EMI COMMON QUESTIONS - MID-1

(1) (a) Accuracy: The Degree of closeness (or) Exactness of a measured Value of the quantity Compared to the True Value.

$$\text{Accuracy } A = 1 - \left| \frac{Y_n - X_n}{Y_n} \right|$$

where
Y_n - True Value
X_n - Measured Value

(or)

Accuracy indicates the ability of an instrument to indicate the true Value. i.e it indicates "confirming the truth".

(1)(b) Attenuator is an Electronic device Consisting of an arrangement of resistors that reduces the strength of a radio Signal (or) Audio Signal without distorting its waveform. it is effectively the Opposite of an amplifier.

(1)(c) CRO is a best and fast X-Y plotter. In X-Y mode, channel 'A' input Signal is applied to Vertical deflection plates and Channel 'B' input Signal is applied to horizontal deflection plates.

(1)(d) phospur Screen Converts the kinetic energy of Electron beam into light energy and

Used for visual display of input Signal. The phospor Screen determines the color & persistance of the trace/ Signal.

P1 (Phospor) – Green Color – Medium persistance

P2 (phospor) – Blue green Color – Medium persistance

P5 (phospor) – Blue color – Very short persistance

P11 (phospor) – Blue Color – short persistance.

(1)(e) Resolution:- Resolution defines the Smallest measurable change in the input to which an instrument can respond. i.e resolution is the Smallest Value an instrument can measure.

$$\text{Resolution} = \frac{\text{Full Scale deflection reading}}{\text{No of divisions on a Scale (or) meter}}$$

(2)(a) Precision:- Precision indicates the ability of an instrument to reproduce the readings again and again in the Same manner for Constant input. i.e "Successive readings do not differ" i.e repeatability of measurements.

$$\text{Precision } P_i = 1 - \left| \frac{\bar{X}_n - X_i}{\bar{X}_n} \right|$$

$\bar{X}_n$ – average of n-readings

X_i – Value of i^{th} reading.

(2) (b) Fidelity: (Faithfull reproduction)

The degree of closeness of practical Curve to Ideal Curve without dynamic Error is known as "Fidelity".

(2) (c) Applications of CRO:-

(i) CRO is very Usefull for testing & developement of Electronic Circuits.

(ii) the parameters of signals like amplitude, timeperiod, frequency, rise time, fall time, duty cycle, phase etc Can be measured by Using CRO.

(iii) CRO is the best X-Y plotter and gives the faster response.

(iv) In the CRO signal being measured Can be Visually displayed on the Screen.

(2) (d). The different types of CRO probes are

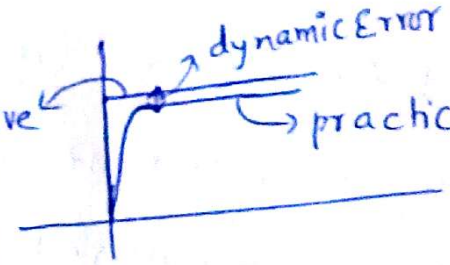
(i) Direct probe
(ii) High impedance probe
(iii) Active probes
(iv) passive probes
(v) High voltage probes.

(2) (e) The dynamic characteristics of an instrument Can be obtained by giving time Varying inputs to an Instrument. these characteristics indicate the

total behaviour of an instrument.

(3)(a) Speed of Response:- It indicates how fast an instrument can respond for change in the input and also indicates activeness of the system.

(3)(b) Dynamic Error:- The difference between practical curve and Ideal Curve with time Varying is known as "dynamic error".



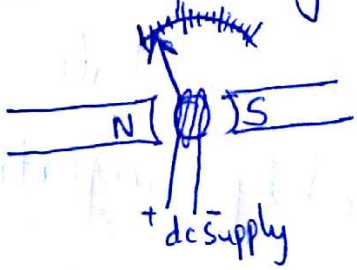
(3)(c) The length of time the trace/signal remains on the CRT Screen when Signal is ended (when power is Switched off) is known as "persistance time"

(3)(d) Trigger circuit Converts amplified input Signal into number of trigger pulses and these trigger pulses provides the Synchronization between input Signal and Saw tooth Signal (or) Sweep Signal which is generated from Time base generator.

(3)(e) In analog Storage OScilloscope wave form is shown the original form, whileadigital Storage OScilloscope Converts the Original analog waveform by Sampling it and Converts them into digital numbers and then

stores them in digital form by using Analog to digital Converter. i.e In analog storage Oscilloscope there is no digital memory but in digital Storage Oscilloscope because of digital memory capable of an infinite storage. digital storage Oscilloscope is more Expensive than Analog Storage.

(4) (a) D'Arsnoval Movement Principle:- A Current Carrying Coil is placed in a magnetic field which is produced from permanent magnet and Current Carrying Coil Experiences the force from magnetic field and rotates around its vertical axis. the force experienced by the Current Carrying Coil is directly proportional to Current passing through the Coil.



(4) (b). Deflection factor:- The reciprocal of the Sensitivity of an instrument is known as "deflection factor".

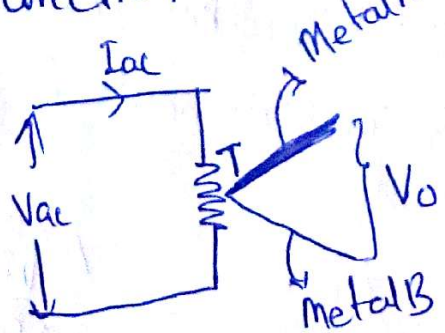
$$DF = \frac{1}{\text{Sensitivity}} = \frac{\Delta \text{input}}{\Delta \text{output}}$$

(4) (c) Delay line is used to delay the Signal for Some time in the Vertical deflection Section. the

delay line is not used, some portion of the input signal can be lost. the input signal is delayed until the time period provided to the horizantal deflection plates through horizantal amplifier.

(4) (d) Features of CRT :- The features of CRT are (i) Size
(ii) phosphor
(iii) Operating Voltages
(iv) Deflection Voltages
(v) Viewing Screen

(4) (e) Thermocouple :- Thermocouple is a junctio
of two dissimilar metals whose Contact pote
ntial is directly praportional to temprature
of the Junction.



