New Driving Method for High Contrast Ratio and Reduction of Reset Period of AC-PDPs

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Abstract

The ramp reset driving method proposed in [1] has been widely adopted because of its stability and high contrast ratio. However, when the conventional ramp reset method is used in PDPs of higher resolution, the long required time for reset often becomes a problem. In this paper, a new driving method that requires much less reset time and that significantly improves the contrast ratio is introduced. Using this new driving method, the required time for reset could be reduced to 150us from 350us of the conventional ramp reset method, and the contrast ratio is almost infinite because the luminance of the off-cell is almost zero.

1. Introduction

Thanks to the introduction of digital broadcasting and variety of contents, the interests and demands for the flat panel display have been increased. Among the flat panel display devices, the PDP has been expanding its market because it is relatively easy to make the PDP over 40 inches, because it is possible to realize the PDP of the same level of image quality as the CRT, and because the manufacturing process of the PDP is simple. However, for the PDP to be more popularized and to take more market share, it should resolve its problems such as low luminance efficiency, high production cost, and image quality.

The broadcasting of HDTV has been initiated. Thus, the display devices are required to be able to drive more vertical lines. In case of the PDP, as the vertical line increases, the required time for the scanning which is necessary in every subfield is proportionally increased. ecause the time for sustaining is reduced in higher resolution PDPs, the decrease in the image quality caused by back ground luminance becomes more significant. The weak discharges generated in the reset period which is necessary for stable addressing make the contrast ratio reduced and this problem is more significant in higher resolution PDPs.

In this paper, a new driving method based on the Address Display Separated (ADS) driving principle is introduced. In this new method, the reset period is significantly reduced compared to the conventional driving method and the contrast ratio is also significantly improved.

2. Conventional ADS Driving Method

Figure 1 shows the conventional ADS driving method adopting the ramp reset pulse. Every subfield is divided into the reset, address and sustain period. The reset waveform used in the reset period strongly affects the wall charge in the cells and thus the reset waveform strongly affects the addressing characteristic in the following address period.

In the conventionaldriving method, the ramp reset pulse is applied to the scan electrode. The major function of the reset period is to equalize the wall charge on the scan and sustain electrodes and to build up positive wall charge on the address electrodes throughout the panel [2-7]. Also, the address voltage necessary becomes fairly low in the case of using the ramp waveform in the reset period. The wall voltage induced due to the wall charge built in the cells in the reset period lowers the address voltage necessary in the address period.

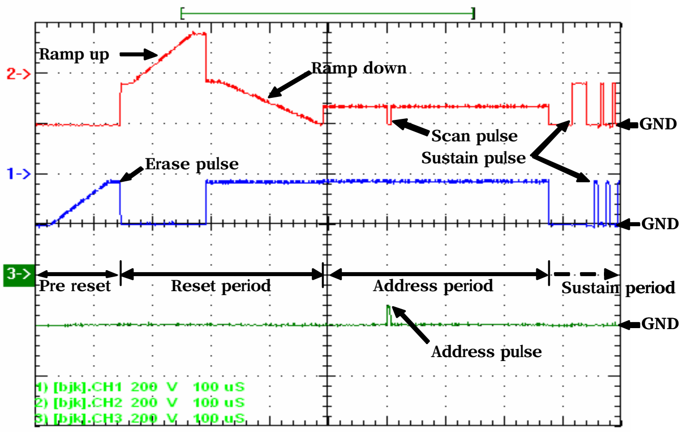


Figure 1. Conventional ADS driving method

Figure 2 shows the conventional ramp reset waveforms and the IR waveforms measured during the reset period. To reset the wall charge throughout the panel, the conventional ramp reset requires both the ramp up and ramp down periods. During the ramp-up period, the ramp voltage builds uniform wall charge in each cell throughout the panel. During the ramp-down period, the wall charges built on the electrodes are rearranged and the charges on the scan and sustain electrodes becomes almost same for effective addressing in the next addressing period. In consequence, right after the reset period, negative wall charges are accumulated on the sustain and scan electrodes and positive wall charge is accumulated on the address electrode. During the address period, each line is scanned line by line. When a line is scanned, the voltage on the scan electrode of the line is dropped to ground and a positive voltage is applied to the address electrodes of the columns to be addressed. In the next sustain period, a positive sustain pulse is first applied to the scan electrode and then the pulse alternates between the sustain and scan electrodes.

