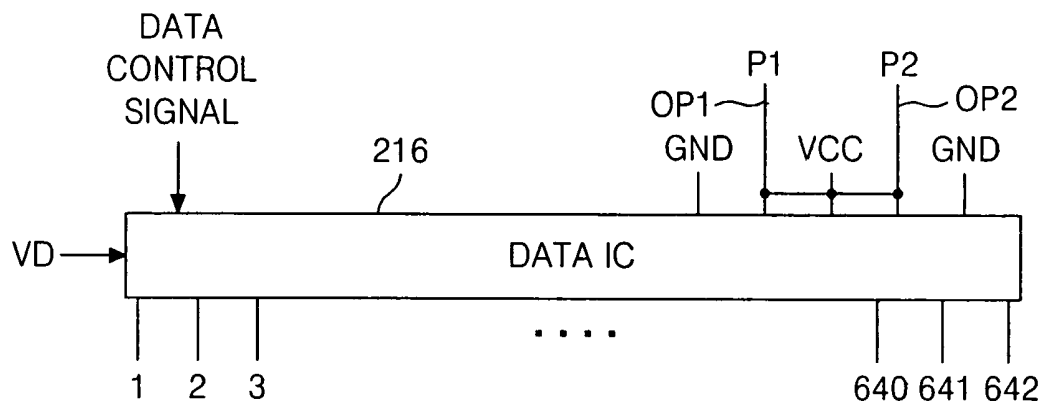


FIG. 15

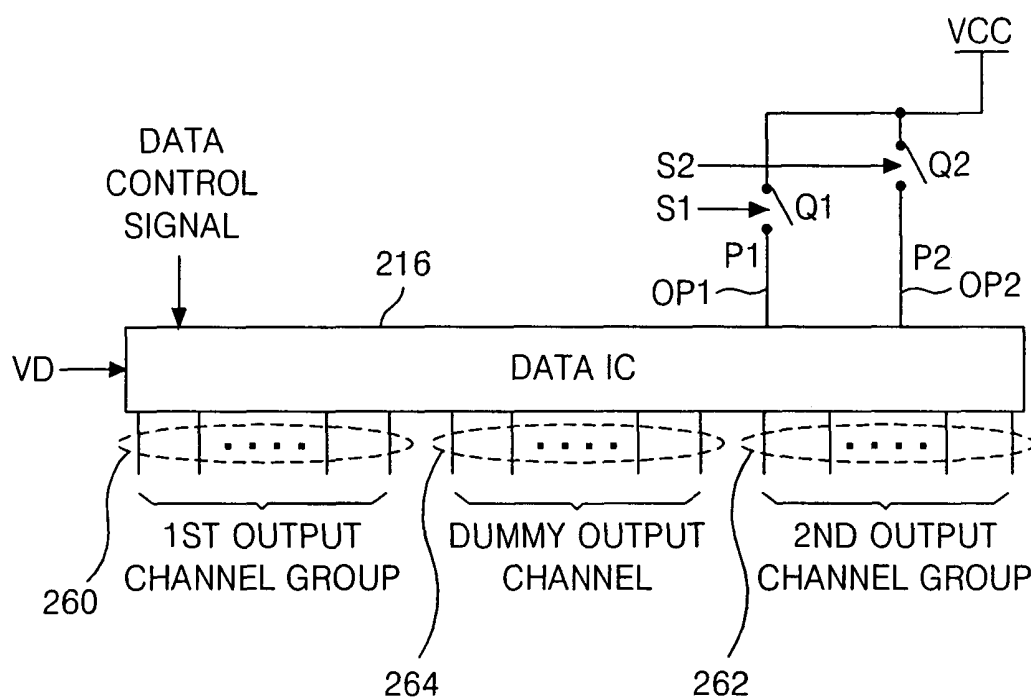


FIG. 16

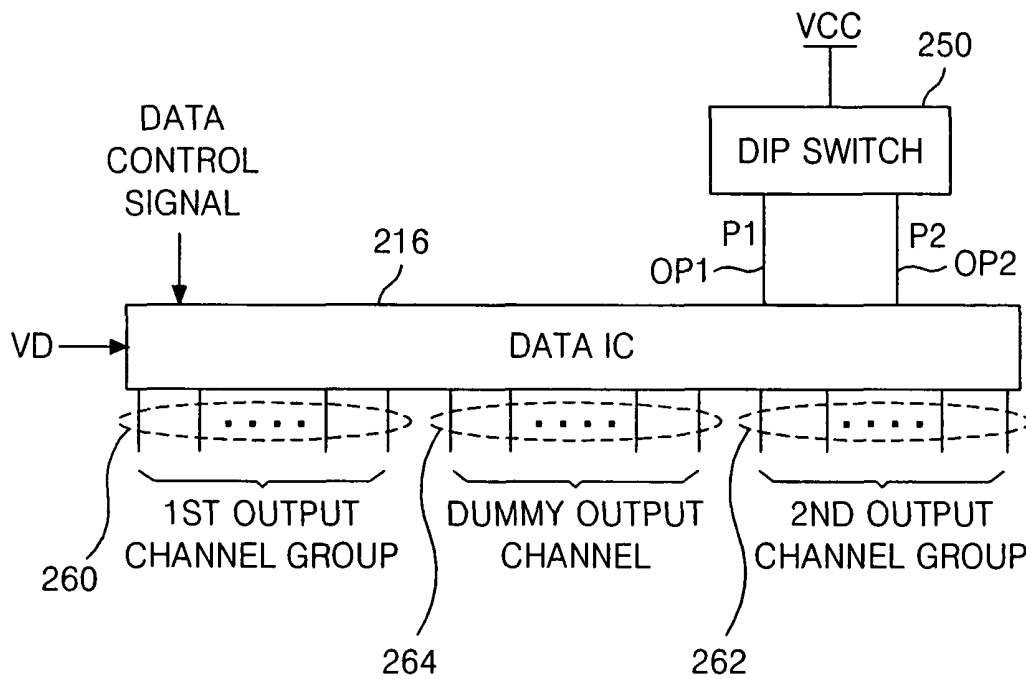
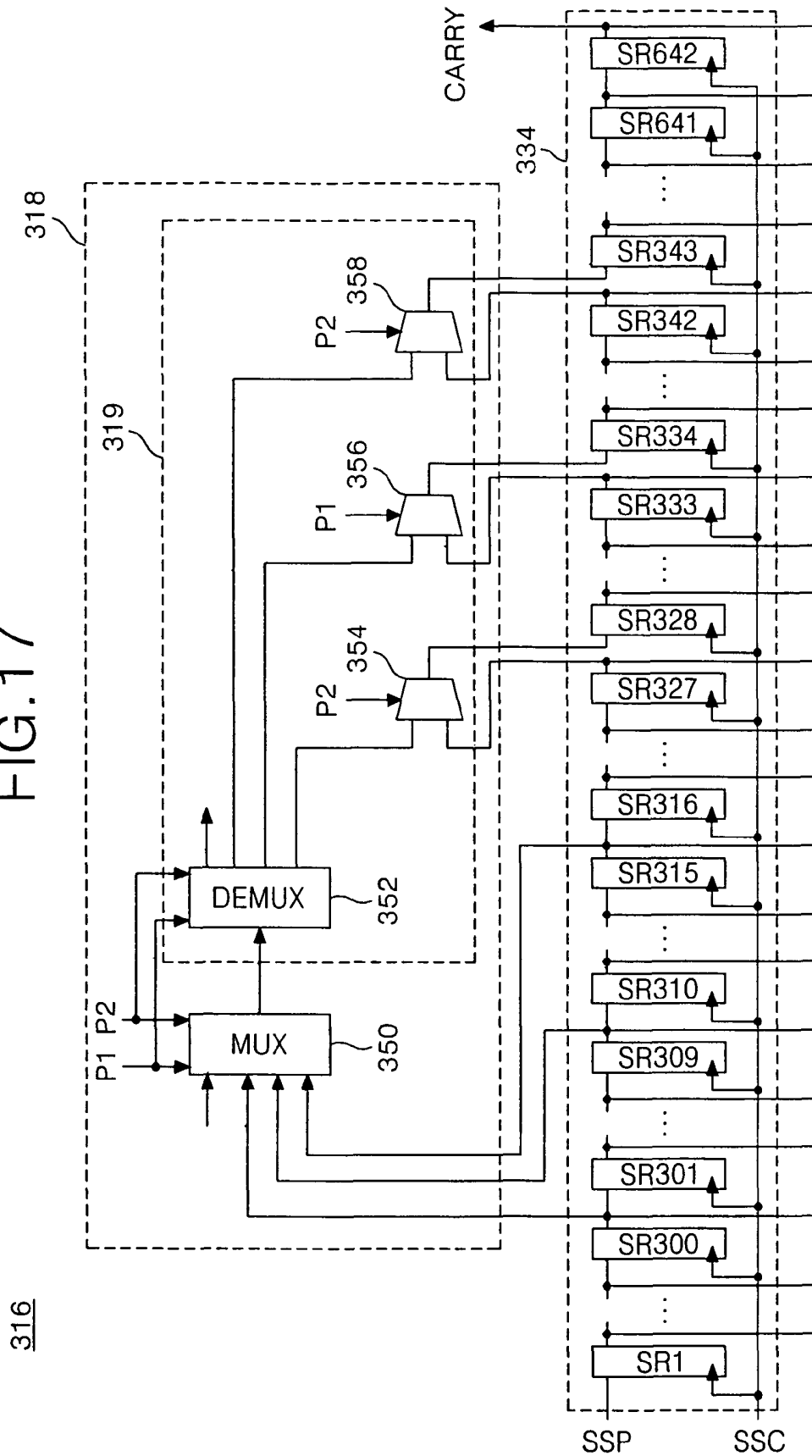


FIG. 17



## LIQUID CRYSTAL DISPLAY DEVICE

## CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a Continuation of application Ser. No. 10/964,779 filed Oct. 15, 2004, now U.S. Pat. No. 7,495,648 now allowed; which claims priority to Korean Patent Application Nos. 10-2003-0090301; 10-2004-0029611, and 10-2004-0029612, filed Dec. 11, 2003 and Apr. 28, 2004 respectively, all of which are hereby incorporated by reference for all purposes as if fully set forth herein.