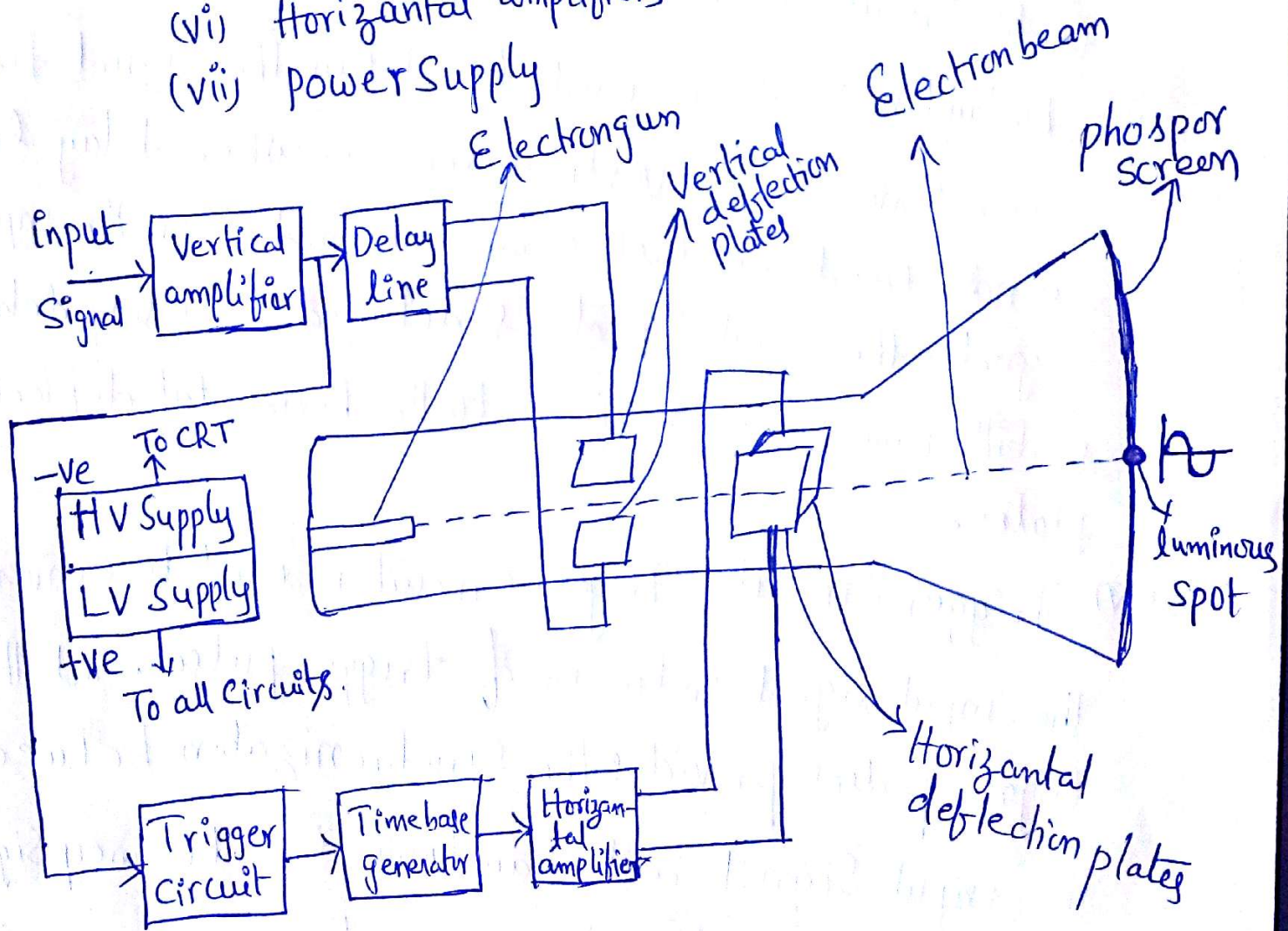
$V_o = f(T)$

EMI - Unit-2 - MID-1

(1) Block diagram of CRO :- (General purpose Oscilloscope)

There are 7 major fundamental functional blocks in the general purpose CRO. They are

(i) CRT (cathode Ray Tube)
(ii) Vertical amplifier } Vertical deflection System
(iii) Delay line
(iv) Trigger ckt
(v) Time base generator } Horizantal deflection System
(vi) Horizantal amplifier
(vii) Power Supply



(i) CRT (Cathode Ray Tube) :- CRT is the heart of the CRO. it consists of Electron gun which emitts the electron-beam and that Electron beam Strikes the phospor Screen and produces the visual display of the input Signal.

(ii) Vertical amplifier :- It is a wide band amplifier and it amplifies the input Signal in Vertical direction (or) Y-direction. it is also called as Y-amplifier. the electron beam deflection in the Y-direction (or) Vertical direction on the Screen that is propotional to amplitude of the input Signal give to the Vertical deflection plates.

(iii) Delay line :- It is used to delay the Signal for Some time in the Vertical Section. when delay line is not used we lost some information in the input Signal. The input Signal is delayed by using delay line Untill time period provided to the horizantal deflection plates.

(iv) Trigger Circuit :- Trigger Circuit is used to Convert the input Signal into no of trigger pulses and these trigger pulses provides the Synchronization between the input Signal and Sawtooth Signal (Sweep Signal) produced by the time base generator.

(v) Time base generator :- Time base generator produces the Sawtooth Signal (or) Sweep Signal to deflect the Electron beam in X-direction (or) Horizantal direction and to provide the time period to Horizantal deflection plates

(vi) Horizantal amplifier :- It amplifies the signal in horizantal direction i.e it amplifies an Externally applied Signal, to the horizantal deflection plates and this is also helps to adjust the magnitude of the Sawtooth Signal.

(vii) PowerSupply :- There are two types of power Supplies used in CRO

(i) -ve HV Supply (-1000V to -1500V)

(ii) +ve LV Supply (+300V to +400V)

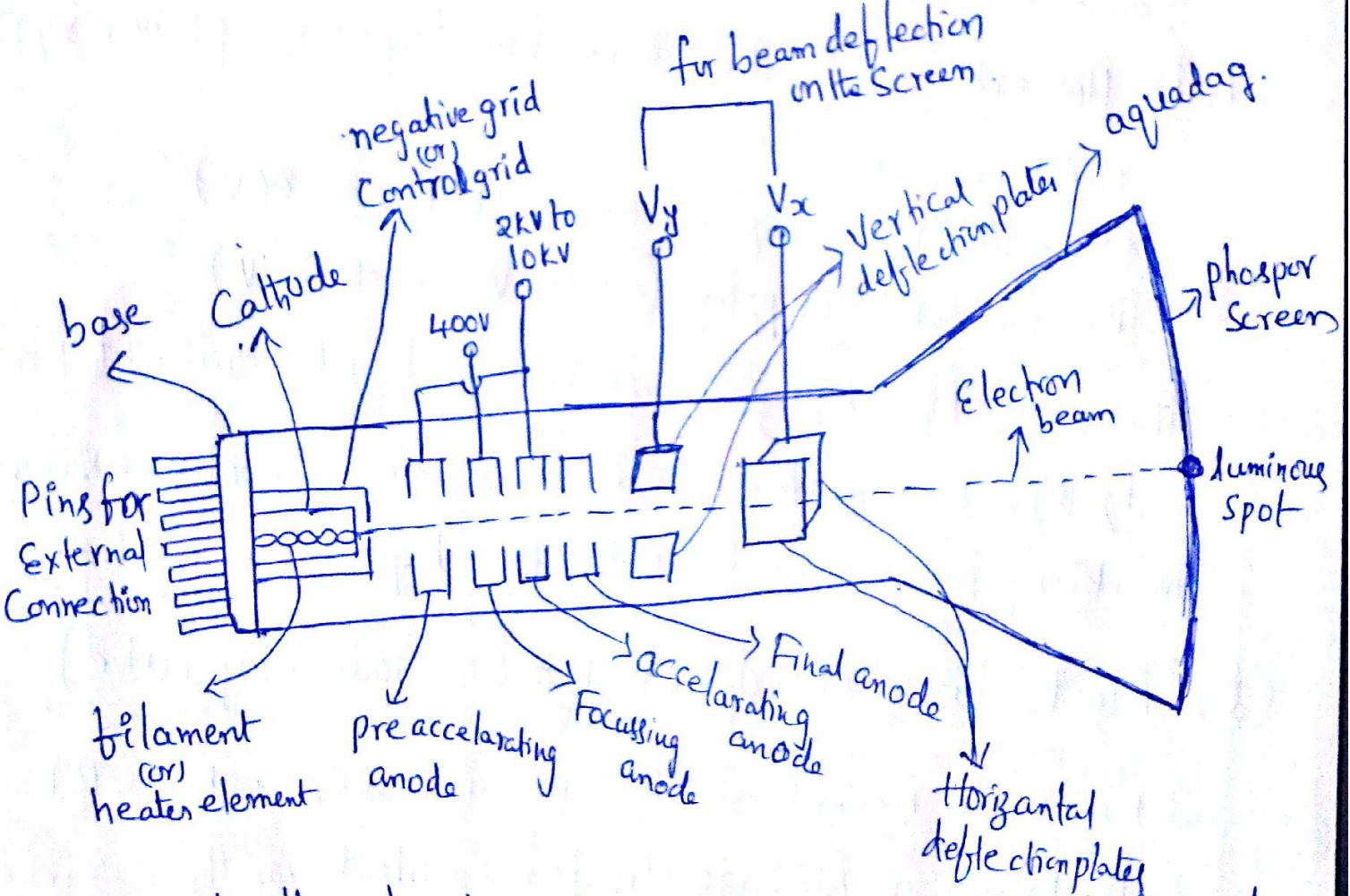
the -ve HV Supply is at ground potential. it protects the operator from high Voltage Shocks when making the connections to the deflection plates.