The conventional ramp reset requires both the ramp-up and ramp-down periods as explained above. Thus, the conventional ramp reset requires 350us. Furthermore, while the ramp reset performs the function described above, it is noticed from the IR measurements shown in Figure 2 that the ramp reset generates background luminance during both the ramp-up and ramp-down periods regardless of the previous state of the cell. This background luminance generated during the reset period is the main cause that limits the contrast ratio.

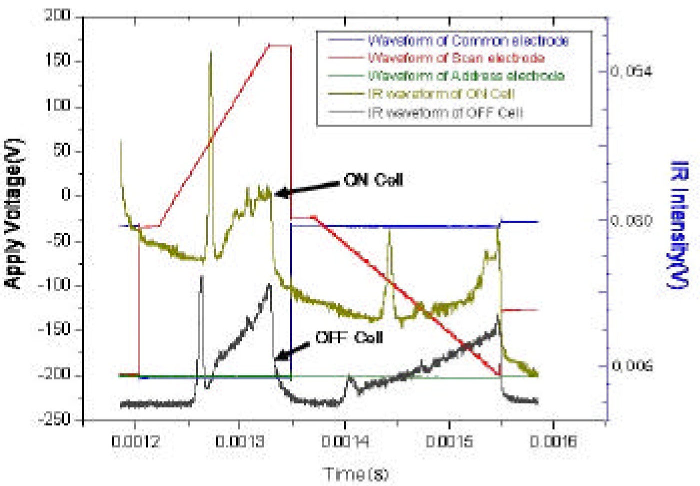


Figure 2. IR Waveform of Conventional Ramp Reset

3. New Driving Method

Figure 3 shows the simpler waveforms of the new driving method. In this new driving method, as shown in Figure 3, the ramp reset pulse is applied to the address electrode instead of the scan electrode and the reset pulse has only ramp-up period. Hence, the required time for reset is reduced to 150us from 350us of the conventional ramp reset.

In this new reset method, during the reset period, the scan and sustain electrodes are both grounded and only the voltage on the address electrode is ramped up. In this way, uniform wall charge distribution throughout the panel is obtained. Furthermore, because the voltages on the scan and sustain electrodes are kept same during the reset period, the wall charges on the scan and sustain electrodes become same at the end of the reset period. Thus, the ramp-down period that is required in the conventional ramp reset method is not necessary in this new ramp reset method.

Detailed analytical investigation of the new ramp reset method reveals that the reset of the cells that were off in the previous subfield does not generate even weak discharge. That is, the reset of the off-cells generates ideally no background luminance except the extremely low background luminance that is generated when the wall charge built in the off-cells in the previous reset period are slightly refreshed during the current reset period.

At the end of the reset period, the polarities of the wall charges on scan, sustain and address electrodes is exactly the opposite to polarities of the wall charges of the conventional ramp reset method. Thus, in the following address period, to address a cell to be turned-on, the voltage on the scan electrode should be positive relative to the voltage on the address electrode (in the conventional method, when a cell is addressed to be on, the voltage on the scan electrode is dropped to the ground and a positive voltage is applied to the address electrode). Because the addressing was done with a positive voltage on the scan electrode, in the following sustain period, a positive sustain pulse should be first applied on the sustain electrode.

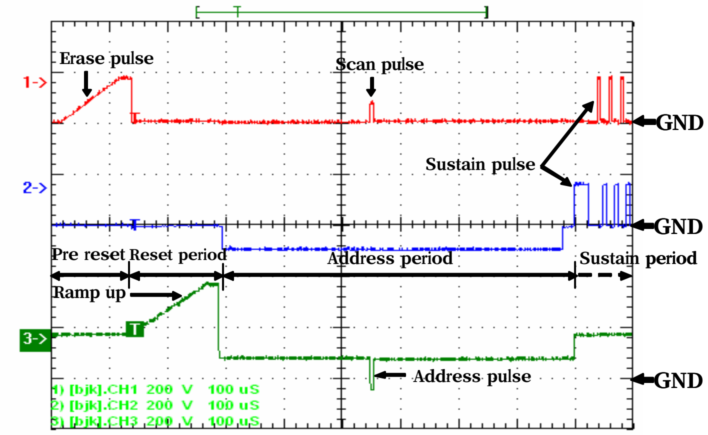


Figure 3. New driving waveform

Figure 4 shows the variation of the wall voltage during the reset period when the new reset method is used. The dotted lines in Figure 4 show the wall voltage variations of the on-cell and off-cell during the reset period respectively. The variation of the wall voltage of the off-cell is ideally none. Thus, the background luminance of the off-cell is ideally expected to be zero.

