American International University- Bangladesh (AIUB)
Faculty of Engineering (EEE)

Course Name:	Engineering Shop Lab	**Course Code:**	EEE 3110
Semester:	Summer 2020-21	**Sec:**	J
Experiment No	01		
Experiment Name	Cathode Ray Tube Technology and Appliances		
Group No.	**07**	**Submission Date**	**03/06/2021**

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Marking Rubrics (to be filled by Lab Instructor)

Category	Excellent [4]	Good [3]	Acceptable [2]	Unsatisfactory [1]	Secured Marks
Theoretical Background, Methods & procedures sections	All information, measures and variables are provided and explained.	All Information provided that is sufficient, but more explanation is needed.	Most information corrects, but some information may be missing or inaccurate.	Much information missing and/or inaccurate.	
Results	All of the criteria are met; results are described clearly and accurately;	Most criteria are met, but there may be some lack of clarity and/or incorrect information.	Experimental results don't match exactly with the theoretical values and/or analysis is unclear.	Experimental results are missing or incorrect;	
Discussion	Demonstrates thorough and sophisticated understanding. Conclusions drawn are appropriate for analyses;	Hypotheses are clearly stated, but some concluding statements not supported by data or data not well integrated.	Some hypotheses missing or misstated; conclusions not supported by data.	Conclusions don't match hypotheses, not supported by data; no integration of data from different sources.	
General formatting	Title page, placement of figures and figure captions, and other formatting issues all correct.	Minor errors in formatting.	Major errors and/or missing information.	Not proper style in text.	
Writing & organization	Writing is strong and easy to understand; ideas are fully elaborated and connected; effective transitions between sentences; no typographic, spelling, or grammatical errors.	Writing is clear and easy to understand; ideas are connected; effective transitions between sentences; minor typographic, spelling, or grammatical errors.	Most of the required criteria are met, but some lack of clarity, typographic, spelling, or grammatical errors are present.	Very unclear, many errors.	
Comments:				Total Marks (Out of 20):	

Title: Cathode Ray Tube Technology and Appliances.

Abstract: A cathode ray tube (CRT) is a vacuum tube that produces an image when an electron beam hits its phosphorescent surface. Electric (oscilloscope) waveforms, visual (television, computer screen), radar targets, and other events can all be represented by images. Or cathode ray tubes, widely used in various electronic devices, including computer monitors, televisions, radar screens, and oscilloscopes used in science and medicine. An envelope or container, electron gun, focusing system, deflection mechanism, and display screen are the five main components of a cathode ray tube.

Introduction: In 1897, German scientist Karl Ferdinand Braun developed the first device with a cathode ray tube. Braun introduced a fluorescent CRT display called the oscilloscope cathode ray. When electrons hit the screen, it emits visible light. Before 1934, the origin of technology itself can be traced back to the late 19th century, when the British physicist J. was inaccessible to the public before the first CRT television stations and television stations appeared. Cathode rays are effective. The first known CRT device appeared later in the same year. In 1907, video signals of geometric shapes were displayed on the screen using CRT units.

Theory: The CRT includes numerous factors beginning with a tube it's vacuum-sealed to preserve air out of it. On one aspect of the internal of the tube, there is a cathode and an anode. The cathode is a negatively charged conductor, and the anode is a positively charged conductor. Electrons, that have a negative charge, waft off the cathode and are attracted closer to the anode. A small hollow withinside the anode lets in a few electrons to skip through it, developing a beam of electrons. On the contrary aspect of the tube is a coating that glows when struck with the aid of using the electrons. In front of J. In the experiment of J. Thomson, it became now no longer nicely installed that there had been electrons. Nobody knew as it an electron beam, therefore. The call cathode ray tube became named ' cathode rays ' rather than what flowed off of the cathode into the anode**.**

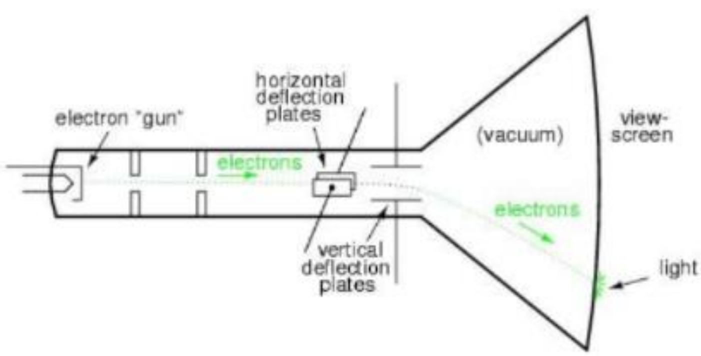


Figure 1: Cathode Ray Tube.

