The Design for 32" CRP

Donyun Kim, Joon-Soo Bae, Kue-hong Lee, Hoo-Deuk Kim, Chang-Ryon Byon
Samsung SDI, Product Design Team

Abstract

Nowadays, CRTs are threatened by the flat panel displays(FPD). The depth of CRTs becomes one of the most important design factor to maintain the dominated portion in the display market. The slim CRT design is introduced in this paper.

1. Introduction

CRTs have played a major role in displays for a long time. However, many kinds of FPD appeared a few years ago and they are threatening the CRTs nowadays. Although CRTs have strong merits of good performances and low cost, they have some defects compared with FPD such as depth, weight and power consumption. The set design with CRTs is bulkier than the flat panel displays. CRTs companies have made efforts to overcome the defects of CRTs, however, they didn't have the good results yet. Now we are developing 32" CPT of which deflection angle is 125° . The wide deflection angle makes it possible to design the set thin enough to compete with FPD. Fig1,2 show the examples of set design for the new CRT. The models show the possibilities the CRT can keep the main stream of displays even in the view of design. We named it CRP(cathode ray panel). This paper introduces the advanced technology for design of CRP.

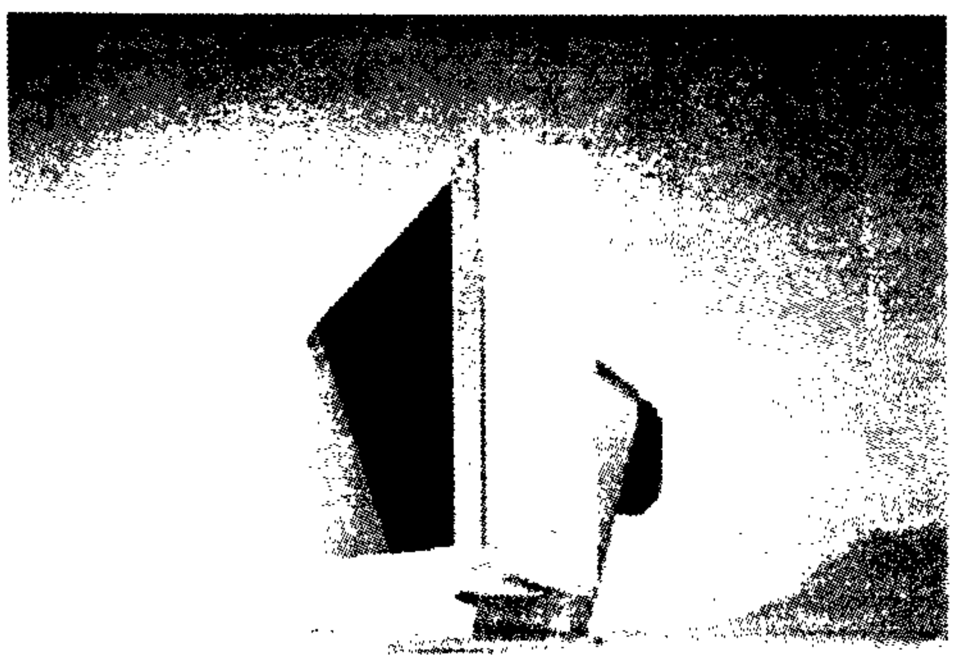

Figure 1. Set design : example1 .

