Advanced Engineering Forum *Online: 2012-06-04*
ISSN: 2234-991X, Vol. 4, pp 111-114
doi:10.4028/www.scientific.net/AEF.4.111

Research on CRT Rear-projection Television Adjustment by Chkscrn Software

Tianhua Li, Hong Sun

Department of Physical and Electrical Engineering, Zunyi Normal College, Zunyi, Guizhou, 563002

lthyy@163.com

Keywords: software; adjustment; CRT; rear-projection television

Abstract. Based on computer platform and Chkscrn testing software, this paper analyzes the structure and operation principle of CRT rear-projection television. It also adjusts luminance uniformity, white balance and geometrical linear of CRT rear-projection television by Chkscrn software. The application has shown that the adjustment of CRT rear-projection television by Chkscrn can effectively update the display effect of television.

Introduction

The principle of projection TV is to utilize optical facilities to project the TV image on a special screen to form an image. Based on projection light source and direction of watching, it can be divided into front-projection television and rear-projection television. The light source of front-projection TV is in accordance of watching direction of audiences. It is mainly used in office equipments, teaching system, computer display, DVD laser video player and other occasions which have lots of audiences. Light source of rear-projection TV is opposite to the watching direction of audiences (shown in figure 1). It has lots of advantages, like integration, small volume and large screen, etc. On the basis of imaging principles, rear-projection TV can be subdivided into cathode ray tube rear-projection TV, liquid crystal display rear-projection TV, liquid crystal on silicon rear-projection TV, digital light processing rear-projection TV, and so on[1].

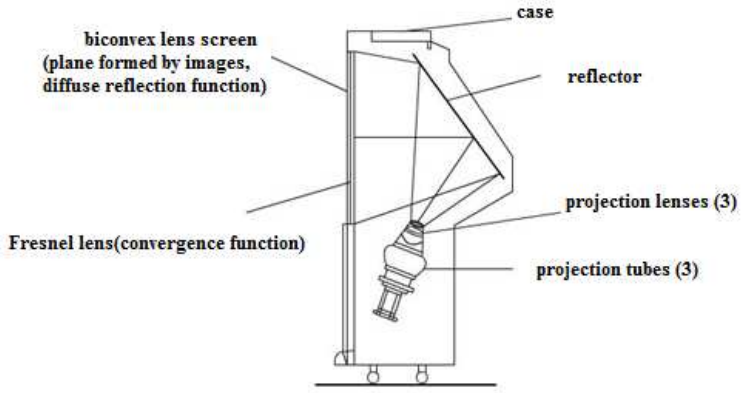

Figure 1 Structure diagram of CRT rear-projection television

CRT (Cathode Ray Tube) is a photo-electricity switch part which can take advantage of high-energy electron beam to activate the fluorescent screen to light. CRT color TV can resolve the input signal into red, green and blue signals, respectively controlling three cathode voltages in kinescope. Then, three cathodes will send out three electron flows to pound accordant phosphors that can give out red, green and blue lights. According to mixed color space principle, color images will be presented on fluorescent screen of kinescope.

Major components of CRT rear-projection television

Projection tube. Projection tube is the light source of three-tube type rear-projection TV (shown in figure 2). The major difference of it from ordinary direct-viewing CRT color kinescope is that it doesn't have color selection equipment--shadow mask. Fluorescent surfaces of three projection tubes

are the same as ordinary black and white kinescope. They are respectively coated by R, G, and B tricolor phosphors fluorescent powders. As there is no shadow mask, high electron beam is allowed to pound fluorescent powder to light, producing high light images. Without limitations of shadow mask, non-rich shadow mask will not be magnetized to cause bad color purity. Automatic degaussing circuit could be eliminated and the bad-color-purity situation that shadow mask is pounded too much by high electron beams to cause hot doming phenomenon can be avoided. In structure, it has the following features: electrostatic focusing, magnetic deflection, electron gun, explosion-proof flat screen, etc. Besides, it has soft discharge protection function.

