Modified Ramp-Reset Waveform Robust for Ambient Temperature in PDP

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ABSTRACT

The changes in the discharge characteristics such as a firing voltage and IR emission among the three electrodes are examined relative to the ambient temperature and working gas pressure based on the Vt close-curve analysis method. The reset discharge does not occur sufficiently at high temperature due to the increase in the firing voltage, thereby resulting in accumulating the sufficient wall charges on the address electrode. As a result, a misfiring discharge often occurs at high temperature. To reduce the misfiring at high temperature, modified reset waveform that can maximize the plate gap discharge to accumulate the sufficient wall charges on the address electrode is proposed. As a result of adopting the proposed reset waveform, it is observed that stable address discharge is produced irrespective of the ambient temperature variation.

Ⅰ. INTRODUCTION

Recently, the image qualities of plasma display panels have been improved rapidly and considerably [1]. However, the further improvement of an image quality in AC-PDPs, especially full high definition (HD) PDP, requires the stable driving condition with a wider driving margin irrespective of the variable temperature. The panel temperature or ambient temperature is one of the important factors for producing the stable discharge in the PDP cells because the discharge characteristics of the micro discharge are varied considerably depending on the panel temperature. Nonetheless, the intense research on the relation between the panel or ambient temperature and the discharge characteristics has often been neglected [2, 3, 4].

In this paper, the changes in the discharge characteristics such as a firing voltage and IR emission among the three electrodes (X-Y, A-Y, and Y-A) are examined relative to the ambient temperature and working gas pressure based on the Vt close-curve analysis. Based on this experimental observation, the modified reset waveform is proposed that can produce the stable address discharge irrespective of the ambient temperature variation.

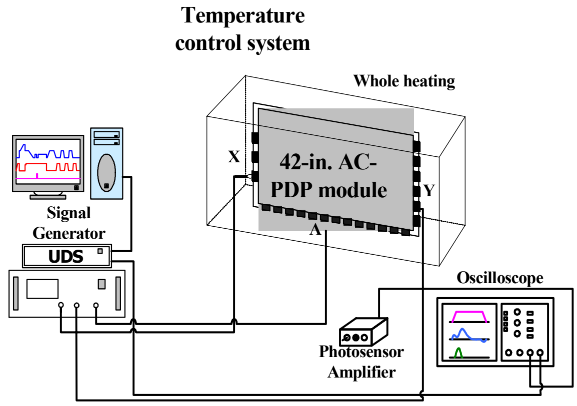


Fig.1. Schematic diagram of experimental setup employed in this work.

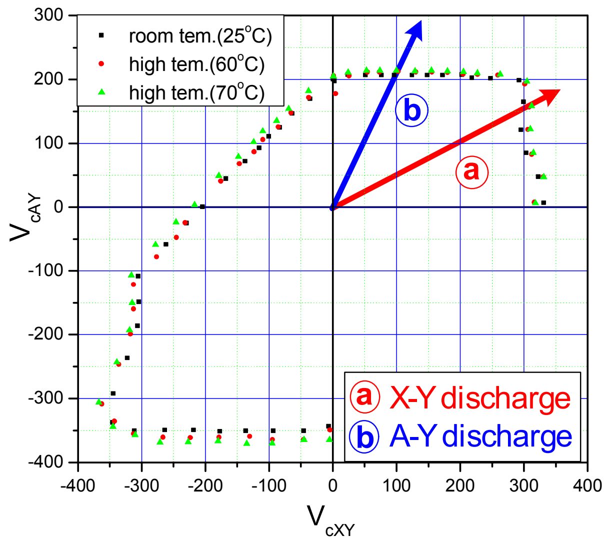
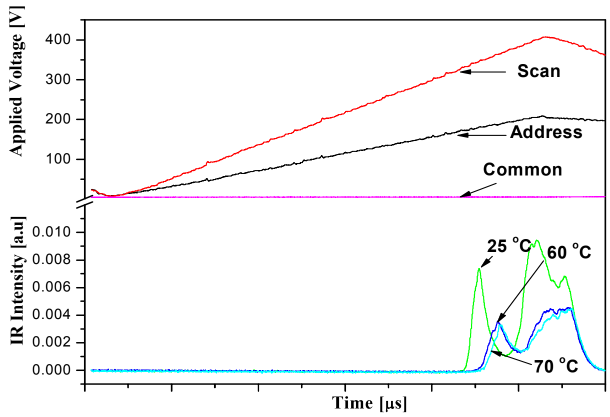


