# What is CRT

CRT stands for Cathode Ray Tube. It is an an old type of television and computer display technology that developed in the 20th century. It used an electron gun to fire electrons at a phosphorescent material to create a display. It was eventually replaced by flat-panel technology like LCD and plasma displays.

## How does CRT works

CRT stands for cathode ray tube, which is a type of display technology that was commonly used in older televisions and computer monitors.

The CRT works by using an electron gun to fire a beam of electrons at the back of the screen, which is coated with phosphors that emit light when struck by electrons. The electron beam is directed at specific locations on the screen to create the image that you see.

The electron gun is located at the back of the CRT, and it consists of three main parts: the cathode, the control grid, and the anode. The cathode is a heated filament that is used to generate a stream of electrons. The control grid is used to control the flow of electrons as they leave the cathode, and the anode is used to accelerate the electrons and focus them into a tight beam.

Once the beam of electrons is produced, it is accelerated and focused by a series of electromagnetic lenses, which direct it towards the front of the screen. At the front of the screen, the beam of electrons strikes a phosphor-coated surface, which emits light. The brightness of the image is controlled by adjusting the flow of electrons, while the color is controlled by using phosphors that emit different colors of light when struck by electrons.

CRT displays were widely used in the past due to the good quality of picture they produced but with the modern LCD, LED technology and flat-panel display is more widely used now due to lower cost and ease of production as well as being more energy efficient.

## Construction of CRT

Cathode Ray Tube (CRT) is a display device commonly used in television and computer monitors. It consists of a glass video display with an electron gun that emits a stream of electrons, which are then directed at the screen by a series of electromagnets. The screen contains a phosphor coating that emits light when struck by the electrons, which creates visible images. The CRT is usually sealed in a vacuum to prevent air from interfering with the flow of electrons. The CRT construction consists of several components including the electron gun, the electromagnets, the phosphor coating, the vacuum, and the aluminum casing.

## CRT Displays

CRT (Cathode Ray Tube) displays are a type of video display technology that was commonly used in televisions and computer monitors before the widespread adoption of LCD and LED displays. In a CRT display, an electron gun at the back of the tube fires a beam of electrons at a phosphor-coated screen, which creates the image that you see on the screen.

One of the advantages of CRT displays is that they can display deep blacks and a wide range of colors. They also have fast response times, making them well suited for displaying fast-moving images such as in video games. However, CRT displays are bulky and heavy, and they consume a lot of power. They also suffer from geometric distortion and convergence errors. This is where the shape of the image on the screen can be distorted or where the colors are not aligned properly.

Due to the invention of LCD and LED display technology, CRT displays have become less popular in recent years and it's now hard to find them for purchase. They are still used for some specialty applications such as oscilloscopes and certain types of medical imaging equipment.

Overall, CRT technology was a great step for displaying images but it's slowly being replaced by newer technology with better energy efficiency, smaller size and lesser distortion problems.

## Types of CRT

* Monochrome CRT – A monochrome CRT (cathode ray tube) is a type of CRT that is used to display images in only one color. The most common color for a monochrome CRT is green, but other colors, such as amber and white, were also used. Monochrome CRTs were commonly used in early computer terminals, oscilloscopes, and other scientific and industrial equipment where the image needs to be simple and easy to read.

The design of a monochrome CRT is relatively simple as compared to color CRT because it only needs a single electron gun and a phosphor screen coated with a single color. The electron beam is directed at the screen and causes the phosphors to emit light of a specific color, creating the image. The image is usually created by modulating the intensity of the electron beam, which varies the brightness of the corresponding areas of the image.

Monochrome CRTs have been largely phased out in favor of color CRTs and LCD and LED displays. Monochrome CRTs have better resolution, less flicker, and also better contrast and sharpness compared to color CRT's, which make them suitable for certain applications where a high level of detail is needed.

* Color CRT – A CRT (cathode ray tube) is a type of display technology that was commonly used in older televisions and computer monitors. It works by firing an electron beam at a phosphor-coated screen, which causes the phosphors to glow and produce the image you see on the screen.

