A new ramp reset waveform for reducing reset period using address pulse of AC-PDP

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Abstract

A new reset waveform is proposed for reducing the reset period. A square pulse is applied to the address electrode while reset pulse ramps and before a discharge between the sustain electrodes occurs. The square pulse induces a discharge between the address electrode and the X electrode, and the induced wall charge is opposite to the applied ramp pulse. Thus, the next discharge between the sustain electrodes becomes weaker. The weaker discharge lowers background luminance and improves contrast ratio. Thus, the new reset waveform can reduce ramp up time in the ramp reset waveform

The experimental results show that the ramp up time can be reduced by about 90% compared with the conventional ramp reset waveform.

1. Introduction

An AC Plasma Display Panel (PDP) has many advantages such as its large size, wide viewing angle, and simple structure. However, the AC-PDP also has drawbacks such as its low efficiency and low dark room contrast ratio, and so on [1]. Because the low dark room contrast ratio is one of the main problems of the AC-PDP, the several reset waveforms have been developed to solve this problem [1], [2].

Recently the ramp reset waveform has been used in the reset period in order to improve the contrast ratio [3]. The ramp reset waveform has not only the advantage of the contrast ratio improvement but also the advantage of the uniform wall charge distribution. However, the ramp reset waveform has the drawback of the long reset period [4]. Because the long reset period reduces the duty ratio of display, it brings about the low luminance.

In order to increase the duty ratio of display, the reset period has to be reduced. However, the shorter reset period does not allowed the higher contrast ratio. Thus, we developed the new reset waveform, which decreases the reset period and keeps the contrast ratio.

2. Experiments

Figure 1 shows the schematic diagram of the single pixel structure of the AC-PDP used in this study. The single pixel is the minimum unit for full-color display [5]. The panel consists of a front glass plate including ITO electrodes, bus electrodes, dielectric layer, and MgO layer and a rear glass plate including the barrier ribs. The R, G, and B phosphors were deposited between the barrier ribs in the rear glass plate [6]. The ITO electrodes were designed with width of 320㎛ and gap distance of 60㎛.

