Driving Techniques for Ferroelectric Liquid Crystal Display.

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Abstract

Driving techniques for ferroelectric liquid crystal (FLC) displays are discussed. C2U alignment state in FLC with τ-Vmin characteristic has shown high contrast ratio and fast switching response. Combining C2U state, spatial dither method and temporal dither method, full color FLC display has been realized. Specification and driving scheme of the prototype full-color FLC display are also shown.

Introduction

Surface stabilized ferroelectric liquid crystal display (SSFLCD)[1] has attracted great interest because of their wide viewing angle, fast response time and high contrast ratio. Especially τ-Vmin mode is promising because it can realize both fast response time and high contrast ratio with C2 alignment state[2),3)].

However FLC displays have several problems such as alignment, shock stability, gray scale and so on. Considering use for practical displays, gray scale is essential. In this paper, we will describe the digital gray scale method for 256 gray levels and other driving techniques applied to our prototype FLC displays.

Grey Scale

One of the biggest problems in FLC displays is difficulty of achieving gray scale. We have achieved 256 grey levels by combining 2bits spatial dither (SD) and 4bits temporal dither (TD)[4),5)]. Each pixel was divided into two sub pixels by 1:2 ratio, which realize 4 gray levels. Using fast response time of the FLC material, 4bits TD with weight of 1:4:16:64 was also applied. 2bits SD and 4bits TD could achieve 256 gray levels.

Addressing

Several addressing schemes have been proposed for τ-Vmin mode FLC[6)-8)]. We have applied DRAMA3(110) driving scheme[8)] (Fig.1) for our prototype FLC displays. One of the reasons is its wide operating margin. Figure 2 shows amplitudes of data voltage and strobe voltage which give the pixel switching for several driving schemes[9)]. The area between the upper curve and the lower one shows the driving margin of each driving scheme. It can be seen that DRAMA3(110) has wider driving margin than others.

In our prototype, strobe pulse has succeeding kickback pulse in order to improve switching error. Figure 3 shows an example of improvement of switching characteristics by adding the following kickback pulse with the strobe pulse[10)].

Prototype 15 FLCD

A 15 video rate full color FLCD was fabricated integrating the above-mentioned technologies[9]. Figure 4 shows a photograph of the FLC display. High contrast ratio and gray scale have been achieved.

References

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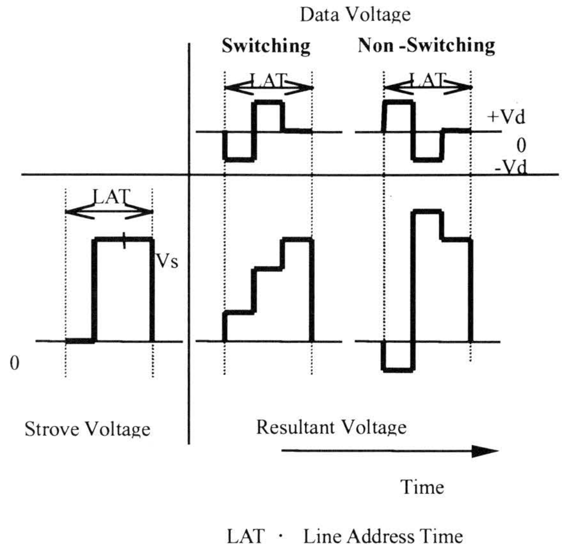

Fig.1 DRAMA3(110) driving scheme.

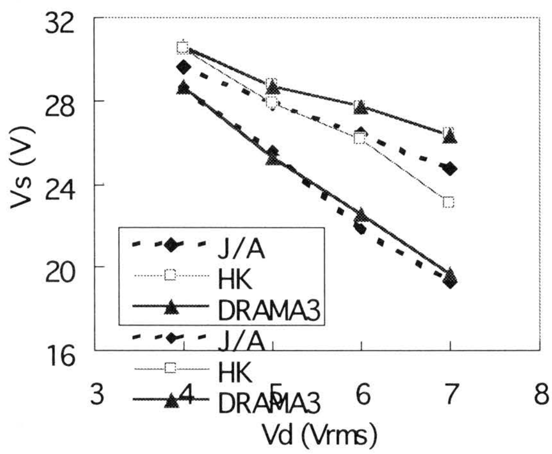

Fig.2 Driving margin of several driving schemes.

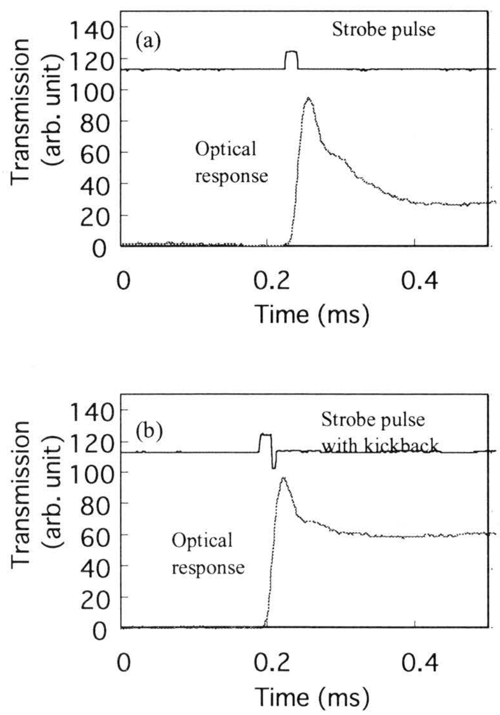

Fig.3 Switching characteristics.
(a) with no kickback pulse.
(b) with kickback pulse.

Fig.4 Photograph of the prototype FLC display.