CRO - Cathode Ray Oscilloscope.

→ Oscilloscope is an instrument that allows signal to be measured by displaying the corresponding signal waveform on a CRT [cathode Ray Tube] or LCD display.
Thus oscilloscope effectively acts as an automated graph plotter that plots the input signal against time.

CRO - Cathode Ray oscilloscope.

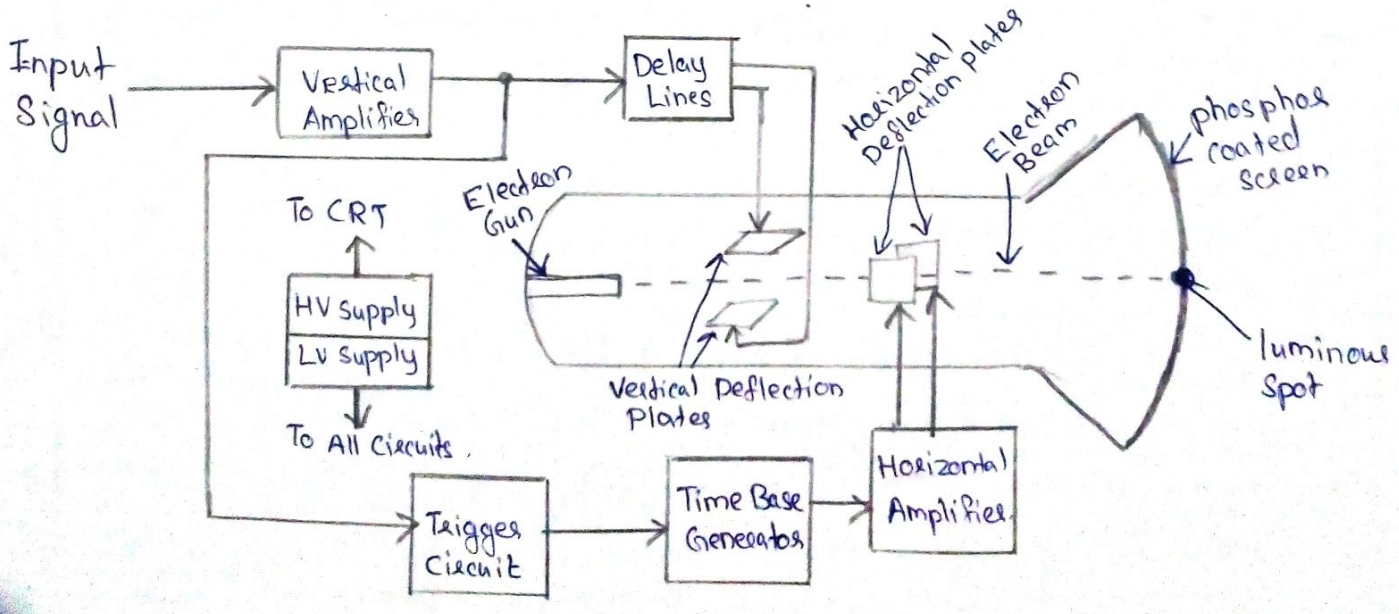
→ It is an electronic test instrument used to display waveforms corresponding to a particular signal.

→ It uses the probes for giving the input signals.

→ It typically includes the following sections:

- × Display Unit
- × Vertical Controllers
- × Horizontal Controllers
- × Triggers
- × power supply Unit.

→ The Block diagram of a CRO is as below:



Block Diagram Explanation:

① Power Supply Circuit

It provides the various electrical signals & voltages to operate the CRO

Low-Voltage → Used for the heater of the electron gun to generate the electron beam

High-Voltage → Used by the CRT to speed up the beam.

Normal-Voltage → necessary for other control units of the oscilloscope.

② Vertical Amplifier

It amplify the weak input signal so that the amplified signal can produce the desired signal to the input of vertical deflection and produce a corresponding vertical deflection for electron beam

③ Horizontal Amplifier

It amplifies the weak input signal obtained from the sweep generator, and pass its output to horizontal deflection plates to provide corresponding horizontal deviation for electron beam.

④ Deflection Plates

It provides corresponding vertical & horizontal deviation for electron beam in accordance with the output of horizontal and vertical amplifier stages.

⑤ Time-Base Generator.

→ It provide a time base signal [ie, sawtooth signal] in accordance with the sweep selector switch in the CRO.

→ This sawtooth signal will be in accordance with the frequency / time period selected for displaying the wave.

→ The output of time base generator is amplified and given to horizontal amplifier to provide horizontal deflection of electron beam.