## BACKGROUND OF THE INVENTION

## 1. Field of the Invention

This invention relates to a liquid crystal display. More particularly, the invention relates to a liquid crystal display device that improves the working efficiency of a liquid crystal display device, as well as reduces manufacturing cost.

## 2. Description of the Related Art

Generally, a liquid crystal display (LCD) controls light transmittance of a liquid crystal using an electric field to display a picture.

To this end, as shown in FIG. 1, the LCD includes a liquid crystal display panel 2 having liquid crystal cells arranged in a matrix, a gate driver 6 for driving gate lines GL1 to GLn of the liquid crystal display panel 2, a data driver 4 for driving data lines DL1 to DLm of the liquid crystal display panel 2, and a timing controller 8 for controlling the gate driver 6 and the data driver 4.

The liquid crystal display panel 2 includes a thin film transistor TFT provided at each crossing of the gate lines GL1 to GLn and the data lines DL1 to DLm, and a liquid crystal cell 7 connected to the thin film transistor TFT. The thin film transistor TFT is turned on when supplied with a scanning signal, for example, a gate high voltage VGH from the gate line GL, to apply a pixel signal from the data line DL to the liquid crystal cell 7. Further, the thin film transistor TFT is turned off when supplied with a gate low voltage VGL from the gate line GL to keep a pixel signal charged in the liquid crystal cell 7.

The liquid crystal cell 7 can be equivalently represented as a liquid crystal capacitor. The liquid crystal cell 7 includes a pixel electrode connected with a common electrode and a thin film transistor with a liquid crystal therebetween. Further, the liquid crystal cell 7 includes a storage capacitor that maintains a signal level of the charged pixel signal until the next pixel signal is charged. The storage capacitor is provided between the pixel electrode and the pre-stage gate line. Such a liquid crystal cell 7 varies an alignment state of the liquid crystal having a dielectric anisotropy in accordance with a pixel signal charged through the thin film transistor TFT to control a light transmittance, thereby implementing gray scale levels.

The timing controller 8 generates gate control signals (i.e., gate start pulse (GSP), gate shift clock (GSC) and gate output enable (GOE)) and data control signals (i.e., source start pulse (SSP), source shift clock (SSC), source output enable (SOE) and polarity control (POL)) using synchronizing signals V and H supplied from a video card (not shown). The gate control signals (i.e., GSP, GSC and GOE) are applied to the gate driver 6 to control the gate driver 6, while the data control signals (i.e., SSP, SSC, SOE and POL) are applied to the data driver 4 to control the data driver 4. Further, the timing controller 8 aligns red (R), green (G) and blue (B) pixel data VD and applies the data to the data driver 4.

The gate driver 6 sequentially drives the gate lines GL1 to GLn. To this end, the gate driver 6 includes a plurality of gate integrated circuits (IC's) 10 as shown in FIG. 2A. The gate IC's 10 sequentially drive the gate lines GL1 to GLn connected thereto under control of the timing controller 8. Specifically, the gate IC's 10 sequentially apply a gate high voltage VGH to the gate lines GL1 to GLn in response to the gate control signals (i.e., GSP, GSC and GOE) from the timing controller 8.

The gate driver 6 shifts a gate start pulse GSP in response to a gate shift clock GSC to generate a shift pulse. Then, the gate driver 6 applies a gate high voltage VGH to the corresponding gate line GL every horizontal period in response to the shift pulse. The shift pulse is shifted line-by-line for each horizontal period, and any one of the gate IC's 10 applies the gate high voltage VGH to the corresponding gate line GL to correspond with the shift pulse. The gate IC's supply a gate low voltage, VGL, in a remaining interval when the gate high voltage, VGH, is not supplied to the gate lines GL1 to GLn.

The data driver 4 applies pixel signals for each line to the data lines DL1 to DLm for each horizontal period. The data driver 4 includes a plurality of data IC's 16 as shown in FIG. 2B. The data IC's 16 apply pixel signals to the data lines DL1 to DLm in response to data control signals (i.e., SSP, SSC, SOE and POL) from the timing controller 8. The data IC's 16 convert pixel data VD from the timing controller 8 analog pixel signals using a gamma voltage from a gamma voltage generator (not shown) to output them.

The data IC's 16 shift a source start pulse SSP in response to a source shift clock SSC to generate sampling signals. Then, the data IC's 16 sequentially latch the pixel data VD for a particular unit in response to the sampling signals. Thereafter, the data IC's 16 convert the latched pixel data VD for one line to analog pixel signals, and apply the signals to the data lines DL1 to DLm in an enable interval of a source output enable signal SOE. The data IC's 16 convert the pixel data VD to positive or negative pixel signals in response to a polarity control signal POL.

As shown in FIG. 3, each of the data IC's 16 includes a shift register part 34 for sequential applying sampling signals, a latch part 36 for sequentially latching the pixel data VD in response to the sampling signals to simultaneously output the signals, a digital to analog converter (DAC) 38 for converting the pixel data VD from the latch part 38 to pixel voltage signals, and an output buffer part 46 for buffering pixel voltage signals from the DAC 38 to output them. Further, the data IC 16 includes a signal controller 20 for interfacing various control signals (i.e., SSP, SSC, SOE, REV and POL, etc.) from the timing controller 8 and the pixel data VD, and a gamma voltage part 32 for supplying positive and negative gamma voltages required for the DAC 38.

The signal controller 20 controls various control signals (i.e., SSP, SSC, SOE, REV and POL, etc.) from the timing controller 8 and the pixel data VD in such a manner to be output to the corresponding elements.

The gamma voltage part 32 sub-divides a plurality of gamma reference voltages input from a gamma reference voltage generator (not shown) for each gray level to output them.

Shift registers included in the shift register part 34 sequentially shift a source start pulse SSP from the signal controller 20 in response to a source sampling clock signal SSC to output it as a sampling signal.

The latch part 36 sequentially samples the pixel data VD from the signal controller 20 for a certain unit in response to the sampling signals from the shift register part 34 to latch them. The latch part 36 is comprised of i latches (wherein i is

3

an integer) to latch  $i$  pixel data  $VD$ , and each of the latches has a dimension corresponding to the bit number of the pixel data  $VD$ . Particularly, the timing controller 8 divides the pixel data  $VD$  into even pixel data  $VD_{even}$  and odd pixel data  $VD_{odd}$  to reduce a transmission frequency, and simultaneously outputs the data through each transmission line. Each of the even pixel data  $VD_{even}$  and the odd pixel data  $VD_{odd}$  includes red (R), green (G) and blue (B) pixel data. Thus, the latch part 36 simultaneously latches the even pixel data  $VD_{even}$  and the odd pixel data  $VD_{odd}$  supplied via the signal controller 20 for each sampling signal. Then, the latch part 36 simultaneously outputs  $i$  latched pixel data  $VD$  in response to a source output enable signal SOE from the signal controller 20.

The latch part 36 restores pixel data  $VD$  modulated such that the transition bit number is reduced in response to a data inversion selection signal REV to output them. The timing controller 8 modulates the pixel data  $VD$  such that the number of transition bits are minimized using a reference value to determine whether the bits should be inverted or not. This minimizes an electro-magnetic interference (EMI) upon data transmission due to a minimal number of bit transactions from LOW to HIGH or HIGH to LOW.

The DAC 38 simultaneously converts the pixel data  $VD$  from the latch part 36 to positive and negative pixel voltage signals. The DAC 38 includes a positive (P) decoding part 40 and a negative (N) decoding part 42 commonly connected to the latch part 36, and a multiplexer (MUX) part 44 for selecting output signals of the P decoding part 40 and the N decoding part 42.

The  $n$  P decoders included in the P decoding part 40 convert  $n$  pixel data simultaneously input from the latch part 36 to positive pixel voltage signals using positive gamma voltages from the gamma voltage part 32. The  $i$  N decoders included in the N decoding part 42 convert  $i$  pixel data simultaneously input from the latch part 36 to negative pixel voltage signals using negative gamma voltages from the gamma voltage part 32. The  $i$  multiplexers included in the multiplexer part 44 selectively output the positive pixel voltage signals from the P decoder 40 or the negative pixel voltage signals from the N decoder 42 in response to a polarity control signal POL from the signal controller 20.

The  $i$  output buffers included in the output buffer part 46 are comprised of voltage followers, etc. connected, in series, to the respective  $i$  data lines DL1 to DL*i*. Such output buffers 46 buffer pixel voltage signals from the DAC 38 to apply the signals to the data lines DL1 to DL*i*.

Such a related art LCD differentiates output channels of the data IC's 16 included in the data driver 4 based upon a resolution of the liquid crystal display panel 2. This is because the data IC's 16 have certain channels connected to the data lines DL for each resolution of the liquid crystal display panel 2. Thus, problems arise in that a different number of data IC's 16 having different output channels for each resolution type of the liquid crystal display panel 2 need to be used. This reduces working efficiency and increases manufacturing cost.