Using CRT monitors is easy. A cathode-ray tube consists of one or more electron guns, possibly internal electrostatic baffles, and phosphor targets. CRT has three electron beams, one for each (red, green, and blue), as shown in the figure. When the electron beam hits the phosphor-coated screen, a tiny bright spot is visible. On each monitor, the entire front of the tube area is scanned regularly and systematically in a fixed pattern called an image (grid), which is displayed by scanning an electron beam on the screen. The phosphor target starts to fade in a short time, and the image must be continuously updated. Therefore, the CRT creates a three-color image as the primary colors. Here we use a frequency of 50Hz to eliminate the flicker when the screen is refreshed. The main components of a cathode ray tube are the cathode, the control grid, the frame, and the screen.

Advantages of CRT:

1. CRTs are less expensive than other types of display technologies.
2. CRT can be used any resolution, geometry, and aspect ratio without compromising image quality.
3. CRT provides the best color and grayscale for all professional calibrations.
4. Excellent viewing angle.
5. It maintains good brightness and provides durability.

Disadvantages of CRT:

1. The Gaussian beam profile of the CRT produces smooth-edged images whose original resolution is not as clear as that of LCDs. Imperfect colors and focus can also reduce sharpness.
2. All the colors on the CRT are impractical for more patterns. Many displays have more drops, which usually won't eliminate them completely.
3. Can be used for geometric distortion and screen control problems. Magnetic fields, including other CRTs, will also be affected.
4. The aspherical or cylindrical screen is available to certain CRTs. More recent CRTs are flat.
5. It is big, heavy and heavy, consumes a lot of electricity and generates a lot of heat.

Some Common types of CRTs:

Oscilloscope CRT: The electronic meter creates a screen that shows the relationship between two or more variables. In most cases, this will be an orthogonal graph (x, y) with a linear function of time on the horizontal axis. The vertical axis is usually a linear function of the voltage at the signal input of the instrument. Since there are many types of sensors that can convert almost any physical phenomenon into a corresponding voltage, the oscilloscope is a very versatile tool that can be used for many forms of physical research. Perform a similar function, but allow continuous recording. The beam-to-beam oscilloscope uses a light beam reflected from a mirror galvanometer and focused on moving photosensitive paper.

