

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 is applied to the address electrode during a sustain-period, were 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. And 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 cells 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.

Keywords : ac-PDP, auxiliary pulse, luminous efficiency, luminance

1. Introduction

Plasma display panel (PDP) has been became one of the promising flat panel display device applicable to large area (>40-in), full color, wall-hanging digital high definition televisions (HDTVs). However, there still remain some problems in terms of image quality, manufacturing cost, and in particular luminous efficiency. These demerits need to be eliminated to realize the high quality plasma display panel television. In this sense, a driving scheme is proposed to improve the luminous efficiency by applying the auxiliary pulse to the address electrode during a sustainperiod [1, 2]. However, the validity of the driving scheme was tested on a small size (4 inch or 7 inch) test panel.

In this paper, to improve the luminous efficiency and luminance, an auxiliary address pulse driving scheme was applied and its validity was examined for 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 sustainperiod on a real full color image patterns and address current flowing through the address electrodes were examined carefully.

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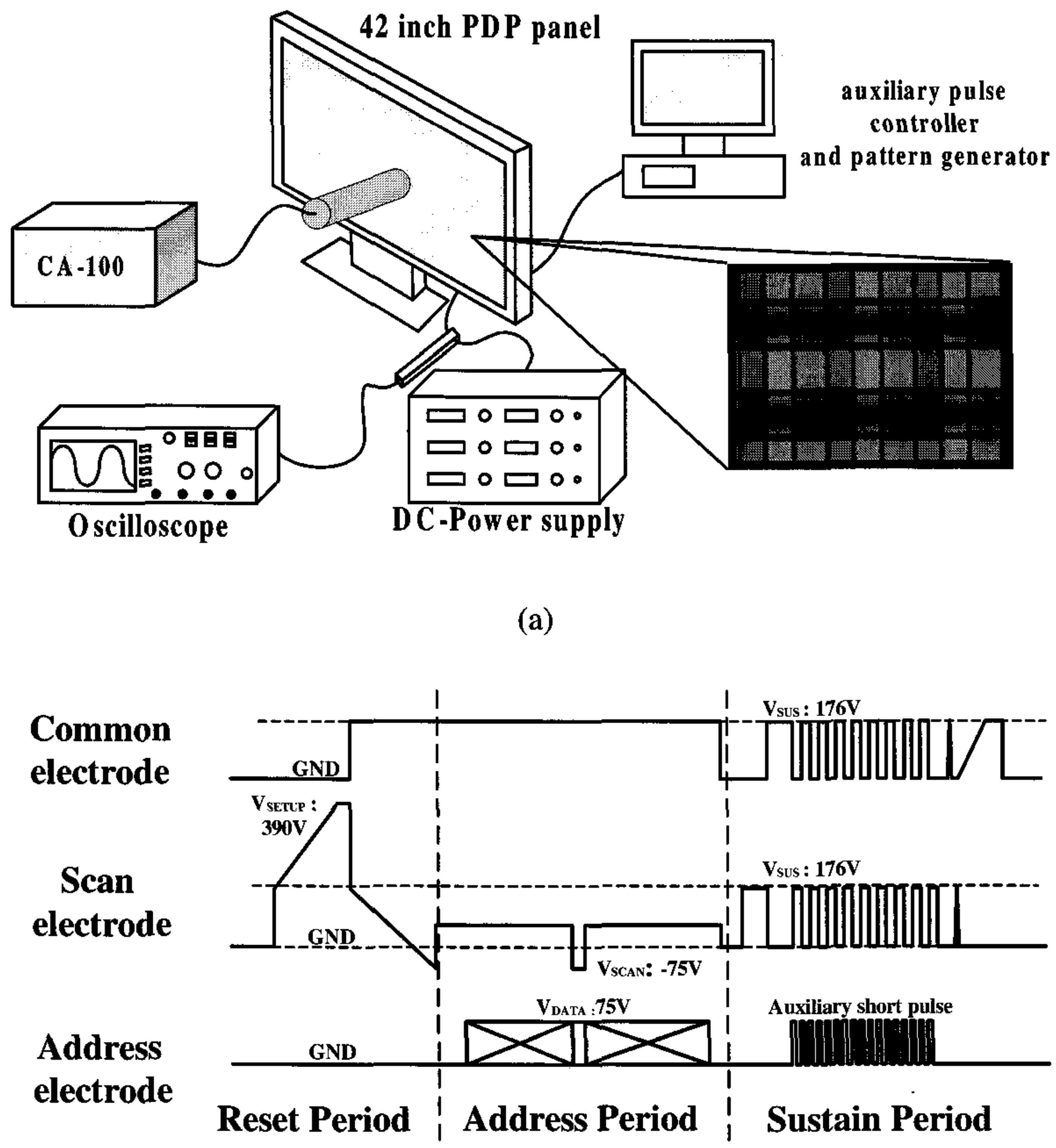
2. Experimental Setup