More specifically, for a liquid crystal display having a resolution of an eXtended Graphics Array (XGA) class (i.e., 1024×3) with 3072 data lines DL, it requires four data IC's 16, each of which has 768 data output channels. For a liquid crystal display having a resolution of a Super eXtended Graphics Adapter+ (SXGA+) class (i.e., 1400×3) with 4200 data lines DL, it requires six data IC's 16, each of which has 702 data output channels. The remaining 12 data output channels are treated as dummy lines. Additionally, a liquid crystal display having a resolution of a Wide eXtended Graphics Array (WXGA) class (i.e., 1280×3) with 3840 data lines DL, it requires six data IC's 16, each of which has 642 data output

4

channels. In this case, the remaining 12 data output channels are treated as dummy lines. As mentioned above, different data IC's 16 having a specific number of output channels have to be used for each resolution of the liquid crystal display panel 2. As a result, the related art liquid crystal display has a drawback in that the working efficiency is reduced and manufacturing cost is increased.

#### SUMMARY OF THE INVENTION

Accordingly, the present invention is directed to a liquid crystal display (LCD) device that improves the working efficiency of the LCD, as well as reduce manufacturing costs.

An advantage of the present invention is to provide a liquid crystal display device that is capable of controlling output channels of data integrated circuits based upon a resolution of a liquid crystal display panel.

Additional features and advantages of the invention will be set forth in the description which follows, and in part will be apparent from the description, or may be learned by practice of the invention. These and other advantages of the invention will be realized and attained by the structure particularly pointed out in the written description and claims hereof as well as the appended drawings.

To achieve these and other advantages and in accordance with the purpose of the present invention, as embodied and broadly described, a display according to one embodiment of the present invention includes  $N$  number of data output channels where  $N$  is an integer including a first data output channel and an  $N$ th data output channel; a data output channel group including  $M$  data output channels (where  $M$  is an integer less than or equal to  $N$ ), the  $M$  data output channels supplying pixel data to a corresponding number of data lines in accordance with a desired resolution of the display, wherein  $(N-M)$  data output channels are not applied with pixel data, and the  $(N-M)$  data output channels are located between the first data output channel and the  $N$ th data output channel; and a channel selector selecting the  $M$  data output channels.

In another embodiment of the present invention, a data driving integrated circuit for connecting to a plurality of data lines of a display includes  $N$  number of data output channels where  $N$  is an integer including a first data output channel and an  $N$ th data output channel; a data output channel group including  $M$  data output channels (where  $M$  is an integer less than or equal to  $N$ ), the  $M$  data output channels supplying pixel data to a corresponding number of the data lines in accordance with a desired resolution of the display, wherein  $(N-M)$  data output channels are not applied with pixel data, and the  $(N-M)$  data output channels are located between the first data output channel and the  $N$ th data output channel; and a channel selector selecting the  $M$  data output channels.

In another embodiment of the present invention, a data driving integrated circuit includes output channels including first, second and third output channel groups, the second output channel group being dummy output channels which do not receive pixel data; and a channel selector for selecting the first and third data output channel groups corresponding to a plurality of data lines of a display having a desired resolution, the channel selector being capable of selecting any one of the first, second and third data output groups as dummy output channels, wherein the second output channel group is located between the first and third output channel groups.

It is to be understood that both the foregoing general description and the following detailed description are exem-

plary and explanatory and are intended to provide further explanation of the invention as claimed.

#### BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and together with the description serve to explain the principles of the invention. In the drawings:

FIG. 1 is a block circuit diagram showing a related art liquid crystal display;

FIG. 2A illustrates gate integrated circuits included in a related art gate driver;

FIG. 2B illustrates data integrated circuits included in a related art data driver;

FIG. 3 is a block diagram showing an internal configuration of the data integrated circuit in FIG. 2B;

FIG. 4 is a block circuit diagram showing a liquid crystal display according to a first embodiment of the present invention;

FIG. 5 illustrates a data integrated circuit set to have 600 data output channels in accordance with first and second output selection signals shown in FIG. 4;

FIG. 6 illustrates a data integrated circuit set to have 618 data output channels in accordance with first and second output selection signals shown in FIG. 4;

FIG. 7 illustrates a data integrated circuit set to have 630 data output channels in accordance with first and second output selection signals shown in FIG. 4;

FIG. 8 illustrates a data integrated circuit set to have 642 data output channels in accordance with first and second output selection signals shown in FIG. 4;

FIG. 9 is a block diagram showing an internal configuration of the data integrated circuit in FIG. 4;

FIG. 10 is a block circuit diagram showing a liquid crystal display according to a second embodiment of the present invention;

FIG. 11 illustrates a data integrated circuit set to have 600 data output channels in accordance with first and second output selection signals shown in FIG. 10;

FIG. 12 illustrates a data integrated circuit set to have 618 data output channels in accordance with first and second output selection signals shown in FIG. 10;

FIG. 13 illustrates a data integrated circuit set to have 630 data output channels in accordance with first and second output selection signals shown in FIG. 10;

FIG. 14 illustrates a data integrated circuit set to have 642 data output channels in accordance with first and second output selection signals shown in FIG. 10;

FIG. 15 illustrates switching devices for generating the first and second channel selection signals shown in FIG. 10;

FIG. 16 illustrates a dip switch for generating the first and second channel selection signals shown in FIG. 10; and

FIG. 17 is a block diagram showing a channel selector and a shift register part in a data integrated circuit according to a third embodiment of the present invention.

#### DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENTS

Reference will now be made in detail to an embodiment of the present invention, examples of which are illustrated in the accompanying drawings.

FIG. 4 schematically shows a liquid crystal display (LCD) according to a first embodiment of the present invention.

In FIG. 4, the LCD includes a liquid crystal display panel 102 having liquid crystal cells arranged in a matrix, a gate driver 106 for driving gate lines GL1 to GLn of the liquid crystal display panel 102, a data driver 104 for driving data lines DL1 to DLm of the liquid crystal display panel 102, and a timing controller 108 for controlling the gate driver 106 and the data driver 104.

The liquid crystal display panel 102 includes a thin film transistor TFT provided at each crossing portion of the gate lines GL1 to GLn and the data lines DL1 to DLm, and a liquid crystal cell (not shown) connected to the thin film transistor TFT. The thin film transistor TFT is turned on when supplied with a scanning signal, that is, a gate high voltage VGH from the gate line GL, to apply a pixel signal from the data line DL to the liquid crystal cell. Further, the thin film transistor TFT is turned off when supplied with a gate low voltage VGL from the gate line GL. The pixel signal remains charged in the liquid crystal cell.

The liquid crystal cell can be equivalently represented as a liquid crystal capacitor. The liquid crystal cell includes a pixel electrode connected with a common electrode and a thin film transistor with a liquid crystal therebetween. Further, the liquid crystal cell includes a storage capacitor for maintaining the charged pixel signal until the next pixel signal is charged. This storage capacitor is provided between the pixel electrode and the pre-stage gate line. Such a liquid crystal cell 7 varies an alignment state of the liquid crystal having a dielectric anisotropy in accordance with a pixel signal charged through the thin film transistor TFT to control a light transmittance and implement gray scale levels.

The timing controller 108 generates gate control signals (i.e., gate start pulse (GSP), gate shift clock (GSC) and gate output enable (GOE)) and data control signals (i.e., source start pulse (SSP), source shift clock (SSC), source output enable (SOE) and polarity control (POL)) using synchronizing signals V and H supplied from a video card (not shown). The gate control signals (i.e., GSP, GSC and GOE) are applied to the gate driver 106 to control the gate driver 106 while the data control signals (i.e., SSP, SSC, SOE and POL) are applied to the data driver 104 to control the data driver 104. Further, the timing controller 108 aligns pixel data VD and applies the data to the data driver 104.

The gate driver 106 sequentially drives the gate lines GL1 to GLn. The gate driver 106 includes a plurality of gate integrated circuits (IC's) (not shown). The gate IC's sequentially drive the gate lines GL1 to GLn connected thereto under control of the timing controller 108. The gate IC's sequentially apply a gate high voltage VGH to the gate lines GL1 to GLn in response to the gate control signals (i.e., GSP, GSC and GOE) from the timing controller 108.

Specifically, the gate driver 106 shifts a gate start pulse GSP in response to a gate shift clock GSC to generate a shift pulse. Then, the gate driver 106 applies a gate high voltage VGH to the corresponding gate line GL for each horizontal period in response to the shift pulse. In other words, the shift pulse is shifted line-by-line for each horizontal period, and any one of the gate IC's applies the gate high voltage VGH to the corresponding gate line GL in accordance with the shift pulse. In this case, the gate IC's supply a gate low voltage VGL in the remaining gate lines.

The data driver 104 applies pixel signals to the data lines DL1 to DLm one line at a time each horizontal period. The data driver 104 includes a plurality of data IC's 116. Each of the data IC's 116 may be mounted in a data tape carrier package (TCP) 110. Such data IC's 116 are electrically connected, via a data TCP pad 112, a data pad 114 and a link 118, to the data lines DL1 to DLm. The data IC's 116 apply pixel

signals to the data lines DL1 to DLm in response to data control signals (i.e., SSP, SSC, SOE and POL) from the timing controller 108. The data IC's 116 convert pixel data VD from the timing controller 108 to analog pixel signals using gamma voltages from a gamma voltage generator (not shown).

Specifically the data IC's 116 shift a source start pulse SSP in response to a source shift clock SSC to generate sampling signals. Then, the data IC's 116 sequentially latch the pixel data VD for a certain unit in response to the sampling signals. Thereafter, the data IC's 116 convert the latched pixel data VD for each line to analog pixel signals, and apply the analog data to the data lines DL1 to DLm in an enable interval of a source output enable signal SOE. The data IC's 116 convert the pixel data VD to positive or negative pixel signals in response to a polarity control signal POL.