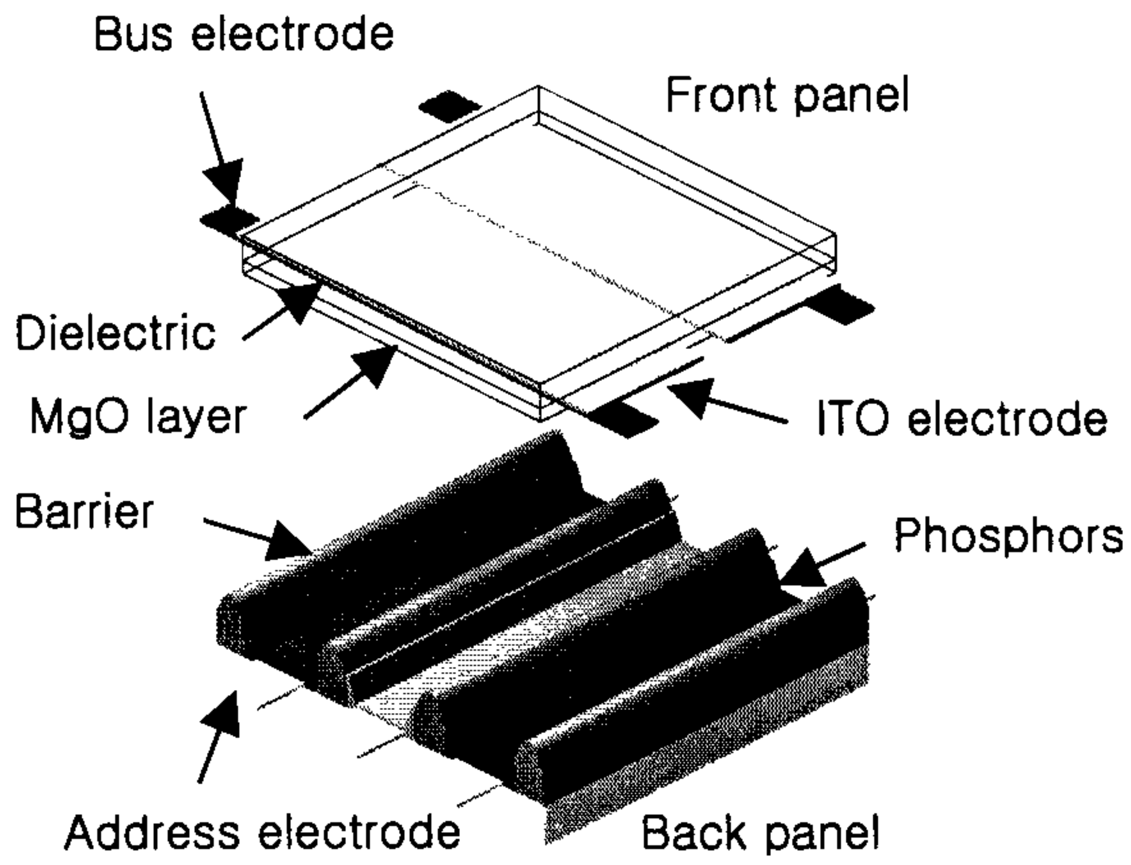

Figure 1. Schematic diagram of the single pixel structure of the AC-PDP

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Figure 2 compares the conventional ramp reset waveforms (a) and the new reset waveforms (b). As shown in Figure 2(a) for the conventional ramp reset waveforms, the wall charges induced by the sustain discharge in the previous sub-field are erased by the ramp erase pulse applied to the X electrode during T1. V_S is applied to the Y electrode during T2 and then, in order to induce weak discharges, the voltage applied to the Y electrode is increased from V_S to (V_S +V_W) during T3 and T4. This voltage is reduced to V_S during T5, and then in order to erase wall charge between the sustain electrodes, it is linearly reduced from V_S to the ground level during T6. After this reset period, positive wall charge is accumulated on the address electrode and negative wall charge is accumulated on the sustain electrodes [2]. As shown in Figure 2(b), the new reset waveforms have a square pulse applied to the address electrode. The pulse is applied while the ramping voltage of the Y electrode rises and before the discharge between the sustain electrodes appears. The discharge behavior during this reset period (T1~T6) depends on whether the address discharge occurred in the previous sub-field or not. If discharges occurred in the previous sub-field, an erase discharge occurs in T1. If a discharge did not occur in the previous sub-field, the wall charge distribution of the address electrode formed in the previous sub-field is maintained during T1 and a discharge occurs in T3 due to this wall charge. This discharge in T3 occurs between the address electrode and X electrode. The wall charge redistribution due to this discharge during T3 is opposite to the wall charge polarity that is being accumulated by the ramping voltage applied to the Y electrode. In consequence, the next discharge in T4 between the sustain electrodes occurs weakly and less light is emitted during the reset period. Therefore, the new reset waveforms proposed in this paper is able to improve the contrast ratio compared with the conventional ramp reset waveforms. Also, if the background luminance of the new reset waveforms keeps that of the conventional ramp reset waveforms, the reset period can be reduced.

Figure 3 shows the new reset waveforms for a test. As shown figure 3, the primary parameters of this study are V_{RA} and T_r. V_{RA} is the voltage applied to the address electrode before the discharge occurs between the sustain electrodes in the reset period. T_r is the ramp up time of the ramp pulse in the reset period. The ramp rate, which determines the background luminance, is V_W/T_r. When T_r is 20μs, the ramp rate is 9.25V/μs and when T_r is 200μs, the ramp rate is 0.925V/μs. The width of address is designed as 3μs, the one TV-field is eight sub-field, and the one sub-field period is about 2.083ms. The sustain pulse specifications, which determine the peak luminance, are the followings; The voltage is 165V, frequency is 83.33kHz, and duty ratio is 50%.

A driving circuit, which is connected with the power supplies, is controlled by Time-98, the voltage waveform is measured by oscilloscope, the luminance is measured by BM-7, and the photo waveform is measured by a photo detector connected with oscilloscope.