(2) Block diagram of CRT :- (Cathode Ray Tube)

CRT is the heart of the Oscilloscope. In CRT Cathode is a Neon Cylinder Coated with oxide layer. The Cathode emitts the plenty of Electrons required for Emission which are accelarated

from Focussing anode to final anode through the Control grid having a Small hole. the amount of Cathode Current which governs the intensity and brightness of the Spot/trace/signal is Controlled by Control grid.

The anodes are maintained at higher potentials i.e we are applying equal and high Voltages to the accelarating and preaccelarating anodes when Compared to the Focussing anode.



due to this high Voltages, the electric field is produced and the electron beam Experiences the force from

Electric field produced at anodes and deflects towards the Screen which electrons nearer to anodes. The electrons which are in the middle of the Electron beam are directly deflects towards the Screen.

The Anodes are acts as a lens System so that the electron beam Converges at phospur Screen because of the potential difference. the Electron beam Experiences the force from Electric field is

$$f = eE$$

Some of the Electrons are reflected, and these electrons are absorbed by aquadag (graphite powder Coating) which is Coated with CRT walls and resend to the phospur Screen. this is known as "Secondary emission".

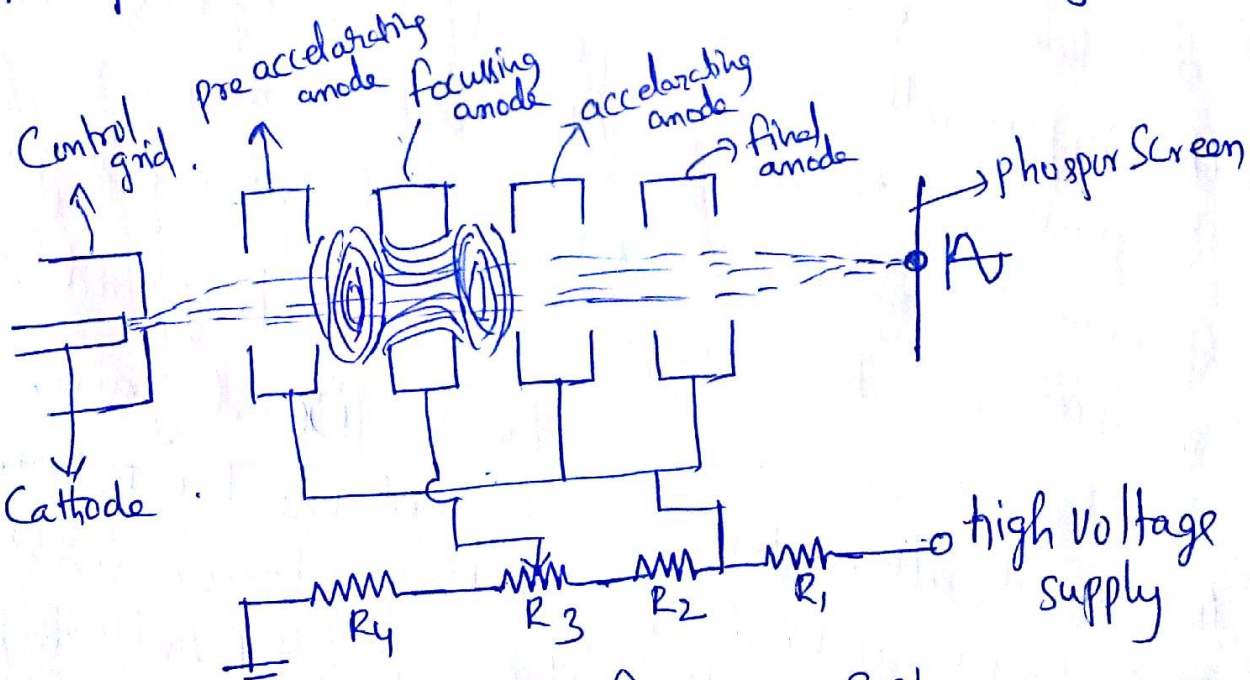


fig: Electron beam focussing System.

x - displacement on x-direction, V_x - Voltage applied to HDP
y - displacement on y-direction V_y - Voltage applied to VDP.

(4)(a)

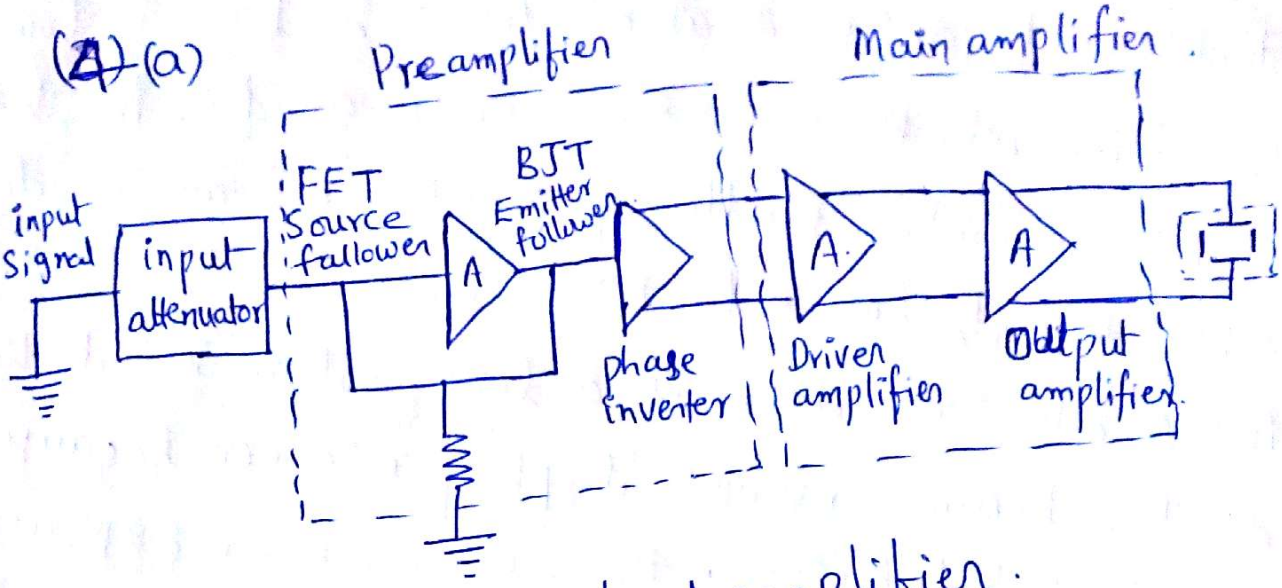


fig: Vertical amplifier.

Input signals are generally not strong to provide the measurable deflection on the screen. Hence, the Vertical amplifier stage is used to amplify the input signal. Here we are using wide band amplifier, so as to pass faithfully to the entire band of frequencies will be measured.

The input attenuator is used for very high voltage signals are to measured. Vertical amplifier consists of several amplifier stages with overall fixed gain. the amplifier can be designed for stability and required bandwidth very easily due to fixed gain.

The input attenuator is followed by FET Source follower has very high input impedence and it isolates the input attenuator and BJT Emitter follower

The BJT Emitter follower provides impedance matching

between FET Source follower and phase inverter.
The phase ~~differed~~ Inverter provides two anti phase Signals and these Signals Can be driven by the driver amplifier and given to the Output amplifier. In ~~put~~ output amplifier, push pull operation Can be taken place, the push-pull operation is having several advantages.

