High Speed Driving Technique in AC PDPs

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Abstract

The new self-priming addressing driving scheme was proposed to improve an address discharge time lag. It utilizes the priming effect maintaining the priming ramp discharge during an address period and the address discharge time lag is significantly improved. In this study, the basic characteristics of the priming ramp discharge are presented.

1. Introduction

Due to the recent progress of PDP technologies, image qualities have been significantly improved and set prices have been greatly reduced. However, several critical issues remain in order to expand the consumer market. The high speed addressing technique is one of the most critical technologies which enable the PDP to improve the image quality, especially, in a High-Definition display format. Accordingly, many studies have been carried out to improve an address discharge time lag.[1]-[5]

It is well known that the priming effect is very essential to a high speed addressing technique; however, it was difficult to utilize the priming effect without any critical expense. In this paper, the new self-priming addressing driving scheme was proposed to improve an address discharge time lag. It utilizes the priming effect maintaining the priming ramp discharge during an address period and the address discharge time lag is significantly improved. In this study, the basic characteristics of the priming ramp discharge are presented.

2. Self-Priming Addressing Driving Scheme

It is well known that the priming effect is significantly influence on the statistical discharge time lag and that of a sustain discharge assisted by the strong priming effect is virtually zero. However the strong priming discharge makes the contrast ratio worsen. So, the only feasible candidate might be a weak priming ramp discharge.[6] Fig. 1 shows the discharge time lag on the dependence of priming effect due to the weak ramp reset discharge, where the interval means time from the end of the reset period to the instant of scan pulse and the Va means an address voltage. The statistical time lag(Ts) is significantly reduced within 20us time scale; furthermore the priming effect makes significantly reduced the statistical time delay even if the address voltage is low. Consequently, the priming effect is one of the best options for a high speed and low voltage addressing technique.

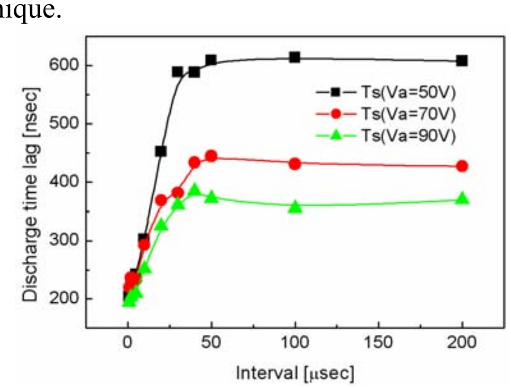


Fig. 1. Statistical time lag of an address discharge as a function of the interval from the end of the reset period to the instant of scan pulse.

<u>1) Concept of self-priming addressing</u>

Fig. 2 shows the schematic diagram of the proposed self-priming addressing(SPA) driving waveform, which mainly studied in this study. The key concept is to continually maintain the ramp reset discharges during an address period. In other words, after a reset period, the negative priming ramp pulse [-Vyr(AD)] is still applied to the scan electrode (Y-electrode) so that the priming ramp discharge(PRD) is maintained during the address period. Therefore, the SPA driving scheme can be regarded as the address during the reset period.

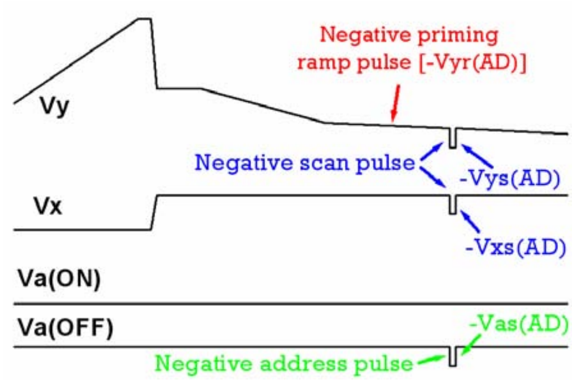


Fig. 2. Proposed SPA Driving Scheme.