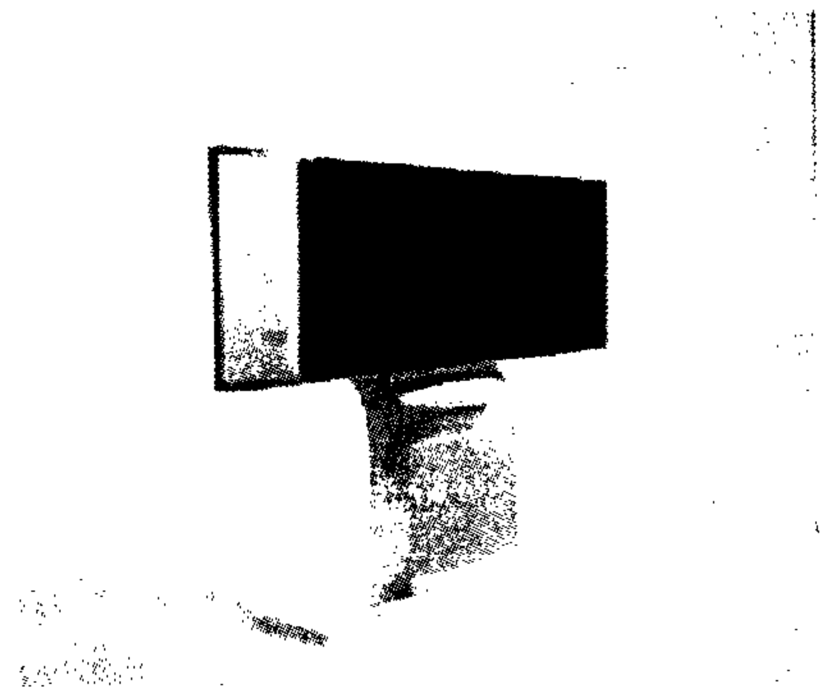

Figure 2. Set design : example2

2. Design for 32" Slim

2-1. Glass design

The glass implosion problem is one of the most important factors which should be considered to design the wide deflection angle CRT. The stress in the glass is increased according to the shortening the total length of tube. The simplest method to decrease the stress is to make the tubes heavier than normal one. However, the designer associated in the new concept CRT can not avoid the cost problem and costumer's needs.

One of the difficult problems to design the glass of CRP is to decide the seal edge thickness (SET). If the implosion problem is considered only, the SET should be increased around 50% more than normal CRT. However, the SET can not be increased so much due to the effective screen size, outside size of the panel, etc. Therefore, we have to consider the variable thickness of seal edge and something to reduce the SET.

The implosion characteristic for normal tubes is mainly dependent on stress of panel, however, the importance of funnel is as much as the panel in CRP.

The Canal shaped funnel(Asahi Glass Co., LTD.) is one of the good method to solve the SET and implosion problem[1]. Fig. 3 shows the Canal funnel used in CRP. The SET of canal funnel is under 30% in comparing with normal one, so the large SET does not necessary. Furthermore, the stresses on the funnel and seal area are smaller than the normal shaped funnel with large SET.

The crack propagation direction in the funnel for the normal tube is not so important, however, it plays an important role for the CRP. The cracks initiate at the tip of scratch of panel and propagate to the funnel in the direction of θ. The crack propagation path influence the final fracture of the materials[2]. If the cracks propagate to the yoke, the most of glasses implode. The crack propagation direction, θ, can be obtained with stress intensity factor, K.

$$\sigma_\theta = \frac{1}{\sqrt{2r}}\cos\frac{\theta}{2}\left[K_I\cos^2\frac{\theta}{2} - \frac{3}{2}K_{II}\sin\theta\right] \quad (2.1)$$

$$\tau_{r\theta} = \frac{1}{2\sqrt{2r}}\cos\frac{\theta}{2}\left[K_I\sin\theta + K_{II}(3\cos\theta - 1)\right]$$

(2.2)

where, r and θ are the cylindrical coordinates of a point with respect to the crack tip, σ_θ and $\tau_{r\theta}$ are the stresses, K_I is mode I stress intensity factor, and K_{II} is mode II stress intensity factor. σ_θ is maximum when $\tau_{r\theta}=0$, therefore the crack propagation direction can be obtained from Eq.(2.2). As shown in Fig. 4, if the cracks in the funnel propagate to the yoke due to $K_I>K_{II}$, the funnels are broken and finally the tubes implode. If the cracks propagate along the yoke due to $K_I<K_{II}$, the funnels remain the own shape after the hitting and the tubes do not implode. The stress distribution and thickness near the yoke of the canal funnel are good enough to prevent the crack propagation direction into the yoke. We finally get the good results for safety test with canal funnel.

