Effects of Various Sustain Waveforms on Discharge Characteristics under High Xe Gas Mixture in AC-PDP

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Abstract
The effects of various sustain waveforms on the discharge characteristics, such as discharge current waveform, IR waveform, luminance, luminous efficiency, power consumption, and static margin are investigated under high Xe (20 %) gas mixture at 200 kHz. The four types of sustain waveforms, such as non-overlapped sustain waveform without auxiliary pulse, non-overlapped sustain waveform with auxiliary pulse, overlapped sustain waveform without auxiliary pulse, overlapped sustain waveform with auxiliary pulse, are examined intensively. As a result, the overlapped sustain waveform with auxiliary pulse shows the best discharge characteristics under high Xe (20 %) gas mixture at 200 kHz.

1. Introduction
Improving the luminous efficiency of plasma display panel (PDP) is a critical issue for enhancing the luminance under full white images. Nonetheless, the luminous efficiency of the current PDP is still low. Increasing the Xe concentration in the PDP is one of the methods to improve luminous efficiency. However, the sustain voltage is increased. Recently, to obtain a high luminous efficiency and a low sustain voltage, many cell structures have been suggested under high Xe gas mixture but, the corresponding sustain waveform has not been investigated carefully yet [1, 2]. In this paper, the effects of various sustain waveforms on the discharge characteristics were examined under Ne-Xe (20 %) gas mixture at 200 kHz without any modification of cell structure.

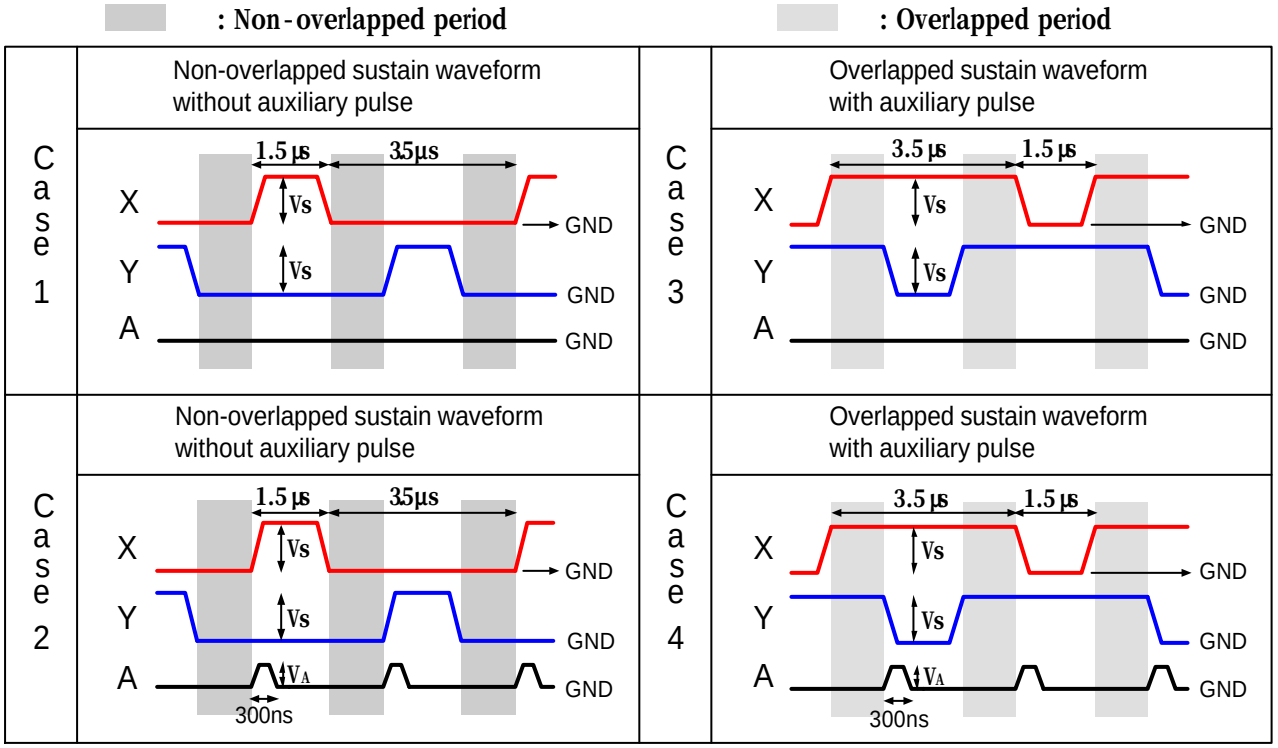


Fig. 1. Various sustain waveforms employed in this research.

