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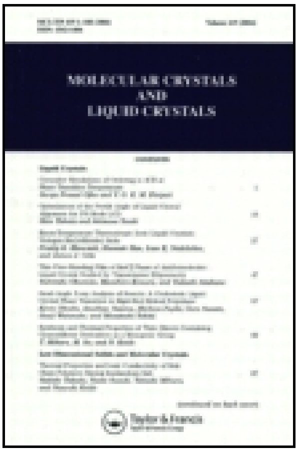

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Characteristics of Motion-Blur Free TFT-LCD Using Short Persistent CCFL

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Characteristics of Motion-Blur Free TFT-LCD Using Short Persistent CCFL

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In applying LCD to TV application, one of the most significant factors to be improved is image sticking on the moving picture. LCD is different from CRT in the sense that it's continuous passive device, which holds images in entire frame period, while impulse type device generate image in very short time. To reduce image sticking problem related to hold type display mode, we made an experiment to drive TN-LCD like CRT. We made articulate images by turn on-off backlight, and we realized the ratio of Back Light on-off time by counting between on time and off time for video signal input during 1 frame (16.7[ms]). Conventional CCFL (cold cathode fluorescent lamp) cannot follow fast on-off speed, so we evaluated new fluorescent substances of light source to improve residual light characteristic of CCFL. We realized articulate image generation similar to CRT by CCFL blinking drive and TN-LCD overdriving. As a result, reduced image sticking phenomenon was validated by naked eye and response time measurement.

Keywords TFT-LCD; Blinking backlight; Motion blur effect; Short persistent phosphor; Blinking driving.

Introduction

Recently, the demands of LCD (Liquid Crystal Display) for TV increase rapidly and image quality of LCD TV at the level of existing CRT is actively investigated [1–2]. One of the most necessary factors to adapt LCD for TV is to present image without residual image. LCD operation-mode for images without residual image has been investigated for a couple of years and this has resulted in profound investigation for VA, SSFLC et al. However, if response time of LCD becomes faster, residual image problem still remains because LCD only control transmittance of light from background light source. And this problem is more prominent for TV, which displays mainly moving images while PC monitor displays still image. So, it needs another approach to improve residual image problem. That is to provide discontinuous images as like CRT with LCD operation-mode of fast response. To achieve discontinuous image similar to CRT, blinking BLU was used as a background light source. However, difficulties arise in fast blinking operation of CCFL [3]. At present technology, electrical circuit is easily achieved but residual light duration of phosphor used in CCFL should be reduced. Generally, CCFL, like fluorescent lamp, remains to emit light after

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power off for tens of millisecond, which makes it difficult to blink within 16.7[ms] (1 frame of moving image).

In this paper, lamp with improved phosphor was used to enable above blinking backlight. Residual light of phosphor is measured and the effect on residual image was also verified. And our aim is to apply this result into LCD for TV [4–8].

Experimental

Method of Residual Time Measurement

Inner wall of CCFL is coated by blended compound of Red, Green, and Blue phosphors (zol-state). So, to achieve fast blinking light, duration times of residual lights of Red, Green, and Blue phosphors should be shortened separately.

At first, residual light of each phosphor is measured as shown in Figure 1. Light magnitude coming from phosphor's excitation with DC-driven UV lamp is interpreted into electrical signal and recorded by oscilloscope.

Results and Discussion

Residual Time Results of Various Phosphors

Figure 2 shows the results of measured residual light from three phosphors in conventional CCFL using system shown in Figure 1. In Figure 2, each phosphor shows significant different residual light characteristics and duration time of Red and Green phosphors need to be improved. New Red and Green phosphors are evaluated to improve residual light and the results are shown in Figure 3. In Table 1, duration times of residual light are summarized before & after improvement of corresponding phosphor.

