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INTEGRATED CIRCUIT RELATED TO LIQUID CRYSTAL DISPLAY

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1. FOREWORD

According to the rapid development and propagation of electronic information devices, electronic display devices have played an important part as the terminal devices displayed all kinds of the informations. In particular, since the liquid crystal display devices have the features distinct from the others such as lightweight, compactness, low power consumption, and also availability of CMOS driver IC's, they have widely been used in measurement, home electronics and industrial devices since old time. Further, in recent years, the wide screen liquid crystal display devices for graphics and full color have been put to practical use by means of improving the characteristics of liquid crystal material and accelerating the development of peripheral IC's, and they have widely been used in various fields as well as information and office automation devices.

Fuji Electric has developed various IC's related to liquid crystal display devices suitable to the market needs on the basis of high qualitative, high reliable CMOS process technology and also characteristic BUMP technology, and has gained popular favor with putting them on the market.

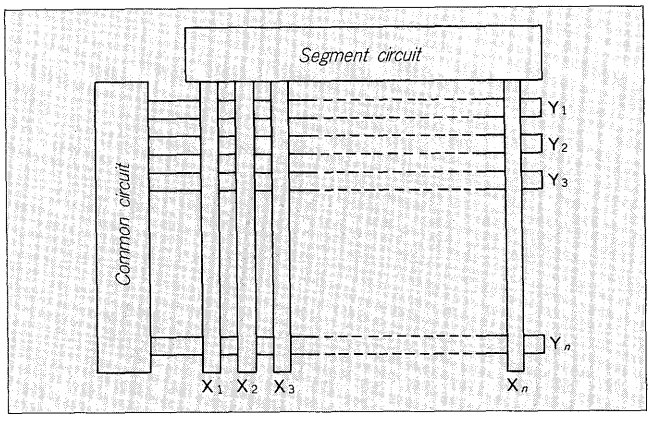
This paper introduces an outline of simple dot matrix IC's from Fuji Electric's IC's related to liquid crystal.

2. SIMPLE DOT MATRIX IC'S

As shown *Fig. 1*, the liquid crystal display devices by simple dot matrix are formed the common electrode Yn and segment electrode Xn into the matrix with a crystal electrofilm such as Indium Tin Oxide inside a pair of glasses, and makes a display by means of driving voltage by time division to a point of intersection (display dot) addressed with the common signal and segment signal.

In the method of simple dot matrix, since the each dot is driven by time division, non display dots are similarly driven by divided voltage, and these make a deterioration in the quality of display such as crasstalk. Therefore, the display devices by simple dot matrix are applied the method of driving on an average voltage which makes a effective voltage droven to display dots and non display

Fig. 1 Simple dot matrix LCD structure



dots best suitable for the operative threshold voltage of liquid crystal, and that guarantees the operative margin of liquid crystal display devices.

But then, this operative margin becomes smaller as the scanning duty ratio (the reciprocal number of common electrodes) decreases. Therefore, for the wide screen display devices, it is necessary that the liquid crystal materials have the rapid photoelectric characteristics, and on the other hand driver IC's are required high voltage driving and high frequency operation. Fuji Electric has developed the common driver IC and segment driver IC available up to 1/200 duty as the simple dot matrix IC's. The following gives a description of the features and application examples of these IC's.

2.1 Common driver IC

The common driver IC is composed of bidirectional shiftregisters, level shifters, and drivers as shown *Fig. 2*.

The shifting direction of the signal data can be selected with an external pin. In addition, the each signal input pin is applied the circuit for increasing the noise margin. Further, the pin configuration of the common driver IC is designed after due consideration that is particularly suitable to mounting.

