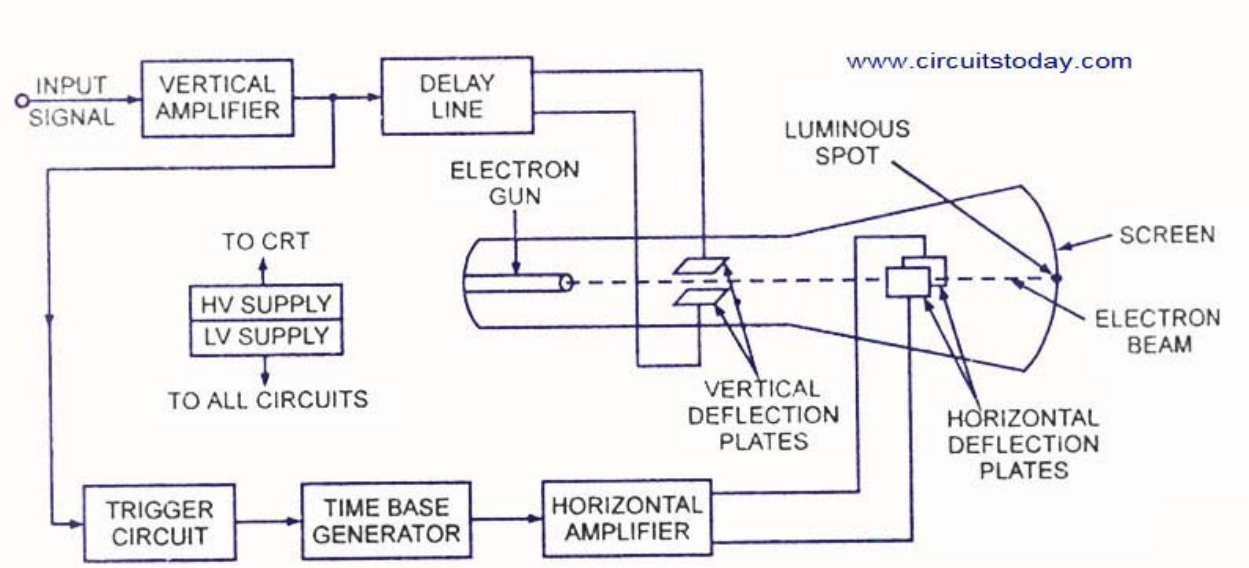
ELECTRON DYNAMICS AND CRO

Cathode Ray Oscilloscope :

It is a very powerful laboratory instrument used for display measurements and analysis of electronic circuits. It is used for measurement of voltage, current, frequency and phase angle. It can also be used to measure non-electrical quantities like pressure temperature etc. by converting non-electrical quantity into equivalent voltage by using transducer.

Block diagram of CRO:

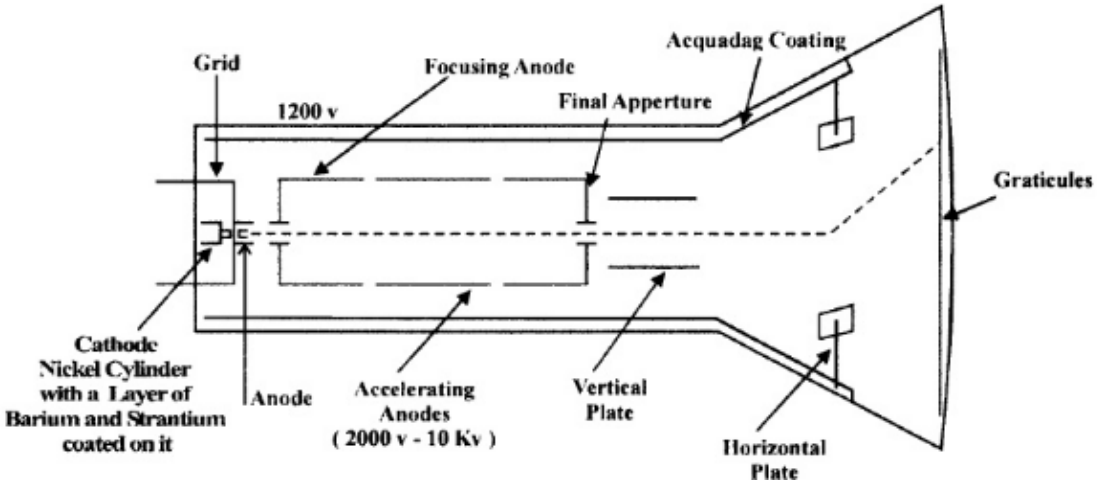


Block Diagram of a General Purpose CRO

Hart of a CRO cathode ray tube ,the input to be measured is applied to vertical deflection plates Horizontal defection plates a sweep wave form is applied that will deflect the electron beam horizontally. Time base generator provides a synchronization between horizontal and vertical deflection plates. To obtain a stable wave form the time base must be triggered with the vertical input signal. Vertical input frequency is equal to or multiply of saw tooth frequency. Time base generator generates sweep waveform. Time base is required because vertical deflection takes some time since it takes the input and then generates the sweep waveform.

Cathode ray tube:

block diagram of crt is shown in figure



CRT is heart of CRO. The main parts of CRT are

1. electron gun assembly
2. Deflection plate assembly
3. Fluorescent screen
4. glass envelope
5. Base (through which the connections are made to various parts)

Electron gun assembly includes cathode, control grid ,accelerating anode

cathode:

which generates electrons when heated by heater

control grid:

controls number of electronic which are emitted from cathode

accelerating anode:

this anode accelerates the incoming electrons

focusing anode:

The combination of first anode and second anode is called focusing anode

This will focus the collection of electrons into a beam since repuleation force between electrons.

Focusing are of two types 1.electrostatic focusing 2.magnetostic focusing

Deflection system are of two types

1.electrostatic deflection system

2.magnetostic deflection system

vertical deflection plates

Deflect the electron beam vertically but kept horizontally

horizontal deflection plates

Deflect the electron beam horizontally but kept vertically. Electronic static deflection system is prefered in CRT of CRO where as electro magnetic deflection system is preferred in picture tube of TV because deflection is more due to magnetic field.

fluorescent screen

Whenever electron beam strikes the screen It illuminates light

Charged Particles :

An electron is a –ve'ly charged particle having a magnitude of charge : 1.602×10^{-19} c.

In addition to the charge electron possess definite mass.

Radius of e^- is small and is equal to $10^{-15} m$.

Radius of atom $10^{-10} m$

so

$$\frac{q}{m} = 1.759 \times 10^{11} c / kg$$

There is two types of electron models.

1. classical model
2. wave mechanical model.

Classical Model :

The assumption here is electron is a small particle having definite mass + charge. The classical models are used for large scale pheromones i.e., e^- trajectories in a vaccum tube.

Wave mechanical model :

Here e^- travels in the form of a wave. This model is used for small scale phenomenon i.e., the electron trajectories in a atom or a crystal .

The term electron ballistics is used because of existing analogy b/w motion of charged particles in field of force and motion of falling body in earth's gravitational field.

Force on a charged particle in an electric field :

Electric Field intensity $(\vec{\varepsilon})$:

The force on a unit +ve charge at any point in an electric filed is called electric field intensity at that point units for electric filed intensity is volt/meter.

The force on a +ve charge 'q' in an electric filed intensity 'ε' given by

$$\vec{f}_q = q\vec{\varepsilon} \quad - \quad (1)$$

Where f_q is in Newtons q is in coulom, ε is in v/m

The path of an charged particle in an electric filed can be calculated by relating the electric force given in eq(1) to the force given by the Newtons II law of motion i.e., $F = m \cdot a$

$$\vec{f}_q = q\vec{\varepsilon} = m\vec{a} = m\frac{d\vec{v}}{dt} \quad - \quad (2)$$

Where m is mass (kg)

$\vec{a}$ acceleration (m/S^2)

$\vec{v}$ velocity (m/s)

Solution to this eq subjected to initial conditions gives the path of the particle resulting from the action of electic force.

If magnitude of charge of electron (e). therefore force on e^- in electric field is given as

Where –ve sign indicates force is in direction opposite to electric filed.