Relationship between Image Retention and Time Lag in an AC PDP

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Abstract

Characteristics of dark image retention and address discharge time lag were investigated simultaneously. It was found that reset waveforms with low black luminance did not guarantee lower image retention. Improved address discharge time lag due to modified reset waveforms similarly did not show improved image retention. The address discharge time lag and the image retention are in a trade-off relation.

1. Introduction

AC plasma display panels (PDPs) have been widely used as large size television screens and information display devices. Although they offer good picture quality including the realization of colors that are almost identical to those of nature, several types of image defects must still be resolved. In particular, image retention poses a barrier to the continuous display of high quality images in AC PDP TVs and information displays. After a few minutes of an iterant strong discharge, the breakdown voltage during the reset period lowers partially [1]. As a result, even though the same waveform is applied to each pixel, pixels undergoing iterant strong discharge have different luminance from other pixels. This phenomenon causes a residual image in the following image, resulting in distortion of the image. Although there have been many attempts to figure it out [2,3,4,5], a precise understanding of the mechanism of the image sticking phenomenon has thus far proved elusive. In the meantime, address discharge time lag is another important obstacle to realizing high resolution. The wall charge distribution after the reset period (at the beginning of the address discharge) influences the address discharge time lag. In this work, the relationship between the image retention and address discharge time lag, both of which are strongly related to the reset discharge, is investigated. The image retention phenomena are measured by a technique proposed in our previous work [6].

2. Results and discussion

A 6-inch diagonal test panel with a Ne+5%Xe gas mixture as the discharge gas was used for the experiment. The test panel was driven by the conventional ADS method with 100 kHz sustain pulses. The duty factor of the sustain pulses was 30%. The image retention phenomena of black luminance were observed as reset waveforms during the reset period were varied. Fig. 1 shows various reset waveforms applied to the scan and common electrodes during the reset period. In our previous work [6], it was found that the case with the lowest luminance for dark image resulted in the smallest quantity of image retention. Based on these results, it was determined that three proposed waveforms showed lower black luminance compared to that of conventional waveforms.

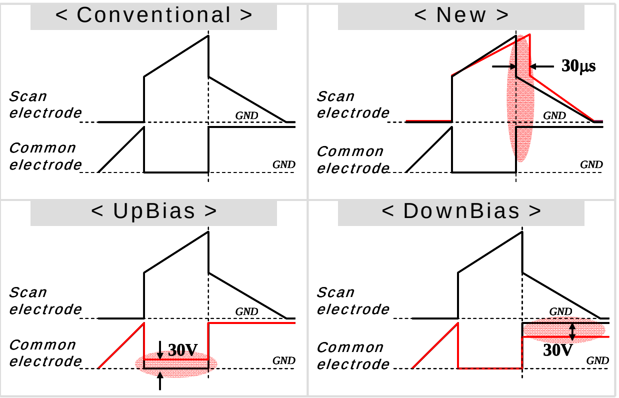


Fig.1 Various reset waveforms for reducing black luminance

In the first modification of the reset waveforms, referred to here as “New” waveforms, the duration of the reset-up and - down period was changed. An enlarged reset-up period yields a more gradual ramp-up pulse slope, which in turn results in a weaker reset discharge during the reset-up period. In this case, the enlarged reset-up affected the black luminance more than shortened reset-down period did. Although the slope of the reset-down pulse became steeper, the reset-down period was shortened and, finally, a lower luminance value was obtained for the dark image.

In addition, based on variation of the bias voltage applied to the common electrode, “UpBias” and “DownBias” waveforms were proposed. The voltage drop between the scan electrode and common electrode can be reduced by varying the bias voltage. Therefore, the discharge during the reset period becomes weaker and the luminance of the dark image is lowered compared to that of the conventional waveform. The amounts by which the values are varied are determined when the test panel is confirmed to have a sufficient voltage margin and good addressability.

Fig. 2 shows the luminance of the dark image of each case. As expected, the luminance for each of the proposed three types of waveforms was lower than that of the conventional waveforms. The proposed waveforms produced 30% less luminance compared to the conventional reset waveforms.

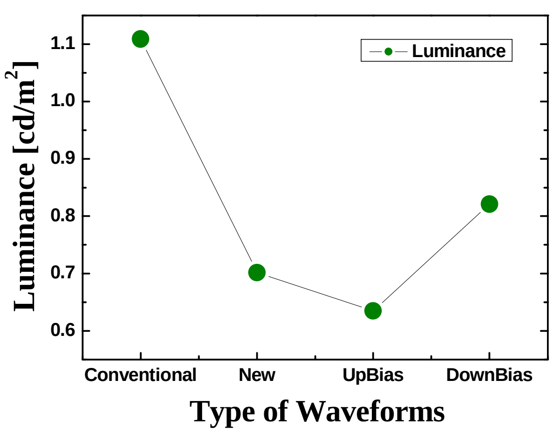


Fig. 2 Luminance of the dark image for the proposed reset waveforms

Fig. 3 shows the image retention obtained from the measurement of dark luminance for each case. Contrary to the prediction that lowered black luminance would result in less image retention, all three cases showed higher temporal sticking, which is defined as the difference in the black luminance (percentage to the reference value) between before and after iterant strong discharge. Due to this increase in temporal sticking, longer time to recover was needed. Here, the retention time is defined as the time when the luminance recovers to 63%. This result indicates that a decrease in the black luminance does not mitigate the image retention phenomenon.

