Auxiliary Address Pulse Driving Scheme for Improving Luminance and Luminous Efficiency in 42-inch WVGA Plasma Display Panel

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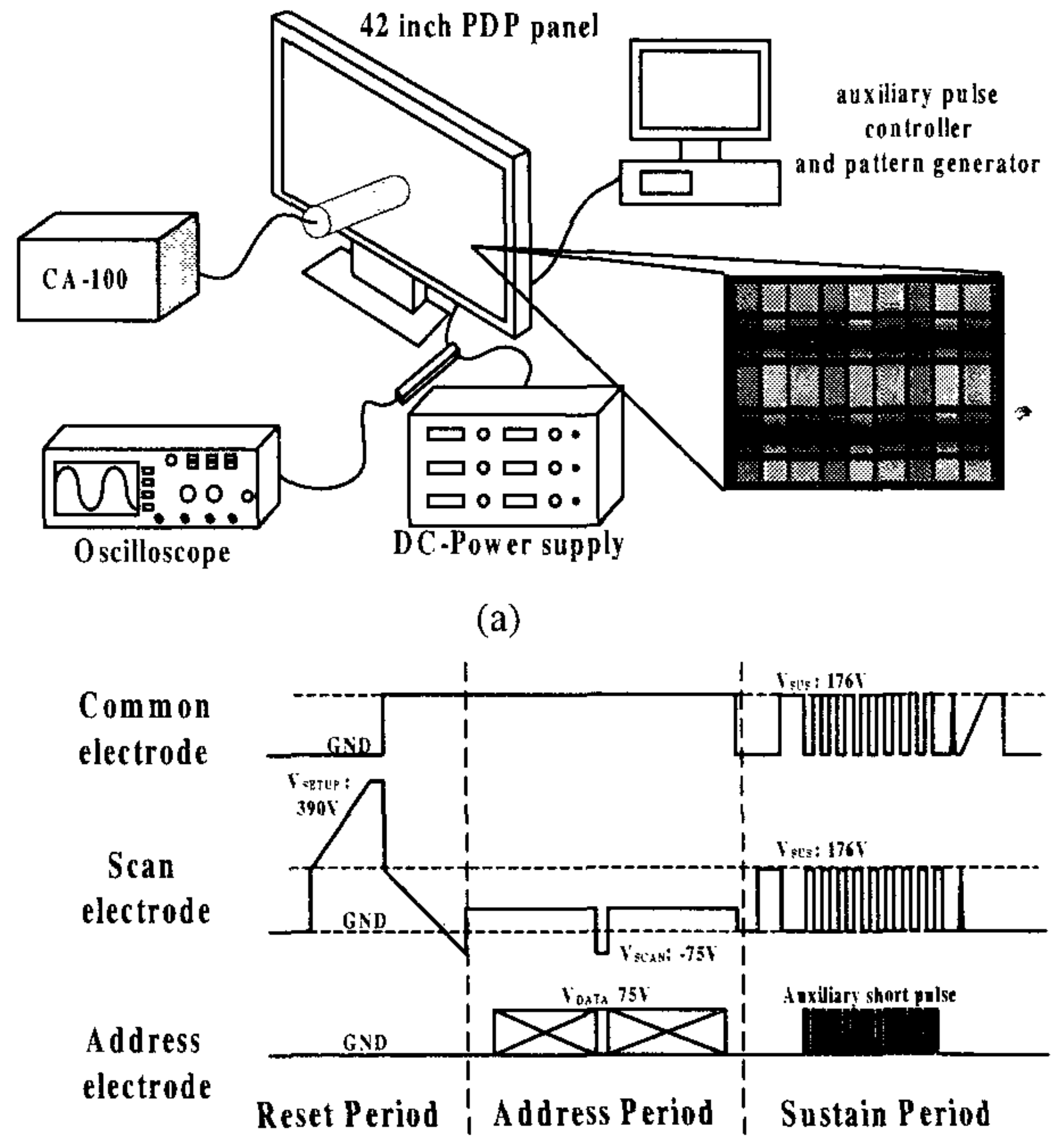
Abstract

The effects of an auxiliary address pulse driving scheme, in which an auxiliary short pulse was applied to the address electrode during a sustain-period, was examined under the various image patterns of the 42-inch WVGA ac-PDP. When the auxiliary address pulse driving scheme was applied, the luminance of the red, green and blue cells were measured respectively. The luminance, luminous efficiency and current were measured under the full-white pattern of the 42-inch ac-PDP. As a result, the luminance of blue cell was improved approximately by 17 %, whereas the luminous efficiency of the full-white pattern was improved approximately by 34 % without a misfiring discharge in comparison with conventional driving scheme.