One of the key characteristics of a CRT is its ability to display a wide range of colors. This is achieved through a process called chrominance modulation, in which the intensity of the three primary colors (red, green, and blue) are modulated to create a wide range of hues. The CRT also uses a process called luminance modulation to adjust the brightness of the image, which allows for a wide range of color intensities.

While CRT technology is now largely obsolete, as it has been mostly replaced by LCD, LED and other types of flat-panel display. CRT still have a significant advantage in color accuracy and picture quality, even today and still used in professional equipment like Television studio, medical and scientific research.

* Beam CRT – "Beam CRT" could refer to a cathode ray tube (CRT) used in a beam-forming display system. CRTs are vacuum tubes that use an electron beam to create an image on a phosphorescent screen. They were used in early televisions and computer monitors, but have largely been replaced by flat-panel displays in modern devices.

A beam-forming display system is a type of display technology that uses an array of micro-mirrors to direct the light from a light source onto a screen, allowing for a more precise control over the shape and direction of the beam of light. This can be used to create more realistic images with increased contrast and brightness, and can also be used to project images over a wider area.

It is also possible that "Beam CRT" might refers to specific brand or model of cathode ray tube, but without more context it is hard to say.

## Application of CRT

1. Oscilloscopes: Cathode ray tubes are used in oscilloscopes to view electrical signals. An oscilloscope is an instrument used to view the waveforms of electronic signals and the variation of a signal over time.
2. Television receivers: Cathode ray tubes are used in television receivers to produce images. These images are created by controlling the intensity of beams of electrons, which are directed to a phosphor reflective surface.
3. Computer monitors: Cathode ray tubes are also used in computer monitors to display images on a screen. This is done by generating electron beams, which are then directed to the phosphor coating of the screen.
4. Radar displays: Cathode ray tubes are used in radar displays to provide an accurate representation of the position of objects.
5. X-ray machines: Cathode ray tubes are also used in X-ray machines to create images and detect objects.

# What is LCD

LCD stands for "liquid crystal display." It is a type of flat-panel display technology that is commonly used in devices such as television screens, computer monitors, and smartphone displays. LCDs work by using the light-modulating properties of liquid crystals to control the passage of light through a layer of the crystals, which are sandwiched between two sheets of glass or plastic. By applying a voltage to the liquid crystals, they can be oriented to allow light to pass through or to block light, which creates the image that is displayed on the screen.

One of the advantages of LCD technology is that it is relatively energy efficient, making it a popular choice for devices that need to run on battery power. It also allows for the production of thin, lightweight displays. Additionally, LCD technology allows for a wider viewing angle, so the image can be seen clearly even when viewed from an angle.

However, it has certain disadvantages such as limited viewing angle, less color accuracy and brightness, limited contrast ratio compare to OLED, slow response time and not suitable for high refresh rate.

There are different types of LCD displays, such as twisted hematic (TN) LCDs, in-plane switching (IPS) LCDs, and vertical alignment (VA) LCDs, each with its own set of pros and cons.

## How does LCD works

An LCD display works by using the light-modulating properties of liquid crystals to produce images. Liquid crystals are a type of matter that have some properties of both liquids and solids. When an electric current is applied to a layer of liquid crystals, the molecules of the crystals will align in a particular way. This alignment can be controlled to allow light to pass through or be blocked, which is how an image is produced on an LCD display.

Here's a more detailed explanation of how an LCD display works:

1. The LCD display consists of two layers of glass with a layer of liquid crystals between them. The glass layers also have electrodes, which are thin layers of conductive material, on their inner surfaces.
2. When an electric current is applied to the electrodes, it causes the molecules of the liquid crystals to align in a particular way. The alignment of the molecules determines whether light can pass through the liquid crystals or not.
3. The LCD display also has a backlight, which is a source of light that is used to illuminate the display. The backlight is typically made up of a series of fluorescent lamps or LEDs.
4. When the electric current is applied to the electrodes, it causes the liquid crystals to align in such a way that they either allow light to pass through or block it. By carefully controlling the voltage applied to the electrodes, it is possible to control the amount of light that passes through each pixel of the display, creating an image.
5. The pixels on an LCD display are arranged in a grid, with each pixel consisting of three sub-pixels (one red, one blue, and one green). By controlling the amount of light that passes through each sub-pixel, it is possible to produce a wide range of colors on the display.