Fig. 1 (a) shows the electrical and optical measurement system with which the luminance and current from the 42-inch WVGA ac-PDP can be measured if the auxiliary address pulse driving scheme is adopted. The 42-inch WVGA ac-PDP panel employed in the current research is the same product as the commercial PDP-TV, such so that it has an asymmetric stripe barrier rib structure as shown in Fig. 1 (a) [3]. The luminance was measured with a color analyzer (CA-100) and the sustain current waveform and the currents flowing through both the sustain and address electrodes were measured by the oscilloscope with currentprobe. Fig. 1 (b) shows the corresponding driving waveform in a subfield used in this experiment. In this figure, the driving waveforms applied to the common- and scan-electrodes are the same as those of the commercial PDP-TV. The position and width of auxiliary short pulses were controlled via the main control chip and ROM coded by the computer, whereas its amplitude was

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

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



(b)

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

controlled simply by adjusting the dc-power supply.

Table 1 is the truth table of the 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 sustainperiod. To obtain high address voltage output, a signal BLK must be high and the signal POL must be low. On the other hand, to obtain the 0-level address voltage output, the signal BLK must be low.

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 points a A and B with current-probe. The quantity of address current flowing through the address electrode was measured at point C. The sustain current waveform was measured at point D where the sustain pulses generated in the sustain circuit board are released into the sustain electrodes. Fig. 2 (b) shows the driving waveforms applied during a sustain period. Sustain voltage was 176 V, and sustain frequency was 200 kHz. In the auxiliary pulse applied to the address electrode, its delay time, width, and amplitude were varied. Delay time of the auxiliary pulse is defined as the time difference in the reference point of the auxiliary pulse and