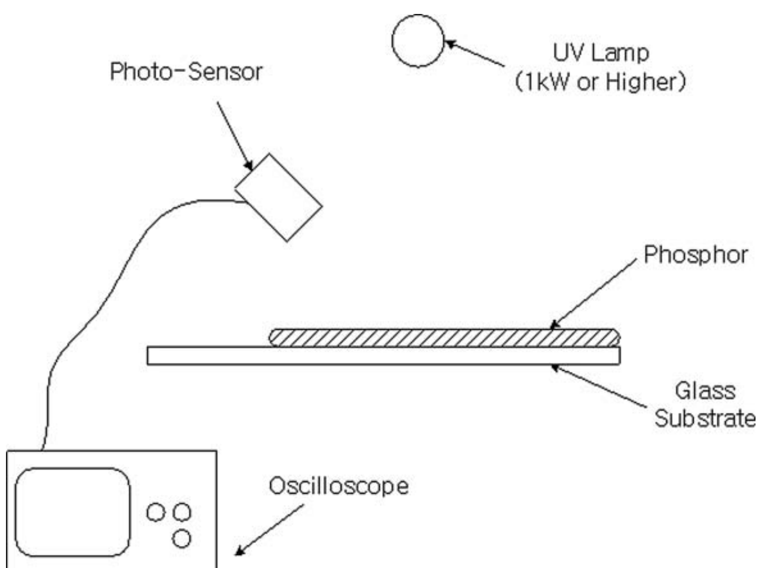

Figure 1. Composition of system for measurement during residual duration time of phosphors.

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Table 1. Duration time of residual light before and after improvement with respect to phosphor [9]

	Red	Green	Blue
Before	4.7 [ms]	11 [ms]	1 [ms]
After	2 [ms]	1 [ms]	—

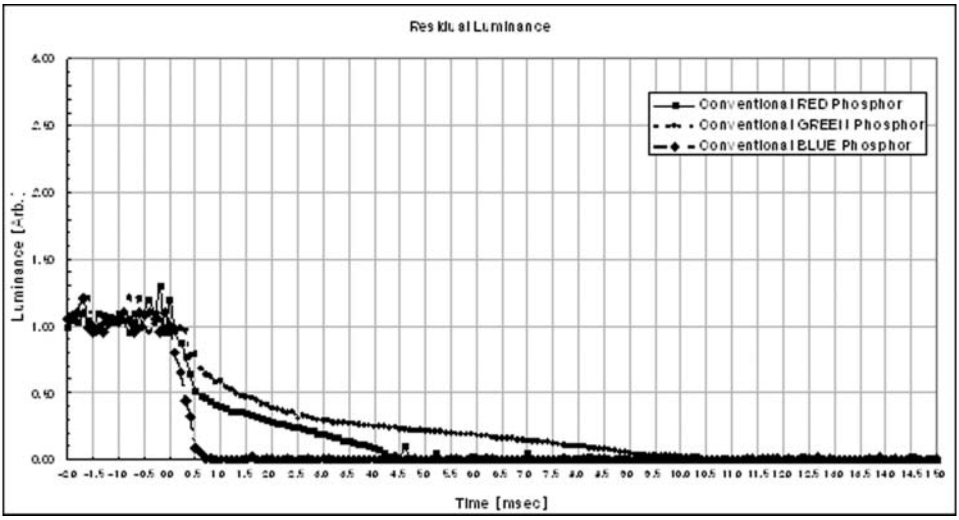

Figure 2. Residual time of conventional phosphors in CCFL [9].

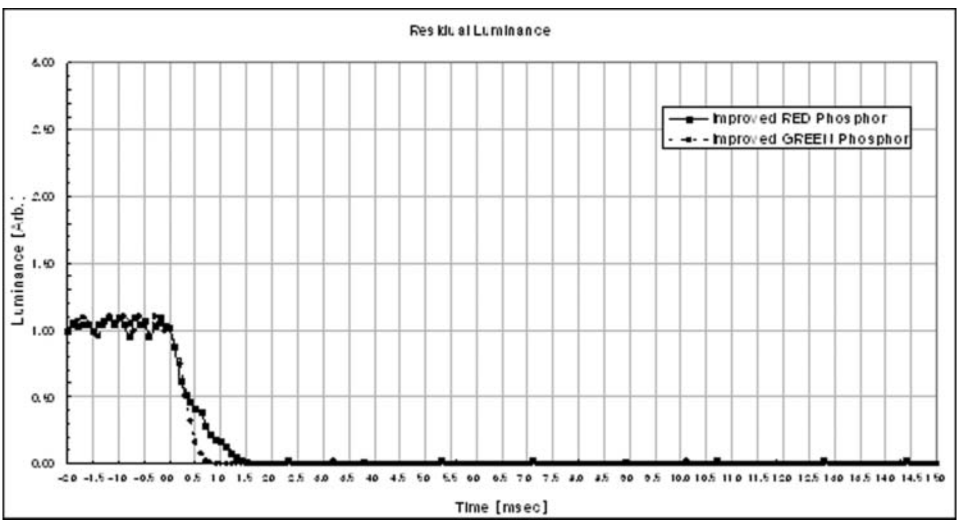

Figure 3. Residual time of improved red and green phosphors in CCFL [9].