The main characteristics of the common driver IC are

Fig. 2 Common driver IC block diagram

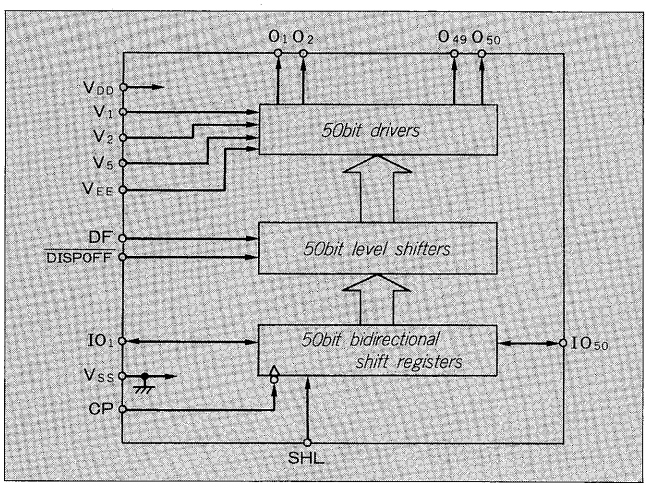
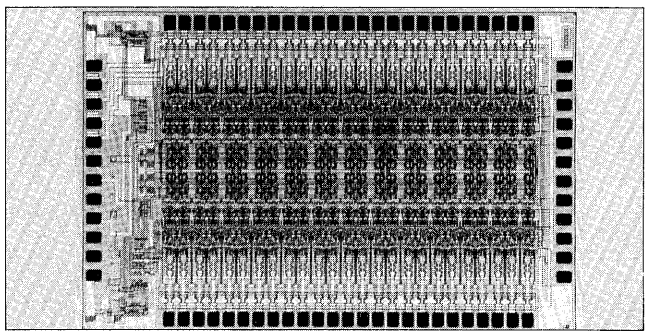


Fig. 3 Common driver IC chip topography



descrived in *Table 1*. The common driver IC contains 50 bit output drivers for liquid crystal, its data shift clock frequency is 1 MHz, and its driving voltage for liquid crystal is 28 V.

The chip topography of the common driver IC is shown in *Fig. 3*. The common driver IC is constructed with Si-Gate CMOS process technology, and has attained high frequency and high voltage operation. In addition, the common driver IC is designed by a careful layout pattern for an isolation between the devices, and power supply lines since the low voltage operating unit and high voltage operating unit are integrated on a chip. Further, the common driver IC has gold BUMP electrodes available for high dence mounting.

2.2 Segment driver IC

The segment driver IC is composed with bidirectional shiftregisters, latches, level shifters, and drivers as shown *Fig. 4*.

The segment driver IC takes the method of 4 bit parallel transfer, so it is able to shift the signal datas on high frequency. In addition, the segment driver IC is built in the power down circuits which are set to non operating state expect on the addressed operating timing when casecading the segment driver IC's, therefore the segment driver IC reduces a consumption current in large. Further,

Table 1. Main characteristics

Parameter	Common driver IC	Segment driver IC
Power supply voltage	5 V	5 V
Number of output drivers	50	80
Driving voltage for LCD	28 V	28 V
Typical output resistance	1 KΩ	1 KΩ
Maximum clock frequency	1 MHz	6 MHz
Number of BUMP electrodes	74	114

Fig. 4 Segment driver IC block diagram

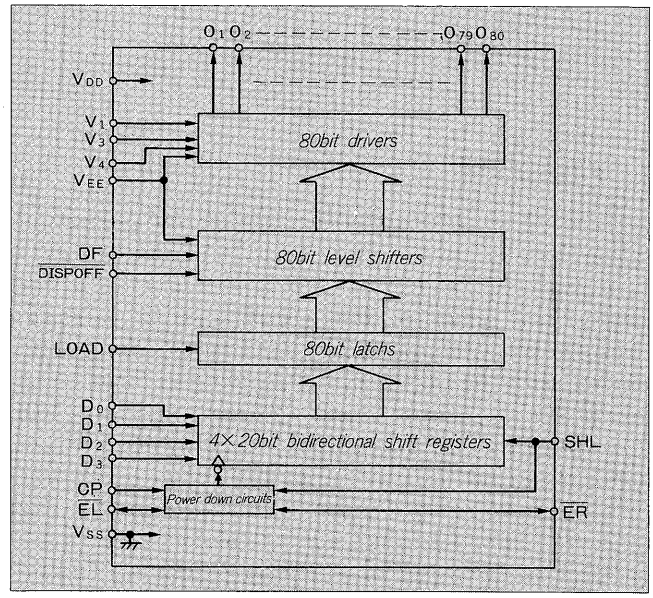
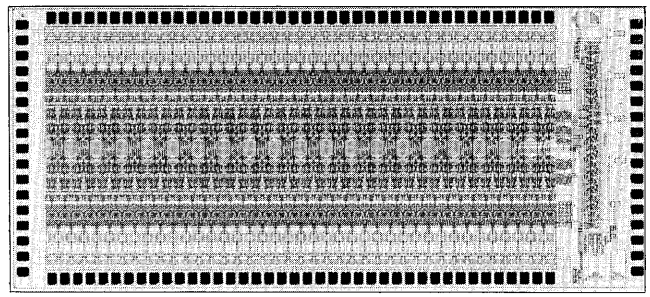


