Development of TFT-LCD panel with reduced driver ICs

Sung-Man Kim, Jong-Hyuk Lee, Hong-Woo Lee, Jong-Hwan Lee, Kwang-Soo Choi

Product Engineering Part 1, LCD Business, Samsung Electronics

Phone: +82-41-529-7826 E-mail: *sm.holylove@samsung.com*

Keywords : TFT-LCD, ASG, cost-down, inversion

Abstract

A 15.4" WXGA TFT-LCD, featuring integrated a-Si:H gate driver circuits and reduced data driver ICs, has been developed. To reduce number of data lines into 1/2 of conventional structure, the pixel array has been re-mapped with re-organized data signal. Unintended artificial effects such as flicker were removed by adopting the novel pixel array having a 'zigzag' map. To minimize the power consumption, a column inversion method was incorporated in the zigzag pixel array (Fig.1) without modifying the polarity map of conventional dot inversion method

1. Introduction

Recently, the increasing capabilities of TFT-LCD supplier drive down the prices, while the LCD panel makers have been constantly trying to make additional cost-down without degradation of performance. For the cost-down mentioned, reducing the number of driver ICs has been one of major topics of TFT-LCD industries [1-2].

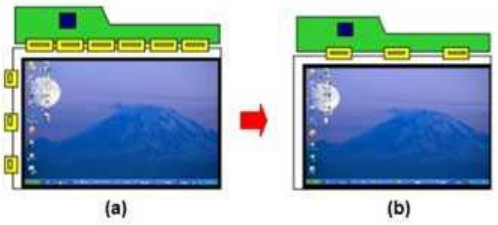

Fig1. (a) Conventional TFT-LCD (b) with reduced driver ICs

Simply reducing the number of data lines by half increases the number of gate lines and reduces charging time to pixels [3], resulting in degradation of the panel's driving performance. Instead of doubling the gate driver ICs, this paper succeeded in completely integrating the doubled gate lines and driving circuits into an a-Si TFT array. The reduced charging time was covered by adopting a modified column inversion method, in which the polarity map of the pixels was arranged in a zigzag map [4].

2. Experimental

In the previous research depicted in Fig. 2, each pixel adjacent to a data line is switched by different gate lines, respectively. The method had unavoidable problems. Firstly, the inversion frequency of a data line increases by double due to the doubled gate lines. In proportion to the frequency, the power consumption also increases. In addition, the dot inversion method deteriorates the pixel charging margin (fig. 2), causing horizontal defectives generated by 4 lines.

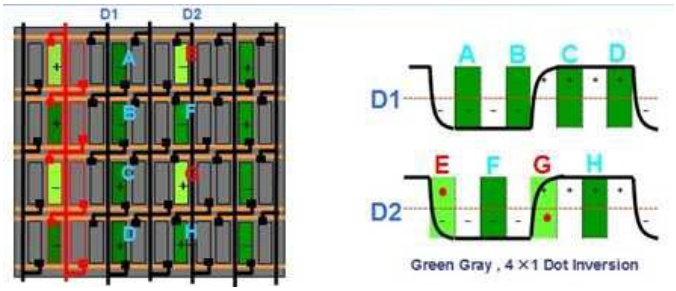

Fig 2. Data IC reduction in the previous scheme

To overcome the problems listed above, the proposed scheme in this paper adopts a modified column inversion method, in which its polarity map is re-arranged as a dot inversion map [5]. The pixel charging margin was enlarged by overlapping the gate turn-on pulses. By overlapping the gate signals, as shown in Fig. 3, a pixel on a n-th gate line can be pre-charged while its previous line is being charged. As a result, the proposed scheme removed both repetitive horizontal and vertical line defects caused by charging

margin and polarity map, respectively.