⑥ Trigger Circuit

It provide the synchronization between the input signals of vertical and horizontal deflection plates, so as to obtain a synchronized deflection of electron beam in both vertical and horizontal axis, (ie in terms of voltage and time axis).

⑦ Delay line

It is to provide a time delay for the input signal.

⑧ CRT — Cathode Ray Tube.

It includes:

- × Electron Gun
- × Deflection plates
- × phosphor coated Screen.

- The electron gun emits the electron beam which is accelerated to a high velocity and allowed to fall on the fluorescent screen / phosphor coated screen.
- The screen produces a visible spot where the electron beam strikes with it.
- The horizontal and vertical deflection plates will deflect the electron beam in accordance with the input signal given.
- Thus electrons act as an electrical pencil of light which produces a light where it strikes.

Application of CRO : CRO can be used for:

- × Voltage measurement
- × Current measurement
- × Examin the waveform.
- × Measurement of phase & frequency.

MULTIMETER

→ Multimeter can be used to measure electrical functions such as, voltage, current, Resistance, Continuity ...etc.

There are 2 main types of multimeters:

- × Analog Multimeter
- × Digital Multimeter.

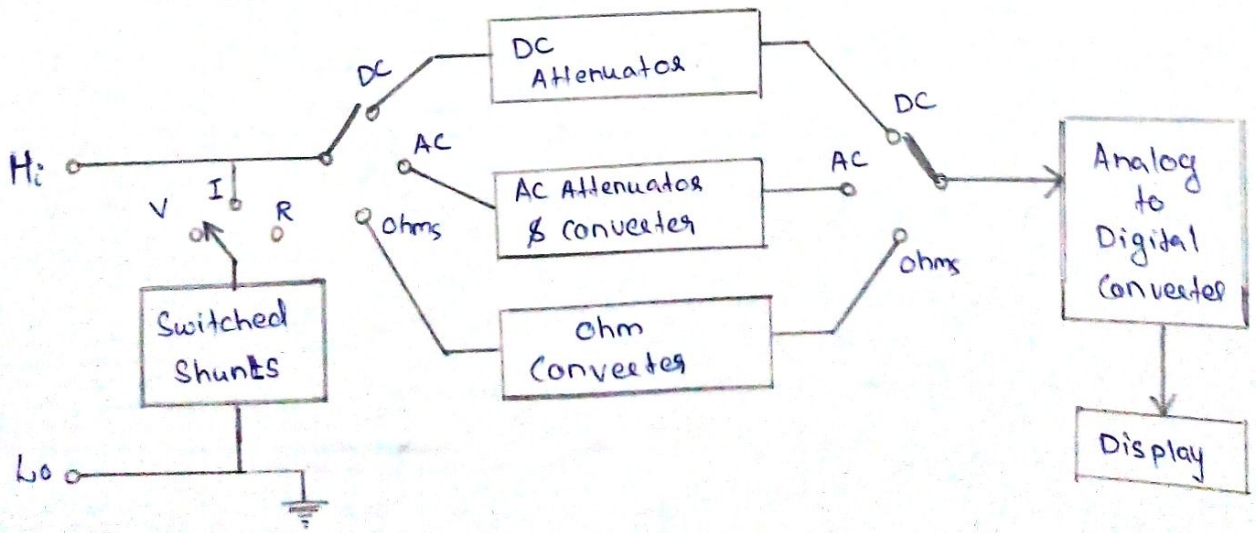
→ Analog multimeters ~~are~~ operates based on electrical mechanical movement and it has less advantage over digital multimeters.

→ Digital multimeter [DMM] is a multifunctional meter that display the measured electrical values on an LCD screen quickly without any computational delay.

- Also processors can be built into the digital multimeter, which allows the user to take:

  * measurement of frequency
  * Inductance of a coil
  * Capacitance of a capacitor
  * and many other high functional electrical measurements.

Block Diagram: - Digital Multimeter.



Block diagram description:

In digital multimeter, to measure an unknown voltage, current or resistance; a voltage proportional to the quantity to be measured is generated using an appropriate circuit.
Now this resultant voltage obtained will be digitized and its corresponding value will be displayed on screen.

→ To measure Voltage

The input voltage signal is fed to an attenuator, which can be switched to vary the input range. The resultant voltage is digitized and displayed.

→ To measure Current

- The input signal is connected across an appropriate shunt resistor, which generate a voltage proportional to the input current.
- Shunt resistor value can be switched to select different input range.

→ To Measure Resistance

- The inputs are connected to an ohm converter. "Ohm converter" passes a small current between the two input connections. The resultant voltage is a measure of the resistance between these terminals.

→ To measure DC signal

If the input current / voltage to be measured is DC-signal, then DC-attenuator is selected.