1. Introduction

A plasma display panel (PDP) has been spotlighted as a promising flat panel device applicable to the large area (>40-in) full color wall-hanging digital high definition televisions (HDTVs). However, there still remain some problems such as an image quality, a manufacturing cost, particularly a luminous efficiency. These demerits should be eliminated in order to realize the high quality plasma display panel television. In this sense, the driving scheme was proposed to improve the luminous efficiency by applying the auxiliary pulse to the address electrode during a sustain-period [1, 2]. However, the validity of the driving scheme was only examined under the small size (4 inch or 7 inch) test panel.

In this paper, in order to improve the luminous efficiency and luminance, an auxiliary address pulse driving scheme was introduced and its validity was examined under various color image patterns of the 42-inch WVGA ac-PDP panel with about 1.2×10^6 R, G, and B cells. In particular, the effects of the application of the auxiliary address pulse during a sustain-period on the real full color image patterns and the address current flowing through the address electrodes, were examined carefully.



(b)

Fig. 1. Schematic diagram of electrical and optical measurement system (a) and one subfield driving waveforms used in this study (b).

2. Experimental setup

Fig. 1 (a) shows the electrical and optical measurement system that can measure the luminance and current from the 42-inch WVGA ac-PDP in the case of adopting the auxiliary address pulse driving scheme. Fig. 1 (b) shows the corresponding driving waveform in a subfield used in this experiment (b). The 42-inch WVGA ac-PDP panel employed in the current research is the same product as the commercial PDP-TV, so that it has an asymmetric stripe barrier rib structure shown in Fig. 1 (a) [3]. The position and width of auxiliary short pulse were controlled via the main control chip and ROM coded by the computer, whereas its amplitude was controlled simply by the dcpower supply.

Power Output Truth Table

Qn	STB	$\overline{BLK}$	$\overline{POL}$	Driver Output	Comment
X	X	L	X	L	Output low
X	X	H	L	H	Output high
X	H	H	H	Qn	Data latched
L	L	H	H	L	Data copied
H	L	H	H	H	Data copied

Table 1. Truth table of data driver IC [STV7610A]

