DEPARTMENT OF ELECTRNICS & COMMUNICATION ENGINEERING, KITSW

COURSE: **U14EI 205 - BASIC ELECTRONICS ENGINEERING**	**ECE-I, Semester-II, 2015-16**

ASSIGNMENT-8 HINTS &SOLUTIONS (PART-2)

7. Draw the block diagram of a Cathode Ray Oscilloscope (CRO) and explain the function of each block.

Block Diagram of a CRO

→ Cathode ray oscilloscope (CRO) is an extremely useful and versatile laboratory instrument.

→ It is used for ~~studying~~ display of waveforms ~~wave shapes~~ and measurement of such quantities as current, voltage, frequency, power, phase-difference etc.

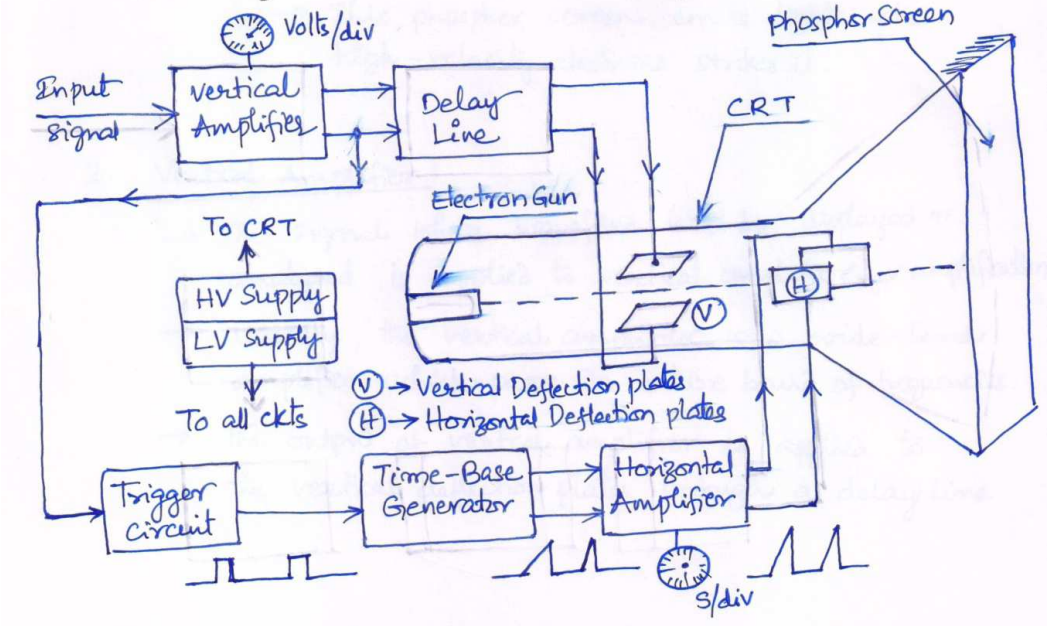
→ It works as an "eye" for the electronics engineer. With the help of CRO, he can "see" what is happening in each part of the electronic circuit.

→ The general purpose CRO consists of the following blocks:

(1) Cathode ray tube (CRT) (2) Vertical amplifier

(3) ~~Delay~~ Trigger circuit (4) Time-base generator (or) Sweep generator

(5) Horizontal amplifier (6) Delay line.



1. Cathode ray tube (CRT)

→ CRT is the heart of the oscilloscope.

→ It essentially consists of three basic components

(i) The electron gun : It produces a focussed (narrow) and highly accelerated beam of electrons

(ii) The deflection system:

→ It consists of a pair of vertical deflection plates and another pair of horizontal deflection plates

→ This system deflects the electron beam both in horizontal and vertical directions in accordance with the waveform to be displayed

→ Electrostatic deflection is employed.

(iii) The Fluorescent Screen :

→ The screen is coated on the inside with a phosphor material

→ This phosphor screen emits light when high-velocity electrons strikes it.