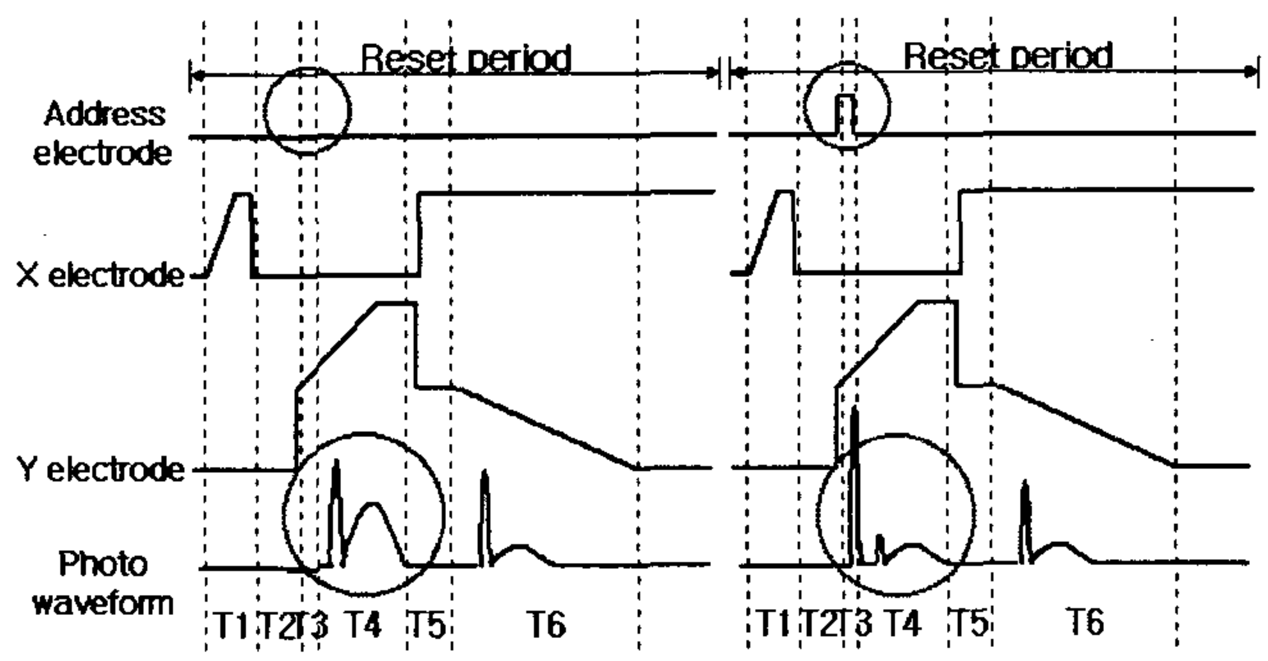

Figure 2. Comparison between the conventional ramp reset waveforms (a) and the new reset waveforms (b)

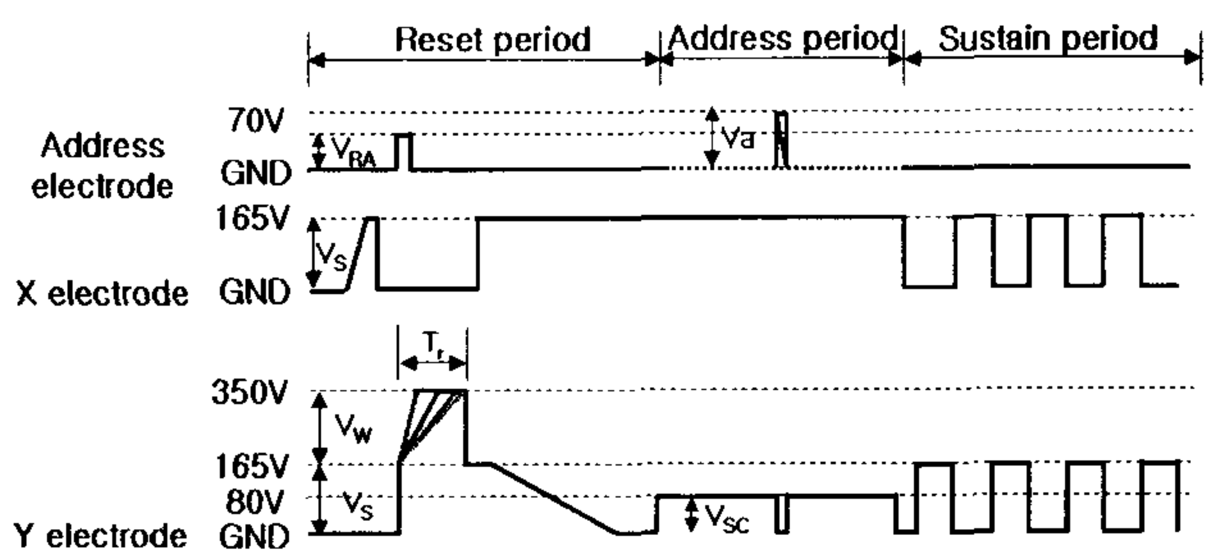

Figure 3. Schematic diagram of the new ramp reset waveforms for a test

3. Result and discussions

Figure 4 shows the background luminance as a function of V_{RA} for different T_r values. The longer T_r showed the less background luminance. When V_{RA} is 95V, the background luminance is the lowest for all T_r. When V_{RA} is increased beyond 95V, the background luminance increased for all T_r. When V_{RA} higher than 110V is used, a misfiring is caused. When T_r is 200μs and V_{RA} is 95V, the background luminance has the minimum value of 0.827cd/m^2.