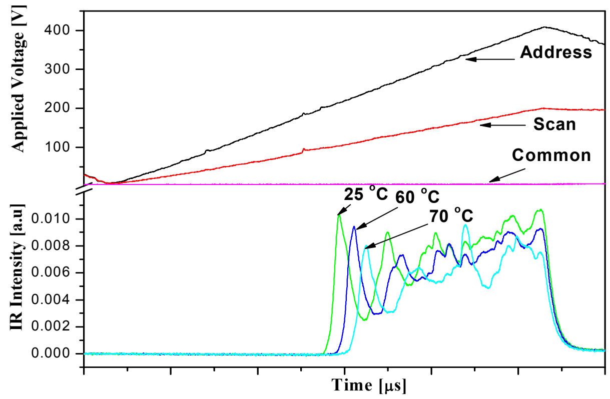
Fig. 2. Vt close curves measured from 42-in. panel when ambient temperatures were 25, 60, and 70 °C, respectively.

Ⅱ. OBSERVATION ON DISCHARGE CHARACTERSTICS UNDER VARIABLE AMBIENT TEMPERATURES

Fig.1 shows the schematic diagram of the experimental setup for measurement. The 42-in. panel with a gas mixture of Ne-Xe (15 %)-He (35 %) and a working



(a) X-Y discharge



(b) A-Y discharge

Fig. 3. Light waveforms emitted from discharge cells at various ambient temperatures: (a) X-Y discharge, and (b) A-Y discharge.

Table 1 Changes in working gas pressure relative to variable temperatures.

Temperature	25 °C	60 °C	70 °C
Pressure	450 Torr	503 Torr	518 Torr

gas pressure of 450 Torr was employed in this research, and its structure and dimensions were the same as the conventional 42-in. wide XGA grade PDP with a box-type barrier rib. The ambient temperature was varied from 25 to 70 °C by the temperature test chamber. To avoid the influence of the ambient temperature on the electronic circuit, all electronics were positioned out of the temperature test chamber.

Fig.2 shows the Vt close-curves measured from the 42-in. panel when the ambient temperatures were 25, 60, and 70 °C, respectively. As shown in the arrows of ⓐ and ⓑ in the Vt close-curves of Fig. 2, the measured Vt close-curve shows that the firing voltage of a surface discharge (case ⓐ) and the plate gap discharge (case ⓑ) is increased when the ambient temperature is raised. The firing voltage fluctuations are 9V for a surface discharge and 5V for a plate gap discharge, respectively,

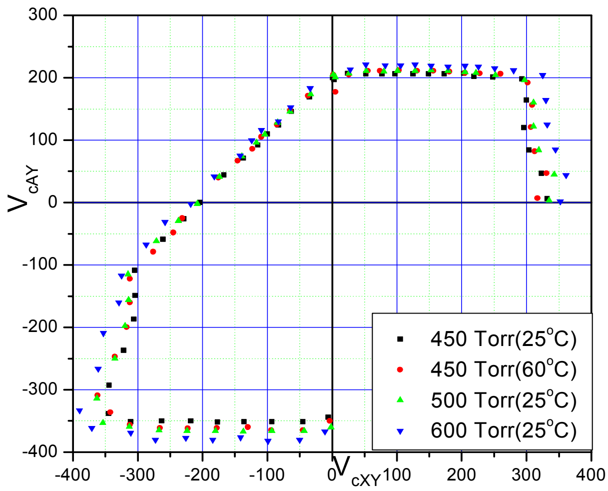


Fig. 4. Vt close-curves measured from 42-in. panel at various ambient temperatures and working gas pressure