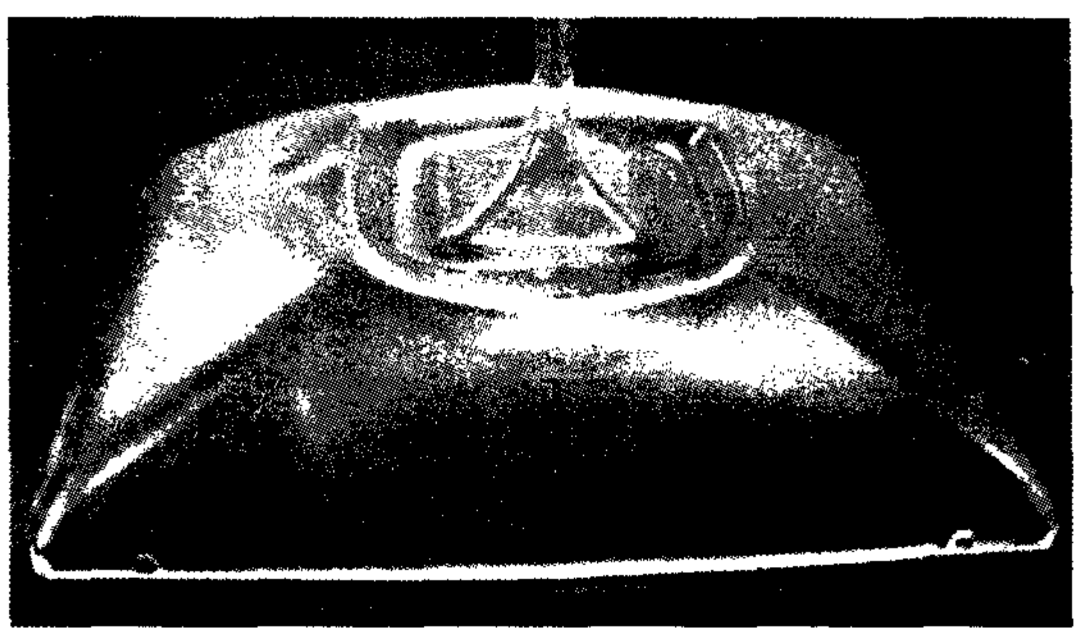

Figure 3. Canal funnel used in CRP

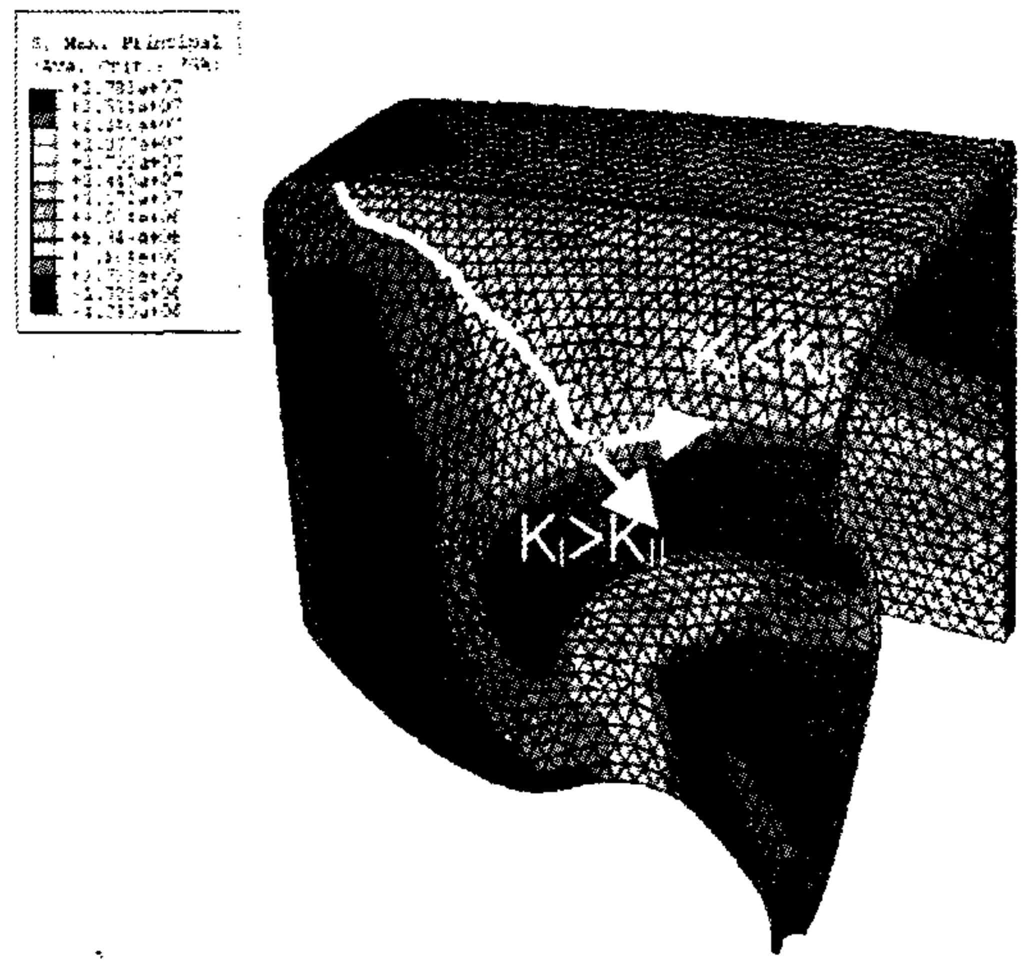

Figure 4. Stress distribution and crack propagation direction in funnel

2-2. DY design

The wide deflection angle causes the deflection sensitivity (LI2) to increase. This is related the cost of the chassis and it is the important commercial factor. Therefore it is important to reduce the deflection sensitivity as possible as. To reduce the deflection sensitivity, The shape of the DY adopt the rectangular.(RAC) (Fig 6 shows the shape of DY) and the comma free system was adopted to be convenient CG control. (Fig 7 shows the comma free). The design tool was used the DY coil modeler[3] and simulation program developed by SDI. Figure 5 shows the design tool of the SDI. At the design step, the deflection sensitivity of the DY was calculated 52mJ by DY simulation.

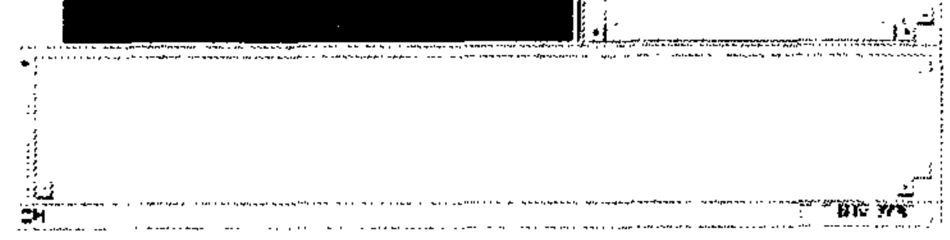

Figure 5. DY design tool

After making the sample, It was finally taken 51mJ. But the CG and G/D are not fulfilled because the DY is being developed.