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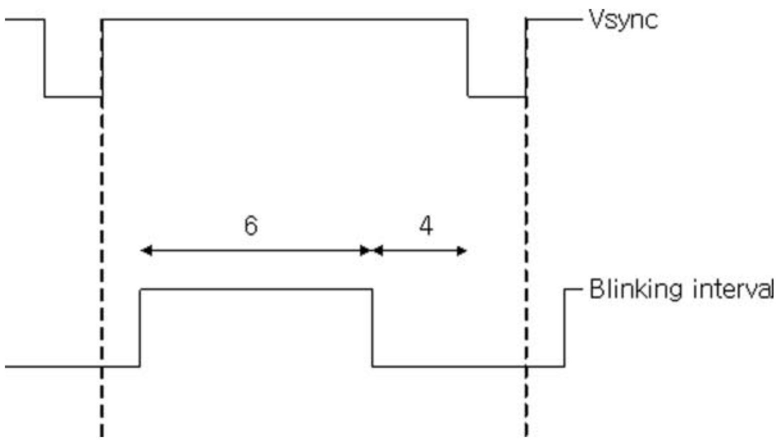

Figure 4. Generating blinking signal using Vsync signal.

Fabrication of Motion Blur Free TFT-LCD

Lamp with reduced residual light has brightness of 20[%] smaller than that of conventional lamp and there is more reduction of brightness by blinking operation. So, to verify the effect of blinking B/L in LCM, a prism sheet is added to get higher brightness.

Blinking signal is applied to inverter with synchronized with Vsync signal and it divided 1 frame to 60[%] turn on time and 40[%] turn off time. To get the same brightness to conventional lamp, lamp was over-driven from general 6[mA] to 10[mA].

In case of 17 inch SXGA (1280×1024 resolution), there is 1280 de(data enable) signal within 1 frame and blinking signal is generated by counting de signal. To get proper timing, delayed de signals d_de and dd_d were made from flip-flop as shown in Figure 4 and

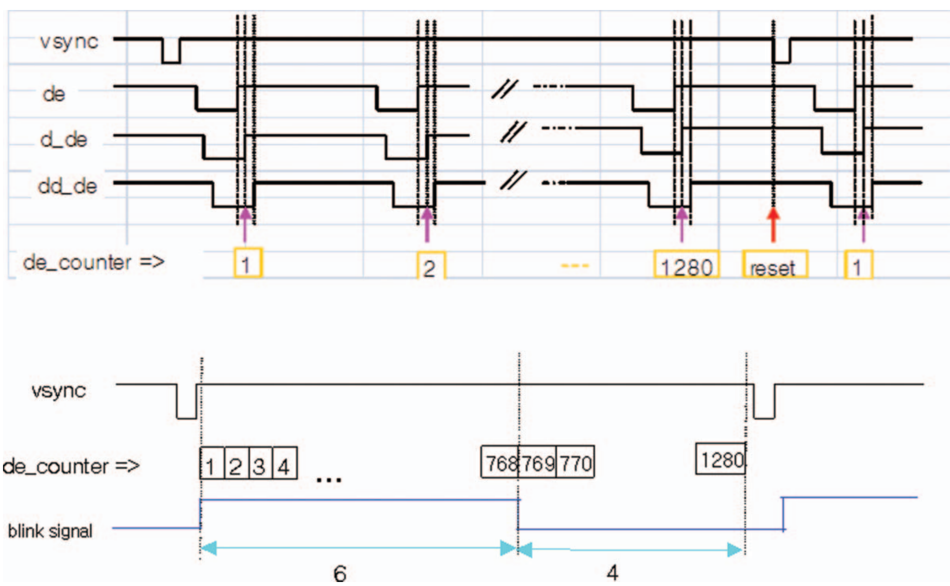

Figure 5. Generating blinking signal using de signal counting.