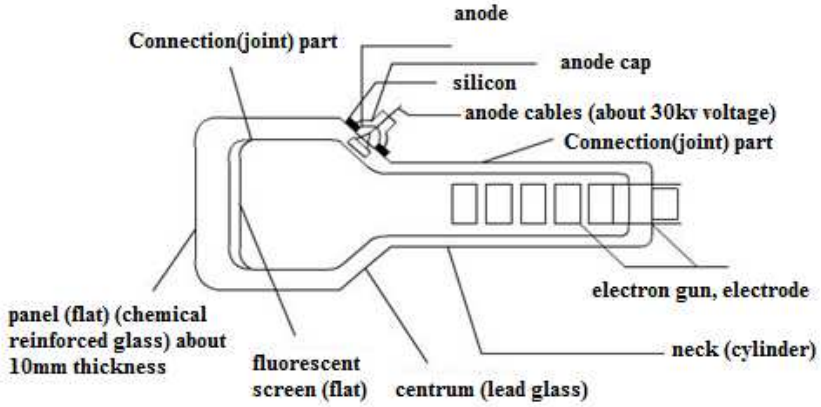

Figure 2 Structure diagram of CRT projection tube

Projection lens. Projection TV utilizes R, G, B three-primary-color beams to form images on specialized projection screen by optical lens synthesis. After shooting of the beam from light source (projection tube), as there's scattering, scattering state will appear on screen. Viewing is not possible without the projection lens. Therefore, optical lens is necessary to both front-projection TV and rear-projection TV.

Projection lens are normally composed of a set of lens, about 3-7 lens. Except for amplification and focus, they are used to compensate and adjust geometric distortions of all kinds of gratings appropriately. In CRT projection TV, structures of projections lens are mainly two kinds: full glass and mixed. Every lens in full glass type is glass; and mixed type has glass lens and plastic lens. At present, the widespread projection lens is mixed type. Its superiorities are high performance, low cost, light weight. But the lenses cannot be all plastic lenses. Though plastic ones could be lighter, the heat will be produced by lens during work. Refractive index of plastic will be changed with temperature. The glass lens is used to prevent blurry focus.

Rear projection screen. An outstanding advantage of rear-projection TV is that the display screen is not limited by kinescope. The screen can be very big. However, with limitation of luminance of light source (limited luminance of projection tube), the big screen will bring about decreased luminance and contract ratio of screen. Insufficient luminance and contract ratio will affect the definition and bright of color of images. Since the coming out of projection TV, while trying to raise the definition, people are doing their best to enhance the luminance and contract ratio of images. Besides raising luminance of projection tube, people giving their best on projection screen. They designed optical screens comprising numerous lenses, such as Fresnel lens and biconvex lens, to ensure the image quality of projection TV. Except for these major components, CRT rear-projection TV has other functional circuits, like "mathematical color convergence circuit" and "automatic convergence adjustment circuit", etc.

As three-primary-color projection tube R, G, B of CRT color projection TV are separated geometrically, wavelengths of three primary colors are different. Therefore, pixels of one image will reach projection screen from different angles and various optical paths. In order to make sure the strict coincidence of three primary gratings R, G, B on rear-projection TV screen, R, G, B of all points in screen should be convergent to one point. All CRT rear-projection color TV has their own grating distortion adjustment system—convergence circuit, which can convert convergence adjustment voltage signals produced by convergence circuit into currents. These currents will be added to

convergence coils of R, G, B three-primary-color projection tubes to adjust distorted images. Moreover, the advantages of automatic convergence adjust circuit are exact convergent adjustment, rapid adjustment, good consistence in convergence adjustment quality. Besides, it will not be affected by human factors.

Though CRT rear-projection TV is equipped with adjustment and revision circuits and related software, it cannot conduct comprehensive adjustment to CRT rear-projection TV due to its structural features. The service lives of three projection tubes are different. Most TV programs are luminous, and luminous equation is Y=0.30R+0.59G+0.11B [3]. Hence, three projection tubes will have different decrepit level and green projection tube will be the most decrepit one. Besides, as projection tubes are CRT glass products, they might be heavy. With time goes by, stands for supporting and fixing projection tubes may deform. Spatial locations of three projection tubes may change, leading to worse convergence of lights. This will cause some issues, which will be shown in displaying, in the use of CRT rear-projection TV. This paper discusses how to use Chkscrn testing software to adjust CRT rear-projection TV.

Connection between computer and television

On most display cards of current computers, there will be mathematics video output port and S port. If the TV has these two input ports, it can be connected with computer. Some TVs have VGA input port, which is more convenient to connect with computers. If computer and TV have no same ports, video converter is necessary. There are lots of kinds of video converters available on the markets. VGA input signal of computer will be input to video converter firstly, and video output port of video converter will be connected with video input port of TV. After connected equipments like this, pre-heat the computer and TV for 20 minutes, then, start the test.