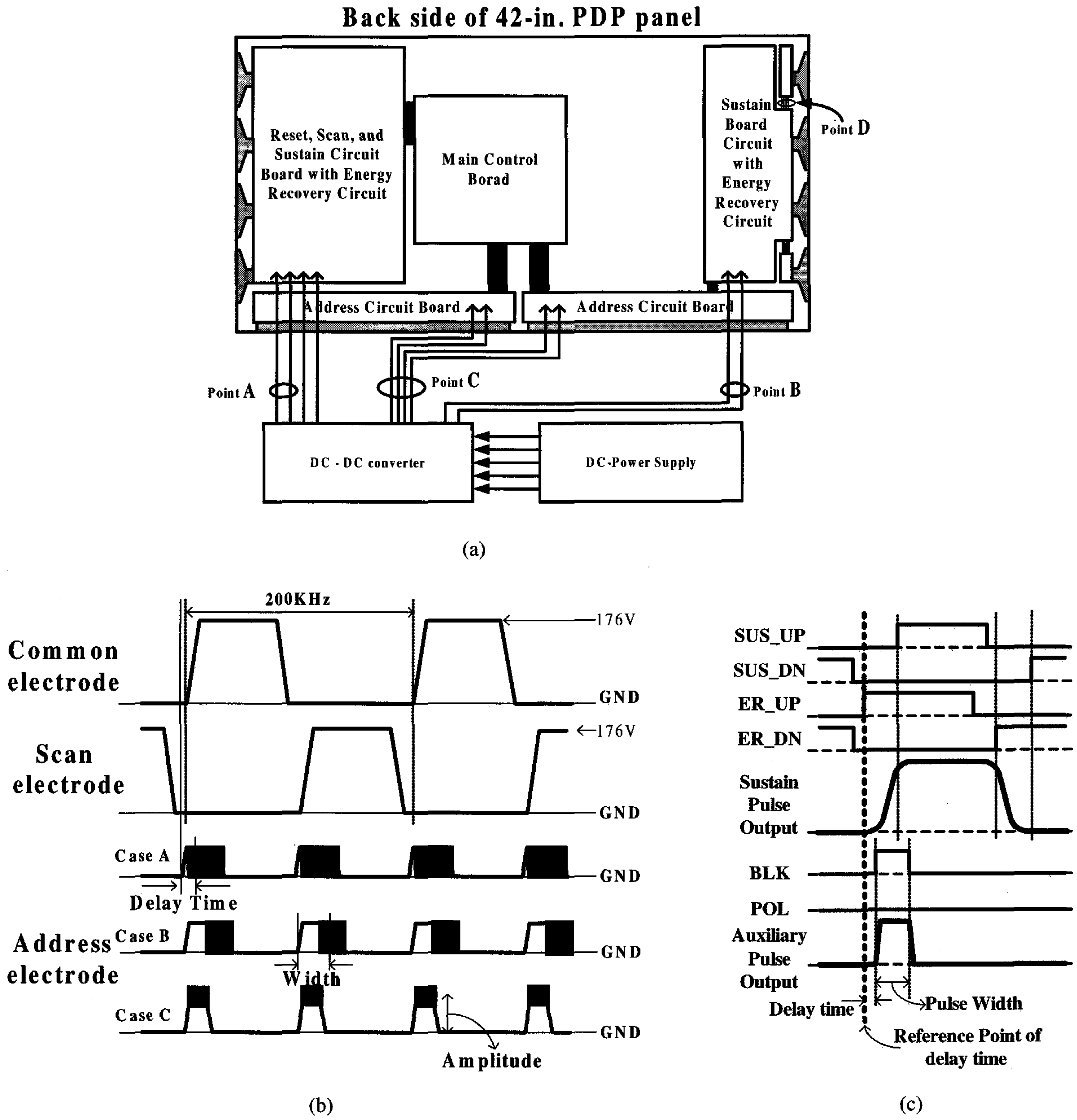


Fig. 2. Block diagram (a) of 42-inch ac-PDP, applied sustain pulse and auxiliary address pulse (b) during sustain-period, and control signals (c) of sustain pulse and auxiliary pulse.

the actual applying point of the auxiliary pulse, where the reference point of auxiliary pulses is synchronized with ER_UP as shown in Fig. 2 (c). The ER_UP and ER_DN are the control signals for the energy recovery part, whereas the SUS_UP and SUS_DN are the 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 a the full-white pattern.