→ To measure AC signal

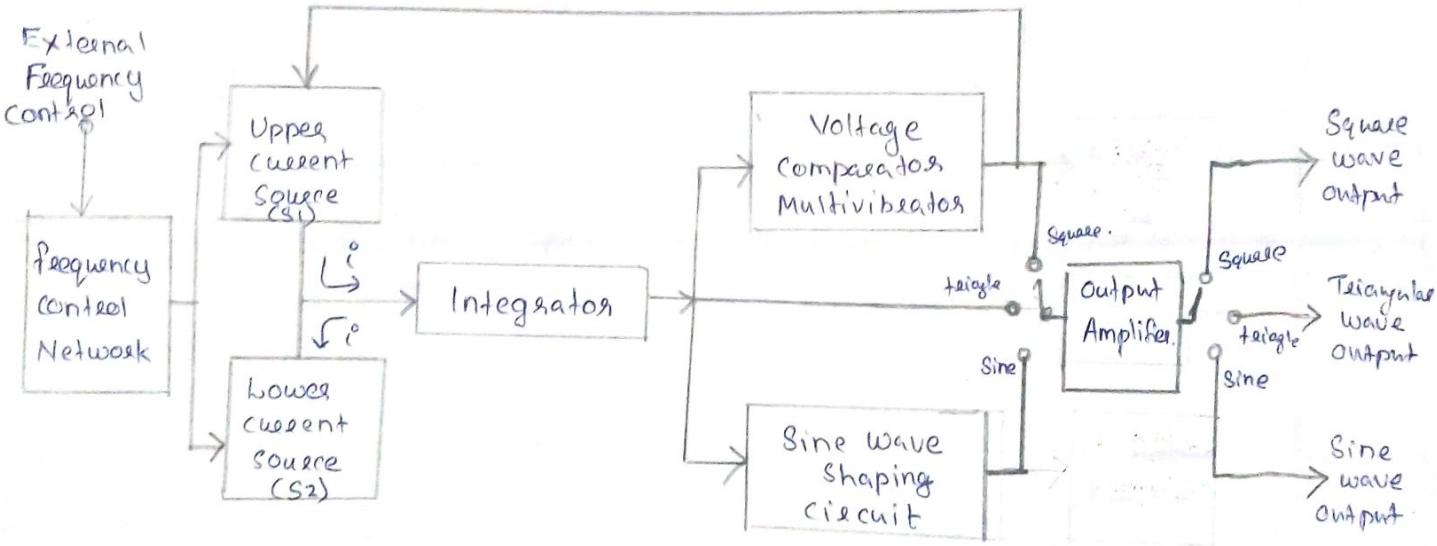
If the input current or voltage to be measured is AC-signal, then AC-attenuator is selected and then the attenuated AC-signal is passed through an AC to DC converter / rectifier to obtain a DC-Vol

The resulting DC-voltage is then converted to digital form by Analog-to-Digital Converter [ADC] and displayed.

FUNCTION GENERATOR

Function generator is a signal source that has the capability of producing different types of waveforms. The most common outputs are sine waves, triangular waves, square waves and sawtooth waves. The frequencies of output signal can be adjusted from hertz to several hundred ~~hertz~~. kHz.

Block Diagram:



→ In this instrument, frequency is controlled by varying the magnitude of current that drives the integrator. Its output can be sinusoidal, triangular or square wave with a frequency range of 0.01Hz to 100kHz

→ With the external frequency control, the output voltage of frequency control network can be adjusted, This frequency controlled voltage regulates two current sources S1 & S2.

→ Upper current source (S1) supplies constant current to the integrator whose output voltage rises linearly with time according to output voltage equation, $V_{out} = \frac{-1}{C}\int_0^t i\,dt$.

→ Any increase or decrease in the current input current will increases or reduces the slope of the output voltage. and thus controls the frequency.

→ The voltage comparator multivibrator changes state at a predetermined maximum level, of the integrator output voltage.

→ This change cuts off the upper current supply from Upper current source [S1] and switches to the supply & Lower Supply source [S2]. The Lower supply source supplies a reverse current to the integrator so that its output drops linearly with time.

→ when the output attains a predetermined level, the voltage comparator again changes state and switches on to the upper current source [S1].

→ The output of Integrator is a triangular wave whose frequency depends on the magnitude of the current supplied by the constant current supply sources.

→ The comparator output provides a square wave of the same frequency as output.

→ The sinewave shaping provides a sine wave of same frequency with less than 1% distortion.

→ Output amplifier is used to provide sufficient ~~output~~ voltage. level for the output signal.