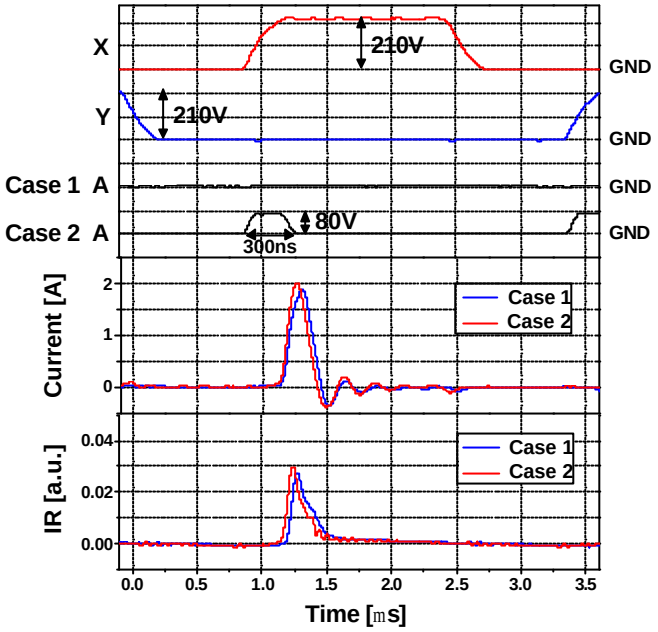


Fig. 2. Corresponding voltage, discharge current, and IR waveforms when applying non-overlapped waveforms under Ne-Xe (20 %) at 200 kHz.

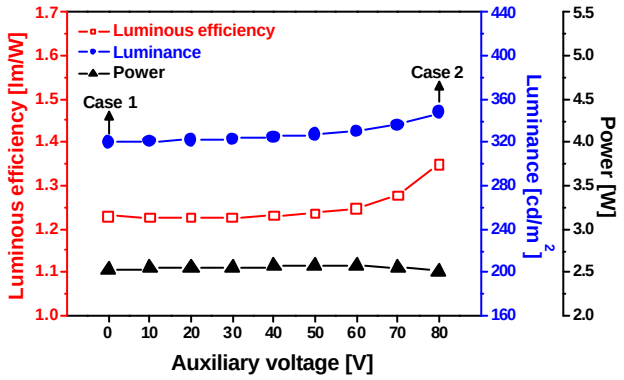


Fig. 3. Corresponding luminous efficiency, luminance and power consumption when applying non-overlapped waveforms under Ne-Xe (20 %) at 200 kHz.

2. Experimental setup

The 7-inch test panel with Ne-Xe (20 %) gas mixture was used to measure the changes in the discharge current, IR waveforms, luminance, luminous efficiency, and power consumption with respect to various sustain waveforms. The detailed sustain waveforms used in this work are shown in Fig. 1, where the case 1 is non-overlapped sustain waveform without auxiliary pulse, the case 2 is non-overlapped sustain waveform with auxiliary pulse, the case 3 is overlapped sustain waveform without auxiliary pulse, and the case 4 is overlapped sustain waveform with auxiliary pulse. The sustain frequency and voltage are fixed 200 kHz and 210 V, respectively. The auxiliary pulse ranging from 0 to 80 V was applied to the address electrode for both the non-overlapped and the overlapped sustain waveforms.

3. Results

Fig. 2 shows the discharge current, and IR waveforms measured from the test panel when applying the non-overlapped sustain waveforms (case 1 and 2) respectively. As shown in Fig. 2, the discharge current and IR waveforms of case 2 were observed to be faster and stronger than those of case 1 because the discharge of case 2 was triggered by the space charges formed due to the pre-discharge between A and Y electrodes by applying the address short pulse of 80V to the address electrode when the sustain pulse of X electrode rose to 210 V [3]. Under the fast and strong discharge by the space charges, the electron heating efficiency tends to increase due to a decrease in the ion heating losses in the cathode sheath. As a result, the Xe is excited more efficiently, thus resulting in increasing the luminance and luminous efficiency and