3. Results and Discussion

Fig. 3 illustrates the sustain current and corresponding

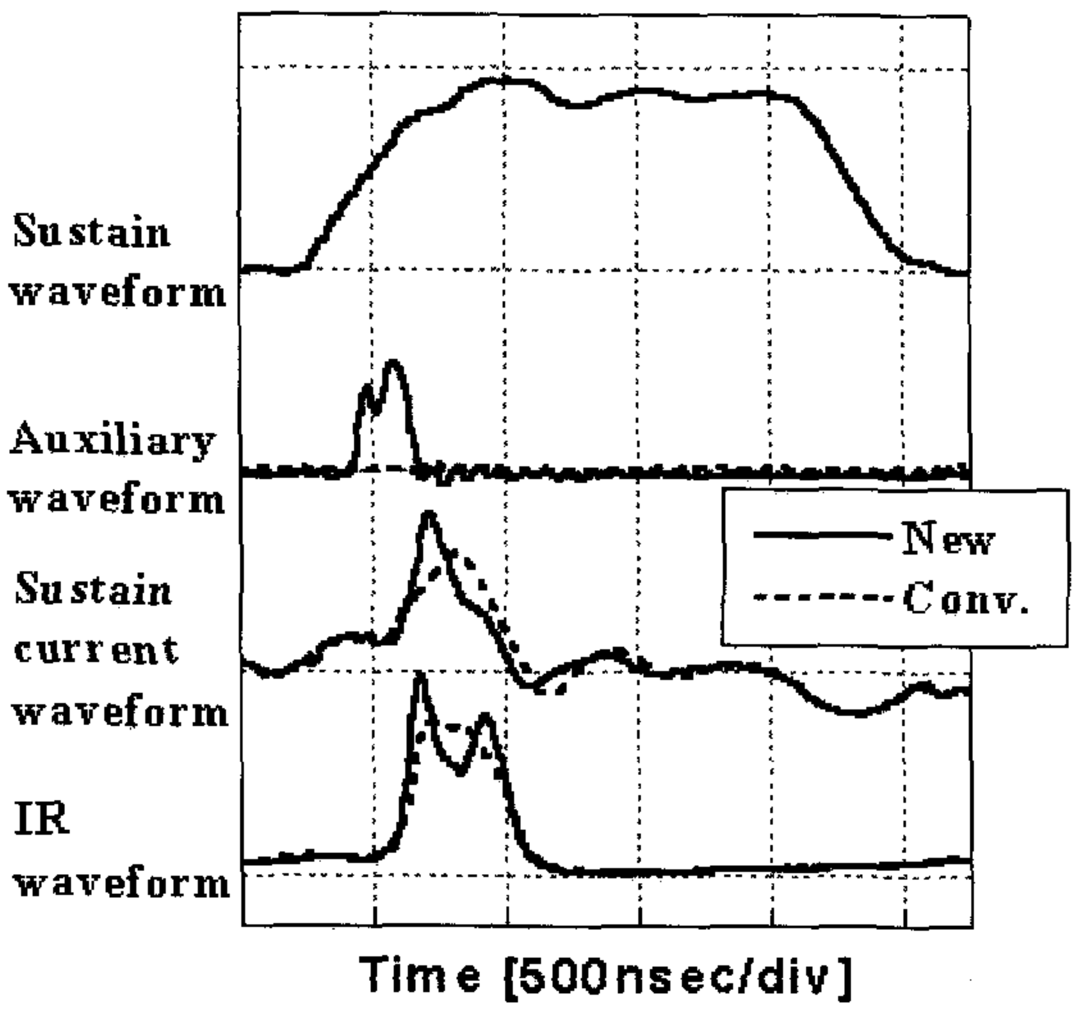
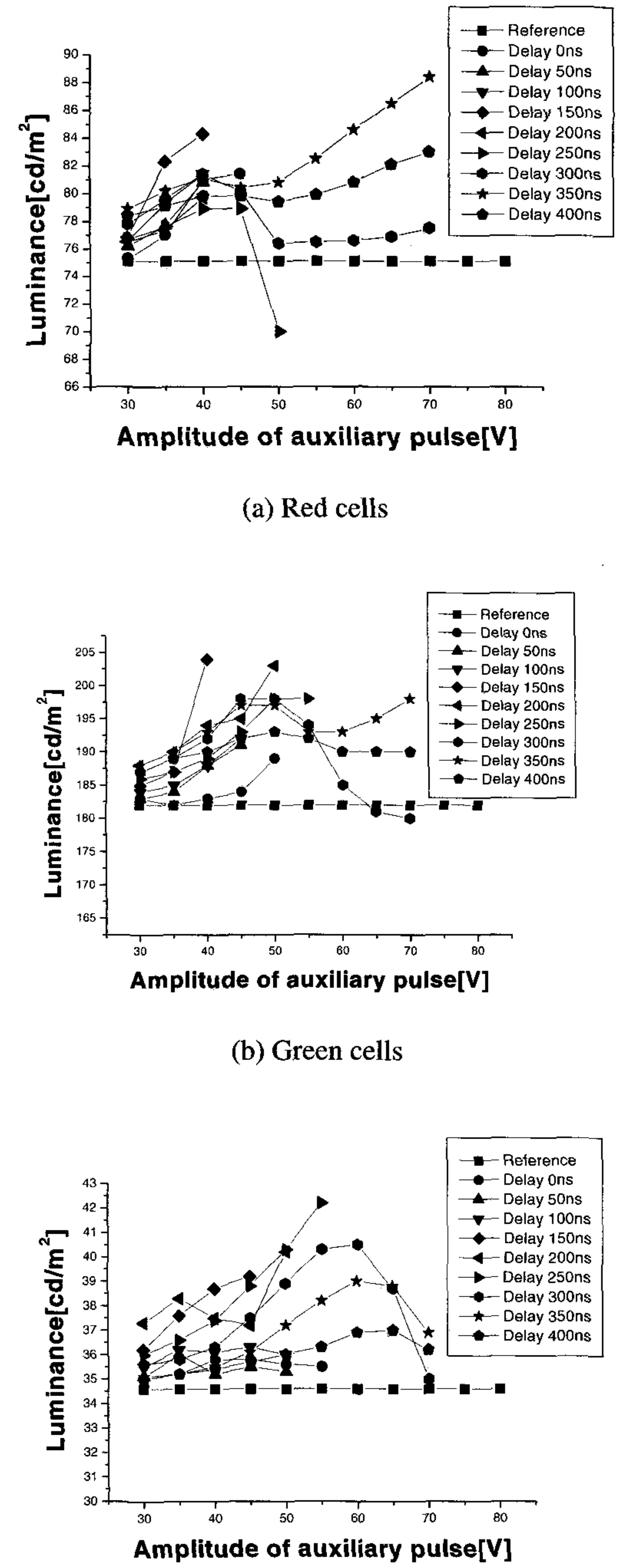