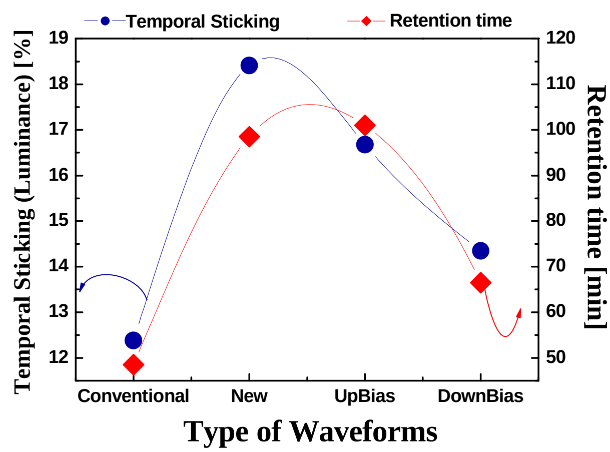
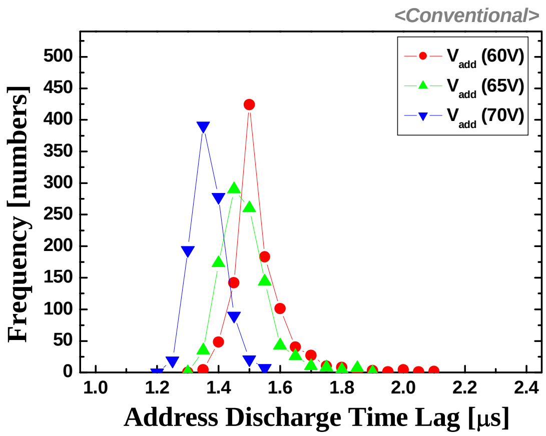
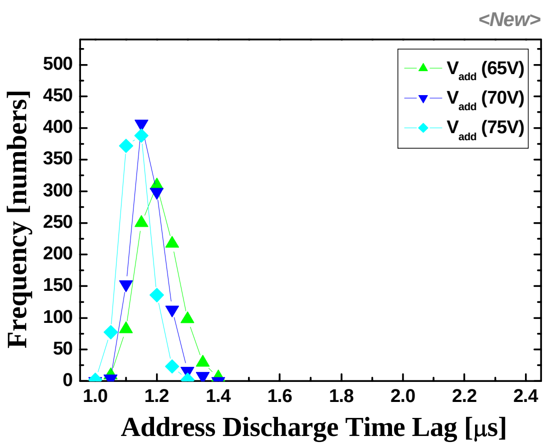


Fig.3 Quantity of temporal image sticking and retention time for the proposed reset waveforms

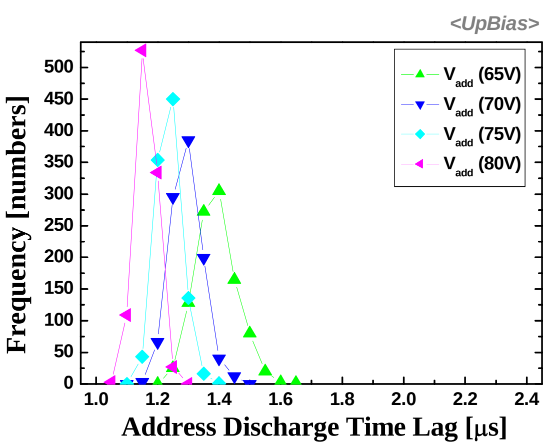
Fig. 4 shows statistical data of the address discharge time lag with the same level of sustain pulses for each case. For the “New” and “UpBias” waveforms, the available address pulse voltage was slightly higher than that of the conventional case. However, for both the “New” and “UpBias” waveforms, the statistical distribution of the address discharge time lag was sharper and located more to the left side in the graph compared to the case of conventional waveforms. Additionally, the address voltage margin of the address pulse is widened when “New” and “UpBias” reset waveforms are adopted. Figs.4(b) and (c) indicate that the “New” and “ UpBias” waveforms can reduce the address discharge time lag and produce a more stable address discharge. In the meantime, the address discharge time lag of the “DownBias” waveform is worsened. The distribution of the address discharge



