The Electron Gun (Mono-Chrome)

The unipotential gun can be broken down into two sections, the triode and the lens section. The triode is the electron-emitting and shaping section formed by the electron source (cathode), the control grid (G1) and the accelerator (G2). The lens of the unipotential design has three elements G3, G4 and G5.

The Triode

The cathode is heated by a 6.3 or 12 volt filament. Operating at an elevated temperature causes electrons to "boil off" the surface of the cathode and form a cloud. The electron emitting surface of the cathode is often impregnated with tungsten and barium. The effective area of the cathode is determined by the aperture size of G1 (control grid).

The video signal is typically applied to the cathode along with video blanking. This permits the G1 and G2 elements to be biased relative to the cathode for uniform operation from CRT to CRT.

Electrons are negative charged particles. They are attracted to positive elements (G2 and the faceplate of the tube) and repelled by the negative charge of G1. The more negative G1 appears to the cathode, the greater the reduction in the flow of electrons. The beam current is pulled through a small hole in G1, called the aperture. Grid two (G2) is the first accelerator and is positive relative to the cathode. This bias voltage applied to G2 is set in conjunction with G1 which establishes a cut-off voltage. The physical relationship of these two elements, along with the cathode, influence the lower beam angle, center focus voltage, and the spot size.

The Lens

The electrostatic lens are used to focus the electron bean on the phosphor in the front of the tube. The combination of G3, G4, and G5 form the lenses. G3 and G5 are connected to the high voltage of the anode. G4 is the variable element which controls the focus distance. Static focus voltage and any dynamic voltage if required, are applied to G4 through the base connector.

High resolution displays require dynamic focus to maintain pixel quality into the corners of the CRT. This is even more critical on flat profile CRTs. Electron guns can be optimized for dynamic focus or flat focus applications. A flat focus gun will provide a compromise of focus quality from center to edge and is appropriate for many low to medium resolution applications. Displays requiring higher resolution such as those in desk top publishing, graphics terminals, document processing, and medical imaging, require dynamic focus.

The function of each of these gun elements and their interaction is critical to the overall performance of the CRT. From cathode to the face of the CRT, it is the relationship between each of these individual elements that determines the final appearance of the undeflected spot in the center of the tube face and how well it responds to being deflected.

Phosphor Selection

The screen of a CRT is comprised of a smooth, continuous coating of phosphor which has been applied to the inside of the glass faceplate. A thin film of aluminum is then applied to the phosphor. This coating protects the phosphor from direct electron bombardment while transmitting the energy from the electron beam to the phosphor crystals. When excited by the electron beam, the phosphor crystals emit light. The aluminum coating reflects light that would otherwise be lost, therefore the operator of the display sees a combination of direct and reflected light.

The design criteria for selecting a phosphor must take into consideration the effects of beam current on spot size and the ability of the electron gun to contain the beam bundle (maintain focus). Additional consideration must be given to the refresh rate for flicker free images.

Smear and tailing are characteristic of scrolling information on a display with phosphor having too long of a persistence. Interlaced displays gain resolution with higher line counts by utilizing long persistent phosphors to prevent flicker at the expense of smearing. However, current display technology in combination with high efficiency, fast phosphors provide a stable image above 76Hz vertical refresh rate without tailing or smearing.

We have provided a list of common phosphor types, as well as a C.I.E Chromaticity Chart. The color chart represents the EIA "Kelly Chart of Color Designation for Lights", but should be used as an example only, due to differences in your monitor's calibration and the limiting factor of resolution on the WWW. To properly view the color chart and table, your monitor must be set to at least 800x600 pixel resolution, and be capable of displaying 256 colors.

Faceplate Type and Treatment

Transmittance Values

Monochrome CRTs are available with two transmittance values. Standard, which is 42%, and Dark, which is 30%. The transmittance value is based on a faceplate thinkness of 10.16mm and a wavelength of 546nm. The fourteen inch, flat profile CRT (Clinton type 914), for example, has a center faceplate thickness of 10.16mm. Smaller CRTs have thinner glass yielding higher transmittance values, while larger CRTs, which have thinker glass, offer lower values.

Enhancing CRT Contrast & Minimizing Glare

The use of darker glass will enhance the contrast and works best with pixel "on" characters. Dark glass is less effective on reverse video applications and will put a heavier load on the electron gun.

Ambient room light which passes through the faceplate and reflects off of the phosphor can also adversely affect contrast. Standard glass does little to limit this effect while dark glass can reduce the effects of ambient light by attenuating the light twice, once on entrance and second upon exit from the glass.

Glare is the result of ambient light reflected off the surface of the CRT faceplate. Standard radius faceplates cause focused glare due to the lensing effect. Depending on the ambient lighting, this can be a minor irritation or a severe problem which can effect the performance of the user. While flat profile faceplates reduce this phenomena, it can not be eliminated. Treating this surface of the faceplate with anti-glare properties further enhances the readability.

Clinton offers a variety of "anti-glare" treatments
to meet the varying demands of CRT applications: Chemical Etching
This process reduces glare by diffusing reflected images, and provides some attenuation of intensity. While this process effectively reduces glare there is some de-focusing of the displayed image. The chemical etching makes the display soft in appearance and can be measured in terms of spot growth relative to the barefaced CRT.

