LGE's Strategy for PDP TV

Jae-Sung Kim, Sung-Hyun Lee, Sung-Yong Ahn, Young-Joon Ahn, Jae-Hwa Ryu and Kwang-Ho Yoon

PDP Research Lab., LG Electronics Inc., Gumi-city Gyoung Buk 730-702, Korea

Abstract

There have been various efforts to achieve a better PDP TV, which have low power consumption, high image quality and low price. As the results, the power consumption of LG's new 42 inch HD PDP could be lower than 42 inch LCD under the general movie display load condition. And the address discharge time lag of ~1 μs for 42 and 50 inch XGA single scan by which the cost can be reduced and image quality can be improved was achieved by using new MgO material and driving waveform. In addition, we have suggested TCA (Triangular Color pixel Arrangement) cell structure for realizing the full HDTV of 60inch diagonal size, which has 1920X1080 resolution. The luminous efficiency of the suggested TCA structure has been increased about 40% compared with that of the conventional cell structure.

1. Introduction

Screen size has been a major stimulant for the flat panel display industry since plasma displays(PDPs) were developed in the 1960's. While the number of display technologies being developed in the 100 inch range is increasing, forecasters are projecting competition will be hottest in the 40~50 inch range where displays will be widely available by 2006. And the leading candidates in the 40~50 inch range will be PDP and LCD. PDP and LCD offer consumer some overlapping benefits(both boast a flat, thin form factor and undistorted, fixed-pixel image rendering), and it is hard to say that which display has a better picture quality because both of PDP and LCD have a merit and demerit for picture qualities such as a luminance, contrast ratio, color gamut and viewing angle and so on [1]. From now, the most important factor that determines the winner in the future is the price. The price difference in 42 inch finished products is that PDP TV is over 70% more competitive than LCD TV and this gap will be maintained by the efforts of PDP side. The single scan technology is a good example of cost reduction technology in PDP.

When we compare the PDP and LCD, the most frequent issue is power consumption, and many people have a prejudice that the power consumption of LCD TV is lower than PDP TV. This prejudice should be verified in the actual user environment.

It is another recent issue for the large size display that the demand for full high definition(HD) display is also rising. Even though 55inch size full HD LCD TV has been already announced, PDP will have a hard time extending the 1920x1080 full HD resolution to 42~60inch screen sizes due to the inherent PDP cell structure that limits pixel density. Therefore, the structural modification of PDP cell is required for realizing the full HDTV.

In this paper, LCD and LG PDP (conventional and newly developed model) have been analyzed to wipe out the prejudice for the PDP power consumption through side-by-side comparison in the actual environment. And the single scan technology by which the PDP price can be more decreased and the image quality can be more improved is introduced. Finally, we have suggested TCA structure for realizing full HD PDP and investigated the electric-optical characteristics of TCA structure compared with conventional closed rib structure.

2. Improvement of LG PDP's competitive

2.1 Power consumption

It is not so easy to compare the power consumption of LCD and PDP because the power consumption of PDP is highly dependent on the APL(Average Picture Level). That is to say, the power consumption of PDP depends on the image load displayed. However, the power dissipated by an LCD is independent on the APL because the entire backlight must be lit even if only one pixel is on.

Fig. 1 shows the power consumption of 42inch LCD and LG PDP(conventional HD model and new HD model) as a various video signals. The resolution of the tested LCD is 1366x768 and that of PDP is 1024x768. Of course, for images that require a full white screen, the PDP will consume more power than the LCD. However, when operating on the general commercial broadcasting and movie signals which have low APL, a PDP can dissipate less power. Especially, the power consumption of our new model that will be launched soon for the movie signal is less than an LCD. The power consumption of LCD and our PDP as a function of the image load displayed is shown in Fig. 2 and in case of our new PDP model, the low power consumption is achieved by developing a new cell structure and gas mixture.