Meanwhile, each of the data IC's 116 of the LCD according to the first embodiment of the present invention varies an output channel to apply a pixel signal to each data line DL1 to DLm in response to first and second channel selection signals P1 and P2 input from the exterior thereof. Each of the data IC's 116 includes first and second option pins OP1 and OP2, for example, supplied with the first and second channel selection signals P1 and P2.

Each of the first and second option pins OP1 and OP2 is selectively connected to a voltage source VCC and a ground voltage source GND to have a 2-bit binary logical value. Thus, the first and second channel selection signals P1 and P2 applied, via the first and second option pins OP1 and OP2 have values of '00', '01', '10' and '11' to the data IC 116.

Accordingly, each of the data IC's 116 has the number of an output channels set in advance based on a resolution type of the liquid crystal display panel 102 using the first and second channel selection signals P1 and P2 applied via the first and second option pins OP1 and OP2.

The number of data IC's 116 according to output channels of the data IC's 116 based upon a resolution of the liquid crystal display panel 102 is described in the following Table:

TABLE 1

Resolution	Pixel number		The number of data IC's according			
	Data line	Gate line	to output channels of data IC's			
			600CH	618CH	630CH	642CH
XGA	3072	768	5.12	4.97	4.88	4.79
SXGA+	4200	1050	7.00	6.80	6.67	6.54
UXGA	4800	1200	8.00	7.77	7.62	7.48
WXGA	3840	800	6.40	6.21	6.10	5.98
WSXGA-	4320	900	7.20	6.99	6.86	6.73
WSXGA	5040	1050	8.40	8.16	8.00	7.85
WUXGA	5760	1200	9.60	9.32	9.14	8.97

In Table 1, all resolutions can be expressed by four channels. Specifically, the liquid crystal display panel 102 having a resolution of XGA class requires five data IC's 116, each of which has 618 data output channels. The remaining 18 data output channels are treated as dummy lines. The liquid crystal display panel 102 having a resolution of SXGA+ class requires seven data IC's 116, each of which has 600 data output channels. The liquid crystal display panel 102 having a resolution of Ultra eXtended Graphics Adapter (UXGA) class requires eight data IC's 116, each of which has 600 data output channels. The liquid crystal display panel 102 having a resolution of WXGA class requires six data IC's 116, each of which has 642 data output channels. The liquid crystal display panel 102 having a resolution of Wide aspect Super

eXtended Graphics Adapter- (WSXGA-) class requires seven data IC's 116, each of which has 618 data output channels. The liquid crystal display panel 102 having a resolution of Wide aspect Super eXtended Graphics Adapter (WSXGA) class requires eight data IC's 116, each of which has 630 data output channels. The liquid crystal display panel 102 having a resolution of Wide aspect Ultra eXtended Graphics Adapter (WUXGA) class requires nine data IC's 116, each of which has 642 data output channels.

The LCD according to the first embodiment of the present invention sets the number of output channels of the data IC's 116 to any one of 600 channels, 618 channels, 630 channels and 642 channels in response to the first and second channel selection signals P1 and P2, thereby expressing all resolutions of the liquid crystal display panel 102. The data IC 116 of the LCD according to the first embodiment of the present invention may be made to have 642 data output channels and the number of active output channels of the data IC's 116 are set in response to the first and second channel selection signals P1 and P2 from the first and second option pins OP1 and OP2, for example, so that it can be compatibly used for all resolution types of the liquid crystal display panel 102.

The data IC 116 of the LCD according to the first embodiment of the present invention may be manufactured to have 642 data output channels. When a value of the first and second channel selection signals P1 and P2 applied to the data IC 116 is '00' by connecting each of the first and second option pins OP1 and OP2 to the ground voltage source GND, the data IC 116 outputs pixel voltage signals via only the 1st to 600th data output channels from the 642 data output channels available as shown in FIG. 5. In this case, the 601st to 642nd output channels become dummy output channels. On the other hand, when a value of the first and second channel selection signals P1 and P2 applied to the data IC 116 is '01' by connecting the first option pin OP1 to the ground voltage source GND and the second option pin OP2 to the voltage source VCC, the data IC 116 outputs pixel voltage signals via only the 1st to 618th data output channels from 642 data output channels available as shown in FIG. 6. In this case, the 619th to 642nd output channels become dummy output channels. When a value of the first and second channel selection signals P1 and P2 applied to the data IC 116 is '10' by connecting the first option pin OP1 to the voltage source VCC and, the second option pin OP2 to the ground voltage source GND, the data IC 116 outputs pixel voltage signals via only 1st to 630th data output channels of 642 data output channels from the 642 data output channels available as shown in FIG. 7. The 631st to 642nd output channels become dummy output channels. Finally, when a value of the first and second channel selection signals P1 and P2 applied to the data IC 116 is '11' by connecting each of the first and second option pins OP1 and OP2 to the voltage source VCC, the data IC 116 outputs pixel voltage signals via the 1st to 642nd data output channels, as shown in FIG. 8.

As shown in FIG. 9, the data IC 116 of the LCD according to the first embodiment of the present invention includes a channel selector 130 for setting an output channel of the data IC 116 in response to the first and second channel selection signals P1 and P2 applied to the first and second option pins OP1 and OP2, for example, a shift register part 134 for sequentially applying sampling signals, a latch part 136 for sequentially latching the pixel data VD in response to the sampling signals from the shift register part 134 to simultaneously output the data a digital-to-analog converter (DAC) 138 for converting the pixel data VD from the latch part 136

to pixel voltage signals, and an output buffer part **146** for buffering pixel voltage signals from the DAC **138** to output them to the data lines.

The data IC **116** further includes a signal controller **120** for interfacing with various control signals from the timing controller **108** and the pixel data VD, and a gamma voltage part **132** for supplying positive and negative gamma voltages required for the DAC **138**.

The signal controller **120** controls various control signals (i.e., SSP, SSC, SOE, REV and POL, etc.) from the timing controller **108** and the pixel data VD so as to output them to the corresponding elements.

The gamma voltage part **132** sub-divides a plurality of gamma reference voltages input from a gamma reference voltage generator (not shown) for each gray level.

The channel selector **130** applies first to fourth channel control signals CS1 to CS4, via the first and second output pins OP1 and OP2, to the shift register part **134** in response to the first and second channel selection signals P1 and P2. In other words, the channel selector **130** generates the first channel selection signal CS1 corresponding to the first and second channel selection signals P1 and P2 having a value of '00', the second channel selection signal CS2 corresponding to the first and second channel selection signals P1 and P2 having a value of '01', the third channel selection signal CS3 corresponding to the first and second channel selection signals P1 and P2 having a value of '10', and the fourth channel selection signal CS4 corresponding to the first and second channel selection signals P1 and P2 having a value of '11'.

Shift registers included in the shift register part **134** sequentially shift a source start pulse SSP from the signal controller **120** in response to a source sampling clock signal SSC and output a sampling signal. In this example, the shift register part **134** consists of 642 shift registers SR1 to SR642.

Such a shift register part **134** applies output signals of the 600th, 618th, 630th and 642nd shift registers SR600, SR628, SR630 and SR642 to a next stage data IC **116** in response to the first to fourth channel control signals CS1 to CS4 from the channel selector **130**.

More specifically, when the first output control signal CS1 is applied from the channel selector **130**, the shift register part **134** sequentially shifts a source start pulse SSP signal from the signal controller **120** in response to a source sampling clock signal SSC using the 1st to 600th shift registers SR1 to SR600, and outputs them as sampling signals. In this case, an output signal (i.e., a carry signal) of the 600th shift register SR600 is applied to the 1st shift register SR1 of the next stage data IC **116** for a daisy chain connection. Thus, the 601st to 642nd shift registers SR601 to SR642 do not output sampling signals. If the shift registers are driven in a bilateral direction, then it becomes possible to more advantageously use them by using a dummy treatment without employing the 42 middle channels.

When the second output control signal CS2 is applied from the channel selector **130**, the shift register part **134** sequentially shifts a source start pulse SSP signal from the signal controller **120** in response to a source sampling clock signal SSC using the 1st to 618th shift registers SR1 to SR618, and outputs them as sampling signals. In this case, an output signal (i.e., a carry signal) of the 618th shift register SR618 is applied to the 1st shift register SR1 of the next stage data IC **116**. Thus, the 619th to 642nd shift registers SR619 to SR642 do not output sampling signals. If the shift registers are driven in a bilateral direction, then it is possible to more advantageously use the shift registers by making a dummy treatment without employing the 24 middle channels.

When the third output control signal CS3 is applied from the channel selector **130**, the shift register part **134** sequentially shifts a source start pulse SSP signal from the signal controller **120** in response to a source sampling clock signal SSC using the 1st to 630th shift registers SR1 to SR630, and outputs them as sampling signals. In this case, an output signal (i.e., a carry signal) of the 630th shift register SR630 is applied to the 1st shift register SR1 of the next stage data IC **116**. Thus, the 631st to 642nd shift registers SR631 to SR642 do not output sampling signals. Herein, if the shift registers are driven in a bilateral direction, then it is possible to more advantageously use the shift registers by using a dummy treatment without employing the 12 middle channels.

When the fourth output control signal CS4 is applied from the channel selector **130**, the shift register part **134** sequentially shifts a source start pulse SSP signal from the signal controller **120** in response to a source sampling clock signal SSC using the 1st to 642nd shift registers SR1 to SR642, and outputs them as sampling signals. In this case, an output signal (i.e., a carry signal) of the 642nd shift register SR642 is applied to the 1st shift register SR1 of the next stage data IC **116**.