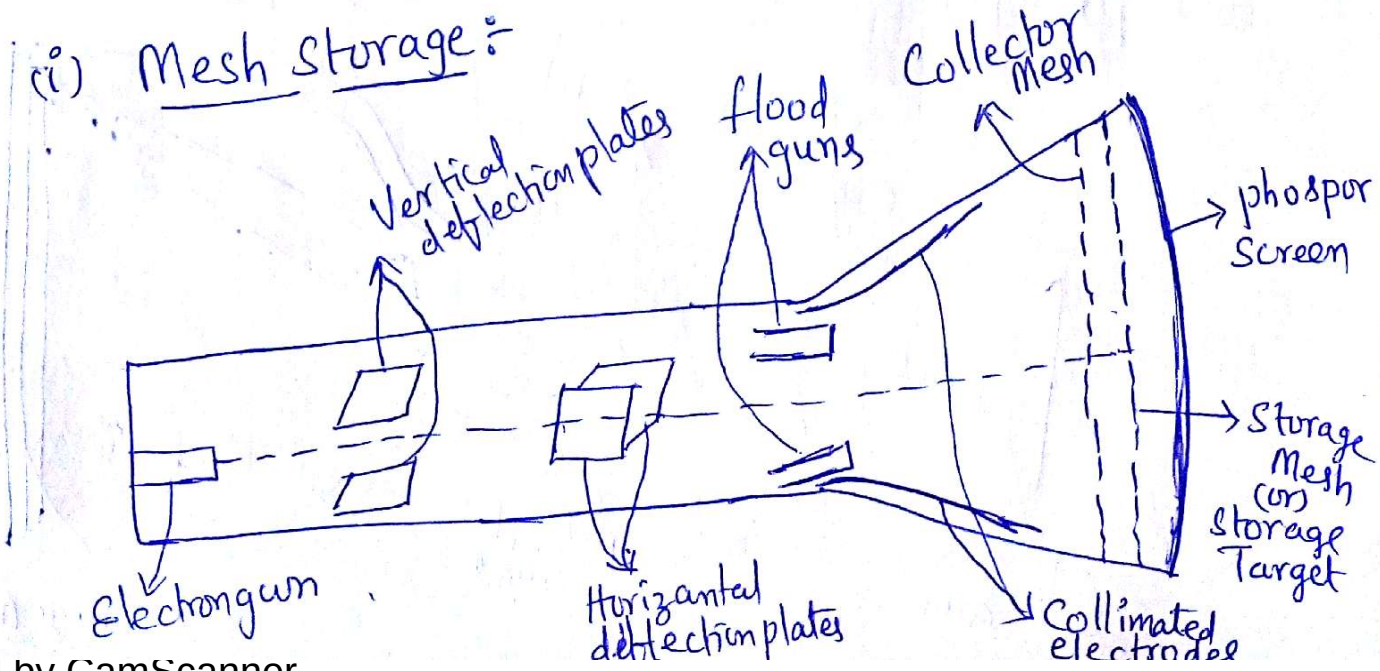
(i) It Suppress the even harmonics (especially Second harmonics)
(ii) It reduces several Non-linear effects.
(iii) It ~~Sep~~ Separates the noise from input signal.

(4)(b) Storage Oscilloscope:-

In analog storage Oscilloscope mainly two types of storage techniques are Used. they are.

(i) Mesh storage.
(ii) phospor storage.

(i) Mesh Storage:-



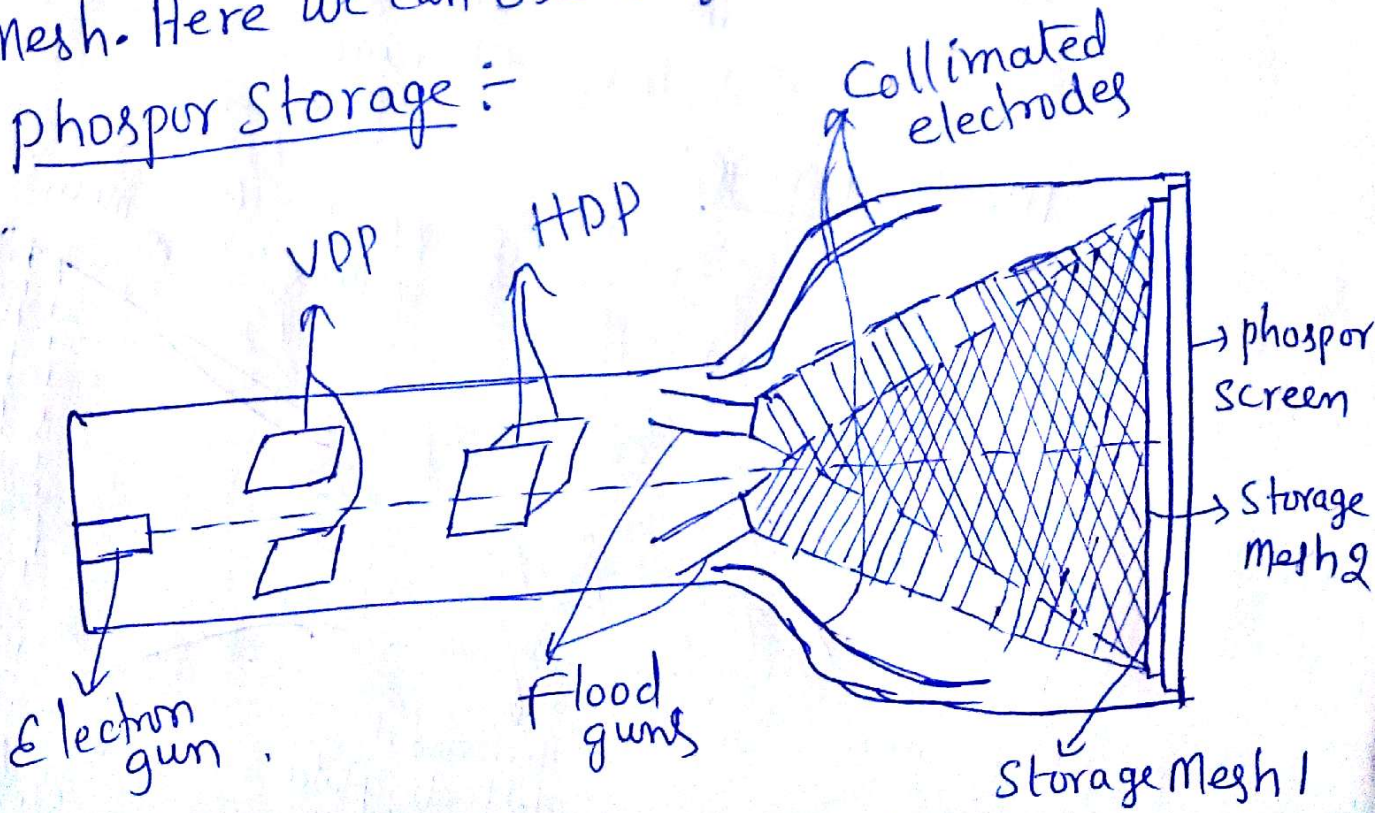
Electron gun emitts electrons, which passes through Vertical and Horizantal deflection plates and then Strikes Storage mesh (Dielectric material - Manganese) so, the Storage mesh contains the information (amplitude, time period) of input Signal, but does not displayed on the phospor Screen.

when the Electron hits the Storage mesh then the "+ve"ly charged area is created.

Flood guns produces the electrons with low velocity, these electrons passes through "+ve" ly charged area of storage mesh, then we can get display of the input signal on the phospor Screen.

If the electrons does not passed through "+ve" ly charged area, that electrons are repelled to Collector Mesh. Here we can use half Tone CRT Tube.