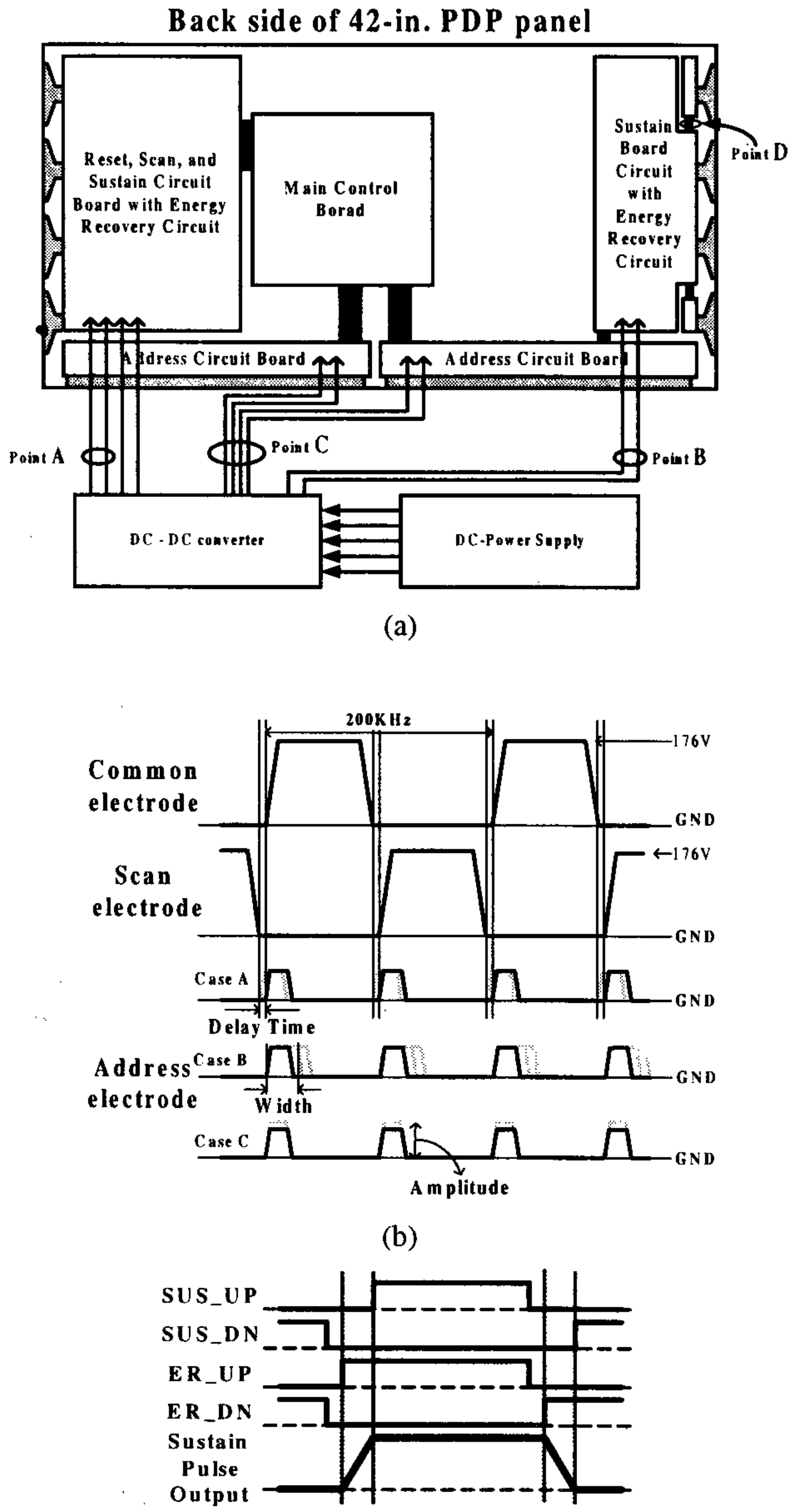


Fig. 2. Block diagram of 42-inch ac-PDP (a), applied sustain pulse and auxiliary address pulse during a sustain-period (b), and control signals of sustain pulse

Table 1 shows the truth table of data driver IC [STV7610A] used in the 42-inch WVGA ac-PDP [4]. Signal BLK and POL were used to control the auxiliary short pulse during a sustain-period. To obtain the high address voltage output, the signal BLK is high and the signal POL is low. On the other hand, to obtain the 0-level address voltage output, the signal BLK is low.

The luminance was measured by the color analyzer (CA-100) and the currents flowing through both the sustain and address electrodes were measured by the oscilloscope with current-probe. Fig. 2 (a) illustrates the back side of 42-inch PDP panel employed in this work. To measure the quantity of the total sustain current flowing through the sustain electrodes, the current flowing into the sustain circuit board with energy recovery circuit was measured at point A and B with current-probe. The quantity of address current flowing through the address electrode was measured at the point C. The sustain current waveform was measured at point D where the sustain pulses generated in the sustain circuit board are provided into the sustain electrodes.

Fig. 2 (b) shows the driving waveforms applied during a sustain-period. The driving waveforms applied to the common- and scan-electrodes are the same as those of the commercial PDP-TV. Sustain voltage is 176 V, and sustain frequency is 200 kHz. In the auxiliary pulse applied to the address electrode, its starting point, width, and amplitude were varied. The starting point of auxiliary pulses was synchronized with ER_UP shown in the Fig. 2 (c). The ER_UP and ER_DN are control signals for the energy recovery circuit, whereas the SUS_UP and SUS_DN are control signals of the sustain circuit. Because the 42-inch WVGA ac-PDP panel had an asymmetric stripe barrier rib structure, the luminance of the full-red, full-green and full-blue patterns was measured respectively when the auxiliary short pulse with various widths, positions and amplitudes were applied. Furthermore, the luminous efficiency was measured under the full-white pattern.

3. Results and Discussion

Fig. 3 illustrates the sustain current and corresponding IR waveforms measured from the 42-inch ac-PDP panel under the full white pattern. In the conventional driving scheme, no auxiliary pulse was applied, whereas in the new driving scheme the auxiliary pulse was applied synchronously with the sustain pulse. The delay time, pulse width, and amplitude of the auxiliary pulse are 400 ns, 200 ns, and 60 V respectively. As shown in Fig. 3, in comparison with the conventional case, the peak of the discharge current was shifted a little to the left direction, and the corresponding IR peak intensity showing the double peaks increased. This result indicates that the auxiliary pulse applied to the address electrode have a significant role in enhancing the additional excitation toward the address electrode [1].