The latch part **136** sequentially samples the pixel data VD from the signal controller **120** for a particular unit in response to the sampling signals from the shift register part **134** to latch them. To this end, the latch part **136** is comprised of at most 642 latches so as to latch 642 pixel data VD, and each of the latches has a dimension corresponding to a bit number of the pixel data VD. Particularly, the timing controller **108** divides the pixel data VD into even pixel data VD<sub>even</sub> and odd pixel data VD<sub>odd</sub> to reduce a transmission frequency, and simultaneously outputs the data through each transmission line. Each of the even pixel data VD<sub>even</sub> and the odd pixel data VD<sub>odd</sub> includes red (R), green (G) and blue (B) pixel data.

The latch part **136** simultaneously latches the even pixel data VD<sub>even</sub> and the odd pixel data VD<sub>odd</sub> supplied via the signal controller **120** for each sampling signal. Then, the latch part **136** simultaneously outputs the pixel data VD through the selected number of output channels, (600, 618, 630 or 642 data output channels) in response to a source output enable signal SOE from the signal controller **120**. The latch part **136** restores pixel data VD which have been modulated such that the transition bit number is reduced in response to a data inversion selection signal REV. This is because the timing controller **108** modulates the pixel data VD, in which the transition bit number goes beyond a reference value, such that the transition bit number is reduced so as to minimize an electro-magnetic interference (EMI) upon data transmission.

The DAC **138** simultaneously converts the pixel data VD from the latch part **136** to positive and negative pixel voltage signals. The DAC **138** includes a positive (P) decoding part **140** and a negative (N) decoding part **142** commonly connected to the latch part **136**, and a multiplexer (MUX) part **144** for selecting output signals of the P decoding part **140** and the N decoding part **142**.

The n P decoders included in the P decoding part **140** convert n pixel data simultaneously input from the latch part **136** to positive pixel voltage signals using positive gamma voltages from the gamma voltage part **132**. The i N decoders included in the N decoding part **142** convert i pixel data simultaneously input from the latch part **136** to negative pixel voltage signals using negative gamma voltages from the gamma voltage part **132**. In the example, at most 642 multiplexers included in the multiplexer part **144** selectively output the positive pixel voltage signals from the P decoder **140** or

the negative pixel voltage signals from the N decoder **142** in response to a polarity control signal POL from the signal controller **120**.

At most, 642 output buffers included in the output buffer part **146** include voltage followers, etc. connected, in series, to the respective **642** data lines DL1 to DL**642**. Such output buffers **146** buffer pixel voltage signals from the DAC **138** to apply the signals to the data lines DL1 to DL**642**.

In the LCD according to the first embodiment of the present invention, the data IC **116** having 600 data output channels is used for the liquid crystal display panel **102** having a resolution of SXGA+ class or UXGA class; the data IC **116** having 618 data output channels is used for the liquid crystal display panel **102** having a resolution of XGA class or WSXGA-class; the data IC **116** having 630 data output channels is used for the liquid crystal display panel **102** having a resolution of WSXGA class; and the data IC **116** having 642 data output channels is used for the liquid crystal display panel **102** having a resolution of WXGA class or WUXGA class as indicated in the above Table 1.

Meanwhile, in the LCD according to the first embodiment of the present invention, the TCP pad **112**, the data pad **114** of the liquid crystal display panel **102** and the link **118** correspond to output channels of the data IC **116** varied in response to the first and second channel selection signals P1 and P2.

The LCD according to the first embodiment of the present invention sets the number of output channels of the data IC **116** in accordance with a resolution of the liquid crystal display panel **102** as indicated in the above Table 1 using the first and second channel selection signals P1 and P2 applied to the first and second option pins OP1 and OP2, thereby configuring multiple resolutions using only one type of data IC **116**. Accordingly, the LCD according to the first embodiment of the present invention improves the working efficiency of an LCD device as well as reduce manufacturing cost.

FIG. **10** is a block diagram showing a configuration of a data IC in a liquid crystal display according to a second embodiment of the present invention.

In FIG. **10**, the LCD according to the second embodiment of the present invention has the same elements as the LCD according to the first embodiment of the present invention except for a data IC **216**. Therefore, in the LCD according to the second embodiment of the present invention, the data IC **216** will be described in conjunction with FIG. **10** and FIG. **4**, and an explanation as to similar elements will be omitted. Herein, a reference numeral "116" of the data IC shown in FIG. **4**.

In the LCD according to the second embodiment of the present invention, the data IC **216** includes a first data output channel group **260** and a second data output channel group **262** for applying data to the data lines DL1 to DLm, and a dummy output channel group **264** provided between the first and second data output channel groups **260** and **262**.

The data IC **216** further includes first and second option pins OP1 and OP2 supplied with first and second channel selection signals P1 and P2 for determining whether a pixel data applied, via a dummy data output channel group **264**, to the data lines DL1 to DLm in accordance with the number of the data lines DL1 to DLm is output.

Each of the first and second option pins OP1 and OP2 is selectively connected to a voltage source VCC and a ground voltage source GND to have a 2-bit binary logical value. Thus, the first and second channel selection signals P1 and P2 applied, via the first and second option pins OP1 and OP2, to the data IC **216** may have values of '00', '01', '10' and '11'.

Accordingly, each of the data IC's **216** has output channels set in advance based on a desired resolution of the liquid

crystal display panel **102** using first and second channel selection signals P1 and P2 applied via the first and second option pins OP1 and OP2.

The number of data IC's **216** according to output channels of the data IC's **216** is based upon a resolution of the liquid crystal display panel **102** as indicated in the above Table 1.

Accordingly, the LCD according to the second embodiment of the present invention may set output channels of the data IC's **216**, for example, to any one of 600 channels, 618 channels, 630 channels and 642 channels in response to the first and second channel selection signals P1 and P2, thereby configuring multiple resolutions of the liquid crystal display panel **102**. In other words, the data IC **216** of the LCD according to the second embodiment of the present invention may be set to have 642 data output channels that are set in response to the first and second channel selection signals P1 and P2 from the first and second option pins OP1 and OP2, so that the data IC **216** can be compatibly used for all resolutions of the liquid crystal display panel **102**. Further, in the LCD according to the second embodiment, the dummy data output channel group **264** of the data IC **216** is arranged according to a determination of the output channel at the middle portion of data output channels of the data IC **216**. In other words, first and second data output channel groups **260** and **262** of the data IC **216** have the same output channels, with the dummy data output channel group **264** therebetween. Thus, the LCD according to the second embodiment of the present invention equalizes the output channels of each of the first and second data output channel groups **260** and **262** of the data IC **216**, which reduces an electro-magnetic interference upon output of the pixel data.

The data IC **216** of the LCD according to the second embodiment of the present invention may be manufactured to have, for example, 642 data output channels.

When a value of the first and second channel selection signals P1 and P2 applied to the data IC **216** is '00', by connecting each of the first and second option pins OP1 and OP2 to the ground voltage source GND, the data IC **216** outputs pixel data via the first data output channel group **260** having the 1st to 300th output channels. From the 642 data output channels available and the second data output channel group **262** having the 343rd from the 642nd output channels available as shown in FIG. **11**. The dummy data output channel group **264** has the 301 st to 342nd output channels which are treated as dummy lines.

In FIG. **12**, when a value of the first and second channel selection signals P1 and P2 applied to the data IC **216** is '01', by connecting the first option pin OP1 the ground voltage source GND and, the second option pin OP2 to the voltage source VCC, the data IC **216** outputs pixel data via the first data output channel group **260** having the 1st to 309th output channels. From the 642 data output channels and the second data output channel group **262** having the 334th from the 642nd output channels as shown in FIG. **12**. The dummy data output channel group **264** has the 310th to 333rd output channels which are treated as dummy lines.

In FIG. **13**, when a value of the first and second channel selection signals P1 and P2 applied to the data IC **216** is '10' by connecting the first option pin OP1 to the voltage source VCC and, the second option pin OP2 to the ground voltage source GND, the data IC **216** outputs pixel data via the first data output channel group **260** having the 1st to 315th output channels from the 642 data output channels and the second data output channel group **262** having the 328th from the 642nd output channels available as shown in FIG. **13**. The dummy data output channel group **264** has the 316th to 327th output channels which are treated as dummy lines thereby.

13

Finally, in FIG. 14, when a value of the first and second channel selection signals P1 and P2 applied to the data IC 216 is '11' by connecting each of the first and second option pins OP1 and OP2 to the voltage source VCC, the data IC 216 outputs pixel data via the first data output channel group 260, the dummy data output channel group 264 and the second output channel group 262, that is, via the 1st to 642nd data output channels as shown in FIG. 14.

To this end, similar to FIG. 9, the data IC 216 of the LCD according to the second embodiment of the present invention includes a channel selector 130 for setting an output channel of the data IC 216 in response to the first and second channel selection signals P1 and P2 applied to the first and second option pins OP1 and OP2, a shift register part 134 for sequentially applying sampling signals, a latch part 136 for sequentially latching the pixel data VD in response to the sampling signals to simultaneously output the data, a digital to analog converter (DAC) 138 for converting the pixel data VD from the latch part 136 to pixel voltage signals, and an output buffer part 146 for buffering pixel voltage signals from the DAC 138.

The data IC 216 further includes a signal controller 120 for interfacing various control signals from the timing controller 108 and the pixel data VD, and a gamma voltage part 132 for supplying positive and negative gamma voltages required for the DAC 138.