Fig. 3. Sustain current and IR (823 nm) waveforms measured from 42-in. ac-PDP panel when sustain pulse with auxiliary pulse is applied during sustainperiod.

IR waveforms measured from the 42-inch ac-PDP panel under a full white pattern. In the conventional driving scheme, no auxiliary pulse was applied, and 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 were 400 ns, 200 ns, and 60 V, respectively. Under the condition of an actual driving of PDP, the rising of ER_UP and that of a sustain pulse were not entirely the same. So, if the auxiliary pulse with a delay time of 250 ns had been applied to the address electrode, the rising of an auxiliary pulse and a sustain pulse would have been the same. As shown in Fig. 3, compared with the conventional case, the peak of the discharge current was shifted a slightly to the left direction, and the corresponding IR peak intensity showed the double peaks was increased. At the two peaks of IR waveform in Fig. 3, the first peak means the face discharge between the address and sustain electrodes induced by the application of the auxiliary address pulse to the address electrode, whereas the second peak means a surface discharge between the two sustain electrodes induced when the sustain pulse is applied[5].

This result indicates that the auxiliary pulses applied to the address electrode play a significant role in enhancing the additional excitation toward the address electrode [1, 6].

Figs. 4 (a), (b), and (c) show the changes in terms of luminance of the full-red, full-green, and full-blue patterns at various amplitudes and delay times of the auxiliary pulses, but with a constant pulse width of 200 ns during a sustainperiod. The auxiliary pulses were applied