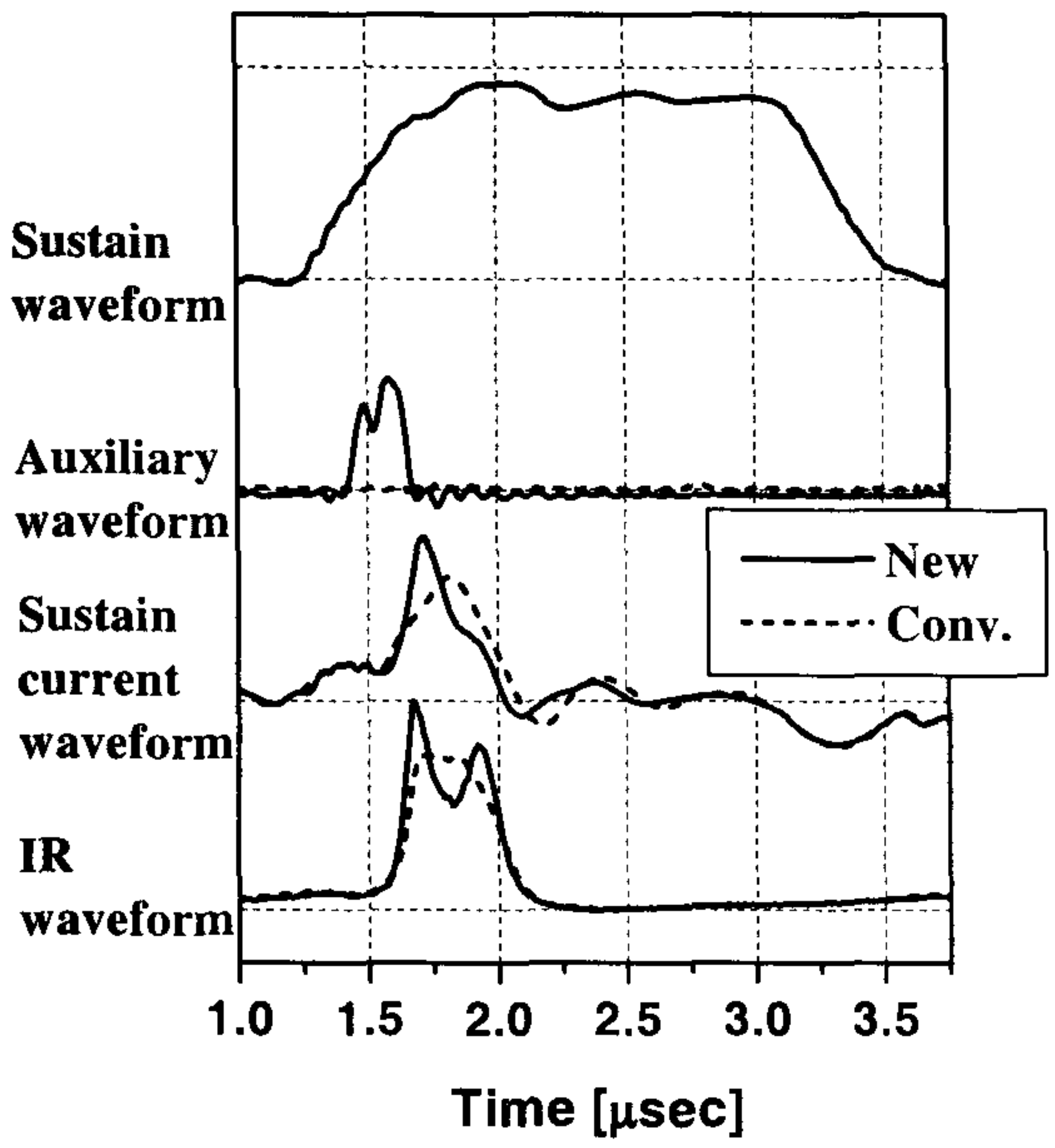
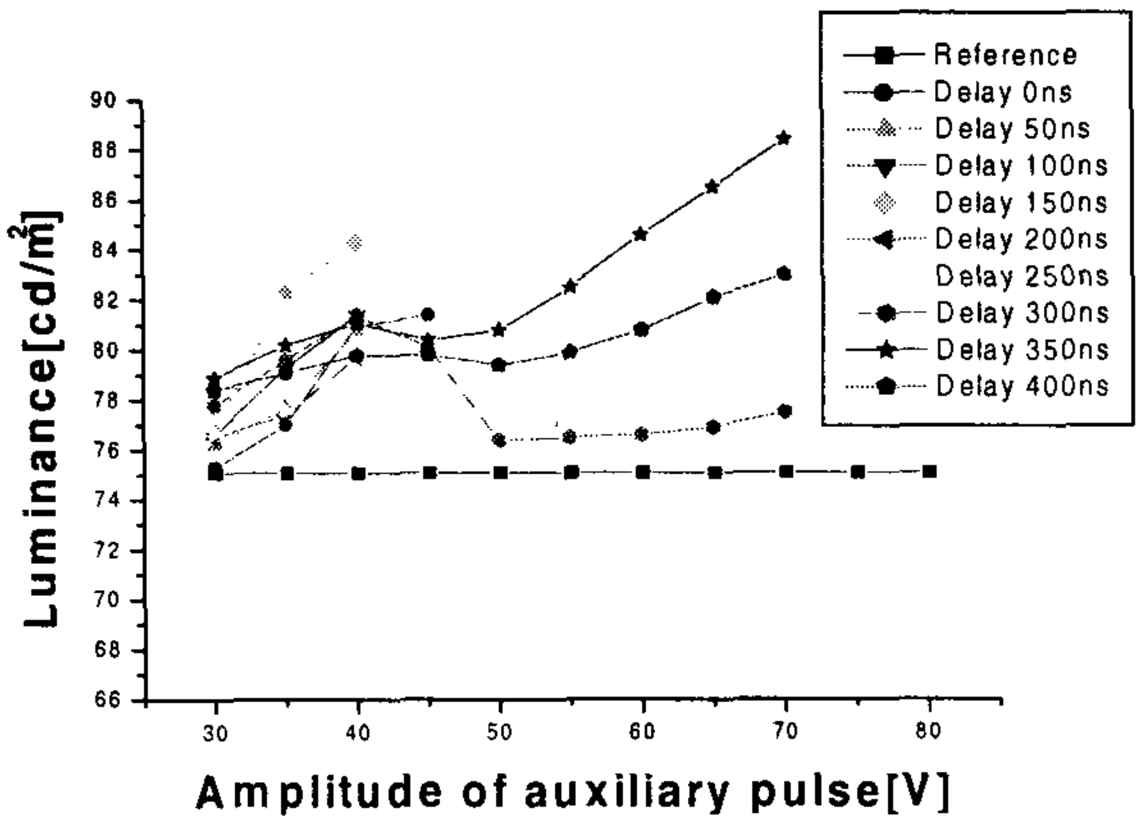