2) New negative address pulse method

In the conventional scan method, a positive bias voltage is applied to the Y-electrode which resulting in ceasing a ramp reset discharge. Therefore, in order to maintain a ramp reset discharge during an address period, the bias technique applied to the Y-electrode can not be used and the continual ramp pulse is applied to the Y-electrode as previously described. However, the slope of a conventional ramp pulse is too large, so the slope of a ramp pulse should be changed as low. Accordingly, the negative scan pulse[-Vys(AD)] applied to the Y-electrode makes the address discharge to turn on the pixels. In order to turn off the pixels, the negative address pulse [-Vas(AD)] should be applied to the A-electrode when the -Vys(AD) is applied to the Y-electrode.

However, after a reset period, since the cell voltages are set to the simultaneous discharge point, the -Vys(AD) generates the discharge between the X and Y-electrodes, regardless of the address voltage. There might be various methods to prevent to generate the XY discharge due to the -Vys(AD) and two feasible methods[1) X-scan method and 2) X-bias method] are presented in this paper. The negative scan pulse[-Vxs(AD)] is applied to the X-electrode when the –Vys(AD) is applied in the X-scan method. In the X-bias method, the bias voltage is applied to the X-electrode during the address period. The additional scan drive ICs are needed in the X-scan method and the X-electrode is difficult to use for maintaining the PRD during the address period in the X-bias method. In this study, the X-scan method is only presented.

3) Maintaining of priming ramp discharge

There are a lot of methods to maintain the PRD during the address period such as XY, AY, AX-ramp discharge or its combinations. By the intuitional consideration of a address operation, the voltage of the A-electrode is frequently changed as the pixel's turn on and off condition during an address period. On the contrary, the voltage of the X and Y-electrode is always same before the scan operation. Therefore, the maintenance of the XY-PRD is regarded as best option for stable addressing operation and it is studied in this study. However, the A-electrode plays a very important role to maintain the PRD in the primary study, which will be studied as the next topic in detail.

3. Results and discussion

The cell structure of the 7-in test panel is conventional reflective three-electrode surface discharge type used in this study. The address discharge time lag (AD TL) was measured from the accumulated 2000 address discharges using the photo sensor amplifier.

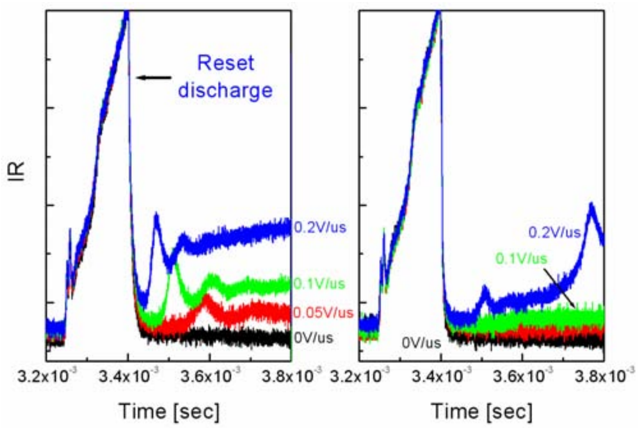
In general, the proposed new negative address pulse method is basically same operation mechanism comparing with a conventional positive address pulse method. One of the differences is the ignition method of an address discharge. In the conventional method, the address discharge is generated by the combination of a positive address voltage applied to the A-electrode and negative scan voltage applied to the Y-electrode. On the contrary, it is generated by the only negative voltage applied to the Y-electrode in the proposed method. Therefore, it might be expected slightly reduced the AD TL.