(ii) phospor Storage :-



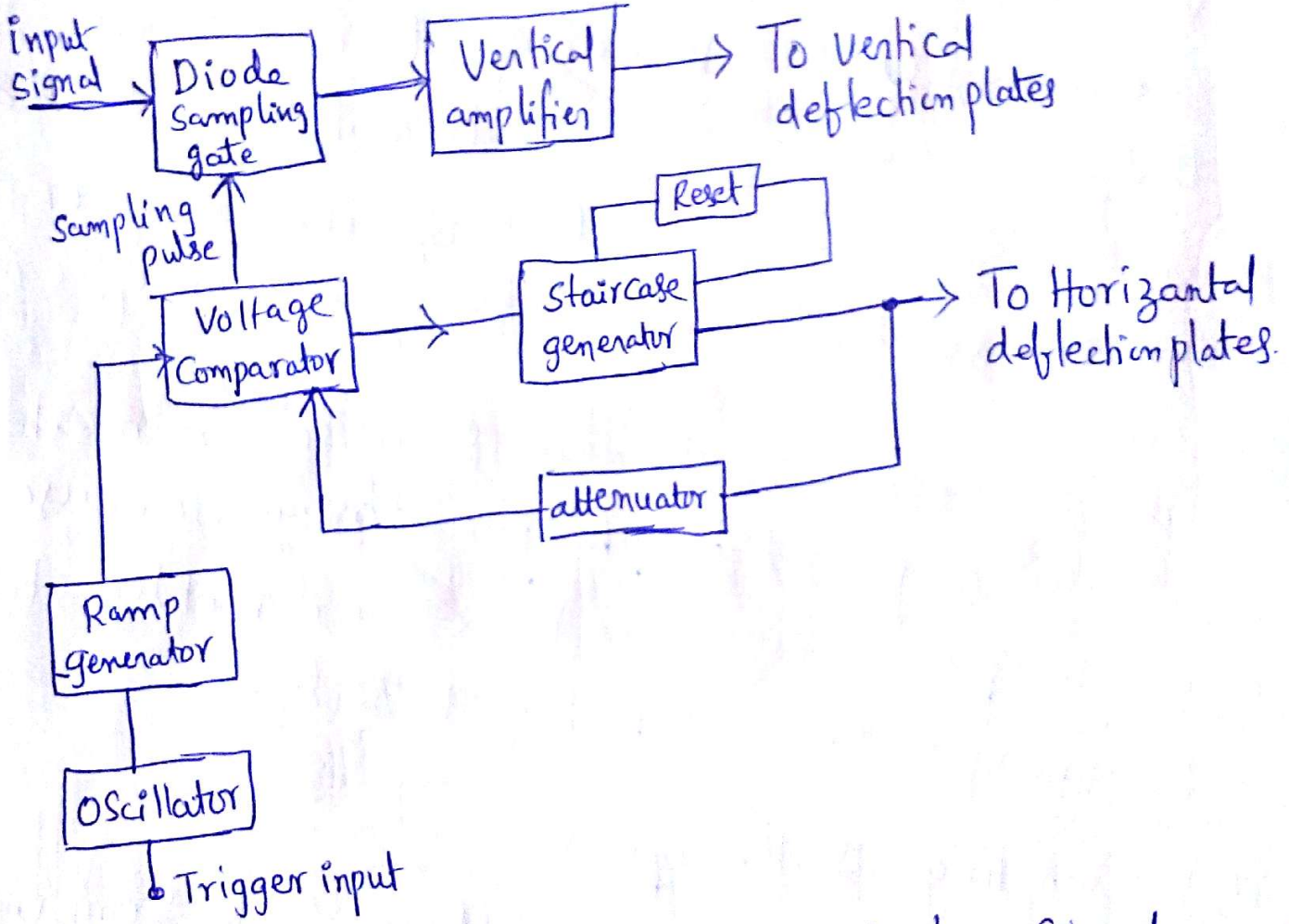
In this phospor storage bistable storage tube is used. here both phospor screen, storage mesh made up of some special phospor P1 and both are combined. From electron gun electrons are emitted and directly strikes the phospor screen and Created positively charged area on the storage mesh. when Flood guns emitts electrons with low velocity. the we can get disply on the phospor screen. here we are using "Split Screen Version" so that we can Compare present and past Signal. we Can get past Signal at Upper portion of CRT Screen and present signal at lower portion of CRT. Screen.

Life time of CRT screen is more in mesh storage Compared to phospor storage because in in phospor storage, electrons are directly strikes the phospor Screen with high velocity.

(5) Sampling Oscilloscope :-

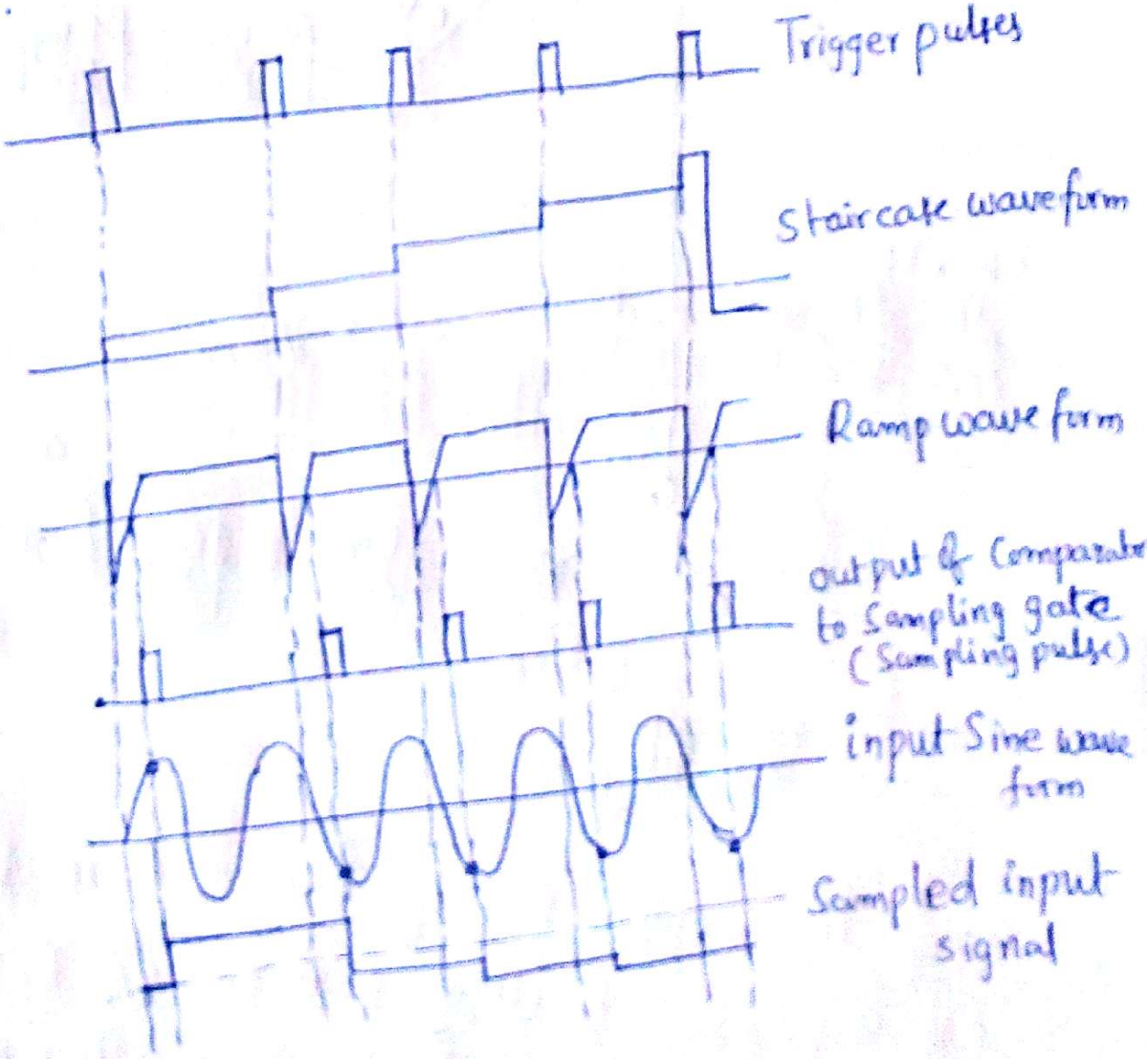
The input signal is applied to diode Sampling gate. at the stat of each Sampling cycle a trigger input pulse is generated which activates the blocking Oscillator. The Oscillator output is given to ramp

generator which generates the linear ramp signal. the linear ramp signal given to the one of the voltage Comparator. the staircase generator produces a staircase waveform which is applied to an attenuator. The attenuator Controls the magnitude of the staircase waveform and then applied to the voltage Comparator.



the voltage Comparator Compare the two signals and produces output pulse (Sampling pulse) when two voltages are equal. these Sampling pulses are applied to diode Sampling gate. these Sampling pulse opens

the diode gate and produces the Sampled Signal and this Sampled Signal is applied to the Vertical Amplifier and then Vertical deflection plates. the output of Staircase generator is also applied to the horizontal deflecting plates, during each step of Staircase the Spot moves on the Screen. After number of the Stair case pulses generated from Staircase generator it resets.