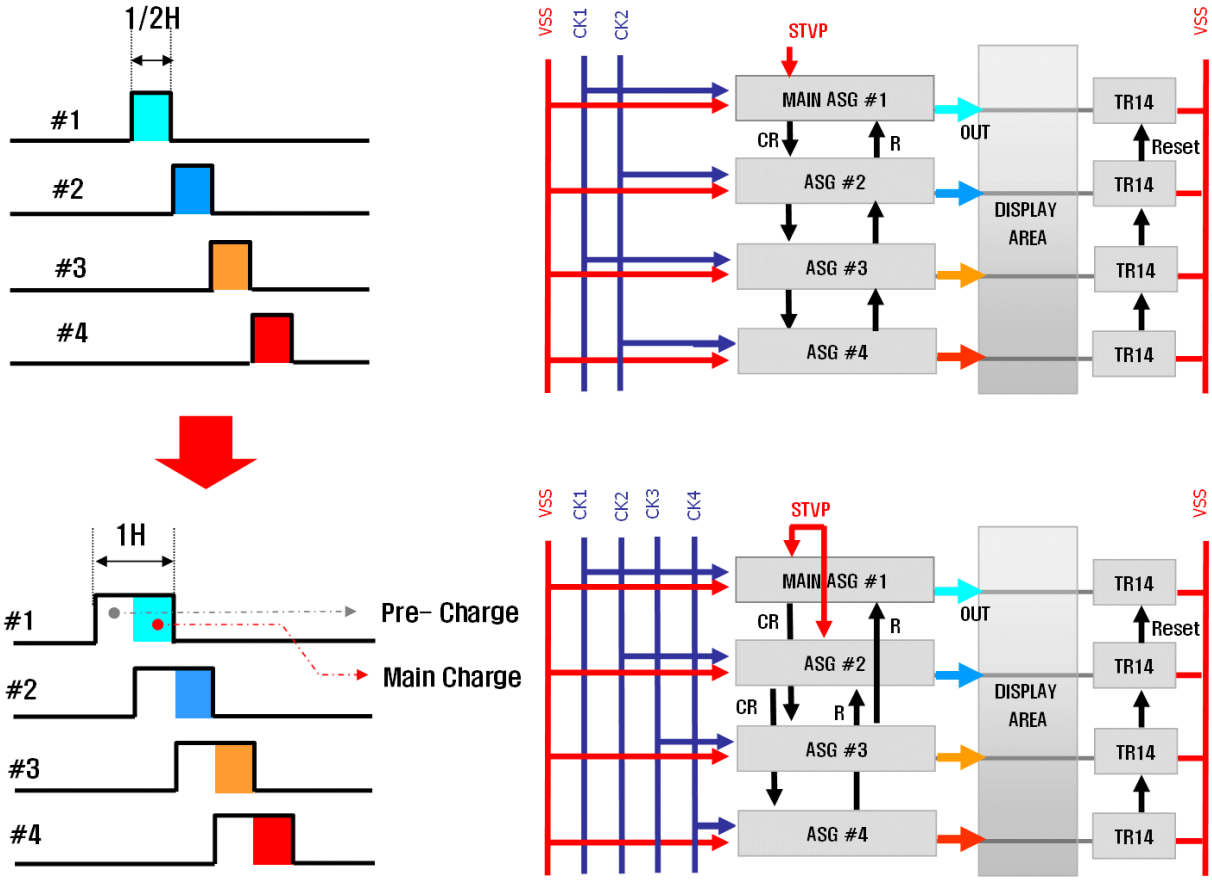

Fig.3 Pre-charge ASG scheme

3. Result and Discussion

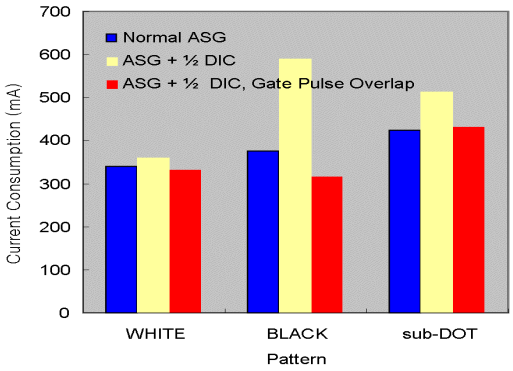

Fig.4 Current consumption differences

By adopting a column inversion method, the variation of data signal voltage was minimized. The current consumption could be reduced to 65% at full black mode and 85% at sub checker mode, respectively. Furthermore, the pixel charging margin was improved by overlapping gate pulses. The current consumption improvement was depicted in Fig. 4.

The picture quality problems such as repetitive vertical line defects caused by column inversion method were proven to be removed by employing a zigzag pixel arrangement depicted in Fig. 5. The zigzag arrangement of pixels transforms the polarity map of the column inversion into a map same as a dot inversion method has.

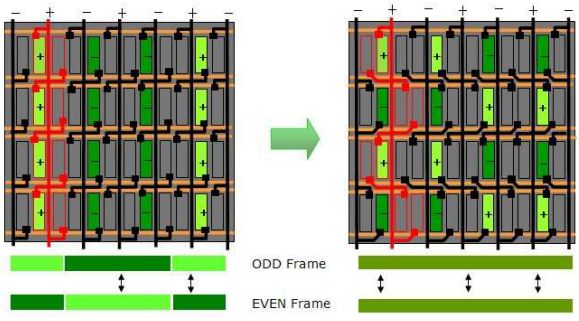

Fig.5 Normal column inversion vs. zigzag method

4. Summary

In this study, a 15.4" WXGA TFT-LCD with half-reduced data driver ICs was successfully developed. The gate driver ICs were completely integrated into the TFT array and thus the total cost-down of the product amounted to 7% of its original cost. The degradation of picture quality, resulting from charging margin and power consumption, were solved by using gate pulse overlapping and zigzag column inversion.

5. References

1. M. Kodate, E. Kanzaki, and K. Schleupen: "Pixel Level Data-line Multiplexing For Low Cost/High Resolution AMLCDs," SID Intl Symp Digest Tech Papers, 1009~1011 (2002)
2. M. Kodate, E. Kanzaki, and K. Schleupen: "Advanced Pixel-Level Data-line Multiplexing For Low Cost/High Resolution AMLCDs," EuroDisplay 2002, 287-290 (2002)
3. M.Sakamoto et al, "Half-Column Line Driving Method Applicable for High Resolution AMLCDs," AM-LCD '97 pp.123-126 (1997)
4. S.K. Kim, N.S. Kang, S.J. Moon, Y. K. Song, S. H. Moon, S. S. Kim, KR 2004-0014631 Thin Film Transistor Array Panel Having Reduced Data-line
5. Y. S. Lee, S. H. Moon, N. S. Kang, KR 2005-0047174 Thin Film Transistor Array Panel