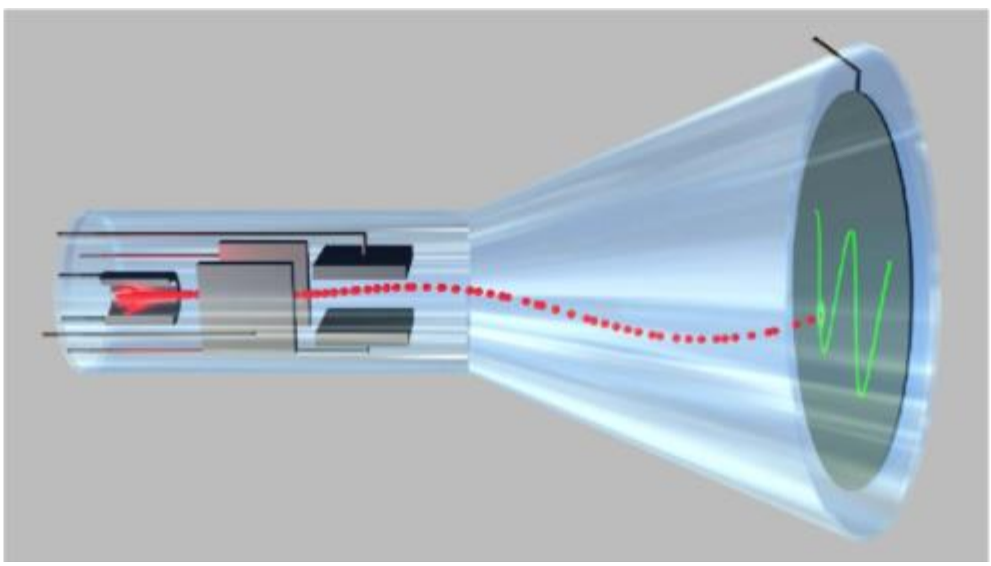


Figure 2: CRT Oscilloscope

Color CRT Display: A cathode-ray tube monitor (CRT) is an analog TV or computer monitor with a large and deep housing. This type of monitor uses a flow of electrons to activate points or pixels on the screen to create a coherent image. LCD monitors and plasma TVs or flat screens use the latest digital technology. Although flat panel displays are becoming more and more popular, CRT models still have some advantages that can be improved in some cases. Dots are not technically pixels, but the term is often used to refer to them. The more dotted lines on the screen, the higher the resolution, the clearer. Therefore, 1024 x 768 resolution, that is, the number of columns multiplied by the number of rows, is clearer than 800 x 600 because the image is denser and more detailed. A higher resolution is important for displaying fine graphic details and clarity text.

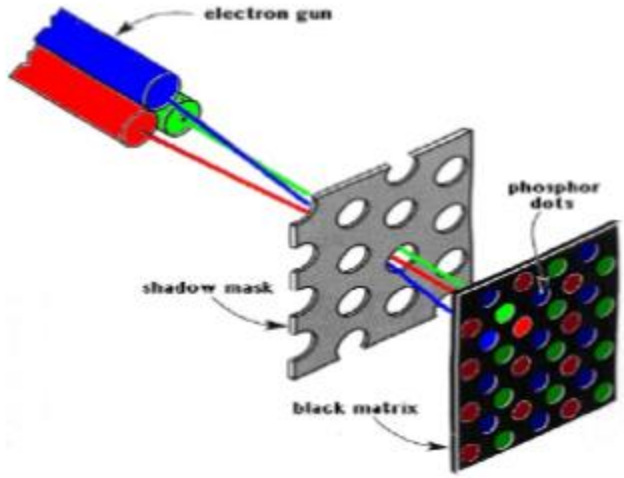


Figure 3: Color Displays on a Monitor and Magnified Shadow

Television: Inside the CRT monitor is a picture tube, which tapers backward into a narrow space. In the bottleneck area is a charged filament or "cathode" enclosed in a vacuum tube. When powered, the filament heats up and emits a stream or "beam" of electrons from the filament. The negatively charged electrons are attracted by the positively charged "anode", which focuses the particles into three narrow beams and accelerates them to hit the phosphor-coated screen. Phosphors emit light when exposed to radiation, absorb ultraviolet rays, and emit visible colored light. Red, green, and blue luminescent materials are used as "stripes" of colored dots in color monitors. The three beams are used to excite the three-color combinations required to create the different tones that make up the picture. The copper control coil is used to precisely guide the electron beam that generates the magnetic field in the tube. The field moves the electron beam vertically or horizontally. B. By applying AC voltage to the control coil, the beam can be positioned at any position on the screen. Each image is "drawn" on the screen by scanning the electron beam on the screen several times per second. This must be done even if the displayed image has not changed because the phosphor only lights up for a short time.

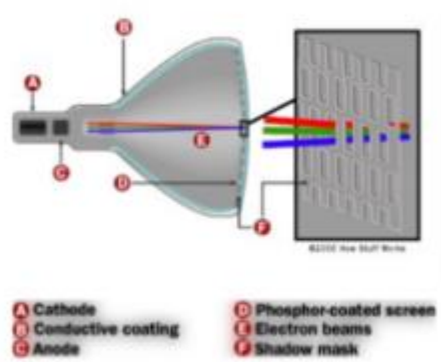


Figure 4: Inner components inside TV.