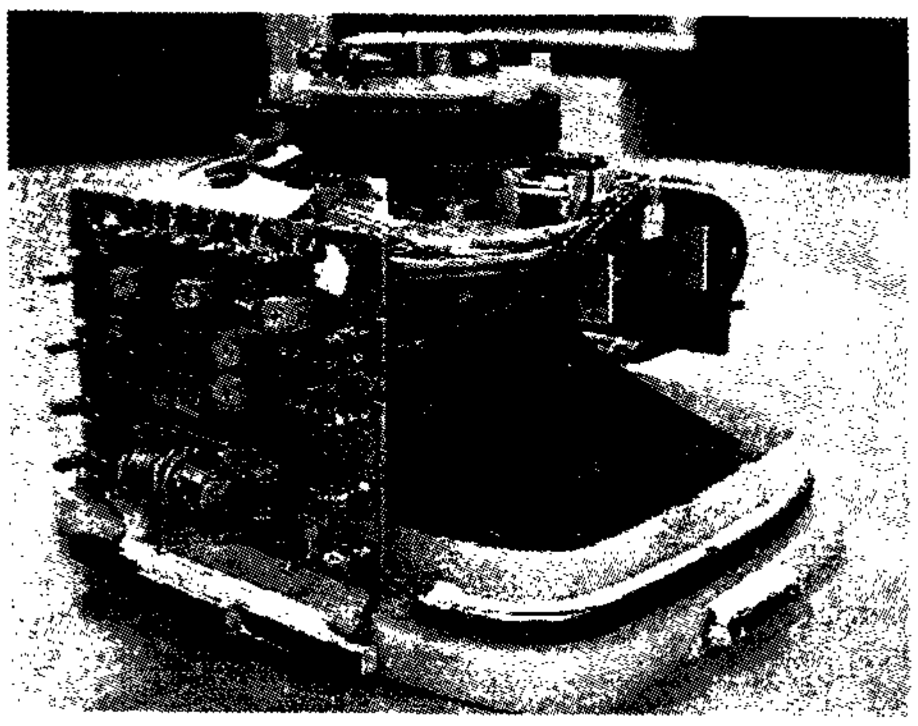

Figure 6. DY for 32" Slim CPT

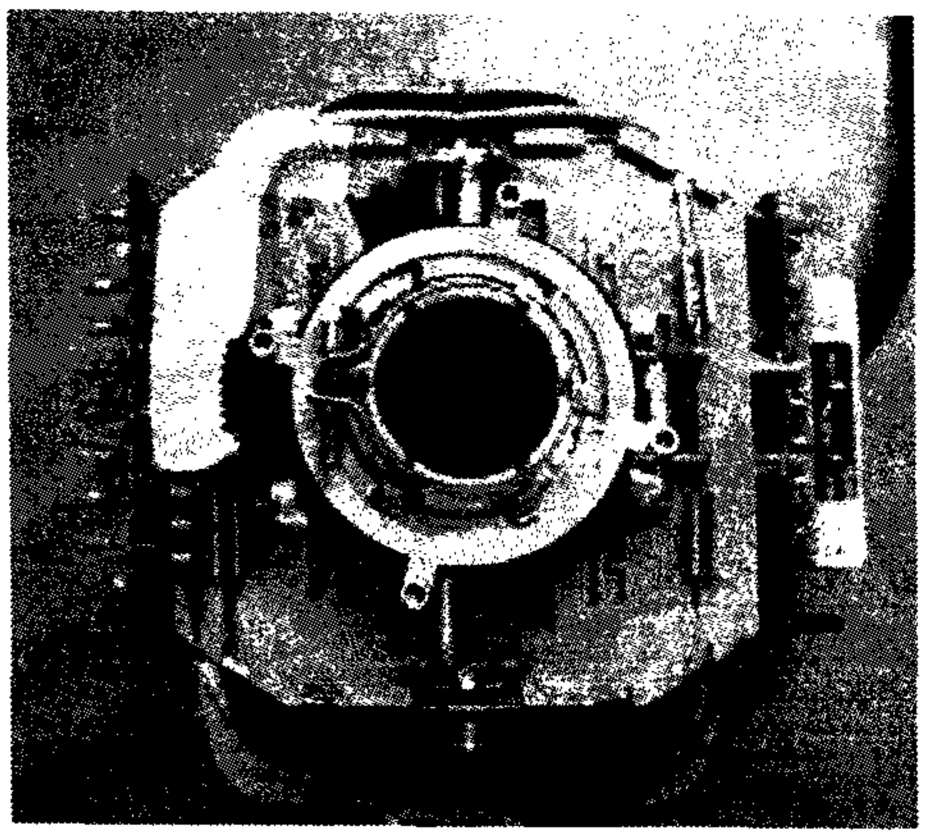

Figure 7. Comma free system

2-3. Gun design

To achieve the desirable tube length of wide deflection angle(125 °), electron gun must be designed to be shorter. And dynamic focus voltage must be reduced due to the increase of deflection angle. Figure 8 shows the structure of a single dynamic focus electron gun applied to this CRT.