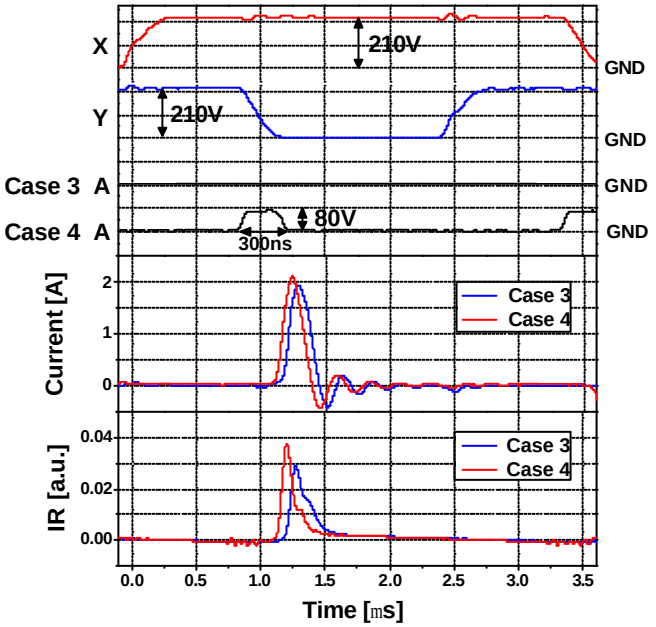


Fig. 4. Corresponding voltage, discharge current, and IR waveforms when applying overlapped waveforms under Ne-Xe (20 %) at 200 kHz.

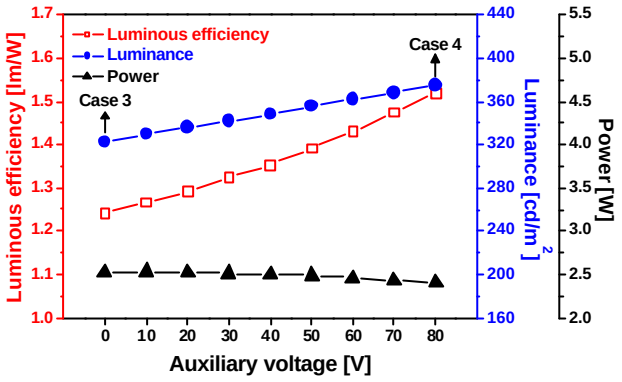


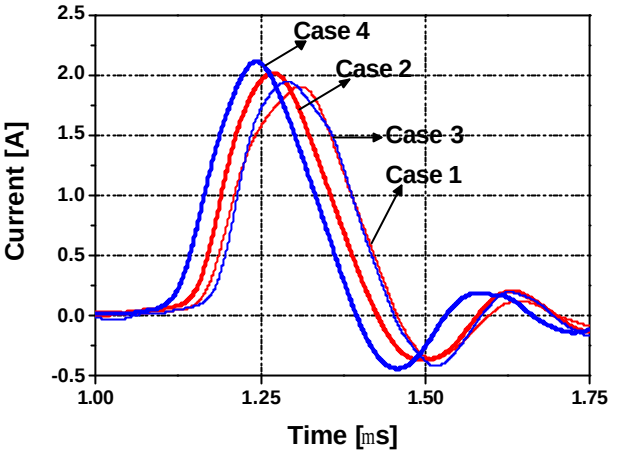
Fig. 5. Corresponding luminous efficiency, luminance and power consumption when applying overlapped waveforms under Ne-Xe (20 %) at 200 kHz.

in reducing the power consumption [4, 5].

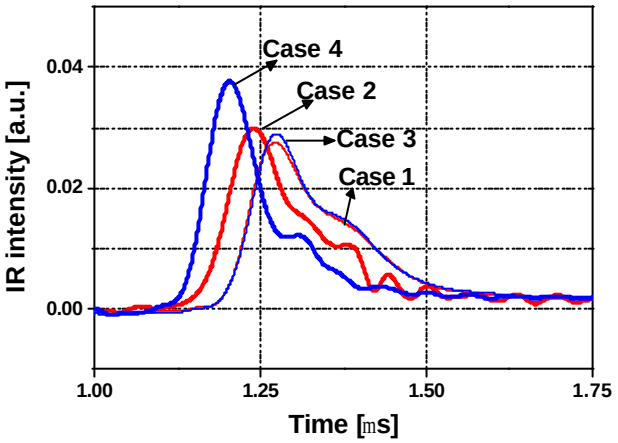
Fig. 3 shows the corresponding luminous efficiency, luminance and power consumption when applying the four types of sustain waveforms under Ne-Xe (20 %) gas mixture condition. Due to faster and stronger discharge, the luminous efficiency and luminance in case 2 were improved by about 9.8 %, and about 8.75 %, respectively, when compared with those in case 1.

Fig. 4 shows the discharge current, and IR waveforms measured from the test panel when applying the overlapped sustain waveforms (case 3 and 4) respectively. As shown in Fig. 4, the discharge current and IR waveforms in case 4 were observed to be much faster and stronger than those in case 3 because the discharge in case 4 was triggered by many space charges formed from the drastic voltage change (290 V) between the A and Y electrodes when the sustain pulse applied to the Y electrodes fell to the ground.