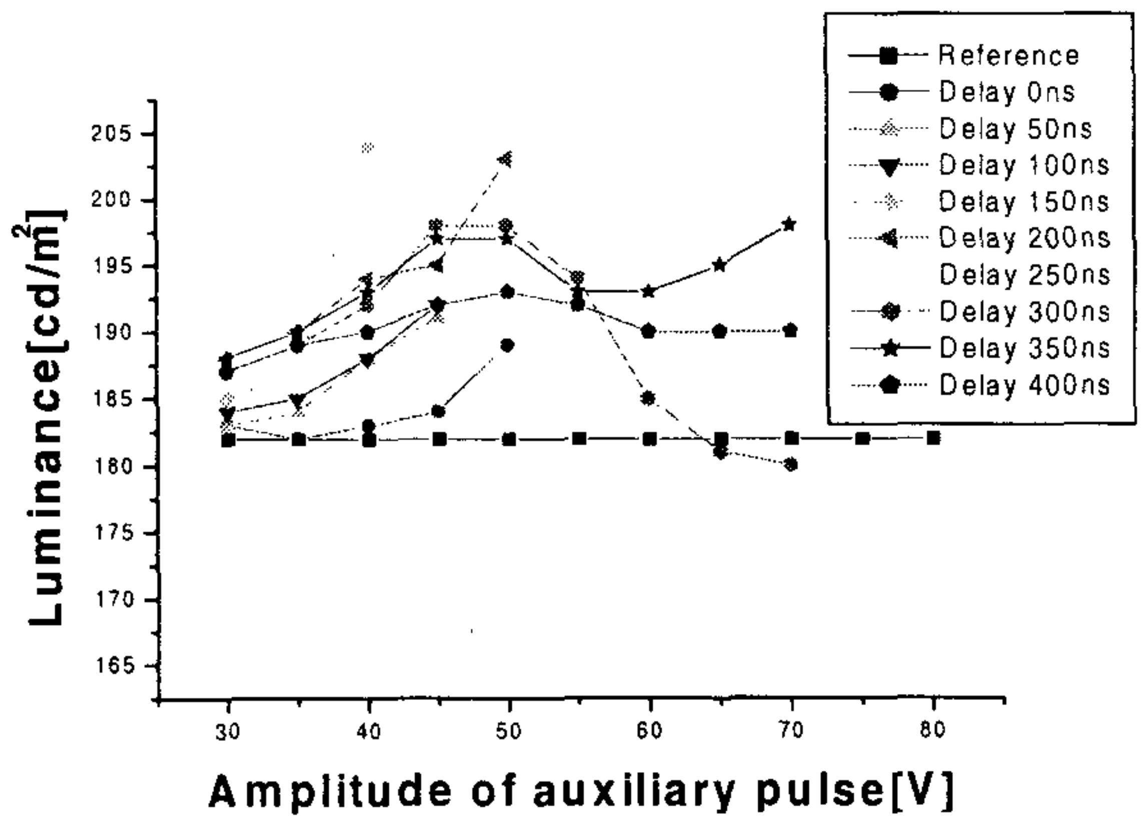
Fig. 3. Sustain current and IR (823 nm) waveforms measured from 42-in. ac-PDP panel when sustain pulse with auxiliary pulse is applied during a sustain-period.