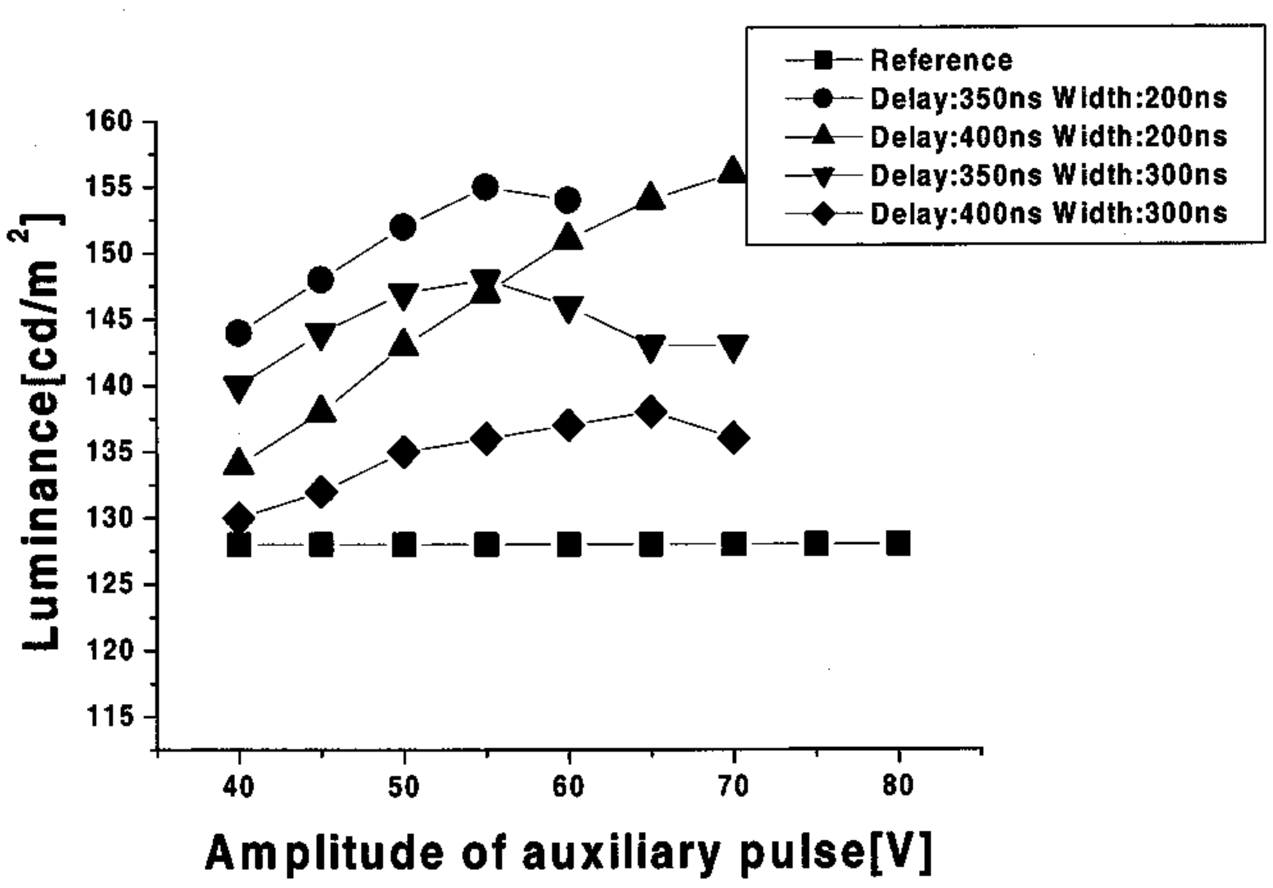
(a) Red cells

(b) Green cells

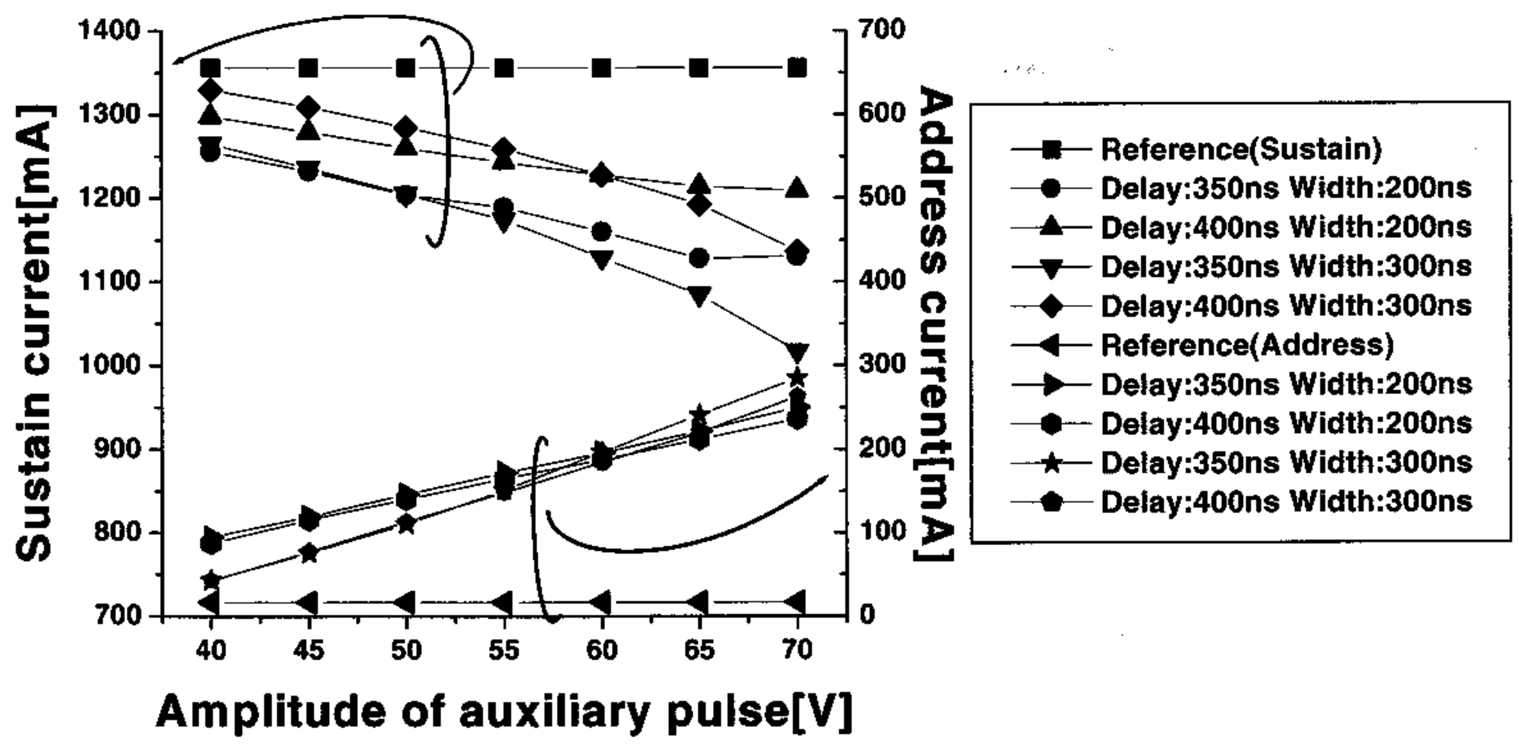
(c) Blue cells

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 200 ns.

separately to the address electrodes of the R, G, and B cells, respectively. In the red cells as shown in Fig. 4 (a), the luminance increased by about 18 % when the auxiliary pulse with 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 as shown in Fig. 4(b), the luminance increased



(a)



(b)

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

by about 8 % at the application of the auxiliary pulse with amplitude of 70 V and a delay time of 350 ns. In Fig. 4 (c), the luminance of the blue cell was improved by about 17 % when the auxiliary pulse with a delay time of 300 ns and amplitude of 60 V was applied. At the delay times ranging from 0 ns to 250 ns, the auxiliary pulse with the amplitude of over 50 V would disturb the sustain discharge, and resulting in the inducement of a misfiring discharge. The luminance was measured when full-red, full-green, and full-blue were displayed. Thus, if some pixels did not turn on, the luminance would not have been measured.

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 were 350 ns and 400 ns, and the widths were 200 ns and 300 ns. As the amplitudes of auxiliary pulses increased, the luminance was also increased while the sustain current was decreased, but the address current was increased as shown in Fig. 5 (b). The decrease of the sustain current was due to the more efficient sustain discharge. As shown in Fig. 3, the auxiliary pulses induced a faster discharge compared with sustain discharge with no auxiliary pulse. Faster discharge means that the sustain discharge can be produced under a lower electric field than conventional case. Under the lower electric field, it is known that an excitation of Xe would be increased, whereas an ionization is decreased, which means that the reduction of an ionization results in the decrease of a sustain current. Nonetheless, the increase in the address current little contributed to the power consumption, because of the lower address voltage. In addition, most of the address current measured in Fig. 5 (b) was consisted of a displacement current. In the 42 inch ac-PDP employed in the current study, the displacement