TV Phosphors: Phosphors are any material that emits visible light when exposed to radiation. The radiation can be ultraviolet or electronic. Any fluorescent color is actually a kind of phosphor: the fluorescent ink absorbs invisible ultraviolet rays in the CRT element and emits visible light, and the phosphor covers the inside of the screen. When the electron beam hits the phosphor, it will make the screen glow; on a black-and-white screen, there is a phosphor that emits white light when it hits. There are three kinds of phosphors on the screen, arranged in dots or strips, emitting red, green, and blue light. There are also three electron beams that illuminate three different colors together. Thousands of different phosphors have been formulated, and they are characterized by their emission color and emission duration after excitation.

The Black-and-White TV Signal: In black and white TVs, the screen is coated with white phosphor, and the electron beam "draws" an image on the screen bypassing the electron beam through the phosphor line by line. The electronic circuit in the TV uses a magnetic coil to move the electron beam on and down the screen in a "raster scan" pattern. The light beam draws a line on the screen from left to right. Then it quickly flies to the left, moves a little down, and draws another horizontal line on the screen, and so on. In this figure, the blue line represents the line that the electron beam "pulls" across the screen from left to right, and the red dashed line represents the electron beam returning to the left. When the beam hits the right side of the bottom line, it should return to the upper left corner of the screen, as shown by the green line in the figure. When the beam "draws", it turns on, and when it flies back it turns off, so as not to leave any traces on the screen. The term horizontal recoil refers to the movement of the beam to the left at the end of each line, and the term vertical recoil refers to the movement from bottom to top. As the light beam draws each line from left to right, the intensity of the light beam changes, resulting in different black, gray, and white shades on the screen. Because the lines are so close together, your brain will combine them into a single image. The TV screen usually has about 480 lines from top to bottom. In the next section, you will learn how the TV "draws" these lines on the screen. A signal containing all three components (intensity information, horizontal echo and vertical echo) is called a composite video signal. The composite video input on the recorder is usually a yellow cinch connector. A typical composite video cable looks like the image on this page. The horizontal return signal is a 5-microsecond pulse at zero voltage (abbreviated as "we" in the figure). The electronics inside the TV can detect these pulses and use them to produce horizontal reflections of the light beam. The actual linear signal is a variable waveform from 0.5 to 2.0 volts, where 0.5 volts is black and 2 volts is white. This signal controls the electron beam intensity circuit. Black and white TV, this signal can be used up about The bandwidth is 5 megahertz (MHz), and the color set is limited to approximately 3.0 MHz The vertical reverse pulse is similar to the horizontal reverse pulse, but the duration is 400 to 500 microseconds. -The pulse is reversed to synchronize the horizontal return line of the TV.