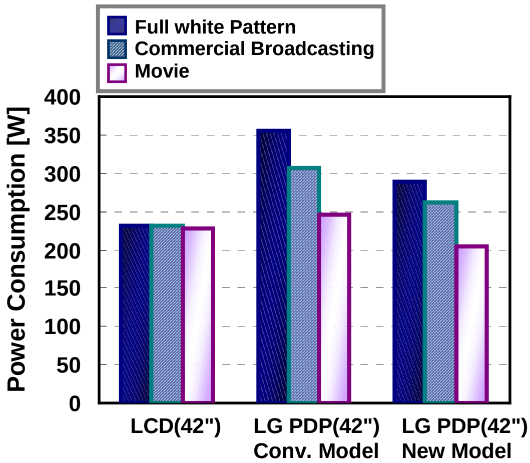


Fig. 1 Power consumption of LG PDP and LCD

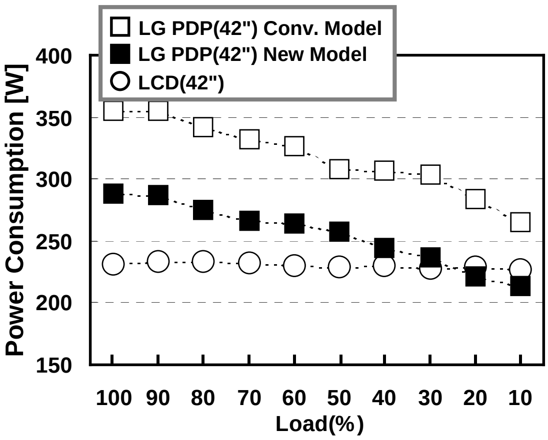


Fig. 2 Power consumption as a function of image load displayed

2.2 Single scan technology

If the addressing speed is improved, the luminance can be improved by increasing a display period and the picture quality can be also improved by increasing the number of sub-field. And if the dual scan driving method is changed to single scan method by increasing the addressing speed, the cost of the driving circuit can be reduced by decreasing the number of data drive IC and finally the power consumption can be also reduced by decreasing the number of address board. To improve the addressing speed and to realize the single scan in high resolution PDP, the scan pulse width should be shorted, that is to say, the discharge time lag at the single addressing discharge should be reduced. The discharge time lag depends on the cell structure, MgO and driving waveform. Therefore, we have been modified MgO material and driving waveform to achieve the single scan technology [2].

First, MgO material and E-beam evaporation condition have been changed in order to reduce the defect level such as oxygen vacancy because the defect level of MgO may affect the discharge characteristics. As the results, the addressing discharge time lag could be reduced without major changing the crystallinity, surface and boundary structure and preferred orientation compared with conventional MgO. Fig. 3 shows the discharge time lag of PDPs on which the new MgO and conventional MgO are deposited, respectively. The mean value and standard deviation of new MgO is 1.47μs and 0.18μs, whereas those of the conventional MgO is 2.56μs and 0.38μs, respectively.

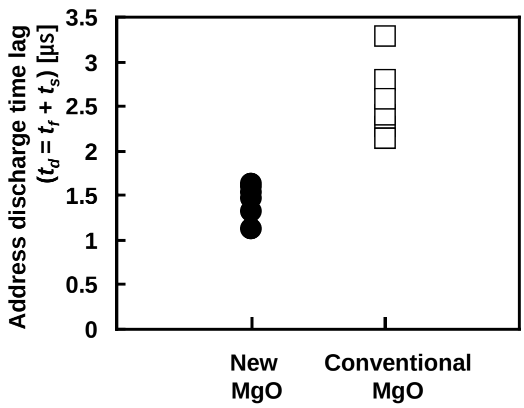
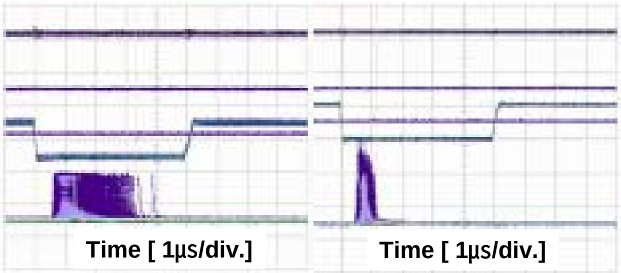


Fig. 3 Discharge time lag measured from PDP deposited with a different MgO

To reduce the discharge time lag consists of the formative time lag(t_f) and statistical time lag(t_s), enough priming particles and wall charges should be supplied at the addressing discharge. And the priming particles and wall charge state in the address period depends on the reset discharge. Therefore, we have modified the reset waveform to ignite easily the facing discharge between scan and address electrode by controlling the cell voltage state prior to addressing discharge. By the applying the modified reset driving waveform and using the new MgO, total discharge time lag of our new model in an address period was reduced about 40~50% and the statistical discharge time lag was reduced up to 70% compared with old model as shown in Fig. 4. Now, the single scan technology was applied to our 50 inch PDP, which has XGA resolution as well as our 42 inch XGA PDP.