Figs. 4 (a), (b), and (c) show the changes in the luminance of the full-red, full-green, and full-blue patterns with variations in the amplitudes and delay times of the auxiliary pulses at the constant pulse width of 200 ns during a sustain-period. The auxiliary pulses were applied separately to the address electrodes of the R, G, and B cells, respectively. In the red cells of Fig. 4 (a), the luminance was increased about by 18 % when the auxiliary pulse with an amplitude of 70 V and a delay time of 350 ns from the application position of the sustain pulse. In the case of the green cells shown in Fig. 4(b), the luminance was increased about by 8 % at the application of the auxiliary pulse with amplitude of 70 V and delay time of 350 ns. In Fig. 4 (c), the luminance of the blue cell was improved about by 17 % when the auxiliary pulse with a delay time of 300 ns and amplitude of 60 V was applied. In the delay times ranging from 0 ns to 250 ns, too high amplitude of the auxiliary would disturb the sustain discharge, thus resulting in inducing a misfiring discharge.

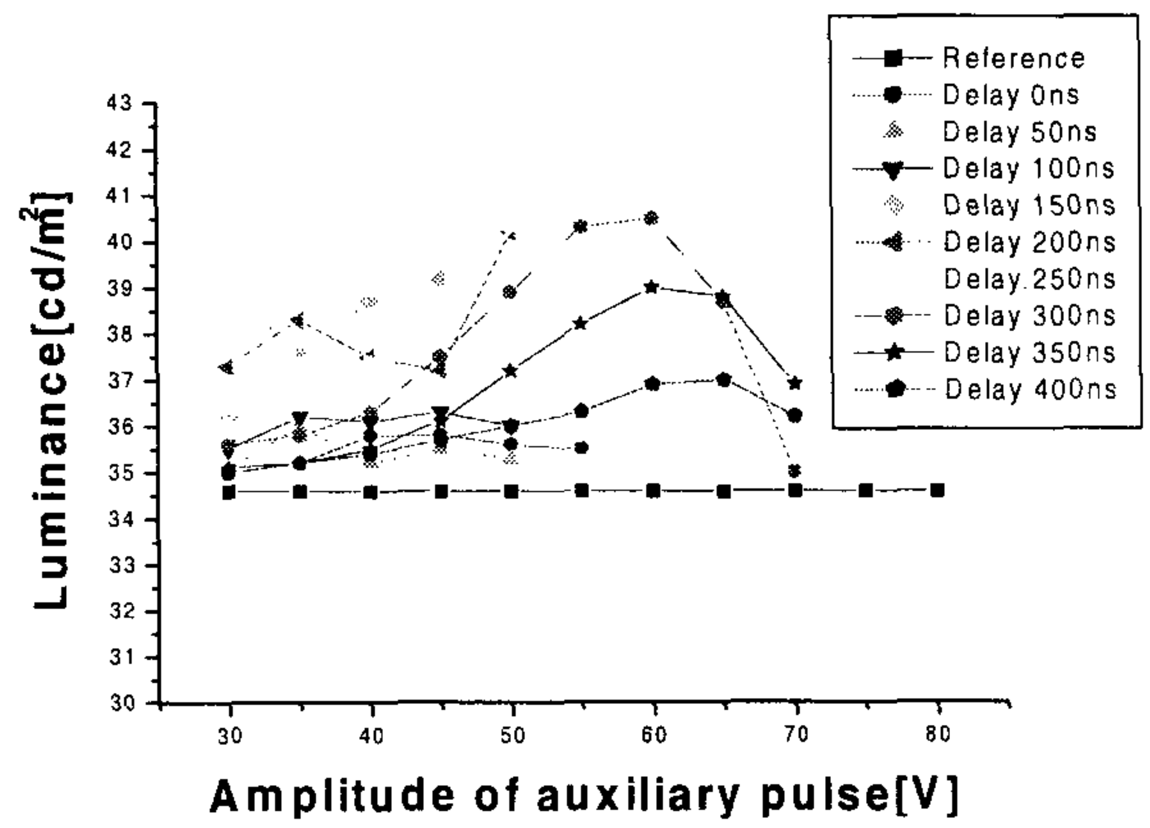
Figs.5 (a) and (b) illustrate the changes in the luminance, sustain and address currents under the full-white pattern in the case of applying the various auxiliary pulses: the amplitude ranges from 40 V to 70 V, the delay times are 350 ns and 400 ns, and the widths are 200 ns and 300 ns. As the amplitudes of auxiliary pulses increased, the luminance



