Analysis and Optimization of Driving Waveforms in 25 inch SMPDP

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Abstract
A prototype of 25-inch SMPDP module had been developed by the end of 2004. Most driving technologies succeeded to those of the previous 34-inch SMPDP module .In this work, we make an optimization effort on the driving waveforms, especially for setup period. Long ramp waves show good wall voltage controllability, with which we can get a reliable addressing and better sustain stability.

1. Introduction
Plasma display panels promise to be an attractive solution for high-definition television (HDTV) home-theater applications. The technology of Plasma display panels has rapidly advanced in recent years and the PDP TV market is continuously growing. While the manufacturing cost is now the primary concern, there are also the significant research activities focused on improving the panel performance such as the efficiency, brightness and contrast ratio.

A novel AC PDP structure with shadow mask (SMPDP) was presented to introduce another way of low cost PDP. It can get rid of the manufactory process of barrier rib and replace with a metal plate with many small holes, which was called the shadow mask in the CRT industry. A single pixel of SMPDP, containing three discharge cells as sub-pixels, has a typical sandwich structure, as illustrated in figure 1. The three main components, including the front plate, the rear plate and the shadow mask, can be fabricated independently before sealed together with special alignment technology. Compared with the traditional coplanar PDP, we can see in SMPDP that only the scan electrodes are reserved in the front plate, the phosphors are painted on the inner wall of discharge cell in the shadow mask and the rear plate has almost the same fabrication processes with the front plate. The discharge cell structure of 25-inch SMPDP has been re-designed, which can provide larger display

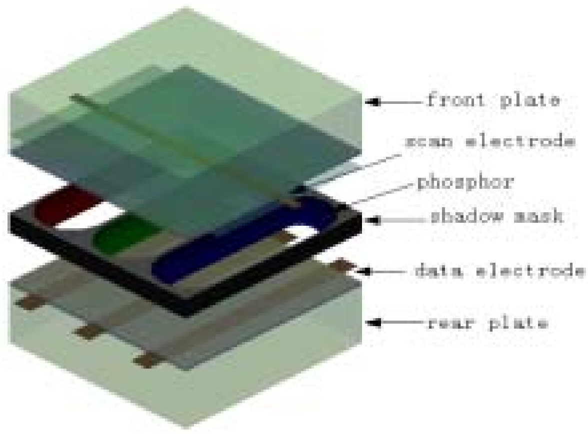

Figure 1 Sandwich structure of single SMPDP pixel containing three discharge cells

area and facilitate the panel fabrication.

2. Waveform design
The main problem of AC-PDP is luminosity, efficiency and cost. To improve electrical characteristics and luminosity of AC-PDP, driving scheme is very important. In 25 inch SMPDP, we use the Address Display-period Separation (ADS) technique to achieve 256 gray scales.

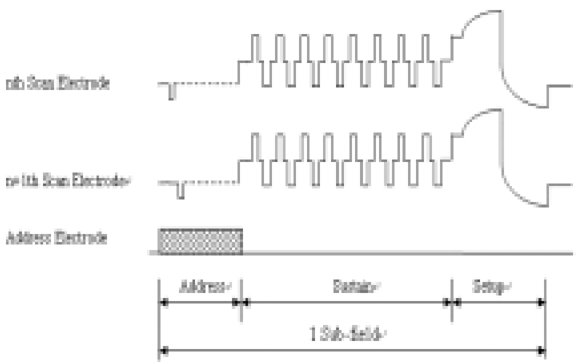

Figure 2 Driving waveform of 25 inch SMPDP during a single sub-filed

Each frame is composed of 8 sub-fields and each subfield is divided into three distinct periods shown in figure 2. The sustain period applies power to the on state pixels for display light emission. The address period switches which pixels will on in sustain period according to the image information. The setup period establishes necessary conditions for reliable addressing.

Next we will make discussions on waveform modification for setup, sustain and address period respectively.

2.1 Setup consideration

The voltage-controlled ramp waveform has recently been used prior to addressing for plasma display. The setup period establish two necessary conditions for reliable addressing. The first is a well established off state wall voltage and the second is adequate priming of the address discharge.

During the process of applying ramping up and down voltage between electrodes in a setup period, the discharge can be controlled for each cell regardless of cell structure or conditions.

Fig. 3 illustrates the detailed ramp waveform of 25 inch SMPDP. Where the V_{pu} is 100V, the V_s is 170V and the V_{pd} is 65 V.

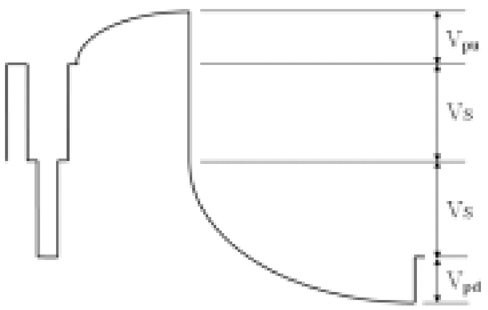

Figure 3 Setup waveform applied in 25 inch SMPDP

As shown in Fig. 4(a), The ON cells in preceding sub-field have a fixed wall voltage when entering into the setup period. During the ramping up phase, there is no discharge because the voltage across the gas was under the breakdown voltage Vb. Vb is an intrinsic device parameter of a PDP cell. During ramping down, as soon as the gas voltage reaches Vb, weak discharge occurs inside the cell. Once the discharge has initiated, the breakdown voltage Vb is maintained across the gas until the ramp stops rising or falling. So the wall voltage of ON state cells when entering the address period only determined by two parameters: V_b and $V_{pd.}$