(a) Old model **(b) New model**

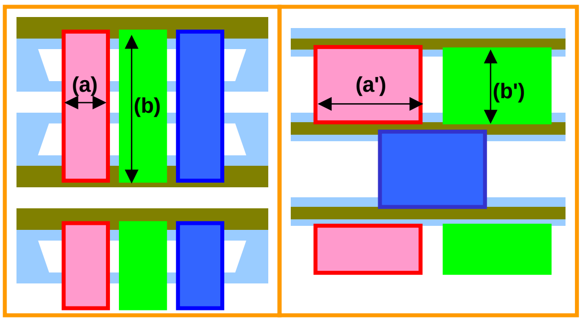
Fig. 4 Light dispersions detected from address discharge of LG's old and new model PDP

3. Technology for Full HDTV

Television has become an integral part of contemporary culture on a worldwide basis, from giant urban centers to tiny villages. And now a revolution in television is under way, representing perhaps the most significant advance since full-color broadcasts started half a century ago. High-definition television promises to deliver higher-resolution images with greater clarity and better image quality than is possible with standard-definition television. Both of PDP and LCD are leading candidate for large size full HDTV. We already developed the 71 and 76 inches full HD PDP in 2003 and want to expand the range of full HD PDP to smaller size that covers 42 to 60 inches. However, PDP will have a hard time extending the 1920x1080 resolution to smaller screen sizes(42~60inch). Generally, a pixel pitch of 42 inch SD is 1.08mm, on the other hand that of 60 inch full HD is 0.69mm. Because the neck top-width of rib which can be manufactured by current process is about 50㎛, the horizontal discharge cell space of the 60 full HD panel is only 0.18mm. Of course, the cell pitch decreases as the panel size decreases. Consequently, the more size of the PDP with full HD resolution decreases, the more plasma loss increases and luminance/luminous efficiency decreases. This problem can be partially solved with the adoption of TCA(Triangular Color pixel Arrangement) structure because the horizontal cell pitch of TCA structure can be larger than that of the conventional [3-4]. In this study, we have suggested TCA structure for 60inch full HD PDP and investigated the electric and optical characteristics compared with conventional for 60 inch full HD.

3.1 Experimental

Fig. 5 shows the schematic diagram of TCA and conventional structure for 60 full HD panel, which has 0.69mm pixel pitch. ITO electrodes of TCA are segmented and electrically connected to bus electrode. The horizontal and vertical discharge space of the conventional structure are designed as (a)0.18mm and (b)0.51mm, and those of TCA are designed as (a')0.38mm and (b')0.25mm, respectively. The experiments were done with a test panel and the other cell specifications, such as barrier rib height and thickness of dielectric and phosphor layers, are same to each other. Ne+Xe(10%) mixture gas was used.



(a) 60 FHD(Conv.) (b) 60FHD(TCA)

Fig. 5 Schematic diagram of conventional and TCA structure

3.2 Results and Discussion

Fig. 6 shows the relative luminance, efficiency power consumption and sustain minimum voltage of TCA to those of the conventional structure for 60 full HD. The measurement has been done with 10kHz sustain driving circuit. The suggested TCA structure shows a lower luminance and power consumption compared with those of the conventional. Consequently, the luminous efficiency is increased about 40% because the decrease rate of the power consumption is higher than that of luminance of TCA compared with conventional.

IR emitted from each panel has been detected by ICCD as shown in Fig. 7 to investigate the reasons why the luminance of TCA structure is lower than that of conventional. IR peak intensity and distribution on the cathode of TCA are lower than those of the conventional because the discharge propagation length from gap to horizontal barrier rib of TCA is shorter than that of conventional. And a striation phenomenon on the anode of TCA is not well observed compared with that of conventional. Therefore, it is necessary to optimize the electrode and barrier rib shapes in order to increase the luminance of TCA. However, it is expected that the plasma diffusion loss of TCA is lower than that of the conventional because the IR propagated toward the vertical barrier rib of TCA is less than that of conventional. That is to say, the power consumption of TCA structure can be lower than that of conventional.