when the ambient temperature rises from 25 to 60 °C. Figs. 3 (a) and (b) illustrate the test pulses for measuring separately the IR emission from (a) the surface (X-Y) discharges and (b) the plate gap (A-Y) with a variation in the ambient temperature, respectively. The initial wall charges were completely removed by the erase pulse, and the application time of the detecting ramp pulse was delayed enough to remove the priming particles. After that, the detecting ramp pulses were applied to produce only the A-Y discharge in (a) and only the X-Y discharge in (b), and the resultant IR emissions were measured for both cases. For the A-Y and X-Y discharges, the discharge initiation time in the high temperature was slower than in the room temperature, and the discharge intensity in the high temperature was weaker than that in the room temperature.

Ⅲ. RELATIONSHIPS BETWEEN AMBIENT TEMPERATURE AND WORKING GAS PRESSURE

One of the main causes of the increase in firing voltage at a high temperature may be due to the increase in working gas pressure. Relationships between the gas pressure (P) and temperature (T) should be expressed by the ideal gas equation (1).

$$PV = nRT \quad \cdots\cdots\cdots\cdots \ (1)$$

where P: pressure, V: volume, n: quantity of gas, R: proportionality constant, T: temperature.

Consequently, the working gas pressure increases as the ambient temperature rises under a fixed volume condition. From this equation (1), the change in working gas pressure at 53 Torr was estimated when the temperature rises from 25 to 60 °C, as shown in Table 1. Fig. 4 shows the Vt close-curve measured from the 42-in. panel at various ambient temperatures and working gas pressures. The measured Vt close-curve shows the firing voltage in 450Torr at a high temperature (60

Table 2 Changes in discharge starting voltage among three electrodes relative to variable ambient temperatures and working gas pressure.

	X-Y discharge	A-Y discharge	Y-A discharge
25 °C (450Torr)	300V	206V	350V
60 °C (450Torr)	309V	211V	361V
70 °C (450Torr)	312V	214V	369V
25 °C (500Torr)	311V	211V	365V
25 °C (600Torr)	330V	219V	380V

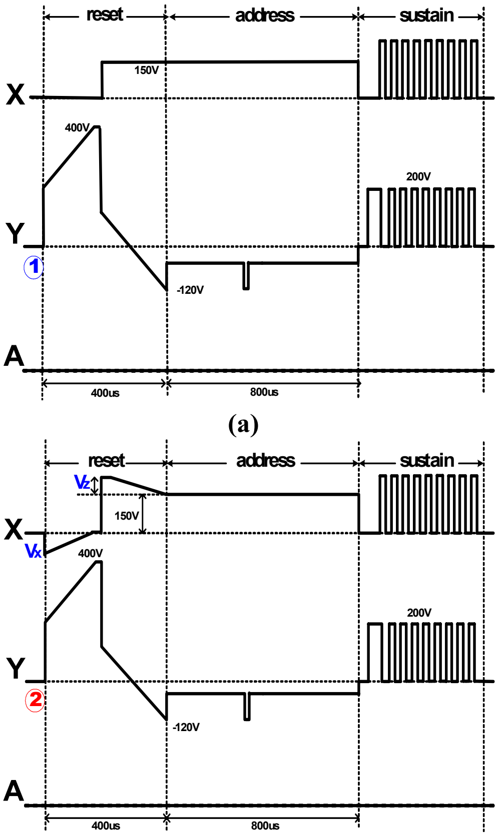


Fig. 5. Schematic diagram of (a) conventional reset waveform and (b) proposed reset waveform with ramp-type X bias.

°C) is similar to that in 500 Torr at room temperature (25°C). More detailed data are shown in Table 2.