Because the data IC 216 including the channel selector 130, the shift register part 134, the latch part 136, the DAC 138, the output buffer part 146, the signal controller 120 and the gamma voltage part are identical to the data IC 116 of the LCD according to the first embodiment of the present invention, an explanation as to the similar elements will be replaced by the above-mentioned description.

As described above, the LCD according to the second embodiment of the present invention sets the output channels of the data IC 216 based upon a resolution of the liquid crystal display panel 102, as indicated in the above Table 1 in response to the first and second channel selection signals P1 and P2 applied to the first and second option pins OP1 and OP2, thereby expressing all resolutions only by a kind of data IC 216. Accordingly, the LCD according to the second embodiment of the present invention improves a working efficiency of the LCD as well as reduces manufacturing costs.

In another embodiment, the first and second channel selection signals P1 and P2 applied to the first and second option pins OP1 and OP2 of the data IC's 116 and 216 of the first and second embodiments, respectively, of the present invention may be generated by a selective switching of first and second switches Q1 and Q2 as shown in FIG. 15.

The first switch Q1 is connected between the voltage source VCC and the first option pin OP1, while the second switch Q2 is connected between the voltage source VCC and the second option pin OP2. The first and second switches Q1 and Q2 are switched by switching signals S1 and S2 from the timing controller 108, respectively, or are switched by switching signals S1 and S2 set based upon a resolution type of the liquid crystal display panel 102, respectively.

Otherwise, the first and second channel selection signals P1 and P2 applied to the first and second option pins OP1 and OP2 of the data IC's 116 and 216 according to the first and second embodiments of the present invention may also be generated by a switching operation of a dip switch 250 connected to the voltage source VCC and, at the same time, connected to the respective first and second option pins OP1 and OP2 as shown in FIG. 16.

The dip switch 250 may be pre-set by a system engineer based upon a resolution of the liquid crystal display panel

14

102, to generate the first and second channel selection signals and apply the signals to the first and second option pins OP1 and OP2, respectively.

FIG. 17 is a block diagram showing a configuration of a data IC in a liquid crystal display according to a third embodiment of the present invention.

In FIG. 17, the LCD according to the third embodiment of the present invention has the same elements as the LCD according to the first embodiment of the present invention except for a data IC 316. Therefore, in the LCD according to the third embodiment of the present invention, the data IC 316 only will be described in conjunction with FIG. 17 and FIG. 4, and an explanation as to the other elements will be omitted. Herein, a reference numeral "116" of the data IC shown in FIG. 4 will be replaced by a reference numeral "316" shown in FIG. 17.

In the LCD according to the third embodiment of the present invention, the data IC 316 includes a first data output channel group 360 and a second data output channel group 362 for applying data to the data lines DL1 to DLm, and a dummy output channel group 364 provided between the first and second data output channel groups 360 and 362.

Such a data IC 316 further includes first and second option pins, for example, OP1 and OP2 supplied with first and second channel selection signals P1 and P2 for determining whether or not pixel data applied, via a dummy data output channel group 364, to the data lines DL1 to DLm in accordance with the number of the data lines DL1 to DLm is output.

Each of the first and second option pins OP1 and OP2 is selectively connected to a voltage source VCC and a ground voltage source GND to have a 2-bit binary logical value. Thus, the first and second channel selection signals P1 and P2 applied, via the first and second option pins OP1 and OP2, to the data IC 216 may have values of '00', '01', '10' and '11'.

Accordingly, each of the data IC's 316 has output channels set in advance based upon a resolution of the liquid crystal display panel 102 in response to the first and second channel selection signals P1 and P2 applied via the first and second option pins OP1 and OP2.

The number of data IC's 316 according to output channels of the data IC's 316 based upon a resolution-type of the liquid crystal display panel 102 is as indicated in the above Table 1.

Accordingly, the LCD according to the third embodiment of the present invention sets output channels of the data IC's 316, for example, to any one of 600 channels, 618 channels, 630 channels and 642 channels in response to the first and second channel selection signals P1 and P2, thereby configuring multiple resolution types of the liquid crystal display panel 102. In other words, the data IC 316 of the LCD according to the third embodiment of the present invention may have 642 data output channels. The output channels of the data IC's 316 are set in response to the first and second channel selection signals P1 and P2 from the first and second option pins OP1 and OP2, so that the LCD panel can be compatibly used for all resolution types of liquid crystal display panel 102. Further, the LCD according to the third embodiment of the present invention arranges the dummy data output channel group 364 of the data IC 316 at the middle portion of data output channels of the data IC 316. In other words, first and second data output channel groups 360 and 362 of the data IC 216 have the same number of output channels with having the dummy data output channel group 364 therebetween. Thus, the LCD according to the third embodiment of the present invention equalizes output channels of each of the first and second data output channel groups 360 and 362 of the data IC 316, thereby reducing an electro-magnetic interference upon output of the pixel data.

15

Specifically, the data IC **316** of the LCD according to the third embodiment of the present invention may be manufactured to have 642 data output channels.

When a value of the first and second channel selection signals **P1** and **P2** applied to the data IC **216** is '00', by connecting each of the first and second option pins **OP1** and **OP2** to the ground voltage source **GND**, the data IC **316** outputs pixel data via the first data output channel group **360** having the 1st to 300th output channels from the 642 data output channels and the second data output channel group **362** having the 343rd to 642nd output channels similar to FIG. **11**. In this case, the dummy data output channel group **264** has the 301st to 342nd output channels and are treated as dummy lines.

When a value of the first and second channel selection signals **P1** and **P2** applied to the data IC **316** is '01' by connecting as the first option pin **OP1** to the ground voltage source **GND** and the second option pin **OP2** to the voltage source **VCC**, the data IC **316** outputs pixel data via the first data output channel group **360** having the 1st to 309th output channels from the 642 data output channels and the second data output channel group **262** having the 334th to 642nd output channels similar to FIG. **12**. In this case, the dummy data output channel group **264** has the 310th to 333rd output channels and are treated as dummy lines.

Meanwhile, when a value of the first and second channel selection signals **P1** and **P2** applied to the data IC **316** is '10' by connecting the first option pin **OP1** to the voltage source **VCC** and the second option pin **OP2** to the ground voltage source **GND**, the data IC **316** outputs pixel data via the first data output channel group **360** having the 1st to 315th output channels of 642 data output channels and the second data output channel group **262** having the 328th to 642nd output channels similar to FIG. **13**. In this case, the dummy data output channel group **264** has the 316th to 327th output channels and are treated as dummy lines.

Finally, when a value of the first and second channel selection signals **P1** and **P2** applied to the data IC **316** is '11' by connecting each of the first and second option pins **OP1** and **OP2** are connected to the voltage source **VCC**, the data IC **316** outputs pixel data via the first data output channel group **360**, the dummy data output channel group **364** and the second data output channel group **362**, that is, via the 1st to 642nd output channels similar to FIG. **14**.

To this end, as shown in FIG. **17**, the data IC **316** of the LCD according to the third embodiment of the present invention includes a channel selector **318** for setting an output channel of the data IC **316** in response to the first and second channel selection signals **P1** and **P2** applied to the first and second option pins **OP1** and **OP2**, a shift register part **334** for applying sequential sampling signals, a latch part (not shown) for sequentially latching the pixel data **VD** in response to the sampling signals to simultaneously output them, a digital to analog converter (**DAC**) (not shown) for converting the pixel data **VD** from the latch part to pixel voltage signals, and an output buffer part (not shown) for buffering pixel voltage signals from the **DAC**.

The data IC **316** further includes a signal controller (not shown) for interfacing various control signals from the timing controller **108** and the pixel data **VD**, and a gamma voltage part (not shown) for supplying positive and negative gamma voltages required for the **DAC**.

Because a data IC **316** including the latch part, the **DAC**, the output buffer part, the signal controller and the gamma voltage part except for the channel selector **318** and the shift register part **334** are identical to the data IC **116** of the LCD according to the first embodiment of the present invention.

16

In the data IC **316** of the LCD according to the third embodiment of the present invention, the shift register part **334** of the data IC **216** is comprised of **N** shift registers **SR1** to **SR<sub>N</sub>**. Shift registers included in the shift register part **334** sequentially shift a source start pulse **SSP** signal from the signal controller in response to a source sampling clock signal **SSC** to output the signals as sampling signals. An output signal, **Carry**, of the **N**th shift register **SR<sub>N</sub>** of the shift register part **334** is applied to the 1st shift register **SR1** of a next stage data IC **216**. In this case, the shift register part **334** will be described assuming that it consists of 642 shift registers **SR1** to **SR642**.