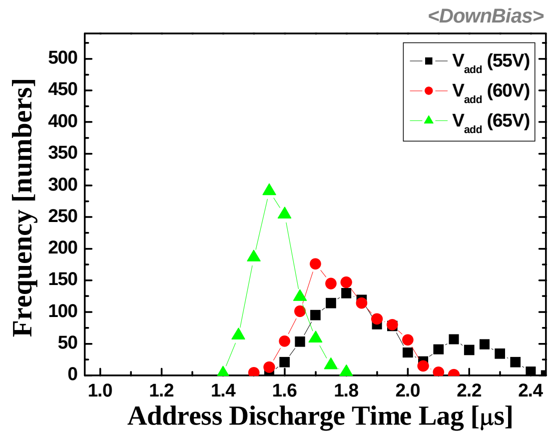
(a)



(b)



(c)



(d)

Fig. 4 Distribution of address discharge time lag (a) Conventional waveforms (b) New waveforms (c) UpBias waveforms (d) DownBias waveforms

time lag was broader and shifted to the right-hand side compared to that of the conventional waveforms. This illustrates that the “DownBias” waveforms require more time to start the address discharge.

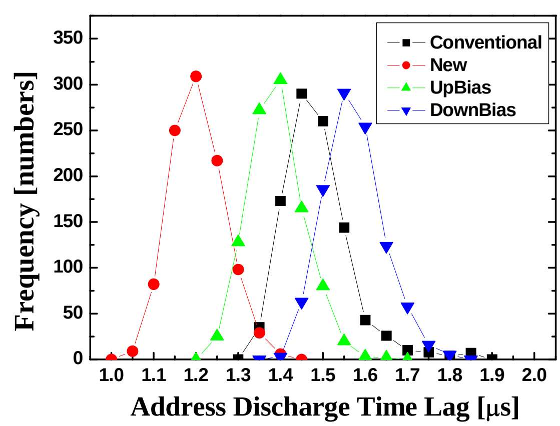


Fig. 5 Distribution of address discharge time lag at an address pulse voltage of 65V in accordance with various reset waveforms

Fig.5 shows the distribution of the address discharge time lag at an address voltage of 65V in accordance with various reset waveforms. In Fig.3, “New” and “UpBias” waveforms show increased temporal sticking and longer retention time, thus indicating that the image retention phenomenon is exacerbated compared to conventional waveforms. On the other hand, the characteristics of the address discharge time lag were improved, as shown in the case of the “New” and “Upbias” waveforms in Fig.5. For the “DownBias” waveform, the time lag was not improved. However, the image retention time was not significantly different from that of the conventional waveform. From the results, it is found that reset waveforms that improve the address discharge time lag require more image retention time.

3. Conclusion

Both image retention and address discharge time lag are affected by the reset discharge. In this work, both characteristics were observed simultaneously in accordance with various reset waveforms. Three types of modified reset waveforms were proposed to reduce the black level luminance. In cases of “New” and “UpBias” reset waveforms, even though their absolute values of black luminance were smaller than that of conventional waveforms, the quantity of temporal sticking was greater than that of conventional waveforms. However, the address discharge time lag obtained using “New” and “UpBias” reset waveforms was shorter than that of conventional waveforms. The experiment results imply that reset waveforms with low black luminance do not guarantee lower image retention.

To summarize, it can be said that the image retention phenomenon and the address discharge time lag are in a trade-off relationship. As such, it is difficult to improve both characteristics by simply changing reset waveforms.

4. References

[1] T.Kosaka, K.Sakita, K.Betsui, “Firing Voltage Fluctuation Phenomenon Caused by Gas Density Nonuniformity in PDPs”, IDW’05, pp.1469-1472, 2005.

[2] S.H.Kim, K.C.Choi, and B.J.Shin, “Study on image Retention in an AC Plasma Display Panel”, IMID’05, pp.259-262, 2005.

[3] J.W.Han, H.S.Tae, B.J.Shin, S.I.Chien, D.H.Lee, “Experimental Observation of Temperature-Dependent Characteristics for Temporal Dark Boundary Image Sticking in 42-in AC-PDP”, IEEE Trans. Plasma Science, Vol.34, No.2, pp.324-330, 2006.

[4] B.J.Shin, K.C.Choi, H.S.Tae, J.H.Seo, J.U.Kim, J.W.Han, “Case Studies on Temperature-Dependent Characteristics in AC PDPs”, IEEE Trans. Plasma Science, Vol.33, No.1, pp.162-169, 2005.

[5] H.S.Tae, J.W.Han, S.H.Jang, B.N.Kim, B.J.Shin, B.G.Cho, S.I.Chien, “Experimental Observation of Image Sticking Phenomenon in AC Plasma Display Panel”, IEEE Trans. Plasma Science, Vol.32, No.6, pp.2189-2196, 2004.

[6] Y.S.Do, K.C.Choi, “Relationship between IR Emission of Reset Discharge and Image Retention in an AC PDP”, IDW’06 Digest, pp.1109-1112, 2006.