New design for SuperSlim CPT

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Abstract

A working prototype of a 32-inch wide-screen CRT is presented with a tube length of only 32 cm. This small length requires a '135°' deflection design, which puts strong requirements upon the DY, glass and mask box design.

1. Introduction

The fast market penetration of the new display technologies like PDP and LCD in the screen sizes from 24 to 40 inch diagonal shows the customers affection for shallow display-sets. Here the traditional CRT scores negatively because of its bulky appearance and the relative large footprint. However, in the past decades lots of efforts have been done to reduce the tube-length, from 90° full diagonal deflection systems in the seventieth of the 20-th century to 110 ° nowadays in production and 120 ° for the so-called slim tubes in development. In this paper we will report the progress in making a next step in this evolution: a 135 ° CRT.

2. Architecture

We have followed the evolutionary approach of enlarging the deflection angle and thus reducing the depth of the CRT. This is in contrast to multi-electron-gun proposals [1] or the reflected beam CRT [2]. In a previous step of our development [3-5] we evaluated the concept of the so-called transposed scan, with a 90° rotated electron gun, deflection yoke and shadow mask structure, in order to minimize the loss of picture quality inherent to the extremely large deflection angle. In view of the progress we achieved on the electron gun concept and the exposure lens design and the huge chassis impact of transposed scan we decided to go for a 'normal scan' concept.

3. Design

3.1 Glass design

We strive for a design fitting smoothly in common furniture in the home. We target on a tube length of 320 mm for a 32inch real-flat 16 to 9 screen-size. The corresponding full diagonal deflection angle is 135 °. This results in a very shallow glass cone design. By its tapered cone design the tube has a shallow perception (see figure 1).

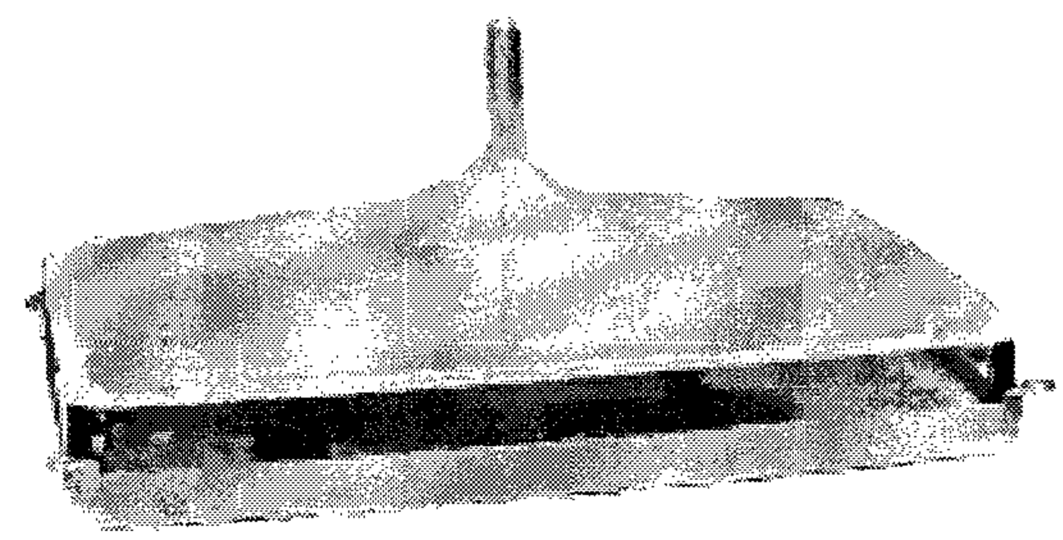

Figure 1: Photograph of the 32"WS RF *SuperSlim* glass tube.

3.2 Landing design

The large deflection angle seriously affects the landing design. The skew projection of the mask hole in the mask on to the screen inner contour at the border of the screen becomes about twice as sensitive, compared to a conventional 110 ° deflection angle design, for mechanical deformations of the mask by thermal load (doming), mismatch of the deflection yoke and for misalignment of the three electron beam. The used unique mask corner suspension compensates fast and complete for thermal effects of overall mask doming and ambient doming [6]. The hinge plate in this concept must be orthogonal to the electron beam going through the ultimate mask hole. For the 135 ° design, the angle with the tube axis is about 17

°, compared to 29° for conventional 110° designs. In order to illuminate the last phosphor lines the ultimate mask hole will be more towards the tube axis due to the large projection distance, compared to 110° deflection angle designs. The mask box size is related to the last mask hole and will be relatively small. The consequence of a small mask box and a steep hinge plate is that the mask pin, to suspend the mask box onto the glass panel becomes significant longer. The length increases from a standard value of about 12 mm to 20 mm in the described 135° deflection angle design. (See figure 2). To suppress mechanical deformations super invar with low thermal expansion coefficient has been chosen for mask box, thus including the mask itself.

