PERIPHERAL CIRCUIT DESIGN OF LOW TEMPERATURE POLYCRYSTALLINE SILICON THIN-FILM TRANSISTOR FLAT PANEL DISPLAY BY USING CONTINUOUS-WAVE LASER CRYSTALLIZATION

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Abstract --- *In this paper, the data driver circuit of thin film transistor-liquid crystal displays (TFT-LCDs) had been proposed and simulated for an 8.4-inch XGA (1024×RGB×768) panel. The shift register, digital to analog converter (DAC) and source follow type output buffer were developed. The proposed shift register can operate in a frequency of 11 MHz. The INL and DNL of the proposed DAC are 0.8 LSB and 0.14 LSB, respectively. Finally, the proposed buffer has the advantage of low power consumption. The presented circuits were demonstrated by using low temperature polycrystalline silicon (LTPS) technology.*

Keywords : *data driver, LTPS, shift register, DAC, buffer*

INTRODUCTION

Comparison with amorphous silicon, the polycrystalline silicon (poly-Si) has higher mobility and better reliability. It can integrate the driving circuits and control circuits on a panel. The application of poly-Si is very extensive and it can achieve the goal of system on panel (SOP). However, the LTPS technology still has some problems in crystallization and uniformity. In order to promote the reliability and decrease the leakage current in TFTs. This research uses new continuous wave (CW) laser to manufacture TFTs and designs the driving circuit which features low power, high quality and small area. The shift register, DAC and output buffer application had been studied [1-3]. Lin et. al. developed a p-type shift register. [1] Shin et. al. adopted a charge sharing method to divide the supply voltage but its response time is too long and the parasitic capacitor effect is too large. [2] Yoo et. al. use switches to modify the circuit for charging or discharging, but the offset voltage of the buffer is too large. [3]

ARCHITECTURE OF THE TFT-LCD PANEL

The circuit structure of the data driver for TFT-LCDs is shown in Fig. 1. The driving circuit includes data drivers and scan drivers. The scan driver is used to control the TFT switch on or off on scan lines. The scan driver includes shift registers, level shifters and output buffers. The developed shift register is presented in Fig. 2. When the TFTs are turned on on one scan line, the data driver will send analog voltages to charge the pixel electrodes. After pixel charging, TFTs will be turned off on the scan line and the next row line will be turned on.

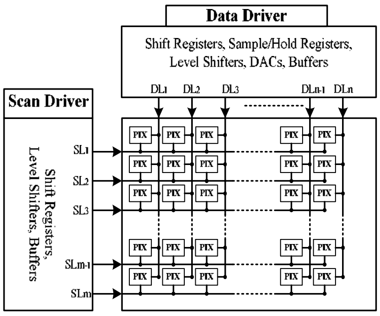

Fig. 1 Architecture of TFT-LCD panels

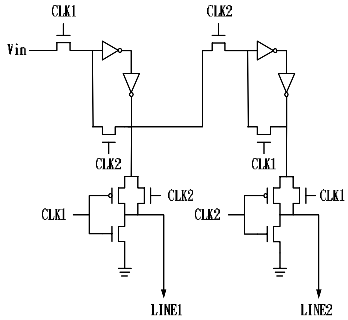

Fig. 2 The proposed shift register

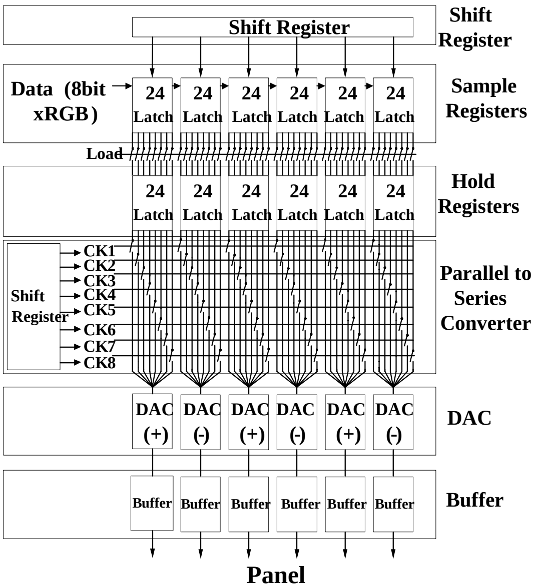

Fig. 3 Block diagram of the data drivers

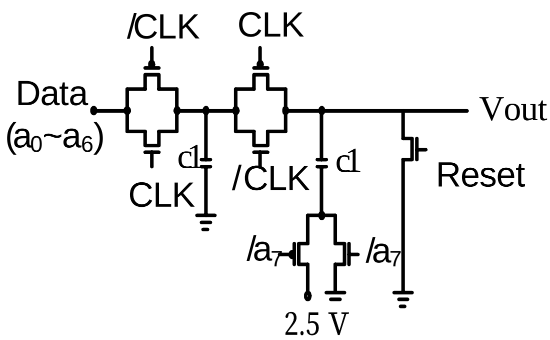

Fig. 4 The proposed digital-analog converter(DAC)

