FLAT APERTURE GRILLE CRT MONITORS

Introduction

A mainstay of the display industry for more than a century, the traditional Cathode Ray Tube (CRT) monitor has been the consumer's display of choice due to its prime combination of image clarity, screen-size selection and affordability. When the CRT was first introduced in 1897, the tube itself was designed and manufactured incorporating cathode ray tubes (CRTs) possessing rounded external surfaces both in the horizontal and vertical direction. This curvature allowed for good focus and convergence at the corners while taking advantage of the gun, yoke and circuit technologies available at that time. While this conventional CRT design delivered high brightness and fine resolution capability, users also experienced some geometric distortion on the horizontal and vertical planes and increased glare from ambient lighting due to the curvature of the monitor face. These drawbacks were even further emphasized on larger screen sizes where the curvature is even more pronounced.

Over the years, monitor manufacturers have been able to gradually "flatten" CRTs, creating display options such as the flat square and aperture grille CRT. It was not, however, until the development and manufacture of flat aperture grille CRTs, that the industry has been able to overcome the inherent cathode ray tube drawbacks and offer consumers a level of performance comparable to "reading off a sheet of paper."

To better explain how these products were developed, the following is a detailed account of the many components that comprise these new flat aperture grille monitors and make them one of the most precise and accurate CRT monitors currently available.

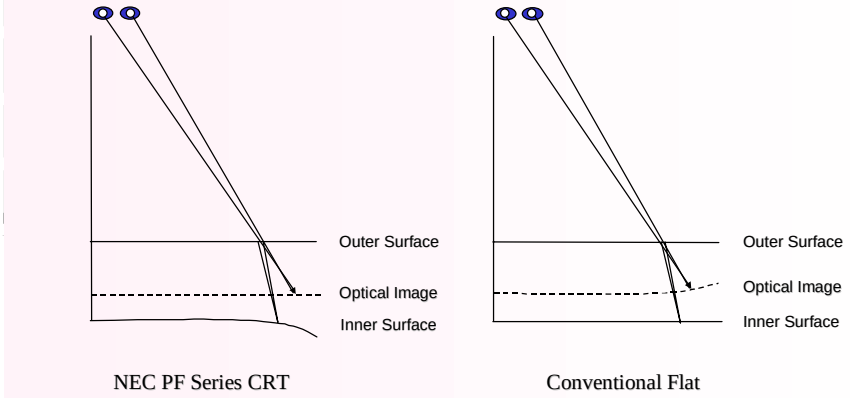
Glass Bulb (CRT)

At the core of the new flat aperture grille CRTs is the glass bulb. Developed to create a flat image rather than a totally flat surface, the glass used here is actually incorporating a slight and precisely calculated curve into the outer radius of the bulb. In doing so, the tube is able to compensate for how the human eye perceives the image coming from the tube, as well as the refraction of light. It also reduces the ambient light reflection and glare, making the image much easier to view. In monitors were the glass itself is perfectly flat, the image appears bowed due to refraction of light off the surface. This phenomenon is often referred to as the "concave or convex look" and is a by-product of flat CRTs that are mechanically designed to be completely flat.

The second goal in the development of this new glass bulb was to increase the bulb's strength and to allow the monitor to pass UL and CSA certifications. By strengthening the glass composition, manufacturers no longer need to incorporate an implosion protection faceplate or sheet, which would effectively increase the CRT's material, weight and manufacturing cost.

The diagram below shows how the optical image has been straightened out compared to a conventional flat face CRT to counteract for refraction