## Construction of LCD

LCD stands for Liquid Crystal Display and is composed of several layers. The layers form a sandwich with the liquid crystal solution held between two transparent electrodes, such as indium-tin-oxide or Aluminum-doped zinc oxide. These electrodes are connected to thin-film transistors (TFTs), which are used to power each individual pixel. On top of the TFT layer there is another layer of polarized glass, which helps to keep the liquid crystal molecules aligned evenly across the screen. Finally, a color filter is applied to the TFTs to produce the colors on the screen.

## How LCD uses Liquid Crystals & Polarized Light

LCD technology is based on the utilization of liquid crystals and polarized light. Liquid crystals are like tiny molecules which have the unique capability to twist and turn when an electrical current is applied to them. When a current is applied, the crystals twist, allowing and blocking light in different directions. This is where polarized light comes in—when light passes through a polarizing filter, the light waves become aligned, allowing some light to pass through while blocking other light, depending on the orientation of the filter. When an LCD uses crystals and polarized light, small areas of the liquid crystals rotate and only allow light to pass if it is properly aligned. This allows sections of color (red, green and blue) to be blended into any color, as well as grouped into patterns that form the images seen on the LCD screen.

## Types pf LCD

There are several types of LCD (liquid crystal display) technology, each with its own advantages and disadvantages. Some common types of LCDs include:

* TN (twisted hematic) – This is the most common type of LCD. It is relatively inexpensive to produce and has fast response times, but it has poor color reproduction and viewing angles.
* IPS (in-plane switching) – This type of LCD has better color reproduction and viewing angles than TN, but it is generally more expensive and has slower response times.
* VA (vertical alignment) – This type of LCD is similar to IPS, but it has even better color reproduction and contrast. However, it also has slower response times and may have issues with color shifting at certain viewing angles.
* AMOLED (active-matrix organic light-emitting diode) – This type of display uses organic materials to create the pixels, which allows for deep blacks and high contrast. It's also has fast response time and wider viewing angles, but it is also more expensive to produce than traditional LCDs.
* Micro LED – This technology is a new LCD technology that uses microLEDs as the light source. It has high brightness, high contrast, and ultra-fast response time. But it also has very high production cost, and not yet widely adopted.

It's important to note that these are general categories, and there can be significant variation within each type of LCD. Factors such as resolution, size, and backlighting can also have a big impact on a display's overall performance.

## Application of LCD

1. Television – LCD TVs are popular for their thin and lightweight design and their ability to display high-quality images.
2. Computer Monitors – LCD monitors are used in both home and office computers, they provide clear and bright images, and they take up less space on a desk than traditional CRT monitors.
3. Smartphones – LCDs are used in many smartphones as well as tablets due to their ability to display vibrant colors and wide viewing angles.
4. Digital Watches – The small size and low power consumption of LCDs make them well-suited for use in digital watches, which need to be both small and battery-efficient.
5. Car instrument panel – In cars, LCDs are used for displaying various information, such as the speedometer, fuel level, and temperature gauge
6. Appliances – LCD displays are also used in a variety of household appliances, such as microwave ovens and washing machines, to display the current time, cooking/washing status, and other information.
7. Medical instruments – In medical field, LCDs are used in various instruments such as X-ray machines, ultrasound machines, blood glucose monitors etc to display the live reading.
8. Industrial Automation – LCD displays are also used in industrial automation systems such as programmable logic controllers (PLCs) and human-machine interfaces (HMIs) to display real-time data and control information.

These are some of the common applications of LCD, the technology is versatile and can be applied in many more fields.