1) Basic characteristics of priming ramp discharge

A. IR emissions of PRD

Fig. 3 (a) shows the IR emissions of the PRD on the dependence of the slope of the negative priming ramp pulse[-Syr(AD)] applied to the Y-electrode during the address period. Therefore, both the XY and AY-PRD are continually maintained during the address period. As shown in Fig. 3 (a), it is increased as the -Syr(AD) is increased and it is extremely weak when the –Syr(AD) is around 0.05V/us, which is suspicious of the effect of the PRD. Consequently, it plays a significant role in reducing the AD TL, which will be described in later.

The noticeable phenomena can be founded that the IR emissions are abruptly changed in the initial address period. It is mostly due to the abrupt change of the slope of the ramp pulse and needs further study. However, by the intuitional consideration, it would be greatly reduced as applying the dual(or multiple) or nonlinear (exponential) slope of a reset ramp pulse or priming ramp pulse. And also, one of the possible solutions is utilizing the priming effect of the reset discharges because the priming effect influences within a 20us time scale as shown in Fig. 1, which will be further discussed in later.



(a) (b)

Fig. 3. IR emissions of priming ramp discharges on the dependence of the -Syr(AD) during address period. (a) The voltage of the A-electrode is maintained same voltage after reset period. (both XY and AY-PRD) (b) The negative address voltage is applied to the A-electrode during the address period will be discussed later. (XY-PRD)

B. Background luminance of PRD

One of the potential problems is a background luminance of PRD in the SPA driving scheme which is important to image quality. It can be easily inferred that the luminance generated by the PRD is weak which is comparable to reset discharges as shown in Fig. 3. Based on the experimental results under the various reset conditions, the maximum luminance due to the PRD is estimated around 0.7 cd/m2 in the case of 0.1 V/us when the number of sub-fields is 10 and the address period is 800usec. However, in practical situation, it would be greatly reduced because the PRD is terminated when the address discharge is occurred.

However, there is another problem. The PRD is only stably maintained when the reset discharge is generated during the reset period. Therefore, conventional driving scheme using the selective erasing method would be modified at the expense of increasing the background luminance because the pixel previously turned off should be experienced in reset discharges. It would increase the negative ramp voltage applied to the Y-electrode during the reset period. One of the feasible solutions is the address bias reset method which provides shortcut to the simultaneous discharge point reducing the ramp reset time and negative ramp voltage.[7]

C. Address discharge time lag

As previously described, the main purpose of the SPA driving scheme is to improve the AD TL using the PRD. Accordingly, it is very important to investigate the AD TL as a function of the amounts of the priming particles. Fig. 4 shows the AD TL as a function of the –Syr(AD). Fortunately, the intensity of PRD is almost enough to maximize the priming effect when the –Syr(AD) is around 0.1 V/us, which is a safe condition in the viewpoint of the background luminance. And also the extremely weak PRD [-Syr(AD)=0.025 V/us] is significantly effective to improve the AD TL.

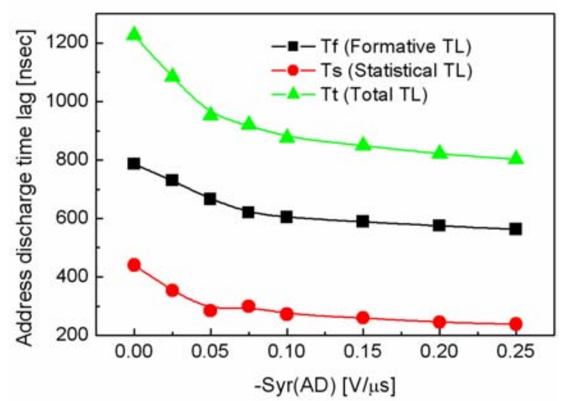


Fig. 4. Address discharge time lag as a function of the Syr(AD). [The AD TL is measured after the PRD is maintained during 200us.]

2) Basic feasibility test

In the general operating condition, it is expected that the driving stability of the SPA driving scheme might be improved, assisted by the priming effects, under the high and low temperature condition. However, in the SPA driving scheme, a lot of additional considerations is needed. In this primary study, basic feasibility test was carried out focused on the stability of the PRD.