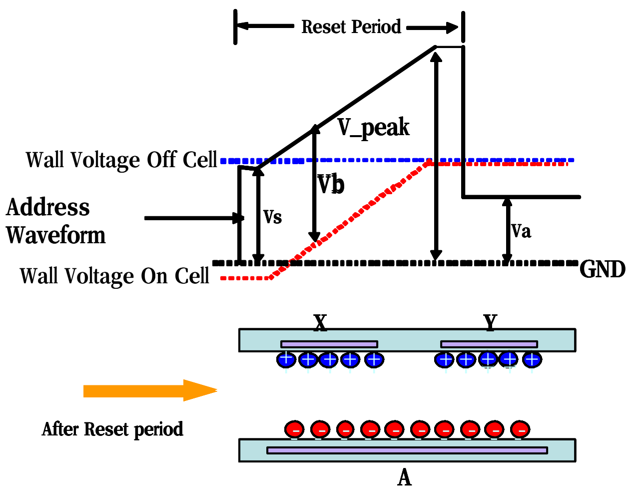


Figure 4. Wall voltage variation during reset period in new driving method

Figure 5 shows the new driving waveforms and measured IR waveforms of the on-cell and off-cell during the reset period. As we can see in the figure 5, there was no measurable background discharge when the new reset waveform was used.

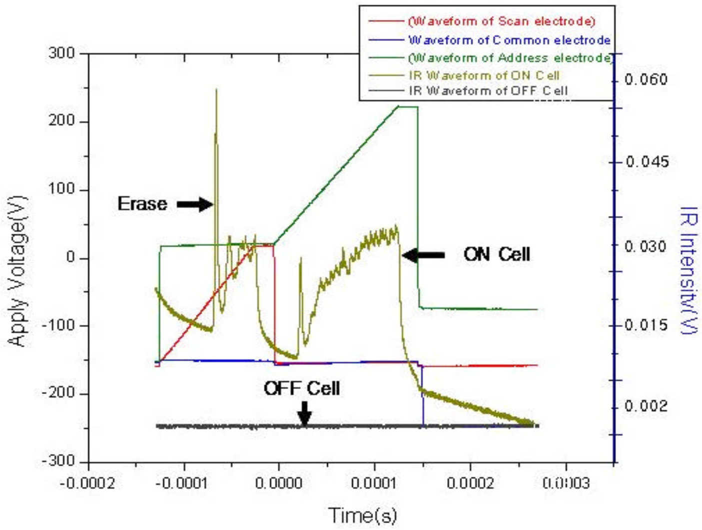


Figure 5. IR waveform of new ramp reset

Figure 6 shows the measured address discharge characteristic applying the new driving method. In the experiment, the width of the address and scan pulses was 5us. The voltage of the address pulse was -30V to and the voltage of the scan pulse was +80V. The sustain electrode was kept at -100V during the address period.

Figure 7 shows the IR waveform measured in the sustain period applying new driving waveform. As we can see in Figure 7, we applied the first positive sustain pulse to the sustain electrode. During the sustain period, in other to avoid the discharge between the scan or sustain electrode and the address electrode, we maintained the address electrode at 180V. From Figure 6 and Figure 7, we can see that the address and sustain discharge occur effectively employing the new driving method.