2. Vertical Amplifier :

→ The signal whose waveform is to be displayed or analysed is applied to vertical amplifier for amplification.

→ Usually, the vertical amplifier is a wide-band amplifier which passes the entire band of frequencies.

→ The output of vertical amplifier is applied to the vertical deflection plates through a delay line.

(3) Trigger Circuit:

→ A sample of input waveform is fed to a trigger circuit, which produces a trigger pulse at some selected point on the input waveform.

→ This trigger pulse is used to start the time-base generator.

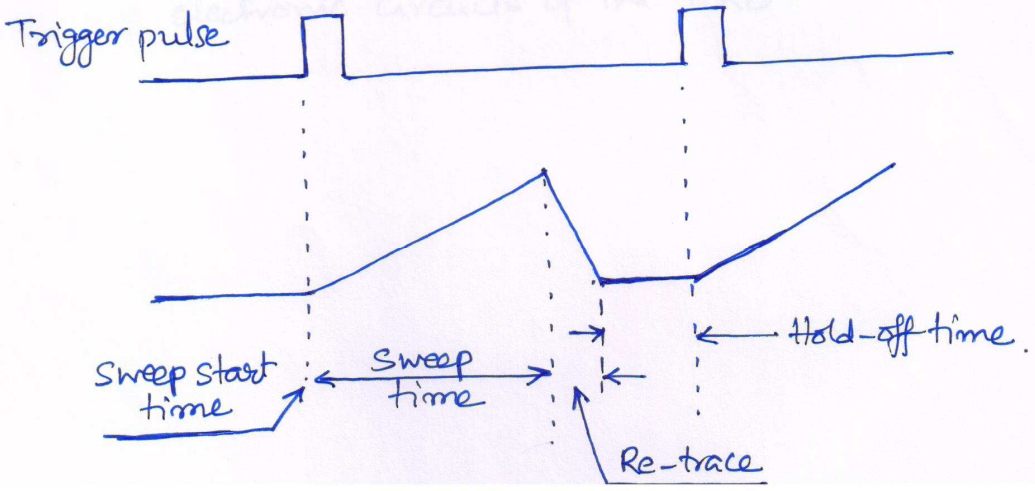
→ The triggering circuit ensures synchronization of two types of deflections so that horizontal deflection starts at the same point of vertical signal each time it sweeps.

(4) Time-base (Sweep) Generator:

→ The time-base generator or sweep generator produces a saw-tooth waveform

→ The saw-tooth waveform is required to deflect the electron beam in horizontal direction.

→ The relationship between the trigger pulse and the sweep is shown below.



(5) Horizontal Amplifier :

→ It amplifies the saw-tooth voltage.

→ The amplified saw-tooth voltage is fed to the horizontal deflection plates.

(6) Delay line :

→ This circuit is used to delay the signal for some period of time in the vertical section.

→ This retards the arrival of the input waveform at the vertical deflection plates until the trigger and time-base circuits start the sweep of the beam in horizontal direction.

→ In general the delay is on the order of 80ns or so.

(7) Power Supply :

→ A high voltage section is used to operate CRT

→ A low voltage section is used to supply electronic circuits of the CRO.

8. Write short notes on CRT screens.

Screens for CRTs

→ The CRT uses a fluorescent screen

→ The screen is coated on the inside with phosphor material

→ The phosphor material emits light when high-velocity electrons strike it

→ The phosphor absorbs the KE of the bombarding electrons and reemits the energy at a lower frequency in the visual spectrum.

→ Fluorescence: The property of some crystalline materials to emit light when activated by a stream of electrons is called fluorescence.

→ phosphor and Zinc oxide are well known fluorescent materials.

→ Fluorescent materials have a second characteristic called "phosphorescence".

→ Phosphorescence: phosphorescence refers to emission of light, that lasts longer, even after the the source of excitation is cut-off.

→ The intensity of light emitted from CRT screen is called "luminance".