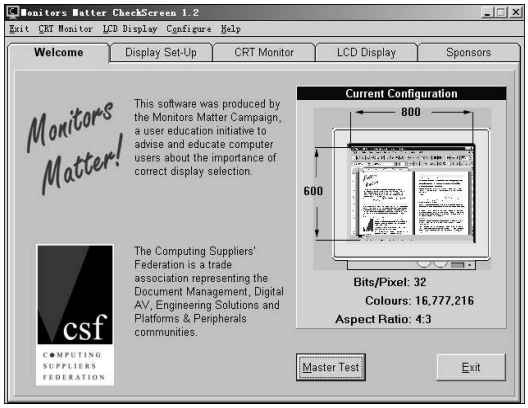

Figure 3 Chkscrn testing software interface

Chkscrn testing software

Software interface (shown in figure 3) has five options in menu bar: respectively “Exit”, “CRT monitor”, “LCD display”, “Configure” and “Help”. And there are five tags under them: respectively “Welcome”, “Display Set-up”, “CRT monitor”, “LCD display” and “Sponsors”.

Software option interface (shown in figure 4) has five options: respectively “Colour”, “Focus”, “Geometry”, “Power Supply”, etc. The major adjustment on CRT rear-projection TV is the influence of decrepit projection tube and change of spatial location on display effect. Issue of decrepit projection tubes is color; and that of location change is geometrical distortion. Choose the two options of “Colour” and “Geometry”.

Luminance uniformity and white balance. “Colour” has seven options: red, green, blue, black, grey, white, color boxes and color distribution. Among them, red, green and blue test the luminance uniformity; the latter five options test adjustment of white balance. In adjustment of luminance uniformity, separately click red, green and blue, making TV display pure red, green and blue. Then, observe these three pure colors to see if there’s anything abnormal [4]. In white balance adjustment, mainly observe white, black and color distribution to see if there is weak green situation (weak green will be accompanied by partial red in white).

Geometrical linear. "Geometry" lists four options: black-white lines, black-red lines, black-blue lines and black-yellow lines. The testing images include circles and squares. It is indispensible to notice whether the circles and squares displayed on the screen are regular (measure if lengths of side of every square are the same with ruler if necessary), and the lengths of side of squares on the four corners of screen.

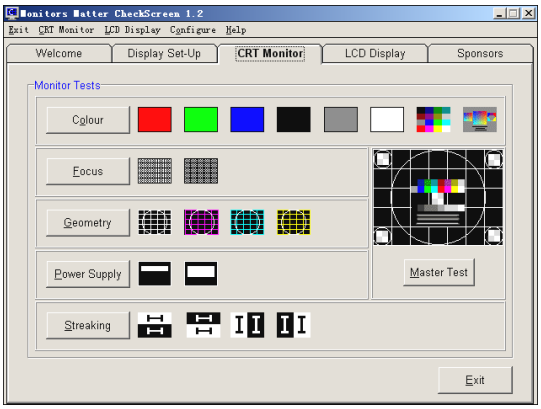

Figure 4 Chkscrn testing software option interface

Conclusions

CRT rear-projection television has the features of large screen, strong sense of immediacy, fine sound quality, full functions and high performance and price ratio. It was one of consumers' favorite products. It takes a large portion in China. Most CRT rear-projection TVs have been used for years, so it is necessary to adjust them. However, adjustment software in most TVs cannot adjust them very well. Chkscrn can be used to adjust luminous uniformity, white balance and geometrical linear of CRT rear-projection TV. These could update the display effect of TV and expand the service life of them.

Acknowledgment

Funding: Fundamental educational research program of Zunyi Normal College (11ZYJ003), Key Discipline Support of Guizhou Province

References

[1] Multi-media Electronic Business Division of TCL Group/TCL Electric Appliance Retail Co. Ltd. Principles and Analysis on Rear-projection Color Television of TCL HiD series [M]. Beijing: The People's Posts and Telecommunications Press, 2005.7:1-50.

[2] Yu Sile. Television Principles [M]. Beijing: National Defense Industry Press, 2005:157-332.

[3] Han Guangxing. Principles and Maintenance of Television [M]. Beijing: Electronic Industry Press, 2005:187-200.

[4] Xiao Yunhong. Television Technologies [M]. Xi'an: Xi' an Electronic Science and Technology University Press, 2004:81-88.