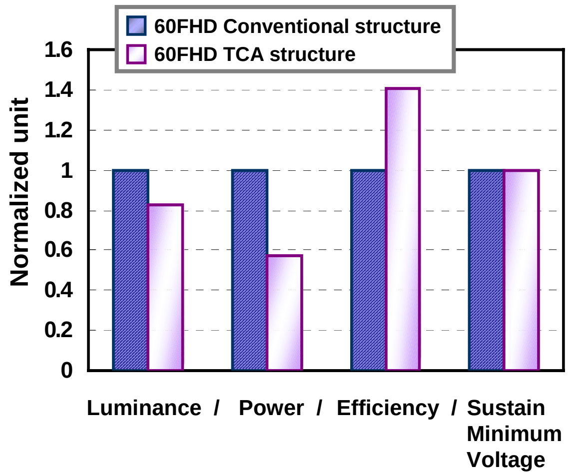
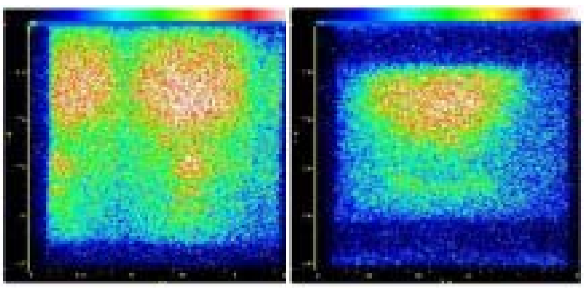


Fig. 6 Comparison of cell performance



(a) 60 FHD(Conv.) (b) 60FHD(TCA)

Fig. 7 IR profile detected by ICCD

Fig. 8 shows the luminous efficiency of TCA and conventional structure as a function of the sustain voltage. The luminous efficiency of conventional structure decreases as the sustain voltage increase, but the efficiency of TCA rather increases as the sustain voltage increases. The efficiency of TCA may be increased as a sustain voltage increases because the plasma loss of TCA through the barrier rib is less and the discharge can be concentrated on the center of the discharge space caused by applying the segmented ITO electrode structure.

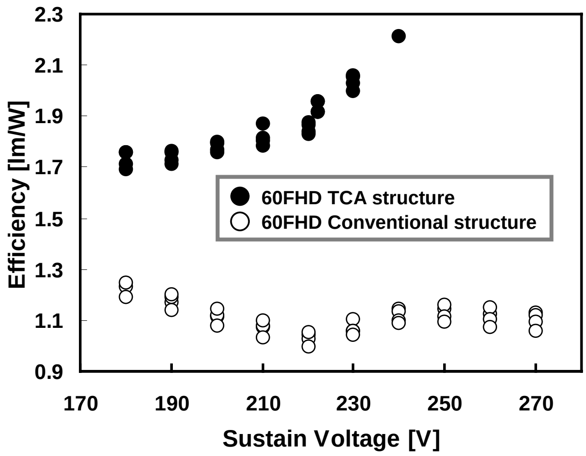


Fig. 8 Variation of the luminous efficiency as a function of the sustain voltage

4. Conclusions

The 42inch LCD and LG PDP have been examined through side-by-side comparison in the actual environment. As the results, the power consumption of LCD is better than PDP within a most display range, but those of our new model PDP is almost same or superior to LCD at a certain display range in which APL is low. Our new model PDP has been changed the cell structure and gas mixture from conventional model to improve the brightness and power consumption. The short address discharge time lag about 1 μs for 42 and 50 inch XGA single scan was achieved by using new MgO material and driving waveform.

In addition, we investigated TCA structure for 60inch full HD application. Consequently, the luminous efficiency of TCA was almost 40% improved compared with conventional closed rib structure, which has 0.69mm pixel pitch.

5. References

[1] Larry. F. Weber, Information Display 8, pp12-17, 2004

[2] K. Y. Choi et al, Asia Diplay/IMID04 Digest, pp231-235, 2004

[3] C. H. Yoon et al, SID03 Digest, pp 140-143, 2003

[4] Y. Hashimoto et al, SID01 Digest, pp5-7, 2001