(a) Red cells

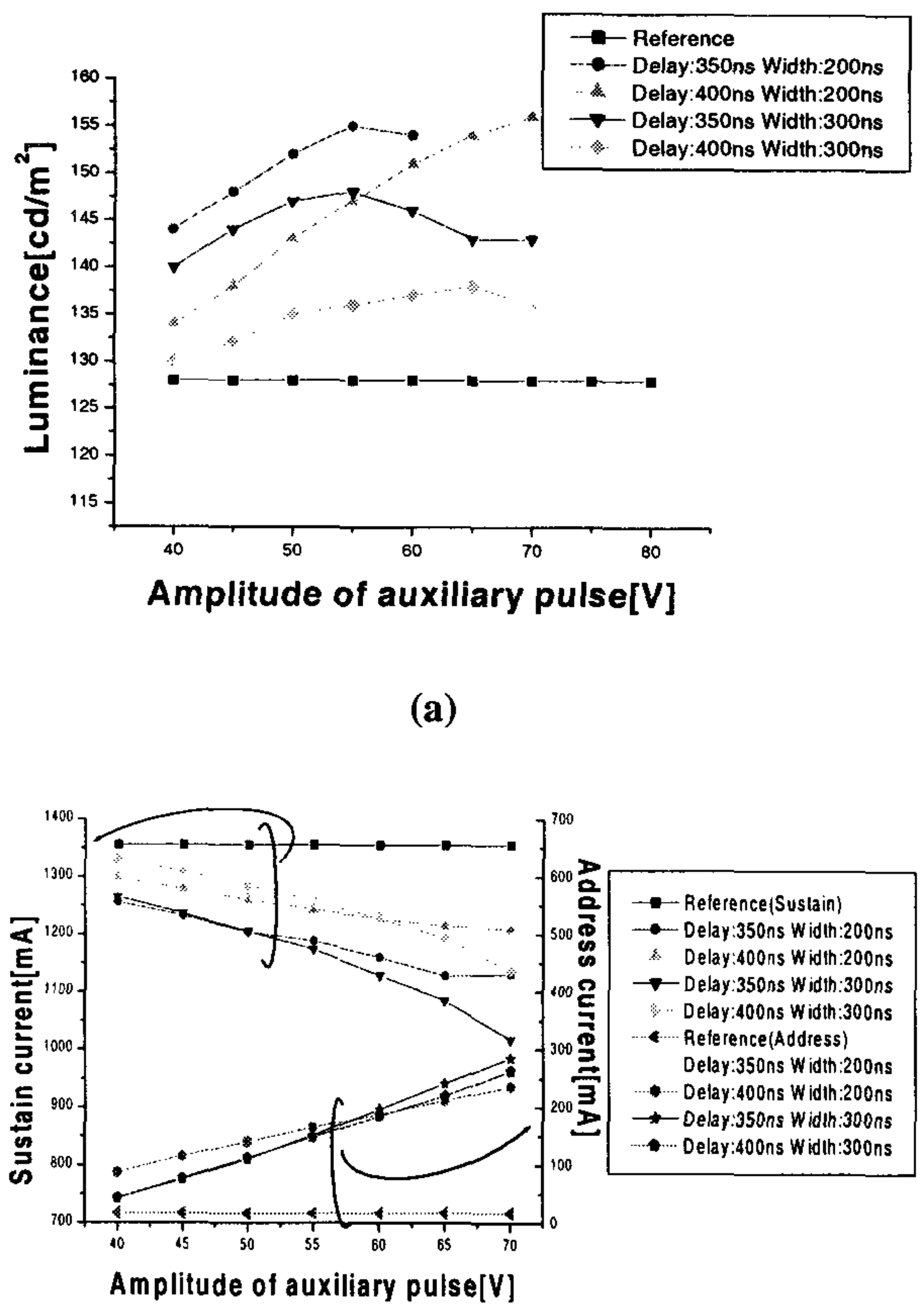


(b) Green cells



(c) Blue cells

Fig. 4. Luminance of red (a), green (b) and blue (c) cells with variations in amplitudes and delay times of auxiliary pulses at constant pulse width of 200ns.



(a)

(b)

Fig. 5. Changes in the luminance (a) and sustain and address currents (b) under full-white patterns with various amplitudes, delay times, and pulse widths of auxiliary short pulses.