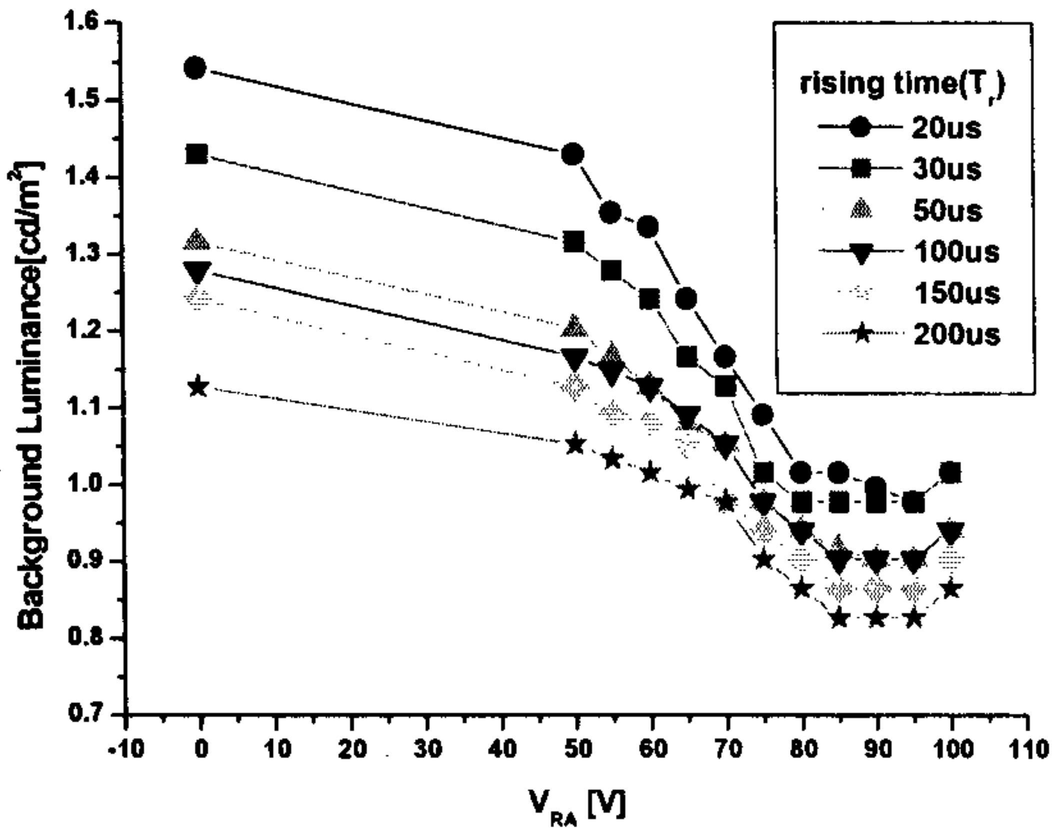

Figure 4. The background luminance as a function of V_{RA} for different T_r values

Figure 5 shows that the background luminance of the new reset waveforms is less than that of the conventional ramp reset waveforms for all T_r. Although T_r of the new ramp reset waveform decrease, the background luminance is somewhat increased compared with the conventional ramp reset waveforms.