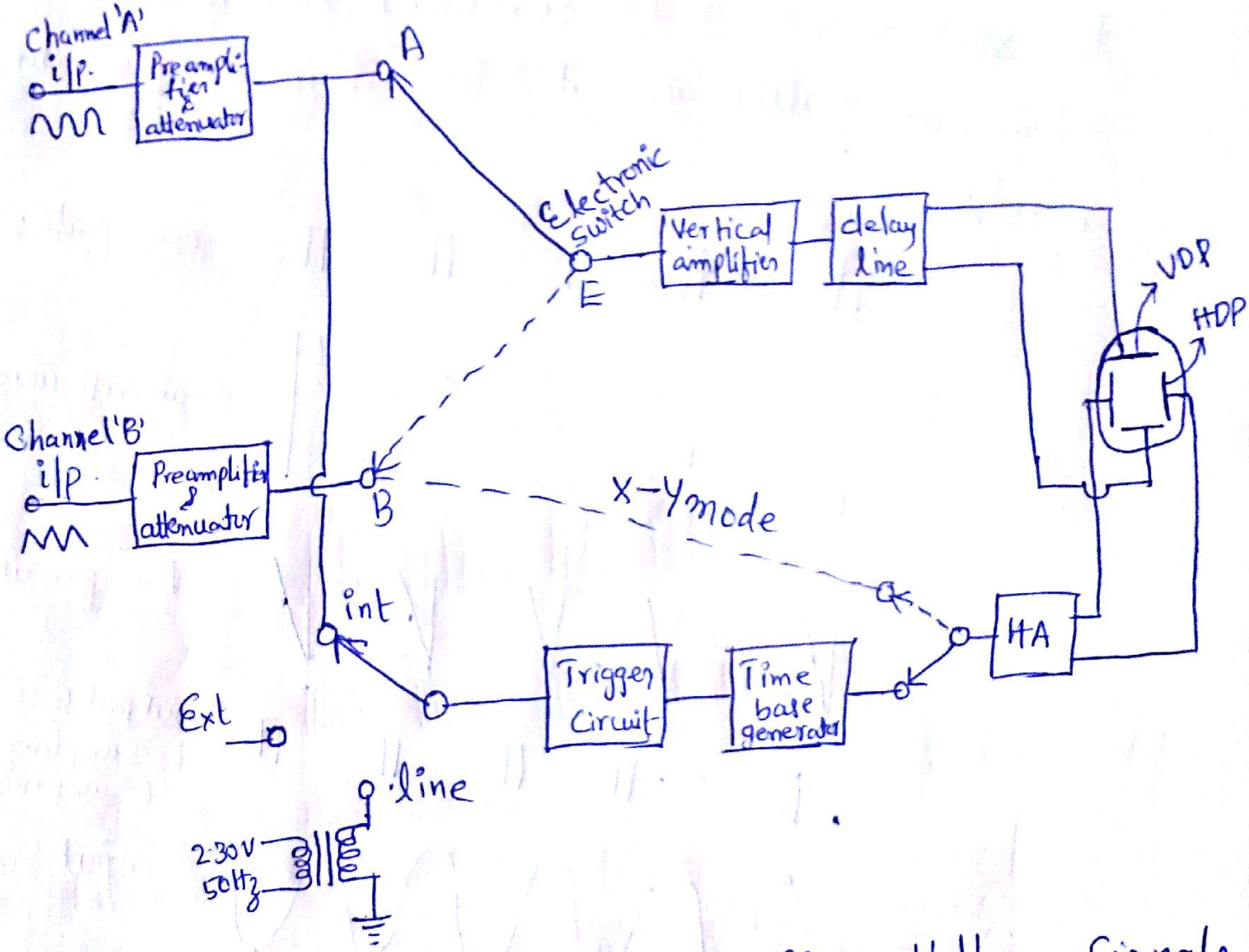


Advantages:-

(i) It is used for displaying high frequency Signals
(ii) Clean display is produced.

disadvantage:- It is not suitable to display the transients.

(6) Dual Trace Oscilloscope:-



The Comparision of Two or More Voltage Signals are analyzed by using Common Vess Costly method is Dual trace (or) Multitrace Oscilloscope. Dual trace CRO Consists of Single Vertical amplifier and single Electron gun.

The Electronic Switch is alternatively Connected to Channel 'A' i/p and channel 'B' i/p.

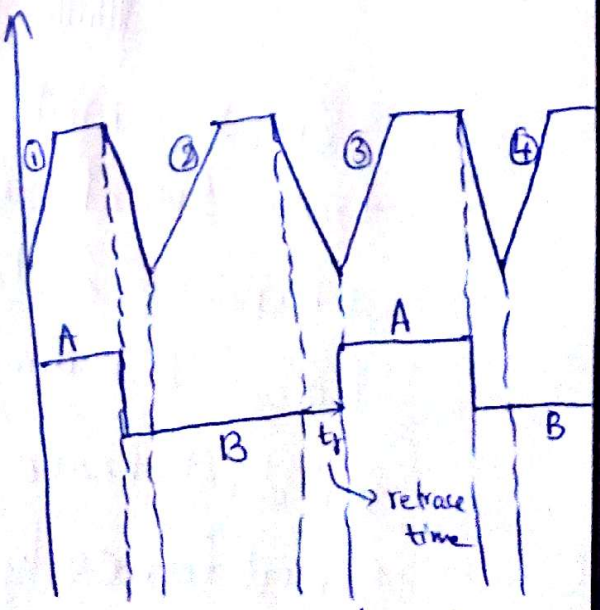
→ when switch is connected to channel 'A' i/p then +ve dc Component is added and we Can get o/p at Upper portion of CRT Screen.

→ When switch is Connected to channel 'B' i/p then -ve dc Component is added and we Can get o/p at Lower portion of CRT Screen.

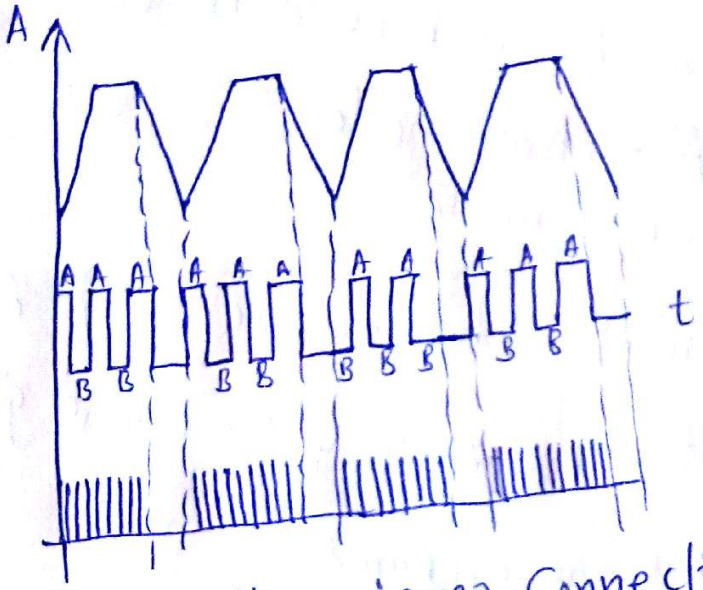
→ these Can be achieved in two modes

(i) Alternate mode
(ii) chop mode

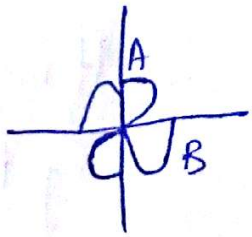
(i) Alternate mode: When frequency of Electronic Switch is equal to frequency of time base generator, both channel i/p's are appeared Simultaneously on the Screen. during the first sweep channel 'A' i/p, during second Sweep Channel 'B' i/p displayed, and so on. during flyback (or) retrace period we cannot get o/p, but this flyback period is very Small i.e few 'μs'.