Fig. 5 Segment driver IC chip topography

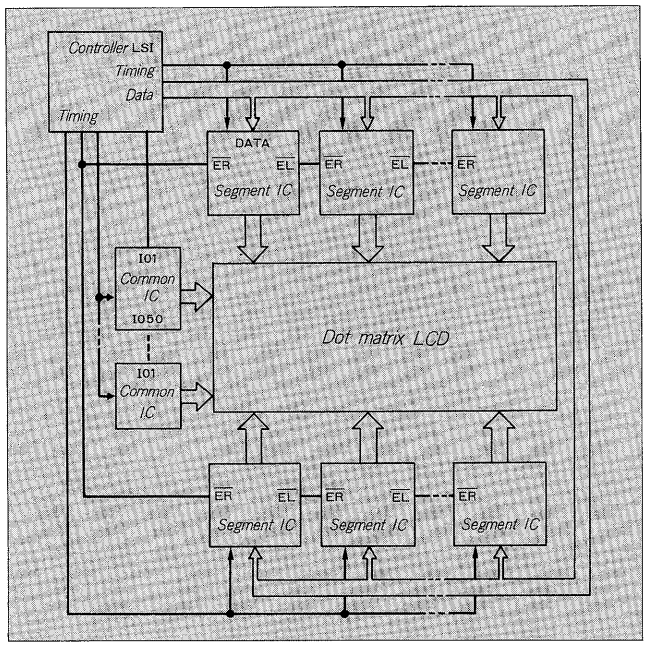


the segment driver IC is able to select the shifting direction of the signal data with an external pin.

The main characteristics of the segment driver IC are descrived in *Table 1*. The segment driver IC containes 80 bit output drivers for liquid crystal, its data shift clock frequency is 6 MHz, and its driving voltage for liquid drystal is 28 V.

The chip topography of the segment driver IC is shown in *Fig. 5*. The segment driver IC is constructed with Si-Gate CMOS process technology, and has attained high frequency and high voltage operation. In addition, the segment driver IC has gold BUMP electrodes available for high dence

Fig. 6 Application block diagram



mounting. Further, the layout pattern of segment driver IC is designed in consideration as well as the common driver IC.

2.3 Application example

The application example of simple dot matrix IC's descrived above is shown in *Fig. 6*. It is the application example of the wide screen graphic liquid crystal display composed of 400x640 dots suitable to wide screen, hig grade functional display terminal devices such as personal computer and word processor. It is used in eight common driver IC's and sixteen segment driver IC's, and is driven by 1/200 duty with halves in the upper and lower sides of the pannel.

3. PASTSCRIPT

The above descrives an outline of simple dot matrix IC's for liquid crystal in Fuji Electric.

In addition, Fuji Electric has also developed the active matrix addressing IC's for liquid crystal as full custom-made IC.

It is expected that the liquid crystal display devices will be more and more accelerated to the super wide screen display and to the high quality display in future, and then will have more widely been used in various application fields. In addition to them, the driver IC's will be required higher frequency, higher voltage, higher grade function, and more outputs.

Fuji Electric intends to develope the characteristic IC's particulary well suitable to these market needs in future.