→ Secondary-emission electrons: When electron beam strikes the phosphor screen, besides giving out visible light secondary-emission electrons are also released.

Aquadag: The secondary-emission low-velocity electrons are collected by a conductive coating called Aquadag on inside surface of the glass tube of CRT.

→ Depending upon phosphor material used in the fluorescent screen, it is possible to have different colors of light

Phosphor type	Fluore-scence	Phosphore-scence	Relative Luminance	Remarks
P1	Yellow-Green	Yellow-Green	50%	General purpose applications
P2	Blue-Green	Yellow-Green	55%	High & low speed applications
P4	White	White	50%	TV Displays
P7	Blue	Yellow-Green	35%	Long Decay & observation of low-speed phenomena
P11	Purple-Blue	Purple-Blue	15%	Photographic applications
P31	Yellow-Green	Yellow-Green	100%	Brightest available phosphor

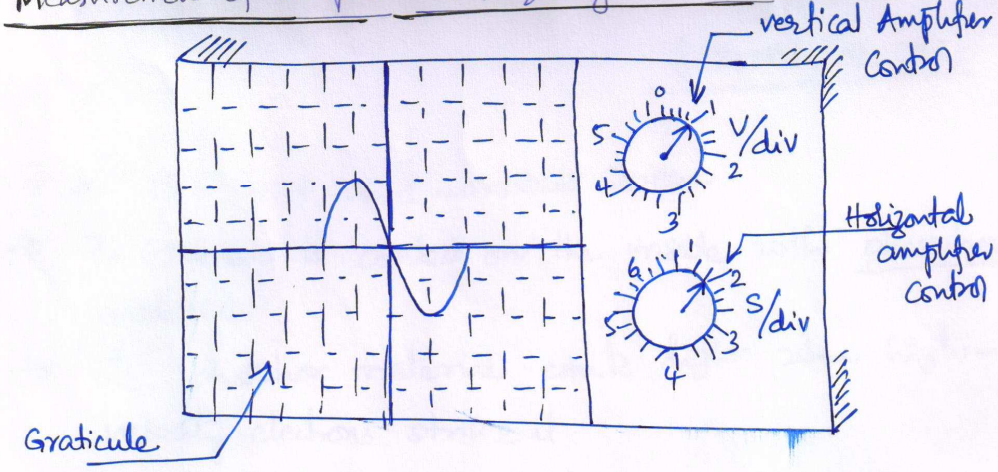
→ **GRATICULE:**

→ The waveforms under investigation are displayed on the screen.

→ The calibrated vertical and horizontal marks (lines) placed on the screen is called graticule.

→ With the help of graticule, the amplitude (vertical divisions) and the time-period (horizontal divisions) of the displayed waveforms can be measured.

Measurement of amplitude, frequency & phase using CRO.



→ Wave form occupies 2 (units) divisions amplitude (vertical)
4 units Horizontal (time)

Amplitude:

→ V/div attenuator is at 1 V/div

Hence amplitude of signal displayed

A = No of units (or No of divisions) × V/div

A = 2 div × 1 V/div

A = 2 V //

Peak-to-peak = 2A = 4V //

Frequency:

→ Time/div or sec/div attenuator is at 2 S/div

Hence time period of wave displayed

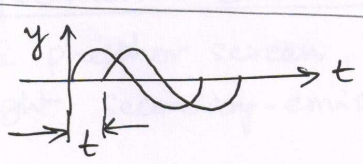
T = No of horizontal div × sec/div

= 4 div × 2 S/div

$$T = 8 \text{ sec}$$

$$\text{Frequency } f = \frac{1}{T} = \frac{1}{8} \text{ Hz}$$

Phase shift:



T — 2π
t → ?

$$\phi = \frac{2\pi \times t}{T}$$ //

9. Explain various applications of a CRO.

(refer to class notes)

Faculty: *Dr. K. Ashoka Reddy, Room #: BI-208*