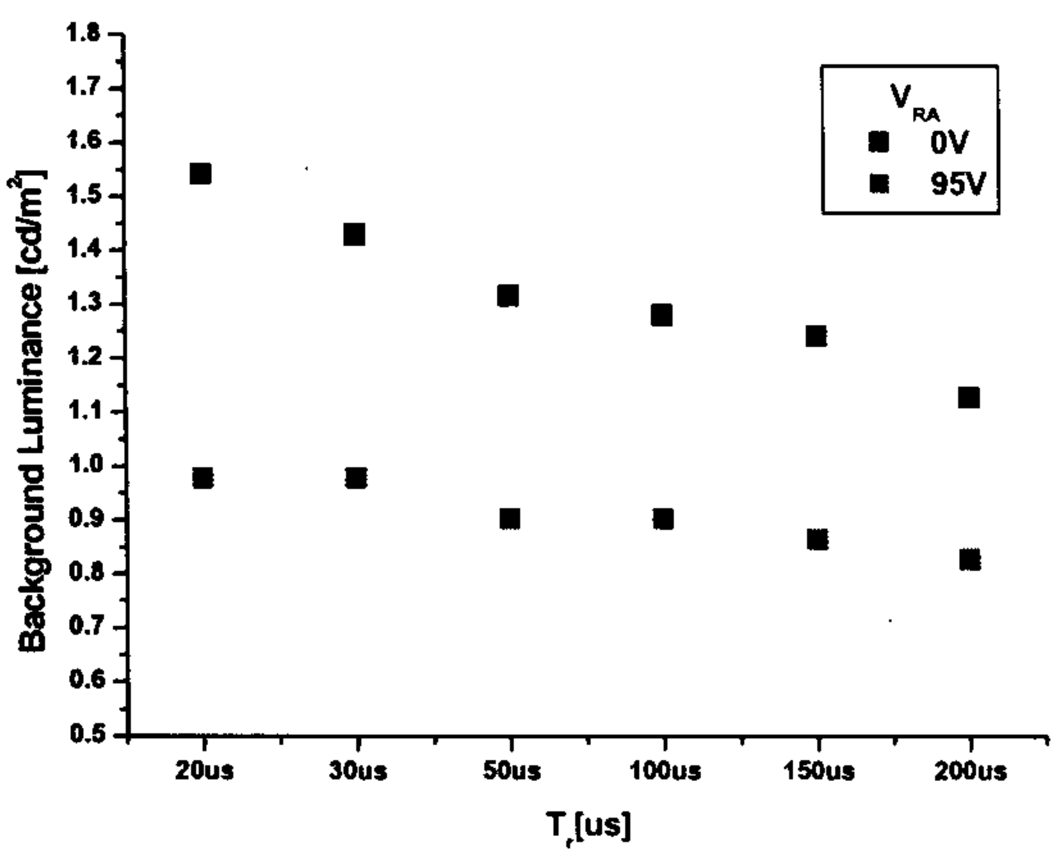

Figure 5. The background luminance for different T_r values when V_{RA} is 0V and 95V

Figure 6 shows the photo waveforms and the voltage waveforms for different T_r values when V_{RA} is 0V and 95V. Figure 6(a), (b), and (c) show the photo waveform when V_{RA} is 0V, that is, when the conventional ramp reset waveforms are applied. Figure 6(a'), (b'), and (c') show the photo waveform when V_{RA} is 95V, that is, when the new ramp reset waveforms are applied. The photo waveform with V_{RA} of 95V is lower than that with V_{RA} of 0V for all T_r.