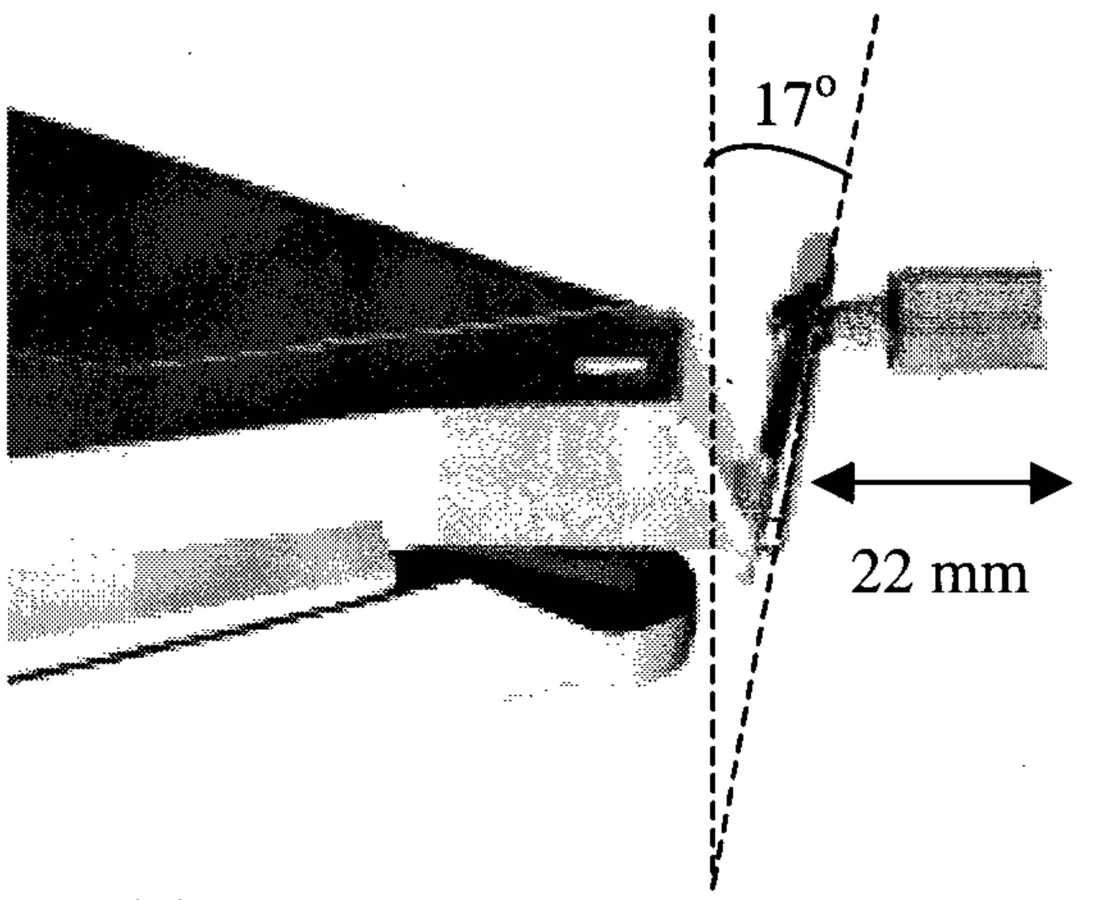

Figure 2: Drawing of corner mask suspension with pin of 20 mm.

As mentioned above, the doming and also the microphony performance of a 135° deflection angle design becomes critical. In the compromises taken in our design we focused on the best performances of these items. The contour of the double curved mask has been optimized for the optimal doming performance.

3.3 DY sensitivity

The large full diagonal deflection angle of 135° degrees is far beyond the normal design space of the deflection yoke (DY). The sensitivity (LI^2) in the double-mussel technology shows a strong dependence on the deflection angle. However, a limit at the temperature rise of the DY due to dissipation and the electrical requirements give an upper limit on the sensitivity. In our design we have taken 60 mJ. Applying the rectangular aperture coil (RAC) technology we gained about 15%. The main front of screen performance items governed by the DY are the mis-convergence and the geometrical deformation. In the DY optimization the trade-off of the horizontal deflection, versus the convergence performance and the geometrical distortions has to be balanced. We found an optimum of LI^2 is about 65 mJ, maximum mis-convergence errors of about 1.5 mm and geometrical distortions of several mm. The mis-convergence can be improved by adding dynamical E-core circuits at the neck side of the DY. One options for improvement of the geometrical distortions are the interaction between panel inner contour and the DY, which has not been fully exploited in this design. The DY is photographed in figure 3 and 4.