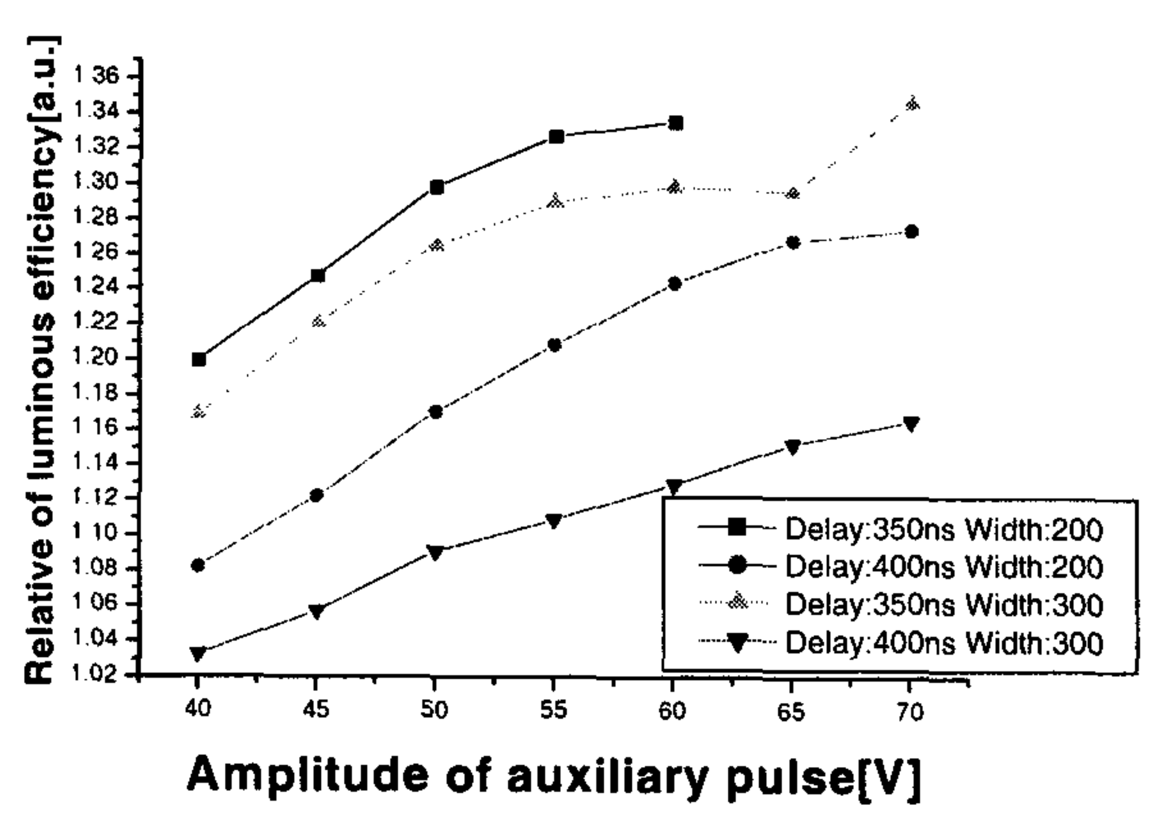


Fig. 6. Changes of the luminous efficiency under full-white patterns with variations in the amplitudes of auxiliary pulses with widths of 200 ns and 300 ns and delay time of 350 ns and 400 ns.

was increased and the sustain current was decreased, but the address current was increased as shown in Fig.5 (b). Nonetheless, the increase in the address current little contributes to the power consumption because of the low address voltage. In addition, most of the address current measured in Fig. 5 (b) consists of a displacement current. In the 42 inch ac-PDP employed in the current study, the displace current in the sustain current was minimized because the sustain circuit has the energy recovery circuit. However, the address circuit board does not have an energy recovery part, so that the measured address current involve much displace current. Accordingly, if the address circuit board with energy recovery was used, the address current was decreased to a great extent when auxiliary pulse was applied.

Fig.6 shows the changes in the luminous efficiency when the full-white pattern was displayed with a variation of the amplitude at different delay times of 350 ns, 400 ns and at pulse widths of 200 ns and 300ns. When the delay time was fixed for 350 ns, the pulse width for 300ns and the amplitude for 70 V, the full-white luminous efficiency was increased maximally about by 34 %.

4. Conclusion

In this paper, an auxiliary address pulse driving scheme was applied to the 42-inch WVGA ac-PDP panel without any additional equipment. In case of the blue cells the luminance was improved approximately by 17 %. As a result, the luminous efficiency of the full-white pattern was improved approximately by 34 % without a misfiring discharge in comparison with conventional driving scheme. We expect that this driving scheme can be applicable to the commercial ac-PDP and contribute to improving the luminance and luminous efficiency of the current 42-inch ac-PDP.

5. Reference

[1] Sang Hun Jang, Ki-Duck Cho, Heung-Sik Tae, Kyung Cheol Choi and Seok-Hyun Lee, "Improvement of Luminance and Luminous Efficiency using Address Voltage Pulse during Sustain Period of AC-PDP," *IEEE Trans. Electron Devices*, Vol.48, no.9. Sep. 2001.

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[3] Koichi Wani. "A Novel Driving Scheme and Panel Design for Realization of a Picture Quality Equivalent to CRTs," *IDW*'99 Digest, pp.775-778 (1999).

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