A. Temporal stability of priming ramp discharge

As previously described in Fig. 3, the temporal behavior of the PRD is somewhat unstable which surely affect to the driving stability. Fig 5. shows that the IR emissions of the address discharges on the dependence of the interval which means time from the end of the reset period to the instant of the negative scan pulse applied to the Y-electrode. As shown in Fig. 5, the characteristic of the AD TL is quite corresponding to the IR emissions in Fig. 3. There are three noticeable changes. From 0us to 50us, the AD TL is increased due to the diminishment of the priming effect of the reset discharges as increasing the interval. From 50us to 100us, it is decreased due to the PRD as increasing the interval and it is almost same after 100us. However, the worst AD TL in the case of a 50us is also improved around 100ns comparing with that of a conventional condition (without priming effect). Of course, this temporal instability should be solved to guarantee the driving stability, and feasible solutions are mentioned previously. And also, one of the effective solutions is to adopt the variable scan width technique.

Considering the characteristics of the AD TL after 100us, it should be notice that the variations of wall voltage set-up condition due to the PRD might be not a critical problem if the stable PRDs (both the XY and AY-PRD) are continually maintained.

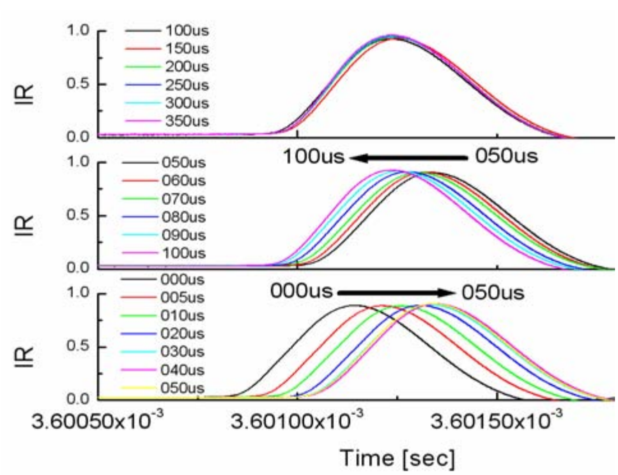


Fig. 5. IR emissions of address discharges on the dependence of the address interval from the initial address period [-Syr(AD)=0.1V/us]

B. Effect of negative address voltage

In the practical driving condition, the address voltage is frequently changed as the pixel's on and off condition. It would be a critical problem when the negative address voltage is applied to the A-electrode resulting in ceasing the AY-PRD and it might be also influenced on the XY-PRD, especially. Therefore, it was investigated that IR emissions of the PRD when the negative address voltage is applied to the A-electrode during the whole address period. In other words, only the XY-PRD can be maintained in this condition. As shown in Fig. 3 (b), though the intensity of the PRD is weakened, it still works.

It should be notice that the negative address voltage is generated weak discharge between the X and A-electrode, which is comparable to the ramp reset discharge, resulting in ceasing the XY-PRD under the certain condition. It is interesting that the occurrence of the XA discharge seems to improve the AD TL and it might be used in the X-bias method previously mentioned, however it is needed a lot of further study.

4. Summary

Based on the primary studies, the driving stability of the proposed driving scheme seems to be feasible under general operating conditions. However, there are a lot of additional works needed to guarantee the driving stability under various operation conditions. It might be not only challengeable work but also a lot of possible way to solve the problems.

Though, in this study, the priming ramp discharge is maintained by the negative ramp pulse applied to the Y electrode, there are a lot of methods to maintain it during the address period, such as a positive ramp pulse applied to the X and A-electrode or its combinations. And also one of the possibilities is surely related to the initial wall voltage setup condition of the address period. Furthermore, the weak discharge generated by the negative address voltage might be the one of the possible way to realize the high speed addressing.

5. Acknowledgements

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6. References

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