First the length of the electron gun is reduced 6mm from the conventional gun. When the spot size at the center of the screen is measured, it is found that the spot size of the new gun is improved than that of the conventional gun

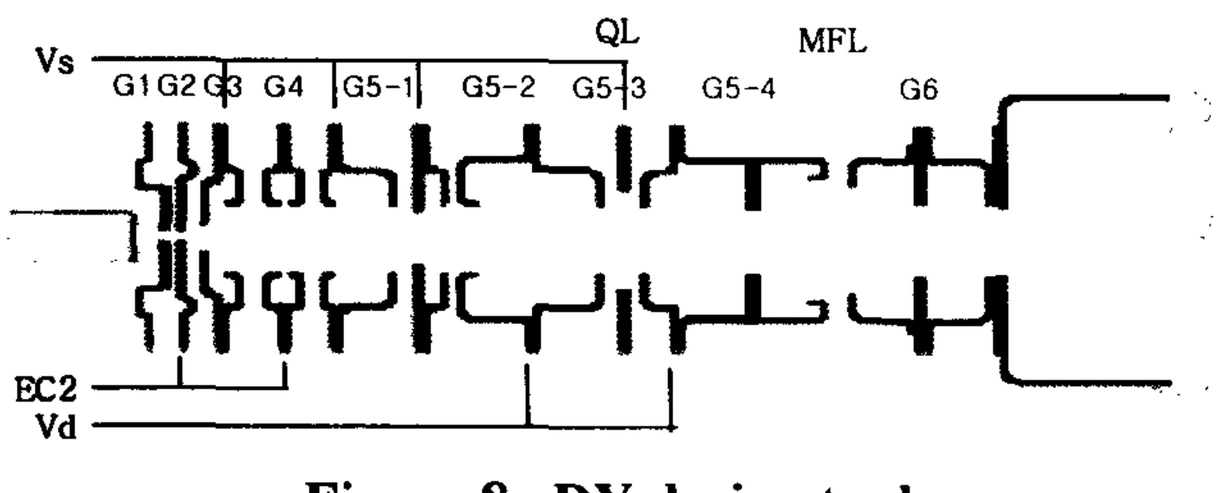

Figure 8. DY design tool

It is because the reduction of the distance from electron gun to screen improves the spot size more than the shorter length of the electron gun deteriorates the spot size. To improve the sensitivity of the dynamic focus at wide deflection angle, the asymmetry of MFL is increased by reducing vertical distance of G6 Sub ¢. Three-electrodes crossed Quadruple Lens (QL), which is in production, is optimized. Figure 9 shows the dynamic focus voltage Vd when G6 vertical width changes at horizontal 320mm position on the screen. At the dynamic focus voltage 1.0kV, the spot size is almost equal to conventional type.