Fig. 5 shows the corresponding luminous efficiency, luminance and power consumption when applying the four types of sustain waveforms under Ne-Xe (20 %) gas mixture. Due to much faster and stronger discharge, the luminous efficiency and luminance in case 4 was improved by about 22.6 %, and by about 16.1%, respectively, when compared with those in case 3. Fig. 6 shows the comparison of discharge current and IR waveforms when applying the four types of sustain waveforms under Ne-Xe (20 %) gas mixture. As shown in Fig. 6, the discharge current and IR waveforms in cases 1 and 3 were observed to be



(a) Discharge current waveforms



(b) IR waveforms

Fig. 6. Comparison of discharge current and IR waveforms when applying four types of sustain waveforms under Ne-Xe (20 %) at 200 kHz.

similar because the voltage change triggering discharge between the X and Y electrodes is similar. As shown in Fig. 6, the discharge current and IR waveforms in case 4 were observed to be faster and stronger than case 2 because the space charges in case 4 was more than those in case 2 by the drastic voltage change between the A and Y electrodes. This means that the discharge in case 4 is the fastest and strongest.

Table 1 shows the comparison of luminous efficiency, luminance and power consumption when applying the four types of sustain waveforms under

	Luminous efficiency [lm/W]	Luminance [cd/m2]	Power[W]
Case 1	1.23 (reference)	320 (reference)	2.53 (reference)
Case 2	1.35 (9.8 %)	348 (8.8 %)	2.51 (-0.8 %)
Case 3	1.24 (0.8 %)	323 (0.9 %)	2.53 (0 %)
Case 4	1.52 (23.6 %)	375 (17.2 %)	2.40 (-5.4%)

Table 1. Comparison of luminous efficiency, luminance and power consumption when applying four types of sustain waveforms under Ne-Xe (20 %) at 200 kHz.

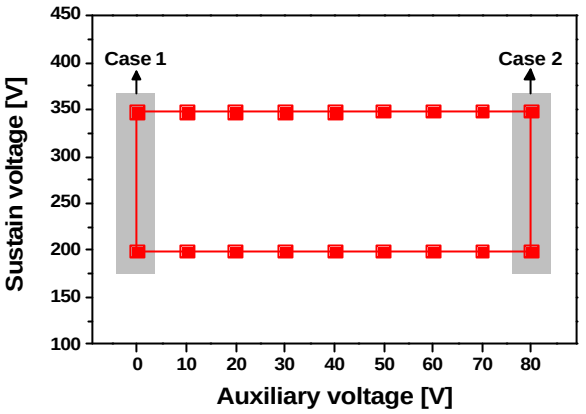
Ne-Xe (20 %) gas mixture.

As shown in table 1, the luminous efficiency and luminance in cases 1 and 3 were similar and, the case 4 shows the highest luminous efficiency, luminance and the lowest power consumption due to the fastest and strongest discharge.

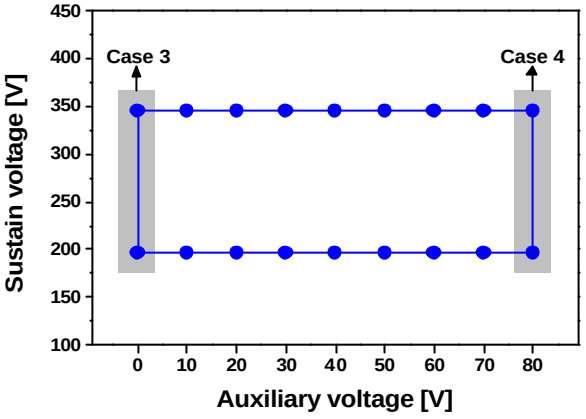
Fig. 7 shows the comparison of static margin when applying the four types of sustain waveforms under Ne-Xe (20 %) gas mixture. As shown in Fig. 7, the static margins of four types were similar.

4. Conclusion

In this paper, four types of sustain waveforms were examined under high Xe (20 %) gas mixture without any modification of cell structure. As a result, the overlapped sustain waveform with auxiliary pulse (case 4) can improve the luminous efficiency of about 23.6 % and the luminance of 17.2 % in comparison with conventional driving scheme (case 1) under the high Xe (20 %). However, high sustain voltage is not improved. Recently, a study on the effects of driving frequency on the low voltage and high luminous efficiency was made [4]. If the effects of the driving frequency on the discharge characteristics in case 4 is investigated carefully, it is expected that the low sustain voltage and high luminous efficiency would be obtained under the high Xe gas mixture.



(a) Case 1 and 2



(b) Case 3 and 4

Fig. 7. Comparison of static margin when applying four types of sustain waveforms under Ne-Xe (20 %) at 200 kHz.

5. References

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