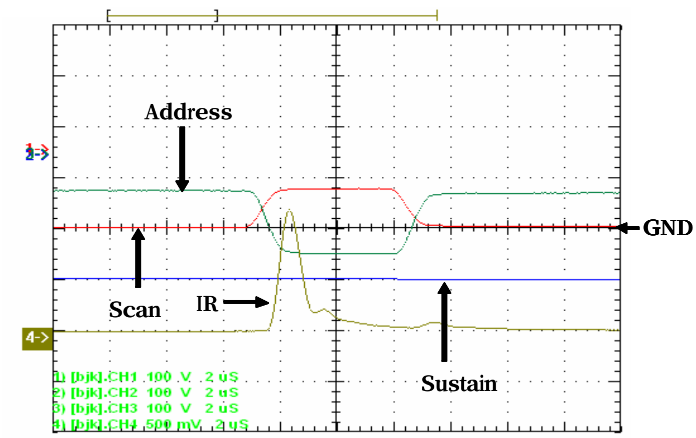


Figure 6. Address discharge of new driving method

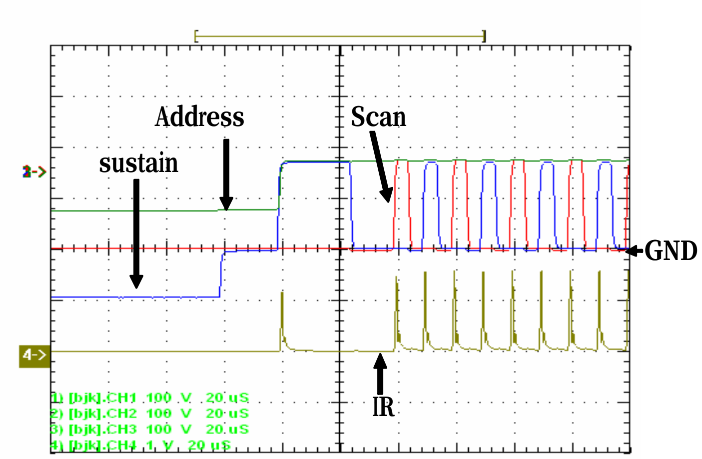


Figure 7. Sustain discharge of new driving method

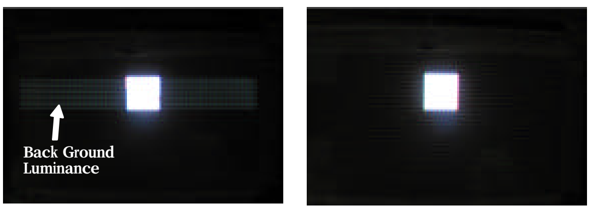
Figure 8 and Table 1 compare the measured characteristics of the conventional driving method and the new driving method. As we can see in Figure 8, the luminance of the off-cell was unnoticeable when the new reset method was used, while the luminance of the off-cell was easily noticeable when the conventional reset method was used. Table 1 compares and summarizes the performances of the conventional driving method and the new driving method proposed in this paper.

Table 1 & Figure8.
Comparison of conventional driving method and new driving method

	Conventional Driving Method	New driving Method
Maximum Reset voltage	390V	380V
Ramp up Pulse Slope	1.4V/us	1.33V/us
Back Ground luminance	1.143cd/m 2	none
Reset Period Length	350us	150us

Experimental condition

60frame/second
RGB - 4inch test panel
Vsustain=180V, Vscan=80V, Address Pulse Width= 5us



(a) Conventional **(b) New**

4. Conclusion

We introduced a new driving method for AC PDPs employing a new ramp reset method. The new driving method is simple and the required reset period could be reduced to 150us from 350us of the conventional ramp reset method. Furthermore, the dark room contrast ratio could be improved to almost infinite. It is expected that high resolution AC PDPs with clearer image can be simply made by employing this new driving method suggested in this paper.

5. Reference

[1] L. F. Weber, "Plasma display device challenges," in Proc. Asia Display '98, Sept. 1998, pp.15-27

[2] J-K Kim, J-H Yang, W-J Chung, and K-W Whang. "The Addressing Characteristics of an Alternating Current Plasma Display Panel Adopting a Ramping Reset Pulse". IEEE Trans. Electron Devices, August 2001, Vol.48, no. 8

[3] K. Sakita, K. Takayama, K. Awamoto, and Y. Hashimoto. "Analysis of a weak discharge of ramp-wave driving to control wall voltage and luminance in AC-PDPs", Proc. Soc. Inform. Display 2000, May 2000, pp.110-113

[4] Jun-Young Yoo, et al, "High Speed-Addressing Method for single-Scan of AC PDP," SID 01 Digest, pp.798~801, 2001.

[5] S.K. Lee et al, "Analysis of Priming Effect Using Vt Close Curve," IDW'02, 2002. pp.709~712

[6] T. Kishi, et al, " A New Driving Technology for PDPs with Cost Effective Sustain Circuit,"SID '01,2001,pp.1236~1239

[7] J. Ryeom, "The New Driving Scheme of Full TV Field Display for 42-in. WVGA PDP," SID'00, 2000,pp.738~741