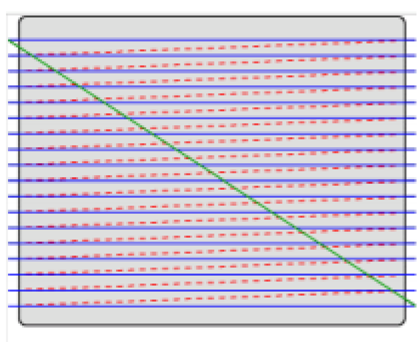


Figure 9: Raster Scanning

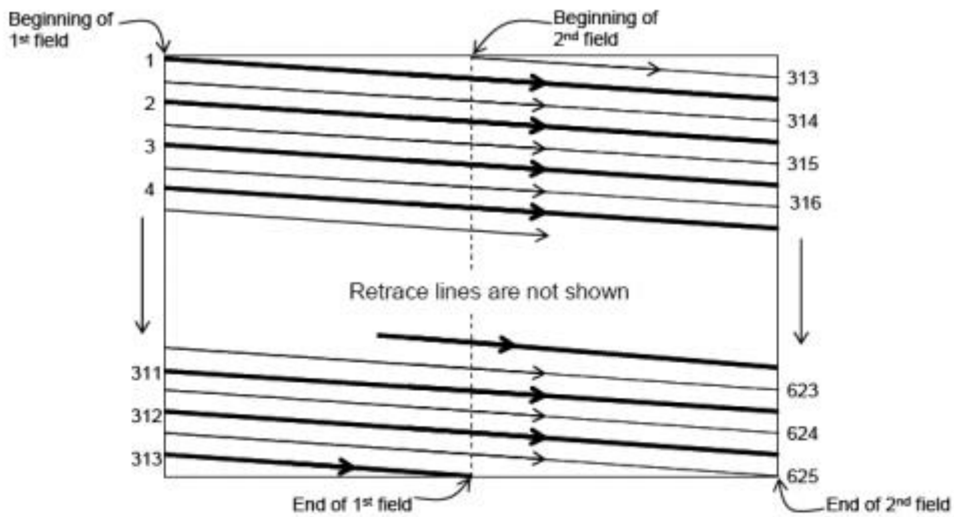


Fig. 10: Principle of Interlaced Scanning

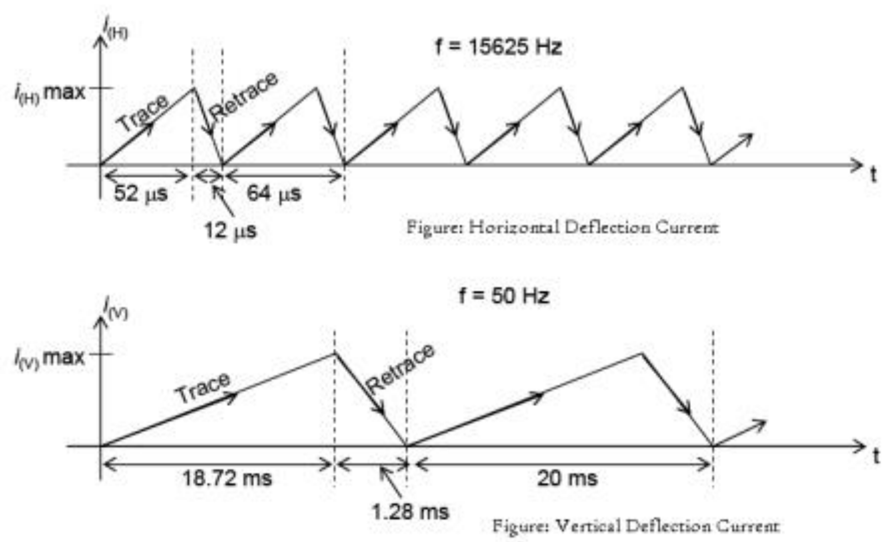


Fig. 11: Horizontal and Vertical Deflection Current

Color TV Screen: A color TV screen differs from a black-and-white screen in three ways:

1. Three electron beams move on the screen at the same time, called red, green, and blue beams.
2. The screen is not covered with a layer of phosphor material in a black-and-white TV but is covered with red, green, and blue phosphors arranged in dots or stripes. If you look closely at the screen with a magnifying glass, you will see dots or lines.
3. In the tube, there is a thin metal screen, called a shadow mask, very close to the phosphor layer. The mask has very small holes corresponding to the dots (or stripes) of the phosphor on the screen.

When a color TV needs to produce a red dot, it will point the red-light beam at the red phosphor. Same for the green and blue points. To create a white point, red, green, and blue light are emitted at the same time-these three colors mix together to form white. To create a black point, all three rays will be turned off when passing through the point. All other colors on the TV screen are combinations of red, green, and blue.

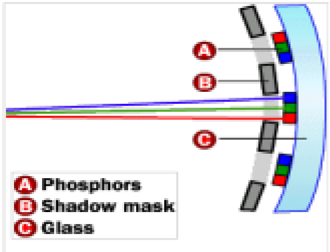


Fig. 12: Color TV Screen

The delta gun assembly consists of three independent electron guns, which are 120 degrees apart on the back neck of the tube to generate three high-speed electron beams. The barrel is slightly inclined to the centerline of the tube, converging into a hole near the bezel. Only in the corresponding position of the colored fluorescent material. Each matchstick trio has an aperture hole, and the condensing beam passes through the mask, illuminating it briefly as the fluorescent trio passes through, so as it moves between openings, it stays open or is masked. This is an important function of the shadow mask. In the absence of a mask, the light will excite all points and always mix colors. Therefore, the shadow mask blocks a considerable part of the lightning current and consumes several watts of power. A fluorescent screen receives less than 20% of the beam, which reduces the brightness of the color tube. For this reason, color CRTs use higher anode voltages and require higher cathode and radiation currents than monochromatic lamps of the same size.