Mechanical Etching

This is the preferred method of treatment for CRTs in high resolution applications where anti-glare is required for and resolution is critical. This process provides greater attenuation of reflected images than Chemical Etching and less defocusing of the displayed image.

Electrostatic Film (ESF)

The ESF treatment utilizes a coating commonly referred to as SIO2 (Silicon Dioxide). This treatment provides the attributes of chemical etching along with static dissipative properties

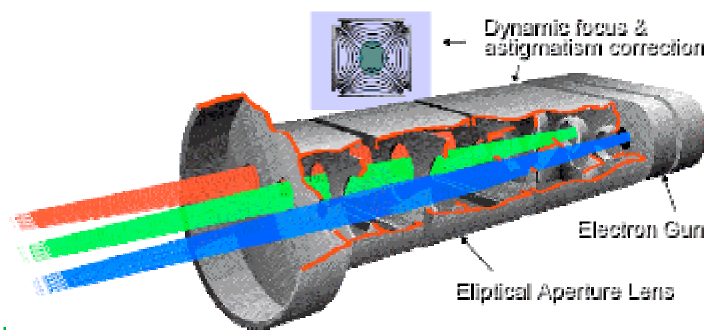
Notched Filter Panels

For applications which require "Sun light readable" displays, such as those in FAA control towers, Clinton offers Notched Filter Panels in combination with various narrow energy spectrum phosphors. Notched Filter panels are typically a laminated configuration utilizing a dyed laminate between two glass substrates.

Tempest Specifications
Many specifications for military applications include electronic emission standards which require a panel subassembly, composed of a conductive mesh, laminated between two glass substrates or a conductive coating. A typical panel configuration for a Tempest application could also incorporate a notched filter and optical coating.   Bonded Panels
Clinton can provide a variety of panels which have been treated with optical anti-reflective coating, chemically etched or bare faced.

The optical coating treatment utilizes a chemical coating on the surface of a panel which is then bonded to the faceplate using a specially formulated resin. This is a neutral density coating that provides one of the most effective methods of controlling first surface reflectance.

Clinton uncoated panels are bonded to the faceplate of the CRT. Available with etched or polished surfaces, these panels offer a range of transmittance levels, the most common of which is 90, 61, and 30 percent transmittance. These panels provide additional contrast, augmenting the transmittance level of the bulb, for special applications. These panels can also be used in applications where additional protection against implosion is required.



Hitachi Elliptical Aperture, Dynamic focus (A-EADF) Electron Gun
At the heart of Hitachi's high performance monitors is the EADF electron gun which ensures the sharp focus, high definition, distortion free image that sets them apart from there competitors. The elliptical aperture lenses produce maximum focusing control while minimising distortion effects due to centreline offset.
Hitachi's dynamic focus capability means that even FST screens have consistently sharp focus, right into the corners where the beam path length is substantially greater than at the centre. Added to this is an electro-static quadra-pole lens which makes constant adjustments to the cross sectional shape of each beam to ensure that the landing spot is precisely circular whatever the deflection of the beam or the position on the screen surface.

Thermionic emission is to electrons what evaporation is to the water molecules in a hot cup of coffee. It is a process by which some of the electrons inside a piece of metal can 'boil away', that is leave the surface of the metal into the surrounding space.

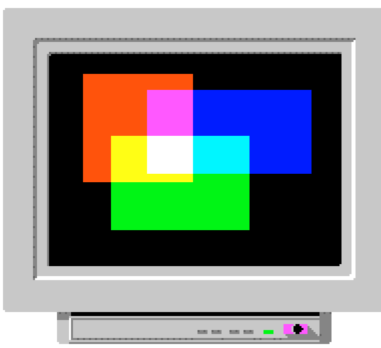
Inside a metal the electrons are not stationary, but are constantly moving, with an average speed which is controlled by the temperature of the metal. It is important to realize that this is only the average speed of the electrons, that some of them will have speeds which are significantly larger than this. It is these higher speed, and therefore higher energy electrons, which have enough energy to escape from the metal. Since the speed of the electrons increases with temperature, the number of electrons with sufficient energy to escape also increases with temperature, in fact exponentiallt so. At room temperature (300 K) the number is very small, but if the wire is heated to 1000K the number of electrons escaping is dramatically increased.

COLORS

Colors are rays of light, i.e. electromagnetic waves with wavelengths between 380 nm and 780 nm. We perceive them with our eyes and our brain translates them into what we call "colors".

In other words: colors are products of our brain. This means that one person may conceive colors slightly differently from another.

To display colors, monitors use what is called "additive color mixing", using red green and blue lights. This is due to the fact that if we mix red, green and blue light together, we get white light. When white is required on the screen, three electron guns hit the red, green and blue dots, or different shapes, of phosphor that coat the inside of the screen, which in turn glow together and produce white light.



16, 256, 65K (High Color), or 16.8M (True Color) of colors could be rendered by monitors depending on their possibilities and according to the graphic card used.