(ii) Chop mode :- In this mode the frequency of Electronic Switch is high Compared to time base generator i.e 100 kHz to 500 kHz then chop rate decreases, in one Sweep period number of alternate Channel 'A' and channel 'B' i/ps are repeated. here also we don't get o/p at fly back period. if frequency of Electronic Switch >>> frequency of time base generator the o/p appeared as lines i.e chop rate is very low.



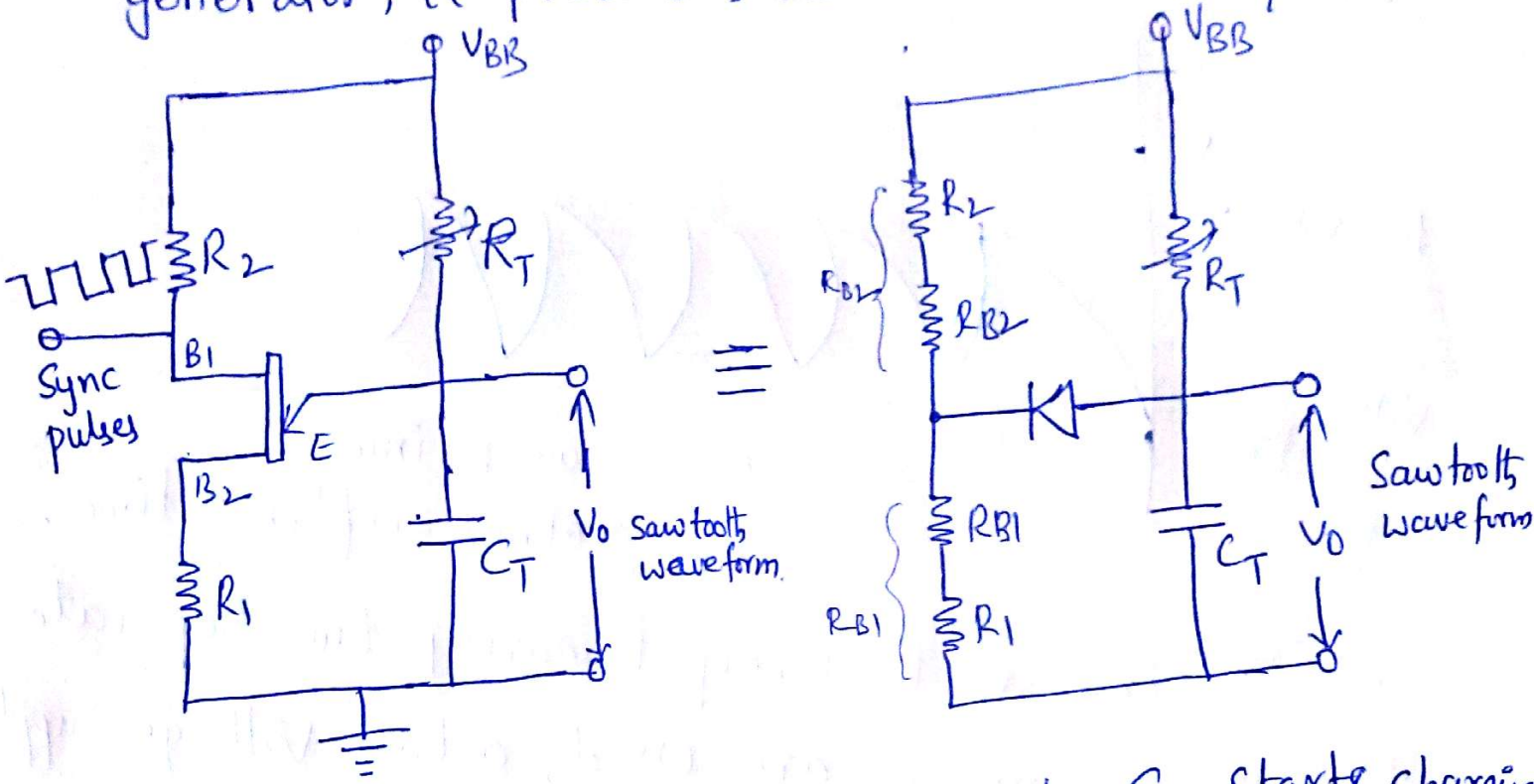
In X-Y mode there is no Connection between Electronic Switch and Time base generator. Channel 'B' is directly Connected to Horizontal amplifier



In dual trace CRO two traces are not displayed Simultaneously in real but appeared to disply Simultaneously.

(3) Continous Sweep CRO (Time base generator) :-

A Continous Sweep CRO using UJT as a Time base generator, it produces the Continous Sweep



when V_{BB} is applied the capacitor C_T starts charging up to peak voltage V_p, when it reaches to peak voltage diode is 'ON' Condition (i.e UJT fires)

$$V_p = \frac{R_{B1}}{R_{B1}+R_{B2}} V_{BB} + V_\gamma$$

$$V_p = \eta V_{BB} + V_\gamma$$

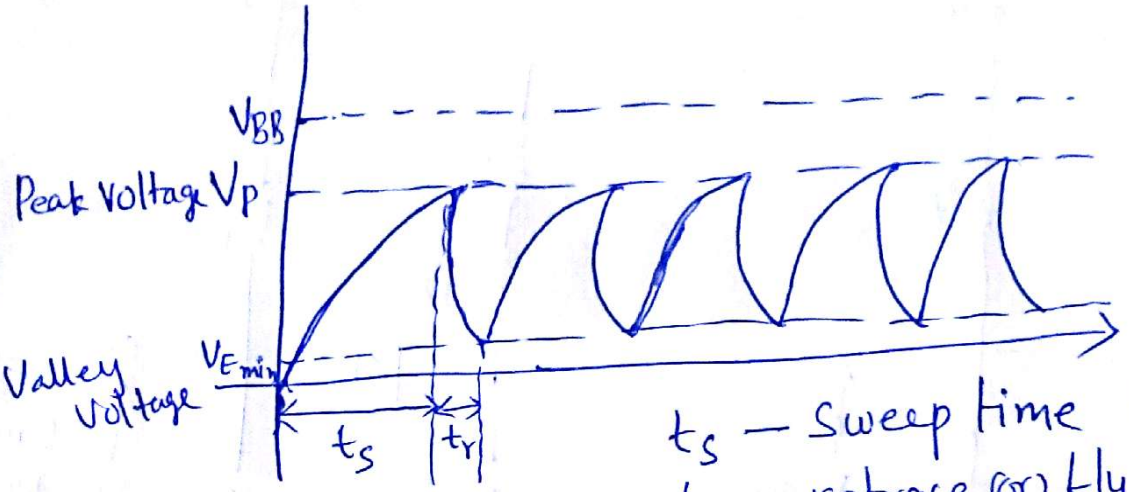
$$\eta = \frac{R_{B1}}{R_{B1}+R_{B2}} \rightarrow \text{Intringic Stand off ratio}$$

$V_A < V_K \rightarrow$ Diode reverse bias

$V_A > V_K \rightarrow$ Diode forward bias

When Diode is ON Condition the Capacitor C_T starts discharging up to Staturation

i.e Up to Valley voltage $V_{E\,min}$ then diode is 'OFF' Condition (UJT is OFF Condition), again Capacitor Starts charging, this process is Continued.