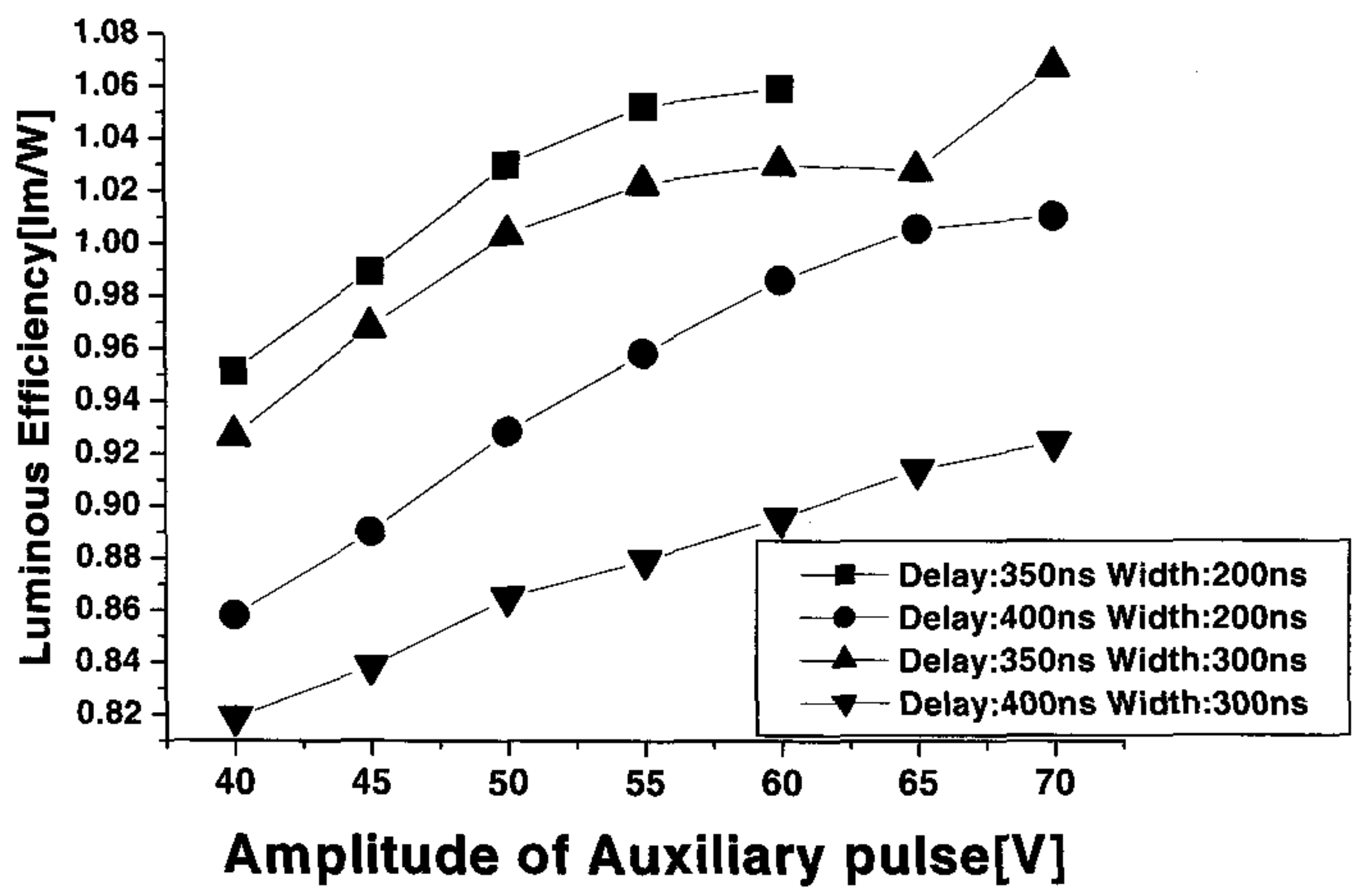


Fig. 6. Changes of luminous efficiency uFnder full-white patterns with variations in the amplitudes of auxiliary pulses with widths of 200 ns and 300 ns and delay time of 350 ns and 400 ns.

current in the sustain current was minimized because the sustain circuit had the energy recovery circuit. However, the address circuit board did not have an energy recovery part, such that the measured address current involved a much greater displacement current. Accordingly, if the address circuit board with energy recovery had been used, the address current would have 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 at various amplitude and at different delay times of 350 ns, 400 ns and at pulse widths of 200 ns and 300ns. The luminous efficiency was determined through correlation between luminance and power consumptions. If the luminance increases, the corresponding efficiency also increases, but if the power consumptions decrease, the corresponding efficiency increases. In this work, the luminance increased as shown in Fig. 5 (a) and the power consumptions decreased due to the decrease in the sustain current, which is the most important factor for the power consumption of a PDP. It should be noted that the increase in the address current in proportion to the decrease in the sustain current may affect power consumption. Nonetheless, the total power consumption decreased even when the address current increased, because the amplitude of auxiliary pulse was far lower than that of the sustain pulse. 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 by about 34 %.

4. Conclusions

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

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