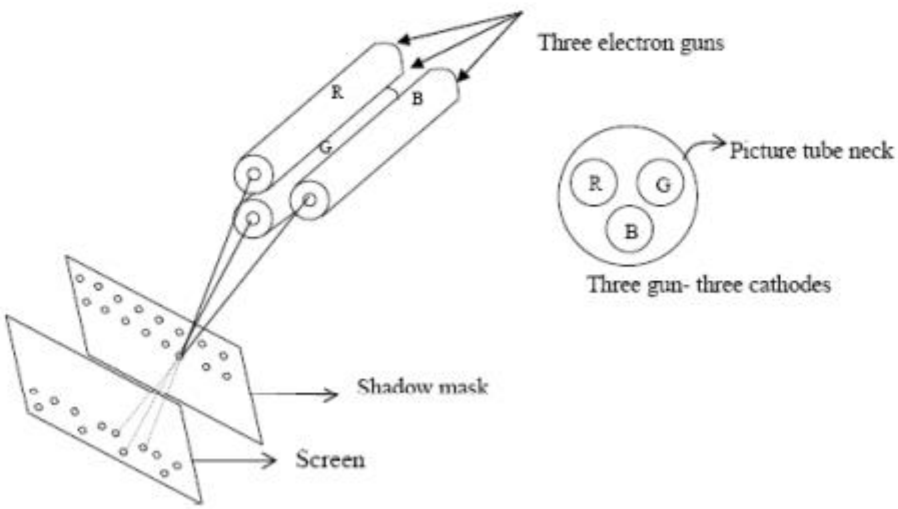


Fig. 13: Delta Gun Assemble of Color Picture Tube

Contrary to the design of the delta gun assembly is the convergent electrode assembly of all three spray guns, which includes a magnetic shield that allows each beam to move without affecting the other and internal pole pieces, as shown. Their shape causes the external coils of the yoke to concentrate the magnetic field generated by the rays, fundamentally changing them so that they converge through the opening of the mask.

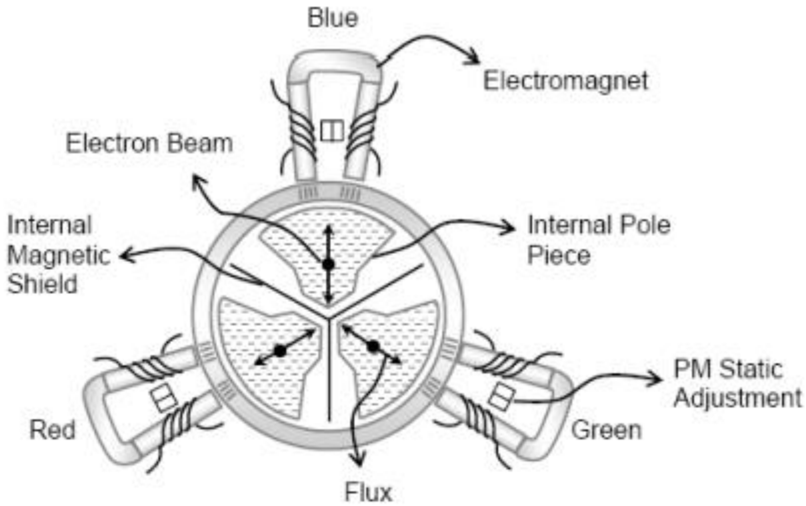
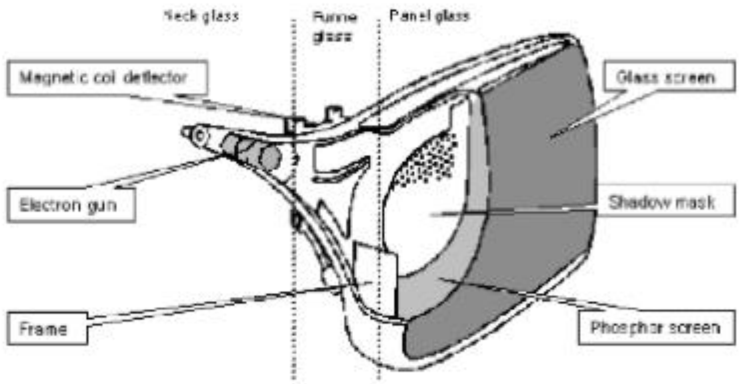