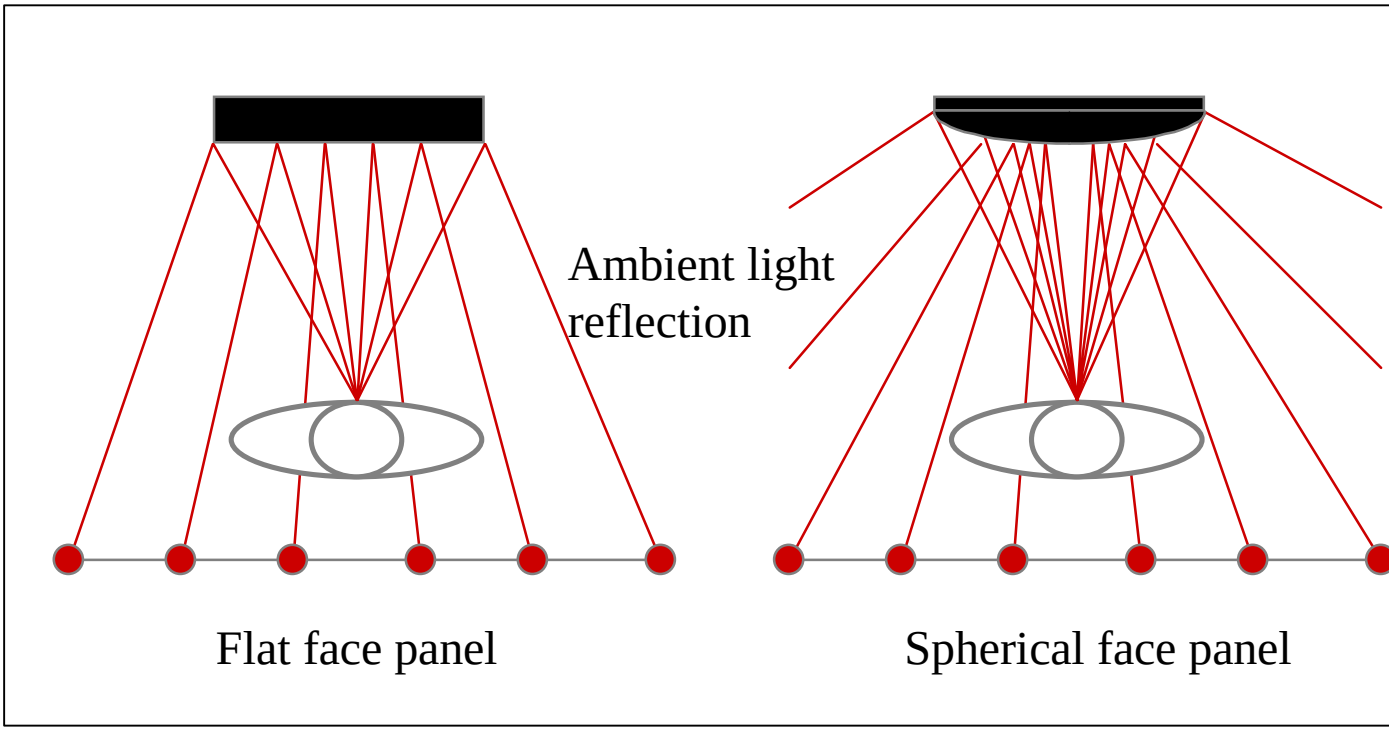
NEC's Flat CRT monitor vs. competitive flat CRT monitors



NEC PF Series CRT

Conventional Flat

Top View of CRT Cross Section



Improved Aperture Grille Design

The glass bulb was not the only CRT component to be reworked in creation of the flat aperture grille CRT. The aperture grille design itself also went under some retooling. By using special design considerations and improved manufacturing processes, two key aperture grille artifacts - vibration and wrinkle - have been addressed and minimized, assuring sharp, crisp images throughout the entire viewing area. These problems arise in manufacturing due to flat CRTs having radii almost twice as large as similar sized conventional CRTs.

New Electron Gun

Flat aperture grille monitors use a new electron gun designed to compensate for the difference in the distance from the electron gun to the perimeter and the center of the CRT surface. This new gun and lens technology assures that the beam spot size remains constant (and circular) regardless of the beam's location with respect to the active phosphor area of the CRT, allowing for exact focus throughout the CRT surface. In addition, a newly developed high voltage electrode improves focus and reduces overall power consumption.

Geometry and Convergence Performance

In developing the flat aperture grille CRT, issues with geometry and convergence performance also need to be taken into consideration. Generally, when the surface of the CRT panel becomes flat, minimizing top-bottom pincushion distortion can become quite a challenge. How well a flat CRT monitor minimizes this distortion is a good indication of the quality of the monitor.

The flat aperture grille incorporates a new type of deflection yoke that corrects for top-bottom pincushion distortion by using an enlarged deflection area. With respect to the screen borders, the deflection area has been increased by about 15mm compared with conventional CRTs. The distribution of the deflection magnetic field in screen area has been designed mainly for correcting distortion. For a flat face CRT, the inner side pincushion distortion tends to be large; therefore, a distortion correction circuit has been applied to the new deflection yoke.

Maintaining good convergence can also become an issue with flat aperture grille CRTs. When developing the new deflection yoke for flat aperture grille, correspondence to stricter convergence specification led to greater accuracy and improved convergence performance. It also resulted in simplifying the convergence adjustment process on the manufacturing line and by the end-user.

Conclusion

Flat aperture grille CRTs offer a perfectly flat viewable image, with reduced geometric distortion and glare, high resolution and brightness, and good contrast. Most importantly, if offers end-users a screen image that appears completely flat, so what they see on the screen is what they see coming out of the printer. These advances allow flat aperture grille CRT monitors to deliver the performance, accuracy and precision that professional users demand and require to make their ideas come to life.