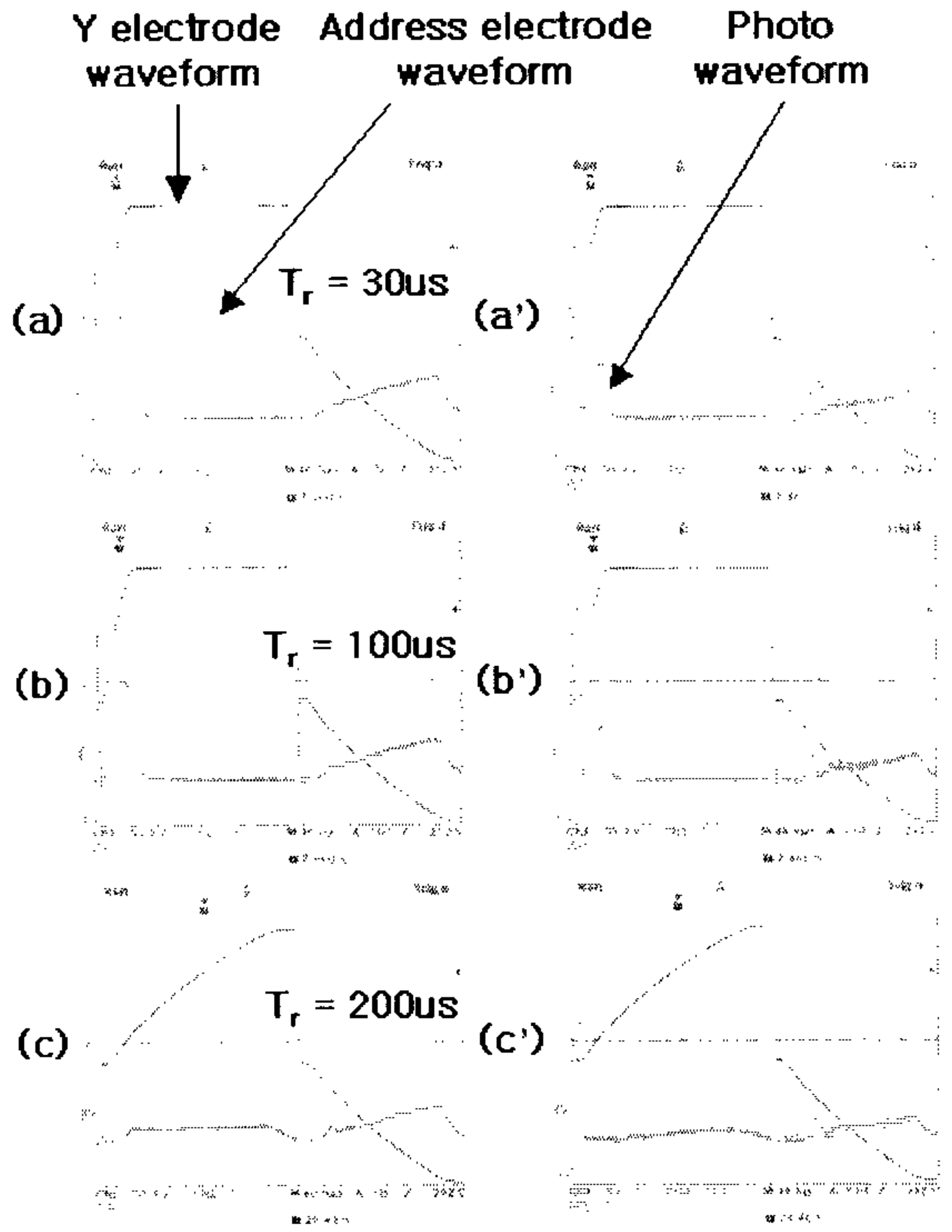

Figure 6. The photo waveforms and the voltage waveforms for different T_r values when V_{RA} is 0V ((a), (b), and (c)) and 95V((a'), (b'), and (c'))

Figure 7 shows the addressing voltage waveform and the dispersion of photo waveforms during the address discharge when V_{RA} is 0V and 95V. As shown in figure 7(a) and 7(b), even when V_{RA} of 95V was applied to the address electrode during the reset period, the address discharge characteristics are almost the same.

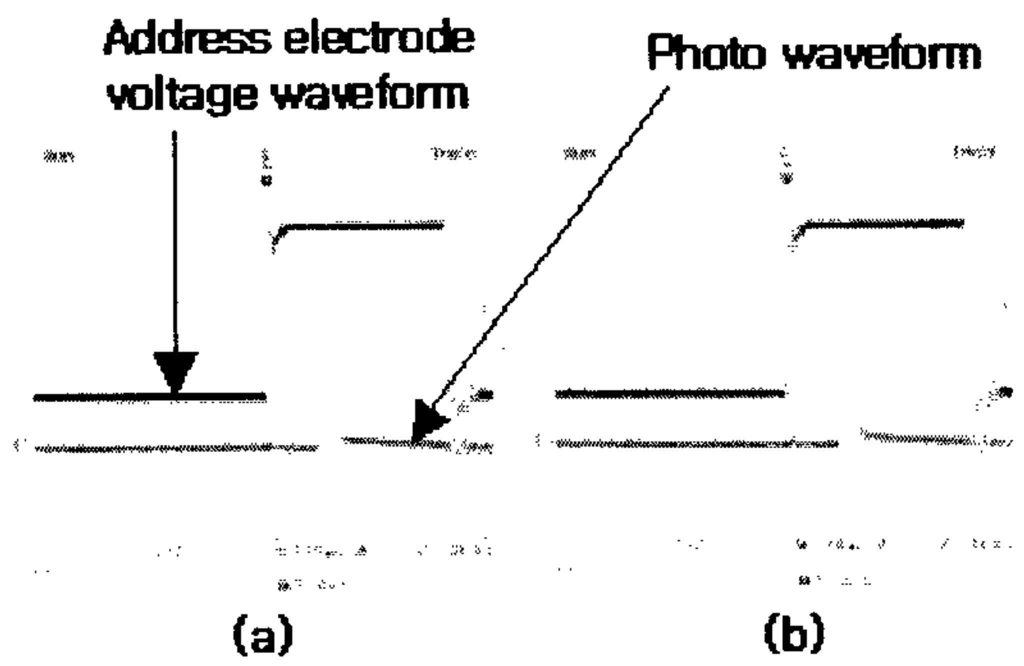

Figure 7. The addressing voltage waveform and the dispersion of photo waveforms during the address discharge when V_{RA} is 0V and 95V