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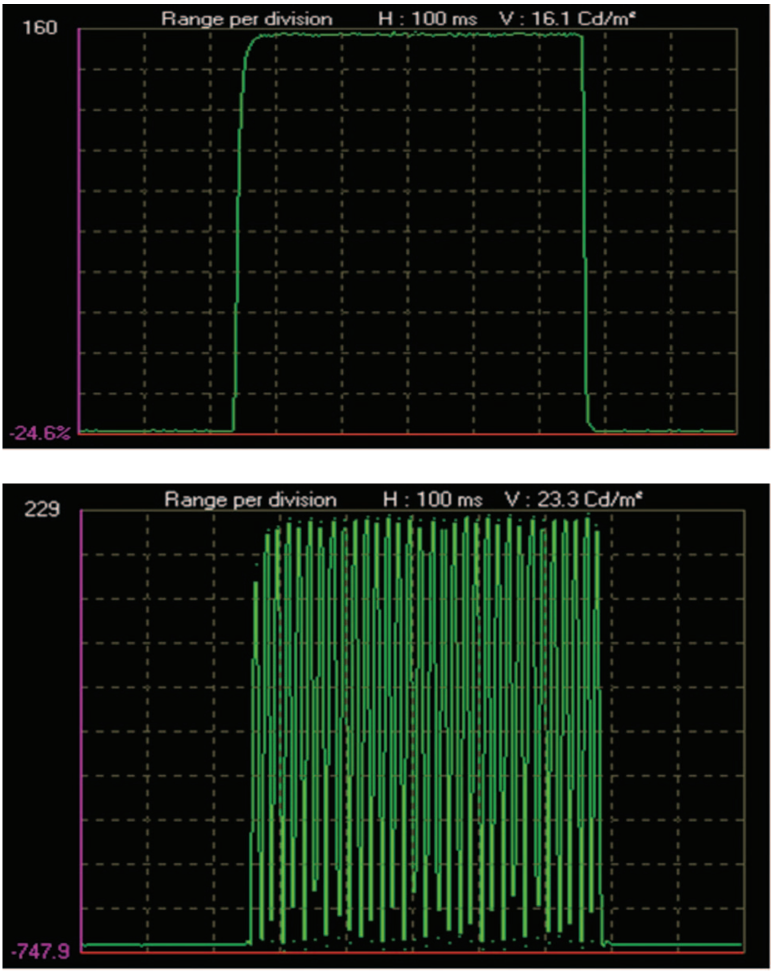

Figure 6. Improvement of optical response characteristics in blinking & overdriving method.

Figure 5 6:4 ratio of white-period to black-period was obtained by appointing 768(60[%]) dd_d's of 1280 as white-period and 512(40[%]) dd_d's as black-period. This method is very simple algorithm to get stable blinking signal at Vsync.

Display quality with blinking backlight was evaluated by measuring response waveform and by naked eye. Figure 6 represents response characteristics with and without blinking drive. Black screen is successfully inserted made by blinking drive as shown in Figure 6 (b), and effect on image sticking in moving picture was excelled. Figure 7 is photograph of vertically moving image with 1/22.8sec shutter speed. Figure 7 (a) is photographic result without blinking and Figure 7 (b) that with blinking and over-driving. In these photographs, improvement of residual image is easily verified.

Conclusions

We studied improvement of image-sticking using BLU of flasher by creating CRT-like moving picture image. Algorithm to make blinking signal with 6:4 ratio was proposed by

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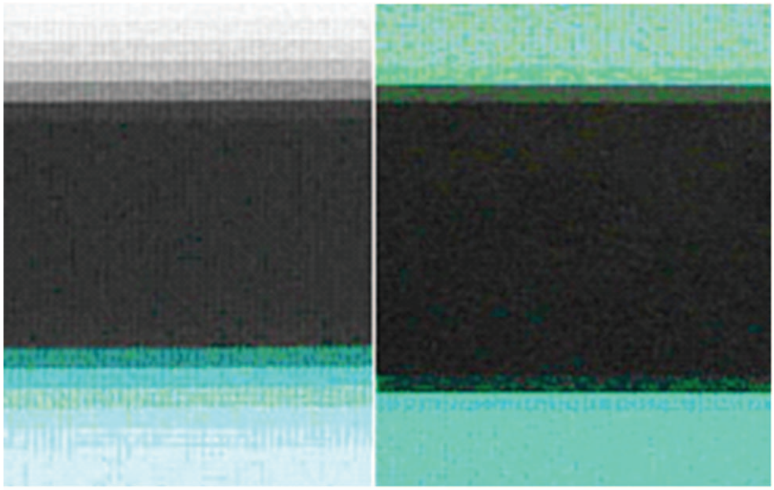

Figure 7. Photographic result of conventional driving and blinking & overdriving method.

using de counter with synchronized with Vsync signal. The improvement of dynamic picture image embodiment was verified by experimental results, and these results are expecting to be applied to the development of TV and Multimedia LCD hereafter.

Acknowledgment

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