IV. MODIFIED RAMP-RESET WAVEFORM ROBUST FOR VARIABLE AMBIENT TEMPERATURE

Fig. 5 (a) shows the conventional reset waveform and Fig. 5 (b) shows the proposed reset waveform with ramp-type X bias for minimizing the variation in the discharge characteristic with the ambient temperature.

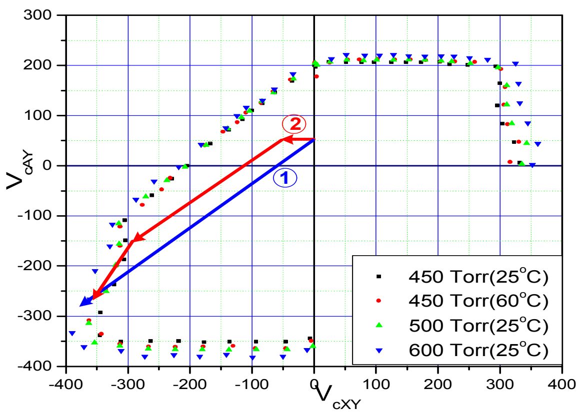
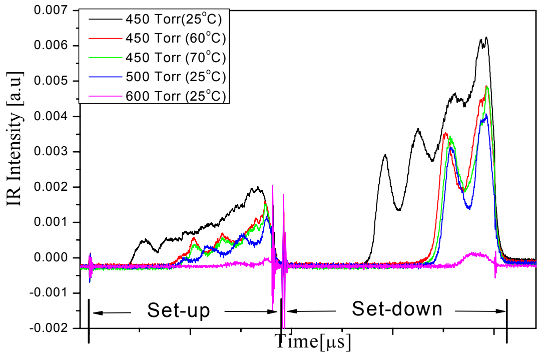


Fig. 6. Analysis of reset waveform using Vt close-curve.

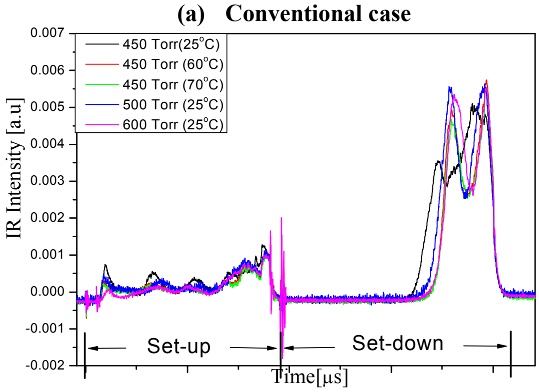
The basic idea of the proposed reset waveform is to maximize the plate gap discharge by minimizing the contribution to the surface discharge for accumulating a sufficient amount of wall charges on the address electrode. As shown in the Vt close-curve of Fig. 6 measured at point ① in the case of applying the convention ramp waveform in Fig. 5 (a), the Y-X discharge is produced as the voltage applied to the Y electrode increases, and many weak Y-X discharges are produced until the discharge point reaches the simultaneous discharge point. In this case, the Y-X and Y-A discharges do not occur sufficiently at a high temperature due to the increase in the firing voltage, which causes an insufficient accumulation of wall charges on the address electrode. On the other hand, as shown in the Vt close-curve of Fig. 6 measured at point ② in the case of applying the proposed ramp waveform in Fig. 5 (b), the Y-X discharge is produced at the lower side of the Y-X discharge side due to the ramp-type X bias applied to the X electrode, and as such relatively only a few weak Y-X discharges are produced until the discharge point reaches the simultaneous discharge point. Vx is applied to the X electrode to produce surface Y-X discharge for a stable reset discharge and the ramp-type X bias is to maximize the plate gap discharge by minimizing the contribution of the surface discharge for accumulating wall charges on address electrode sufficiently.