Figure 8 shows the peak luminance for different T_r values when V_{RA} is 0V and 95V. As shown in figure 8, the peak luminance with V_{RA} of 95V is almost equal to that with V_{RA} of 95V for all T_r.

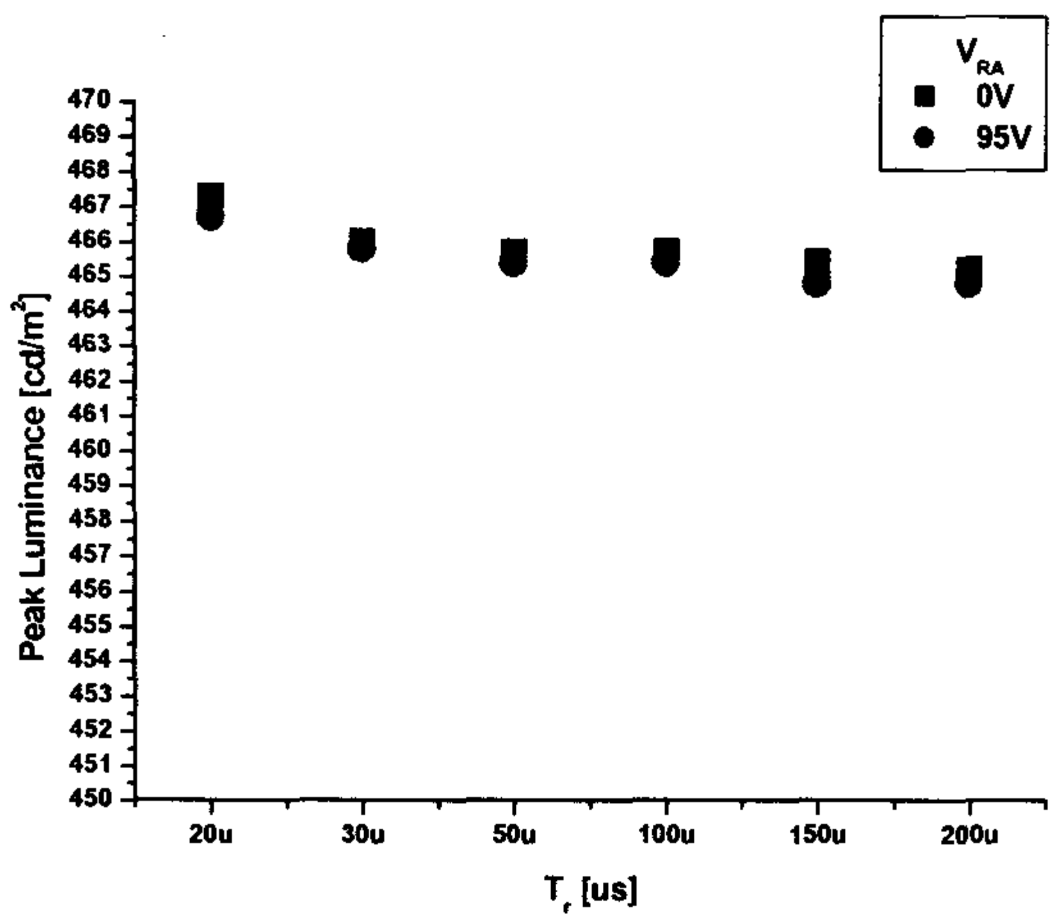

Figure 8. The peak luminance for different T_r values when V_{RA} is 0V and 95V

Figure 9 shows the contrast ratio for different T_r values when V_{RA} is 0V and 95V. As shown in figure 9, the contrast ratio of the ramp reset waveforms with V_{RA} of 95V is higher than that of the conventional ramp reset waveforms with V_{RA} of 0V for all T_r. The contrast ratio of the new reset waveforms with T_r of 20μs is higher than that of the conventional ramp reset waveforms with T_r of 200μs.