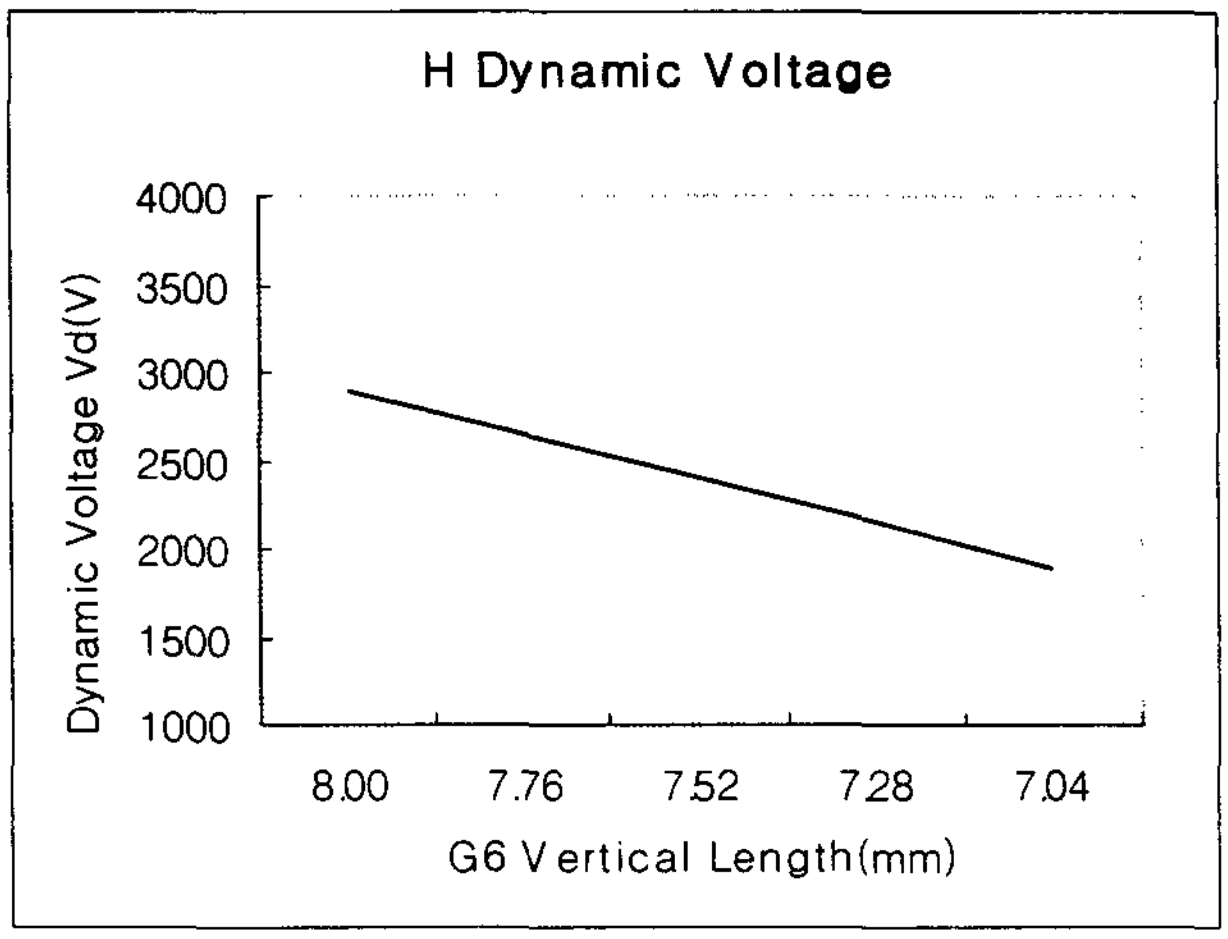

Figure 9. Dynamic voltage vs G6 vertical length.

The spot size of conventional type and new type(125°) is compared in Table 1

Unit(%)

Beam Spot Size	Screen Center		Screen Corner	
	Horizontal	Vertical	Horizontal	Vertical
Conventional CRT(102°)	100	100	100	100
NEW CRT(125°)	87	93	105	101

Table 1. Beam spot size conventional CRT vs. wide deflection angle CRT

3 Conclusion

Although the CRTs have good performance, they have the defects such as depth and weight in compare with FPD. If the set design is shallow, CRTs can compete with flat panel displays and continue to play a main role in display. However, CRTs with wide deflection angle are difficult to make due to the problems such as the glass implosion, the deflection power and the beam spot size etc.

We developed new concept CRT of which length is shortened and have found the possibilities to overcome the difficulties for design.

4. References

1. Tsunehiko Suagawara and Toshihide Murakami, Asahi Glass Co., LTD., Status of Glass Bulb Development for Flat and Thin CRTs, SID 02 Digest, pp.1218-1221, 2002

2 Joon-Soo Bae, Sridhar Krishnaswamy, Subinterfacial cracks in bimaterial systems subjected to mechanical and thermal loading, Engineering Fracture Mechanics 68, pp.1081-1094, 2001

3 Do-Nyun kim, Pilyoung Park and Joo Hwa Lee "DY Coil Modeler using Monte Carlo Method" IDW 01. pp 817-819,2001