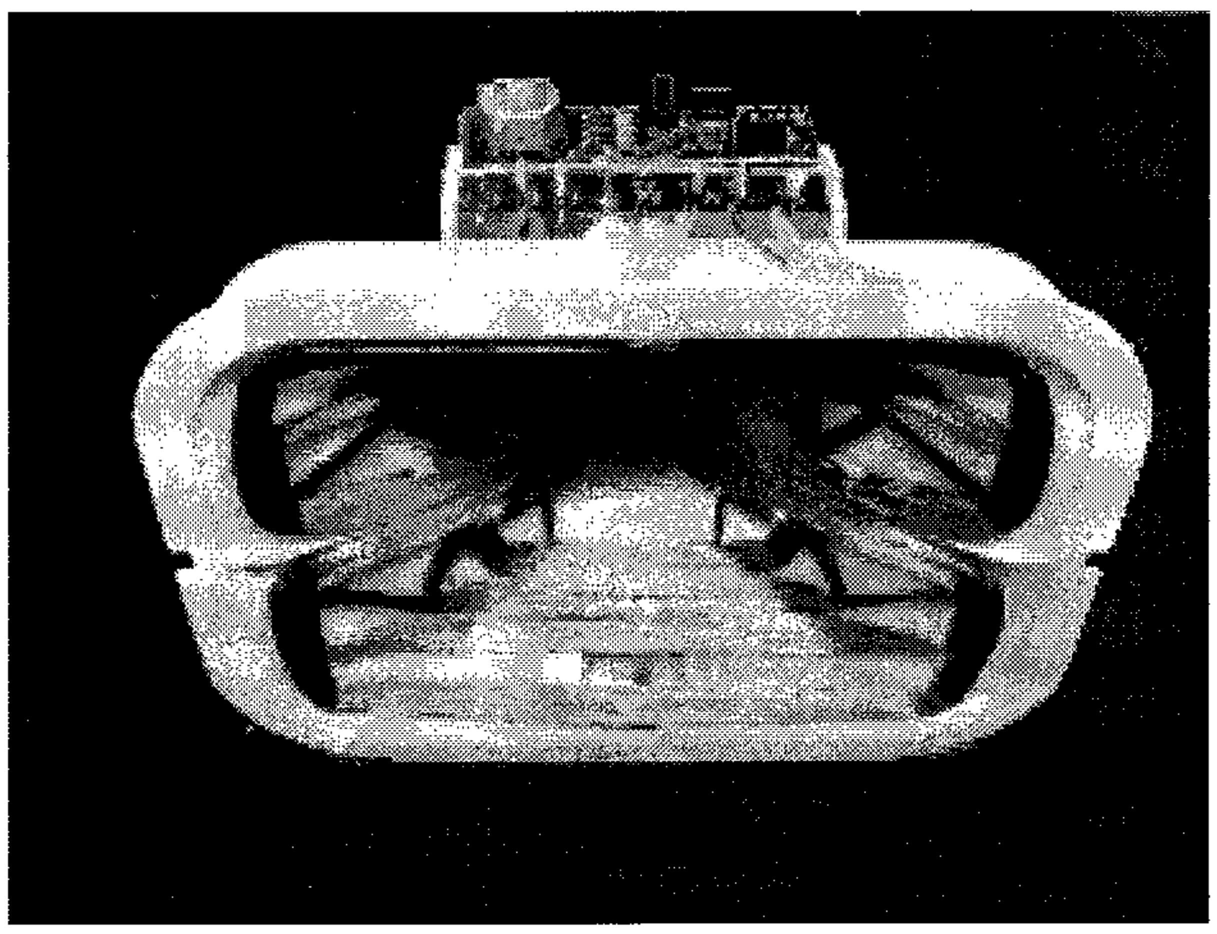

Figure 3: Viewing in the double mussel RAC DY for 32" WS RF SuperSlim

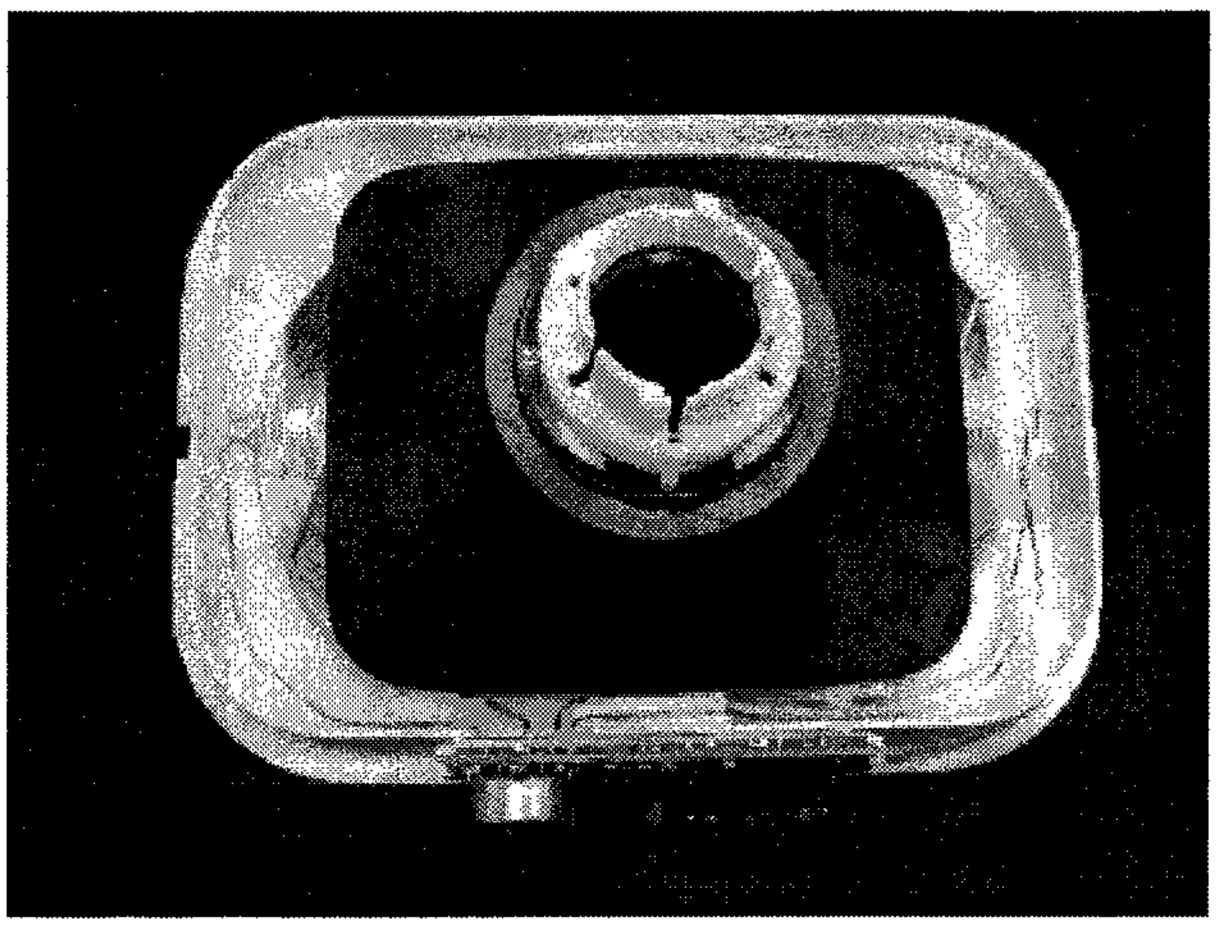

Figure 4: Viewing up the double mussel RAC DY for 32" WS RF SuperSlim

3.4 Gun design

Due to a new concept for the design of electron gun [5] the spot uniformity over the entire screen is expected to be of high definition quality. The short distance to the center of the screen and the inherent small spot size enlarge design freedom in the electron gun. Furthermore, the dynamic focus voltages of less than 1350 V are within the typical range used.

3.5 Design specifications

The design specifications are given in table 1.

Table 1: Target design specifications

Performance item	Specification
Screen size	32" WSRF
Tube length	320 mm
Frequency	32kH
High voltage Va	32 kV
Convergence errors	<1.5 mm
Sensitivity (LI^2)	60 mJ
Geometrical distortions	<2 mm
Spot uniformity	High definition quality

4. Manufacturing process

In the so-called front-end processes, the exposurability of the black matrix and the flow coat process of the three colored phosphors were not within the process-parameter window. The microscopic intensity distribution at the plane of the panel inner contour during screen exposure has too low contrast for the standard development process. In combination with a large lamp rotation up to 8 degrees in several areas, a large variation in multiplication factor of the lamp size due to the large distance variation of the lamp to the center and to the corner the peak contrast is lower than the required minimum. Nevertheless, we succeeded in manufacturing the SuperSlim CRT on a prototype scale. In the evaluation of its performance and the fabrication processes we will identify bottlenecks, which have to be improved in the next phases of the development.

A lens exposure system with two lenses has more design freedom and is thought to solve the process problems.

5. Conclusions

The customer will perceive shallowness by a tapered shape of the glass envelope and a relative small total depth of 320 mm of the 32"WS RF *SuperSlim* set. This leads to new shallow set-design opportunities for CRT's. We have realized the first prototypes of a 32" 16 by 9 full color television tubes.

6. Acknowledgement

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7. References

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