Unlike the well defined ON state wall voltages, there is great uncertainty in the wall voltage of the OFF state. As shown in Fig.5, in the beginning of the setup period, two OFF state cells have different wall voltages, as the ramp voltage progresses, every cell will eventually discharge with their respective Vb

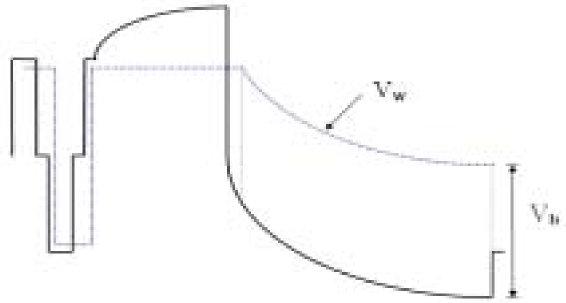

Figure 4 The wall voltage change of ON state cell

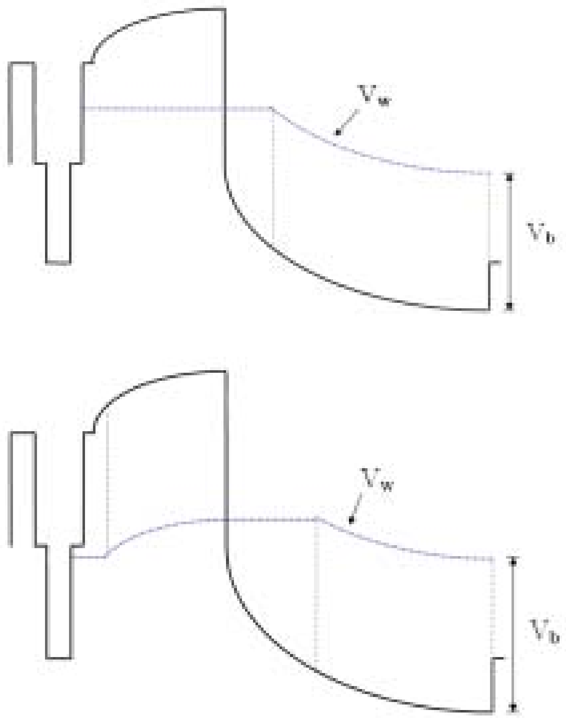

Figure 5 The different wall voltage change of OFF state cells

values appropriate for each individual cell. Such exact setting of the wall voltage during the setup is very practical because different input wall voltages result in only one output wall voltage. Another benefit is that no excess voltage is needed to cover any possible uncertainty in wall voltages.

To get precise wall voltage controllability, even when priming particles decrease, the low ramp rate is necessary. Also, this inequality should be met:

$$2V_s+V_{pu}+V_{pd} > 2V_b$$

In our experiment, when using the abnormal lower Vpu and Vpd, we can find some cells are flickering during sustain periods, especially some low gray levels cells. As we increase the amplitude of Vpd and Vpu, flickering cells disappeared gradually.

This discharge under ramp waves naturally emits low light. It establishes a high dark room contrast ratio.

2.2 Sustain consideration

SMPDP is a two electrodes, opposite discharge display panel. So sustain waveform used is the alternate positive and negative pulses and the voltage is 170V, the frequency is 166 KHz, and its duty ratio is 75%.

During our experiments, we found that the discharges induced by first two sustain pulses in each sub-field is not as strong as the rest discharges. They affect the subsequent discharges in the same sub-field. And even worse, they break up the gray levels continuity .So we decide to use 10 us wide pulse for first two sustain pulses in each subfield.

2.3 Address consideration

One of the crucial problems in ADS method is that it has a long addressing period. If the addressing time increases, the sustaining period for display image should be decreased. In 25 inch SMPDP, the width of data pulse is 1.5us.

Table 1 Detailed performance of 25-inch SMPDP

Diagonal Size	25 inch
Resolution	800×RGB×600
Pitch Size	0.22mm×RGB×0.66mm
Gas Mixture	Ne+20%Xe 450Torr
Gray Scale	256 level each color
Sustain Voltage	170V
Sustain Frequency	166K Hz
Address Pulse Width	1.5 μs
Luminance	500cd/m^2
Contrast	3000:1
Power Consumption	100W

3. Results

By applying the modifications both in fabrication and driving system mentioned above, the 25-inch SMPDP module has been developed and shows clear SVGA.

resolution video images, as shown in figure 6. The detailed performance is listed in the following table 1.

Figure 6 The 25 inch SMPDP module

4. Conclusions

Some modifications have been made in driving waveforms. Most works were focused on the optimization of setup period. Long ramp waves have been applied in controlling wall voltages.

Moreover, in order to compensate the insufficient discharges of first two sustain pulses in every sub-field, we use wider pulses instead. A prototype of 25-inch SMPDP with a SVGA resolution has been built. ADS driving scheme with 8 sub-fields, 166 KHz sustain pulse frequency, 1.5μs address time and new ramp setup period helped us to achieve a reliable addressing and better sustain stability.

5. Acknowledgements

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6. References

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