The channel selector **318** includes a first multiplexer **350** for selectively outputting one of an output signal of the **I1**th shift register **SR<sub>I1</sub>** (wherein **I1** is an integer larger than 1), an output signal of the **I2**nd shift register **SR<sub>I2</sub>** (wherein **I2** is an integer larger than **I1**) and an output signal of the **I3**th shift register **SR<sub>I3</sub>** (wherein **I3** is an integer larger than **I2** and smaller than **N**) in response to the first and second channel selection signals **P1** and **P2**; a demultiplexer **352** for applying the output signal of the first multiplexer **350** to one of the **J1**th shift register **SR<sub>J1</sub>** (wherein **J1** is an integer larger than **I3**), the **J2**nd shift register **SR<sub>J2</sub>** (wherein **J2** is an integer larger than **J1**) and the **J3**th shift register **SR<sub>J3</sub>** (wherein **J3** is an integer larger than **J2** and smaller than **N**) in response to the first and second channel selection signals **P1** and **P2**; a second multiplexer **354** for applying one of the output signal of the (**J1**-1)th shift register **SR<sub>J1</sub>**-1 and the output signal of the demultiplexer **352** to the **J1**th shift register **SR<sub>J1</sub>** in response to the second channel selection signal **P2**, a third multiplexer **356** for applying one of the output signal of the (**J2**-1)th shift register **SR<sub>J2</sub>**-1 and the output signal of the demultiplexer **352** to the **J2**nd shift register **SR<sub>J2</sub>** in response to the first channel selection signal **P1**, and a fourth multiplexer **358** for applying any one of the (**J3**-1)th shift register **SR<sub>J3</sub>**-1 and the demultiplexer **352** to the **J3**th shift register **SR<sub>J3</sub>** in response to the second channel selection signal **P2**. Hereinafter, **I1** should be referred to as the 300th shift register **SR300**; **I2** should be referred to as the 309th shift register **SR309**; and **I3** should be referred to as the 315th shift register **SR315**. Further, **J1** should be referred to as the 328th shift register **SR328**; **J2** should be referred to as the 334th shift register **SR334**; and **J3** should be referred to as the 343rd shift register **SR343**. Herein, the first multiplexer **350** becomes a first selector, and the demultiplexer **352** and the second to fourth multiplexers **354**, **356** and **358** become a second selector **319**.

The first multiplexer **350** selects an output signal of the 300th shift register **SR300** when a logical value of the first and second channel selection signals **P1** and **P2** is "00", and applies it to the demultiplexer **352**. The first multiplexer **350** selects an output signal of the 309th shift register **SR309** when a logical value of the first and second channel selection signals **P1** and **P2** is "01", and applies it to the demultiplexer **352**. The first multiplexer **350** selects an output signal of the 315th shift register **SR315** when a logical value of the first and second channel selection signals **P1** and **P2** is "10", and applies it to the demultiplexer **352**. When a logical value of the first and second channel selection signals **P1** and **P2** is "11", the first multiplexer **350** and demultiplexer **352** are not necessary.

The demultiplexer **352** applies an output signal of the first multiplexer **350** to the fourth multiplexer **358** when a logical value of the first and second selection signals **P1** and **P2** is "00". The demultiplexer **352** applies an output signal of the first multiplexer **350** to the third multiplexer **356** when a logical value of the first and second selection signals **P1** and **P2** is "01". The demultiplexer **352** applies an output signal of

the first multiplexer **350** to the second multiplexer **354** when a logical value of the first and second selection signals **P1** and **P2** is "10". On the other hand, the demultiplexer **352** is not necessary when a logical value of the first and second selection signals **P1** and **P2** is "11".

The second multiplexer **354** applies an output signal of the demultiplexer **352** to the 328th shift register **SR328** when a logical value of the second channel selection signal **P2** is '0'. The second multiplexer **354** applies an output signal of the 327th shift register **SR327** to the 328th shift register **SR328** when a logical value of the second channel selection signal **P2** is '1'.

The third multiplexer **356** applies an output signal of the demultiplexer **352** to the 334th shift register **SR334** when a logical value of the first channel selection signal **P1** is '0'. The third multiplexer **356** applies an output signal of the 333rd shift register **SR333** to the 334th shift register **SR334** when a logical value of the first channel selection signal **P1** is '1'.

The fourth multiplexer **358** applies an output signal of the demultiplexer **352** to the 343rd shift register **SR343** when a logical value of the second channel selection signal **P2** is '0'. The fourth multiplexer **358** applies an output signal of the 342nd shift register **SR342** to the 343rd shift register **SR343** when a logical value of the second channel selection signal **P2** is '1'.

Operations of the channel selector **318** and the shift register part **334** according to the first and second channel selection signals **P1** and **P2** will be described below.

First, as shown in FIG. 11, when the 1st to 300th output channels, of the output channels of the data IC **216**, are selected as a first output channel group **260**, the 301st to 342nd output channels are selected as a dummy output channel group **264**, and the 343rd to 642nd output channels are selected as a second output channel group **262**. The channel selector **318** of the data IC **316** is supplied with the first and second channel selection signals **P1** and **P2** having a logical value of "00". Thus, the shift register part **334** sequentially shifts the source start pulse **SSP** signal in response to the source sampling clock signal **SSC** using the 1st to 600th shift registers **SR1** to **SR600** to thereby output them as sampling signals. At this time, an output signal of the 300th shift register **SR300** is applied, via the first multiplexer **350**, the demultiplexer **352** and the fourth multiplexer **358**, to the 343rd shift register **SR343**. Further, an output signal of the 642nd shift register **SR642** is applied to the 1st shift register **SR1** of the next stage data IC **316**. Thus, the 1st to 300th shift registers **SR1** to **SR300** and the 343rd to 642nd shift registers, **SR343** and **SR642**, apply the sampling signals to the latch part. At this time, the 301st to 342nd shift registers **SR301** to **SR342** also substantially apply the sampling signals to the latch part.

Next, as shown in FIG. 12, when the 1st to 309th output channels of the output channels of the data IC **216** are selected as a first output channel group **260**; the 310th to 333rd output channels are selected as a dummy output channel group **264**; and the 334th to 642nd output channels are selected as a second output channel group **262**, the channel selector **318** of the data IC **316** is supplied with the first and second channel selection signals **P1** and **P2** having a logical value of "01". Thus, the shift register part **334** sequentially shifts the source start pulse **SSP** signal in response to the source sampling clock signal **SSC** using the 1st to 600th shift registers **SR1** to **SR600** to thereby output them as sampling signals. At this time, an output signal of the 309th shift register **SR309** is applied, via the first multiplexer **350**, the demultiplexer **352** and the third multiplexer **356**, to the 334th shift register **SR334**. Further, an output signal of the 642nd shift register,

**SR642**, is applied to the 1st shift register **SR1** of the next stage data IC **316**. Thus, the 1st to 309th shift registers, **SR1** to **SR309**, and the 334th to 642nd shift registers, **SR334** and **SR642**, apply the sampling signals to the latch part. At this time, the 310th to 333rd shift registers **SR310** to **SR333** also substantially apply the sampling signals to the latch part.

Subsequently, as shown in FIG. 13, when the 1st to 315th output channels of the output channels of the data IC **216** are selected as a first output channel group **260**, the 316th to 327th output channels are selected as a dummy output channel group **264**, and the 328th to 642nd output channels are selected as a second output channel group **262**. The channel selector **318** of the data IC **316** is supplied with the first and second channel selection signals **P1** and **P2** having a logical value of "10". Thus, the shift register part **334** sequentially shifts the source start pulse **SSP** signal in response to the source sampling clock signal **SSC** using the 1st to 600th shift registers **SR1** to **SR600** to thereby output them as sampling signals. At this time, an output signal, of the 315th shift register **SR315** is applied, via the first multiplexer **350**, the demultiplexer **352** and the second multiplexer **354**, to the 328th shift register **SR328**. Further, an output signal, Carry, of the 642nd shift register, **SR642**, is applied to the 1st shift register **SR1** of the next stage data IC **316**. Thus, the 1st to 315th shift registers, **SR1** to **SR315**, and the 328th to 642nd shift registers, **SR328** and **SR642**, apply the sampling signals to the latch part. The 316th to 327th shift registers, **SR316** to **SR327**, also substantially apply the sampling signals to the latch part.

Consequently, as shown in FIG. 14, when the 1st to 321st output channels of the output channels of the data IC **216** are selected as a first output channel group **260**, and the 322nd to 642nd output channels are selected as a second output channel group **262**, the channel selector **318** of the data IC **316** is supplied with the first and second channel selection signals **P1** and **P2** having a logical value of "11". Thus, the shift register part **334** sequentially shifts the source start pulse **SSP** signal in response to the source sampling clock signal **SSC** using the 1st to 642nd shift registers **SR1** to **SR642** to thereby output them as sampling signals. The first multiplexer **350** and the demultiplexer **352** are not necessary when the logical value is "11." Further, an output signal of the 327th shift register **SR327** is applied, via the second multiplexer **352**, to the 328th shift register **SR328**; an output signal of the 333rd shift register **SR333** is applied, via the third multiplexer **356**, to the 334th shift register **SR334**; and an output signal of the 342nd shift register **SR342** is applied, via the fourth multiplexer **358**, to the 343rd shift register **SR342**. Thus, each of the 1st to 642nd shift registers **SR1** to **SR642** of the shift register part **334** applies the sampling signal to the latch part. Herein, an output signal of the 642nd shift register **SR642** is applied to the 1st shift register **SR1** of the next stage data IC **216**.

Such a data IC **316** of the LCD according to the third embodiment of the present invention converts data **VD** from the timing controller **108** to pixel data using the sampling signals output from the shift register part **334** in accordance with an operation of the data IC **116** of the LCD according to the first embodiment of the present invention to thereby apply them, via a portion of the first and second output channel groups **260** and **262** and the dummy output channel group **264**, to the data lines **DL** of the liquid crystal display panel **102**.

As described above, the LCD according to the third embodiment of the present invention sets the output channels of the data IC **316** in accordance with a desired resolution of the liquid crystal display panel **102** as indicated in the above

Table 1 in response to the first and second channel selection signals P1 and P2 applied to the first and second option pins OP1 and OP2, thereby configuring multiple resolution types using only one data IC 316. Accordingly, the LCD according to the third embodiment of the present invention improves working efficiency as well as reduces manufacturing cost.

Alternatively, in the LCD according to the third embodiment of the present invention, the first and second channel selection signals P1 and P2 applied to the first and second option pins OP1 and OP2 of the data IC 316 may be generated by selectively switching first and second switches Q1 and Q2 as shown in FIG. 15. An explanation as to the first and second switches Q1 and Q2 is identical to the above-mentioned description of the LCD according to the second embodiment of the present invention.