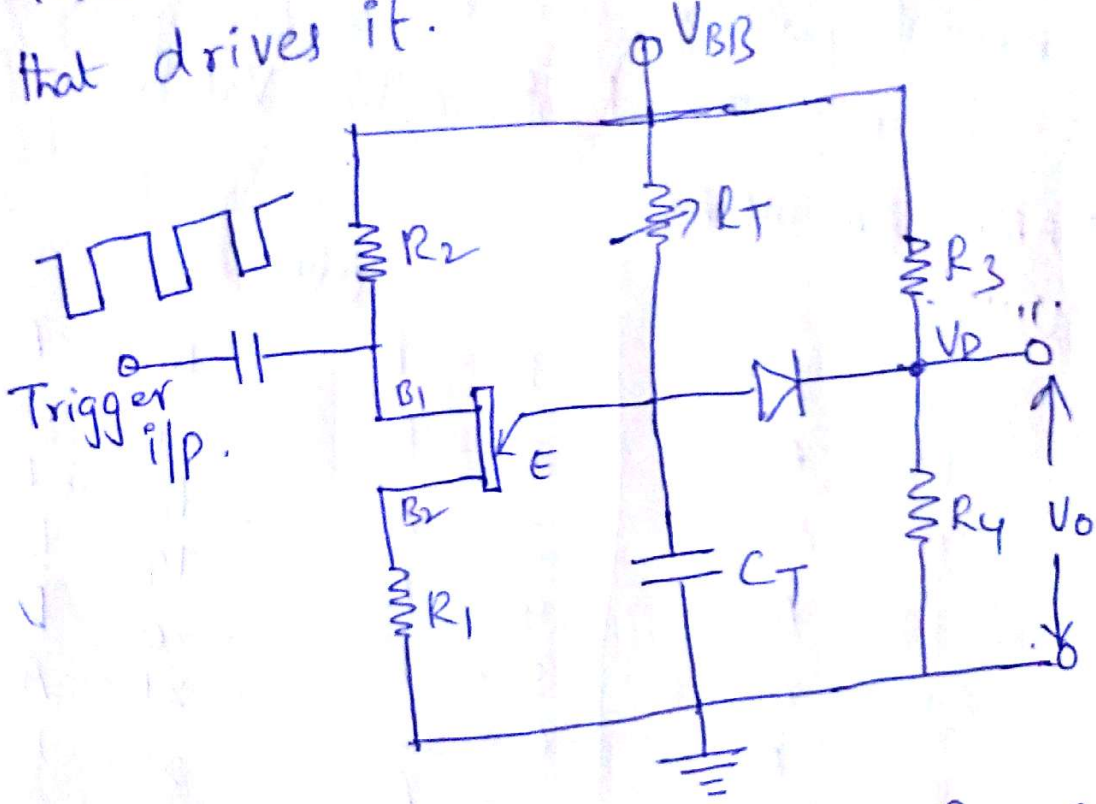


t_s – Sweep time
t_r – retrace (or) flyback time.

To improve the Sweep linearity two Seperate Voltage Supplies are used, a low Voltage Supply for UJT and high Voltage Supply for $R_T C_T$ ckt. R_T is used for Continous Control of frequency with in a range and C_T is Varied Steps range changing. The Synch pulse enable Sweep frequency to be axactly equal to the input signal frequency, sothat Signal is locked on the Screen and does not drift.

Triggered Sweep CRO: The Continous Sweep is limited use in displaying periodic Signals of Constant frequency and amplitude.

A triggered sweep can display such signals and short duration, narrow pulses. In trigger mode the i/p signal is used to generate substantial pulses, that trigger the sweep. Thus ensuring that the sweep is always in step with the signal that drives it.

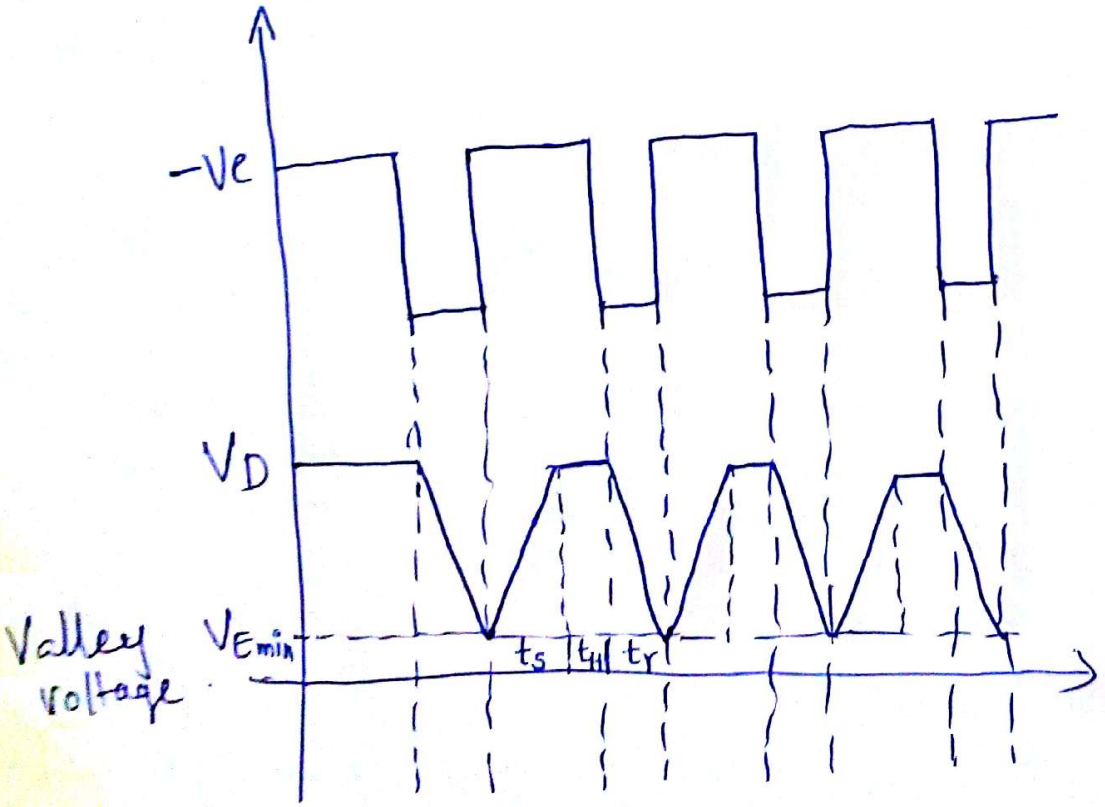


When V_{BB} is applied, the capacitor C_T starts charging up to 'V_D'. when it reaches to V_D the diode is in 'ON' condition

$$V_D = \frac{R_4}{R_3+R_4} \times V_{BB}$$

that V_D voltage maintained up to when-ever the negative trigger pulse is occured.

when the negative trigger pulse is occured the voltage reaches to peak voltage 'Vp' then UJT Fires (ON), then the capacitor C_T starts discharging upto Valley voltage $V_{E\,min}$ then UJT is OFF Condition, again Capacitor starts charging, this Process is Continued. when we are changing 'V_D' Value to Change the R_3, R_4 & V_{BB} Values



t_s — Sweep time
t_H — Hold time
t_r — retrace (or) flyback time

Common Questions

3 (e)

Analog storage Oscilloscope	Digital storage Oscilloscope
(i) Wave form is stored as positively charged area on storage mesh	(i) Wave form Converted into digital and it is stored in Memory
(ii) Only one wave form can be stored in storage Mesh	(ii) Multiple wave forms can be stored in Memory
(iii) Less cost	(iii) Expensive.
(iv) wave form Can be stored for Comparatively less time	(iv) wave form Can be stored for long time.
(v) It has Low resolution than DSO	(v) It has High resolution than ASO

(5) Sampling Oscilloscope (Wave forms)