Fig. 14: Convergence System

Degaussing Coil: Degaussing stands for demagnetization. The name comes from the gauss unit, which measures flux density. The purpose of demagnetization is to remove the magnetic flux of the magnetized metal. In a color TV, the steel chassis and its support, the inner frame of the fixed shadow mask, and the shadow mask itself are all affected by the injected magnetic force. These local magnetic fields can interfere with the path of electrons through the CRT and cause the electron beam to land incorrectly, resulting in poor color purity. Therefore, speakers, toys, and other devices with magnets should be kept away from color TVs. However, the PM (permanent magnet) field is inevitable: we are all immersed in the earth's magnetic field. Geomagnetism is the main reason. Why does color CRT need degaussing? In the case of color tubes, magnetization affects the color purity and convergence of the three electron beams. However, magnetization is not a problem for monochromatic CRTs. Therefore, the degaussing coil is not used for B/W picture tube. No matter which direction the TV is pointed, there should be an automatic demagnetization circuit (ADG) to compensate for the earth's magnetic field. Using this method, the cathode ray tube is automatically demagnetized every time the TV is turned on. The built-in strap supports the tubes on the top, bottom, and sides of the screen. When the device is turned on for the first time, a large current from the AC input passes through these coils. Then the current quickly drops to a negligible value within a fraction of a second.

The future of CRT technology: With the continuing trend of electronic image capture, archiving and transmission, high-quality paper photo products will continue to be in demand. For the human eye and brain's response system, the film is transparent, durable, and can provide excellent resolution and dynamic range. So how are future films edited, exposed and processed? In the next one to three years, CRT will still be the cheapest way to convert electronic images into light energy that illuminates film. The prices of lasers and LEDs will drop so much that they can be considered acceptable. Replace CRT, because the coherent light source has been implemented in other products, such as computer printing on plain paper for the Office/commercial setting.

Experimental procedure:



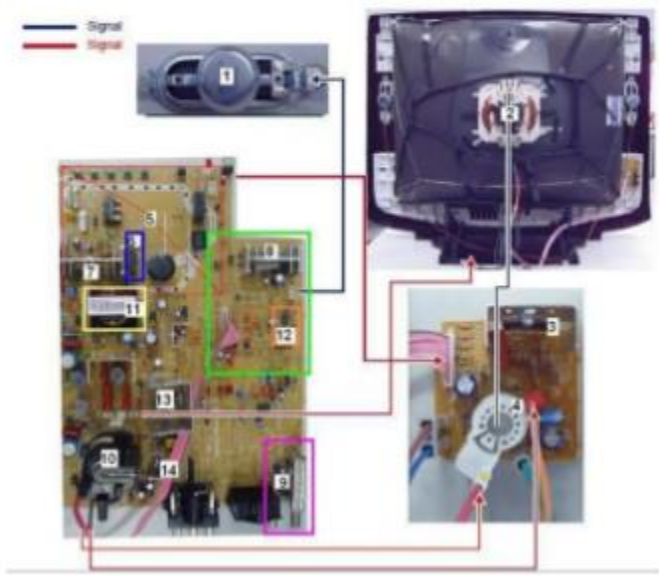


Figure: Inside of a CRT TV

Parts name of above diagram:

1. Speaker.
2. Yoke.
3. Video Amplifier.
4. CRT Socket.
5. High Voltage Section.
6. Bridge Diode.
7. Regulator.
8. Audio Amp (green square) Audio Section.
9. Tuner.
10. Fly back.
11. Chopper.
12. EEPROM (Memory IC).
13. Vertical Deflection.
14. Horizontal Deflection.

Discussion: CRTs are still important equipment that many of us will consider in the coming years, especially if they were purchased in the past year or two. Therefore, we thought it would be interesting to look at the current state of CRT design. In exchange for color, CRT design sacrifices spatial resolution and photon efficiency. There is no doubt that CRT will be more affordable, and manufacturers are still struggling to minimize physical size and weight, which requires a lot of engineering design.