The data driver converts the video data to analog voltages and then sends to the pixel on the array. The data driver in TFT-LCDs includes shift registers, sample latches, hold latches, digital to analog converters (DACs) and output buffers. The circuit structure of the data driver is shown in Fig. 3. Fig. 2 shows the shift register, it chooses where the input data transmit to. The shift registers will enable the first sample latches, and then the first data saved in it. The sample registers will catch RGB data from the timing controller. After catching the data, there will be a load signal to control the video data to transmit to hold latches. After hold registers, level shifters raise the digital supply voltage (VDD) to the analog supply voltage (AVDD) in order to drive liquid crystals. Because the data from hold register is either low ‘0’ or high ‘1’, the gray levels in TFT-LCDs are driven with analog voltages. So we need DAC to convert this digital signal. The circuit of the proposed DAC is shown in Fig. 4. In addition, we also need a parallel to series converter before the series type of DAC.

Because the R-C loads of data lines on the panel are heavy, we need output buffers to amplify the analog voltages from DACs and to charge them quickly to data lines and pixel electrodes on the array. Fig. 5 shows a source follower type of buffer. The simulated TFT-LCDs adopt an XGA resolution. We use the source follower type of output buffer to compare with the OPA type of buffer amplifier and the results are listed in table. 1. The DNL and INL of the proposed DAC for 256 gray levels are shown in figures 6 and 7. The DNL and INL are smaller than 0.6 and 8 LSB, respectively.

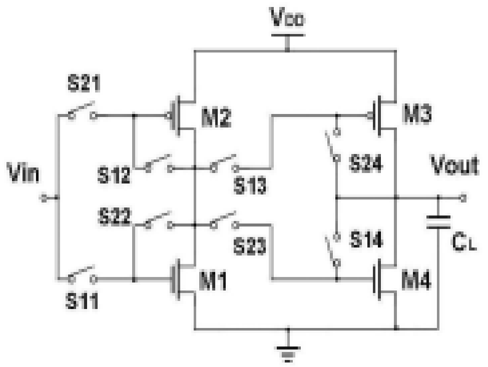

Fig. 5 Source follower type of output buffer

Table 1 Comparison of the output buffers

	OPA Type	Source Follow Type
Offset Voltage	Vin: 0~2 ------ 30.7mv Vin: 2~8 -------9.71mv Vin: 8~10 ------88.3mv	Vin: 0~2-------1.55mv Vin: 2~8------ 1.41 v Vin: 8~10-----639 mv
Slew Rate	1.2656v/us	1.023v/us
Setting Time	5.613us	32.92us
Rising Time	1.36us	2.906 us
Falling Time	5.406us	6. 303us
Swing	0.237v~9.1171 v	1.03v~ 9.09 v
Power	2.0906mW	0.1733mW

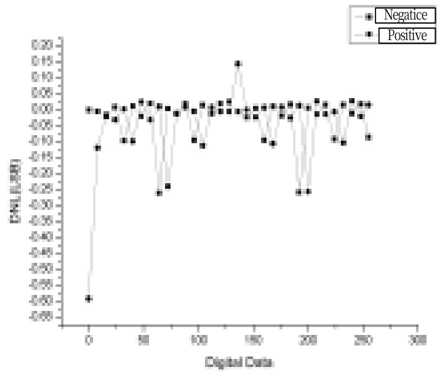

Fig. 6 DNL of the DAC in TFT-LCDs data drivers

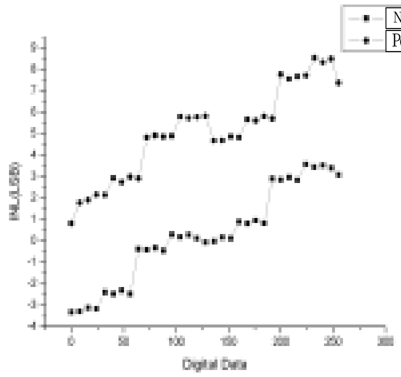

Fig. 7 INL of the DAC in TFT-LCDs data drivers

CONCLUSION

In this paper, we have developed the peripheral circuit of data driver with the model which is extracted with CW-laser crystallized LTPS TFT device. The shift register, digital to analog converter (DAC) and the source follow buffer is the proposed circuit. We have assembled this circuit for a source driver and the simulation result of the driver is satisfied the specification of 8.4-inch XGA (1024×768×RGB) panel.

REFERENCES

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