Otherwise, in the LCD according to the third embodiment of the present invention, the first and second channel selection signals P1 and P2 applied to the first and second option pins OP1 and OP2 of the data IC 316 may be generated by a switching operation of a dip switch 250 connected to the voltage source VCC and, at the same time, connected to the respective first and second option pins OP1 and OP2 as shown in FIG. 16. An explanation as to the dip switch 250 is identical to the above-mentioned description of the LCD according to the second embodiment of the present invention.

The LCD according to the first to third embodiments of the present invention as described above is not limited to only varying output channels of the data IC's 116, 216 and 316, each having 642 data output channels in response to the first and second channel selection signals P1 and P2, but is applicable to the data IC's 116, 216 and 316 having 642 output channels or less and 642 output channels or more.

Furthermore, the output channels of the data IC's 116, 216 and 316 set in response to the first and second channel selection signals P1 and P2 is not limited to only 600, 618, 630 and 642 data output channels, but may be applicable to other cases. In other words, the output channels of the data IC's 116, 216 and 316 set in response to the first and second channel selection signals P1 and P2 are determined based upon at least one condition of a resolution type of the liquid crystal display panel 102, the number of data TCP's, a width of the data TCP and the number of data transmission lines between the timing controller 108 and the data IC's 116, 216 and 316 for applying the pixel data from the timing controller 108 to the data IC's 116, 216 and 316. Accordingly, the number of output channels of the data IC's 116, 216 and 316 set in response to the first and second channel selection signals P1 and P2 may be 600, 618, 624, 630, 642, 645, 684, 696, 702 or 720, etc.

Moreover, the channel selection signals P1 and P2 for setting the output channels of the data IC's 116, 216 and 316 also are not limited to a 2-bit binary logical value, but may be a binary logical value having two or more bits.

The data IC's of the LCD according to the first to third embodiments of the present invention may be used for a flat panel display device including the above-mentioned LCD.

As described above, the LCD according to the present invention varies channels of the data integrated circuit in accordance with a resolution type of the liquid crystal display panel using the channel selection signals, thereby configuring multiple resolution types of the liquid crystal display panel.

Furthermore, the LCD according to the present invention includes the data integrated circuit having the dummy data output channel group provided between the first and second data output channel groups for applying data to the data lines, and varies channels of the data integrated circuit based upon a resolution type of the liquid crystal display panel using the

channel selection signals, thereby driving all resolutions of the liquid crystal display panel using one-type of data integrated circuit.

Accordingly, the LCD according to the present invention can compatibly use the data integrated circuit independently of a resolution type of the liquid crystal display panel, so that the number of data integrated circuits can be reduced. As a result, the LCD according to the present invention improves working efficiency as well as reduces manufacturing cost.

It will be apparent to those skilled in the art that various modifications and variation can be made in the present invention without departing from the spirit or scope of the invention. Thus, it is intended that the present invention cover the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

What is claimed is:

1. A display having a data driving integrated circuit, comprising:

N number of output channels where N is an integer including a first to Nth output channel;

first and second data output channel groups having data output channels which supply pixel data to a corresponding number of data lines in accordance with a desired resolution of the display, wherein a number of channels of the first data output channel group equals a number of channels of the second data output channel group;

a dummy output channel group provided at a middle portion between the first and second data output channel groups and having dummy output channels wherein the dummy output channels are not supplied with pixel data; a shift register part including a sequence of N shift registers for shifting a source start pulse, wherein the Nth shift register outputs a carry signal to a carry bit output terminal of a next data driving integrated circuit; and

a channel selector setting the data output channels and the dummy output channels in advance based on the desired resolution of the display by applying a channel selection signal to the data driving integrated circuit; and

a second selector receiving inputs from the channel selector and at least one of first to Mth (where M is an integer less than N) shift registers and controlling an output timing of the carry signal from the Nth shift register to the carry bit output terminal by using a multi-bit control signal including at least two integer values,

wherein the channel selector for selecting a number of dummy output channels and the number of the first and second data output channels,

wherein the first data output channel group, the dummy output channel group and the second data output channel group are consecutively arranged to form the N number of output channels of the data driving integrated circuit, wherein the first data output channel group has a plurality of first data output channels being consecutively arranged, the dummy output channel group has a plurality of dummy output channels being consecutively arranged, and the second data output channel group has a plurality of second data output channels being consecutively arranged.

2. The display according to claim 1, wherein the channel selection signal applied to first and second selection terminals selectively connected to a voltage source and ground voltage source.

21

3. The display according to claim 1, further comprising:  
 a selection signal generator for generating and applying the  
 channel selection signal to select the data output chan-  
 nels; and  
 a timing controller controlling the data driving integrated 5  
 circuit and supplying the pixel data to the data output  
 channels.
4. The display according to claim 3, wherein the selection  
 signal generator includes first and second selection terminals,  
 each of the first and second selection terminals being con- 10  
 nected to one of a voltage source and a ground voltage source  
 to generate and supply the channel selection signal.
5. The display according to claim 1, wherein the channel  
 selection signal is a two-bit binary logical value.
6. A display having a data driving integrated circuit, com- 15  
 prising:  
 N number of output channels of the data driving integrated  
 circuit where N is an integer including a first to Nth  
 output channel;  
 a first and second data output channel groups having M 20  
 number data output channels of the N number of output  
 channels (where M is an integer less than N) which  
 supply pixel data to a corresponding number of data  
 lines in accordance with a desired resolution of the dis- 25  
 play;  
 a dummy output channel group provided at a middle por-  
 tion between the first and second data output channel  
 groups and having dummy output channels of (N-M)  
 number wherein the dummy output channels of (N-M) 30  
 number are not supplied with pixel data;  
 a shift register part including a sequence of N shift registers  
 for shifting a source start pulse, wherein the Nth shift  
 register output a carry signal to a carry bit output termi- 35  
 nal of next data driving integrated circuit; and  
 a channel selector setting the data output channels and the  
 dummy output channels in advance based on the desired  
 resolution of the display by applying a channel selection  
 signal to the data driving integrated circuit; and  
 a second selector receiving inputs from the channel selec- 40  
 tor and at least one of first to Mth shift registers and  
 controlling an output timing of the carry signal from the  
 Nth shift register to the carry bit output terminal by using  
 a multi-bit control signal including at least two integer  
 values,  
 wherein the channel selector for selecting a number of  
 dummy output channels and the number of the first and  
 second data output channels,  
 wherein the first data output channel group, the dummy  
 output channel group and the second data output channel

22

- group are consecutively arranged to form the N number  
 of output channels of the data driving integrated circuit,  
 wherein the first data output channel group has a plurality  
 of first data output channels being consecutively  
 arranged, the dummy output channel group has a plural-  
 ity of dummy output channels being consecutively  
 arranged, and the second data output channel group has  
 a plurality of second data output channels being con-  
 secutively arranged.
7. A data driving integrated circuit comprising:  
 N output channels (where N is an integer), which is an  
 entire output channels of the data driving integrated  
 circuit, including a first output channel group, a second  
 output channel group and a dummy output channel  
 group,  
 wherein the first output channel group has 1<sup>st</sup> to Kth output  
 channels, the second output channel group has Mth to  
 Nth output channels, and the dummy output channel  
 group has (K+1)th to (M-1)th output channels, where  
 each output channel is connected to a corresponding 1<sup>st</sup>  
 to Nth shift register, K and M are an integer, and  
 N>M>K, and  
 wherein first and second output channel groups supply  
 pixel data to a corresponding number of data lines, and  
 the dummy output channel group is not supplied with  
 pixel data,  
 wherein the first output channel group, the dummy output  
 channel group and the second output channel group are  
 consecutively arranged to form the N number of output  
 channels of the data driving integrated circuit,  
 wherein the first data output channel group has a plurality  
 of first data output channels being consecutively  
 arranged, the dummy output channel group has a plural-  
 ity of dummy output channels being consecutively  
 arranged, and the second data output channel group has  
 a plurality of second data output channels being con-  
 secutively arranged,  
 a channel selector selecting a number of output channels of  
 the first and second output channel groups; and  
 a second selector receiving inputs from the channel selec-  
 tor and at least one of 1<sup>st</sup> to Mth shift registers and  
 controlling an output timing of a carry signal from the  
 Nth shift register to a next data driving integrated circuit  
 by using a multi-bit control signal including at least two  
 integer values.
8. The data driving integrated circuit, according to claim 7,  
 wherein a number of output channels of the first output chan-  
 nel group equals a number of output channels of the second  
 output channel group.

\* \* \* \* \*

专利名称(译)	液晶显示装置		
公开(公告)号	<a href="#">US9305480</a>	公开(公告)日	2016-04-05
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CPC分类号	G09G3/20 G09G3/3688 G09G2300/0426 G09G2310/027 G09G2340/0421 G02F1/136 G09G3/32 A47J17/02 B26D3/02 B26D3/283 B26D2003/285 B26D2003/288		
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外部链接	<a href="#">Espacenet</a> <a href="#">USPTO</a>		

#### 摘要(译)

具有数据驱动集成电路的显示器包括N个输出通道（其中N是整数），其具有包括第一输出通道和第N输出通道的至少两个区域，包括M个数据输出通道的数据输出通道组（其中M是小于N的整数，M个数据输出通道根据显示器的所需分辨率将像素数据提供给相应数量的数据线，其中（N-M）个输出通道不提供像素数据，并且（N-M）个输出通道位于第一个输出通道和第N个输出通道之间，通道选择器选择M个数据输出通道。