V. EFFECTS OF PROPOSED RESET WAVEFORM WITH RAMP-TYPE X BIAS ON ADDRESS DISCHARGE RELATIVE TO AMBIENT TEMPERATURE

Fig. 7 (a) shows the IR emission during the reset-period measured at different ambient temperatures and different working gas pressures when applying the conventional reset waveform. At high temperature and high working gas pressure, the reset discharge is produced slower and the total amount of the IR emission during the reset period is decreased. On the other hand, in the case of applying the ramp-type X



(a) Conventional case



(b) Proposed case

Fig. 7. IR waveforms measured during reset discharges at various ambient temperatures and working gas pressure.

bias, the difference in the IR emission caused by the ambient temperature tends to be minimized, as shown in Fig. 7 (b). As a result, there seems no difference in the IR emission during the address discharge when applying the proposed reset waveform, even though the address discharge intensity at high temperature and high working gas pressure are reduced when applying the conventional reset waveform, as shown in Figs. 8 and 9.

VI. CONCLUSION

From a viewpoint of the discharge instability, the investigation on the relation between the discharge characteristics and the ambient temperature is very important. This paper describes the experimental observation on the changes in the surface or plate gap discharge relative to the ambient temperature ranging from 25 to 70 °C and the working gas pressure. It is observed that the firing voltage increases at a high temperature due to the increase in working gas pressure. The modified reset waveform, which can maximize the plate gap discharge to accumulate a sufficient amount of wall charges on the address electrode, is proposed. The experimental observation confirms that the proposed reset waveform can produce a stable address discharge irrespective of the ambient temperature.

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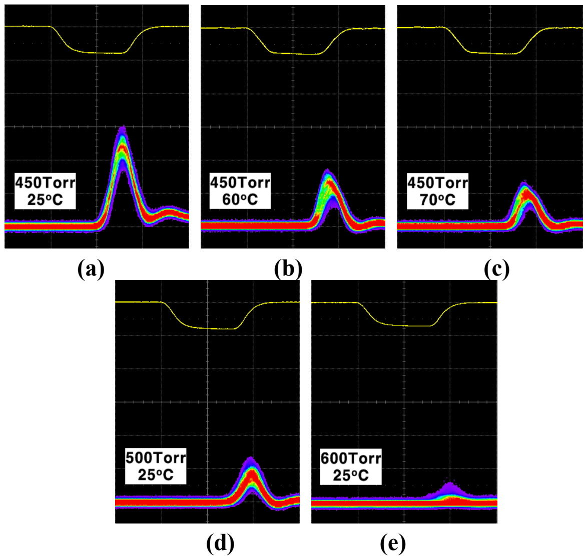

Fig. 8. IR waveforms measured during address discharge when applying conventional reset waveform of Fig. 5 (a).

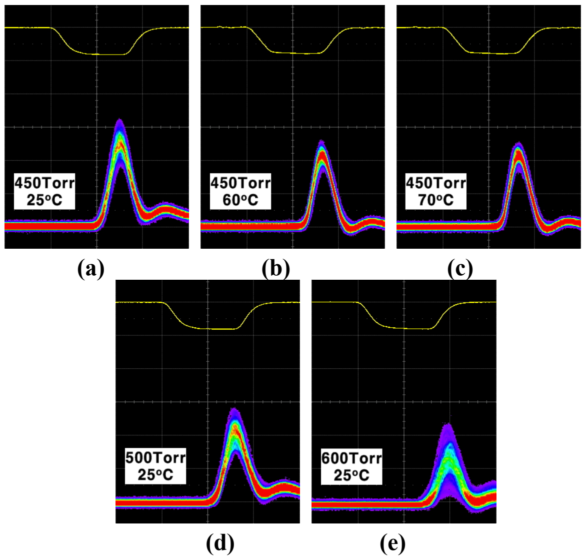

Fig. 9. IR waveforms measured during address discharge when applying proposed reset waveform with ramp-type X bias of Fig. 5 (b).

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