This experimental result indicates that the new reset waveforms can improve the contrast ratio and reduce the reset period. If the reset period decreases, the address period or the sustain period can be increased. A long address period can make the stable address discharge and a long sustain period can improve the luminance and the luminance efficiency.

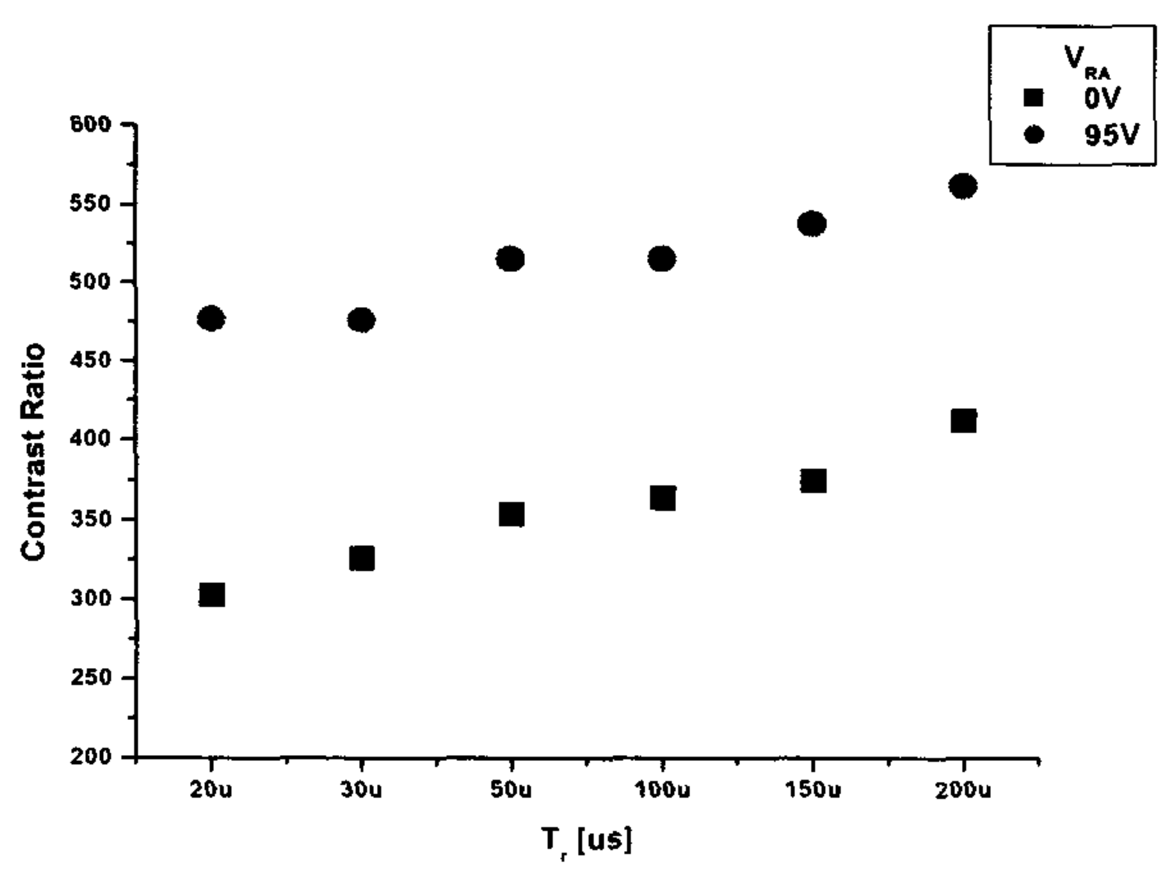

Figure 9. The contrast ratio for different T_r values when V_{RA} was 0V and 95V

4. Conclusion

In order to reduce the long reset period, which is one of the main problems of AC plasma display, we proposed a new reset method. Compared with the conventional ramp reset waveforms, the new reset waveforms can decrease the background luminance. Thus, the new reset waveforms can decrease the reset period by the shorter T_r. As a result, the new reset waveforms with T_r of 20μs is somewhat increased the contrast ratio compared with conventional ramp reset waveforms with T_r of 200μs. Thus, the ramp up time in the reset period can is decreased by about 90% using the new reset waveforms compared with the conventional reset waveforms.

5. Acknowledgements

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6. References

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