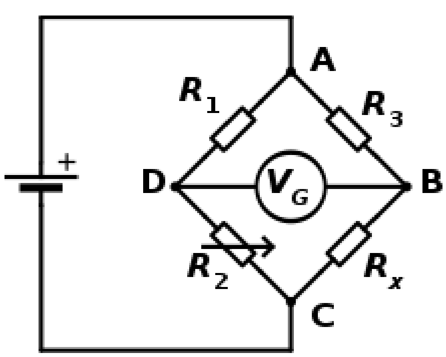
ELECTRICAL AND ELECTRONIC MEASURING EQUIPMENT

Name	Purpose
Ammeter (Ampermeter)	Measures current
Capacitance meter	Measures the capacitance of a component
Curve tracer	Applies swept signals to a device and allows display of the response
Cos Phi Meter	Measures the power factor
Distortionmeter	Measures the distortion added to a circuit
Electricity meter	Measures the amount of energy dissipated
ESR meter	Measures the equivalent series resistance of capacitors
Frequency counter	Measures the frequency of the current
Leakage tester	Measures leakage across the plates of a capacitor
LCR meter	Measures the inductance, capacitance and resistance of a component
Microwave power meter	Measures power at microwave frequencies
Multimeter	General purpose instrument measures voltage, current and resistance (and sometimes other quantities as well)
Network analyzer	Measures network parameters
Ohmmeter	Measures the resistance of a component
Oscilloscope	Displays waveform of a signal, allows measurement of frequency, timing, peak excursion, offset, ...
Psophometer	Measures AF signal level and noise
Q meter	Measures Q factor of the RF circuits
Signal analyzer	Measures both the amplitude and the modulation of a RF signal
Signal generator	Generates signals for testing purposes
Spectrum analyser	Displays frequency spectrum
Sweep generator	Creates constant-amplitude variable frequency sine waves to test frequency response
Transistor tester	Tests transistors

Tube tester	Tests vacuum tubes (triode, tetrode etc.)
Wattmeter	Measures the power
Vectorscope	Displays the phase of the colors in color TV
Video signal generator	Generates video signal for testing purposes
Voltmeter	Measures the potential difference between two points in a circuit. (Includes: DVM and VTVM)
VU meter	Measures the level of AF signals in Volume units

BRIDGE

A **bridge circuit** is a topology of electrical circuitry in which two circuit branches (usually in parallel with each other) are "bridged" by a third branch connected between the first two branches at some intermediate point along them. The bridge was originally developed for laboratory measurement purposes and one of the intermediate bridging points is often adjustable when so used. Bridge circuits now find many applications, both linear and non-linear, including in instrumentation, filtering and power conversion.



Schematic of a Wheatstone bridge

The best-known bridge circuit, the Wheatstone bridge, was invented by Samuel Hunter Christie and popularized by Charles Wheatstone, and is used for measuring resistance. It is constructed from four resistors, two of known values R_1 and R_3 (see diagram), one whose resistance is to be determined R_x, and one which is variable and calibrated R_2. Two opposite vertices are connected to a source of electric current, such as a battery, and a galvanometer is connected across the other two vertices. The variable resistor is adjusted until the galvanometer reads zero. It is then known that the ratio between the variable resistor and its neighbour R1 is equal to the ratio between the unknown resistor and its neighbour R3, which enables the value of the unknown resistor to be calculated.

The Wheatstone bridge has also been generalised to measure impedance in AC circuits, and to measure resistance, inductance, capacitance, and dissipation factor separately. Variants are known as the Wien bridge, Maxwell bridge, and Heaviside bridge (used to measure the effect of mutual inductance). All are based on the same principle, which is to compare the output of two potential dividerssharing a common source.

In power supply design, a bridge circuit or bridge rectifier is an arrangement of diodes or similar devices used to rectify an electric current, i.e. to convert it from an unknown or alternating polarity to a direct current of known polarity.

In some motor controllers, an H-bridge is used to control the direction the motor turns.

CATHODE RAY OSCILLOSCOPE (CRO)

Cathode Ray Oscilloscope is an electronic device in which various types of waveforms can be seen on the screen. In abbreviated form, it is called as CRO.

CRO was invented by German Scientist Karl Ferdinand Braun in 1897.

Figure shows Front panel of a Cathode Ray Oscilloscope.

Functions of important front panel controls of a CRO

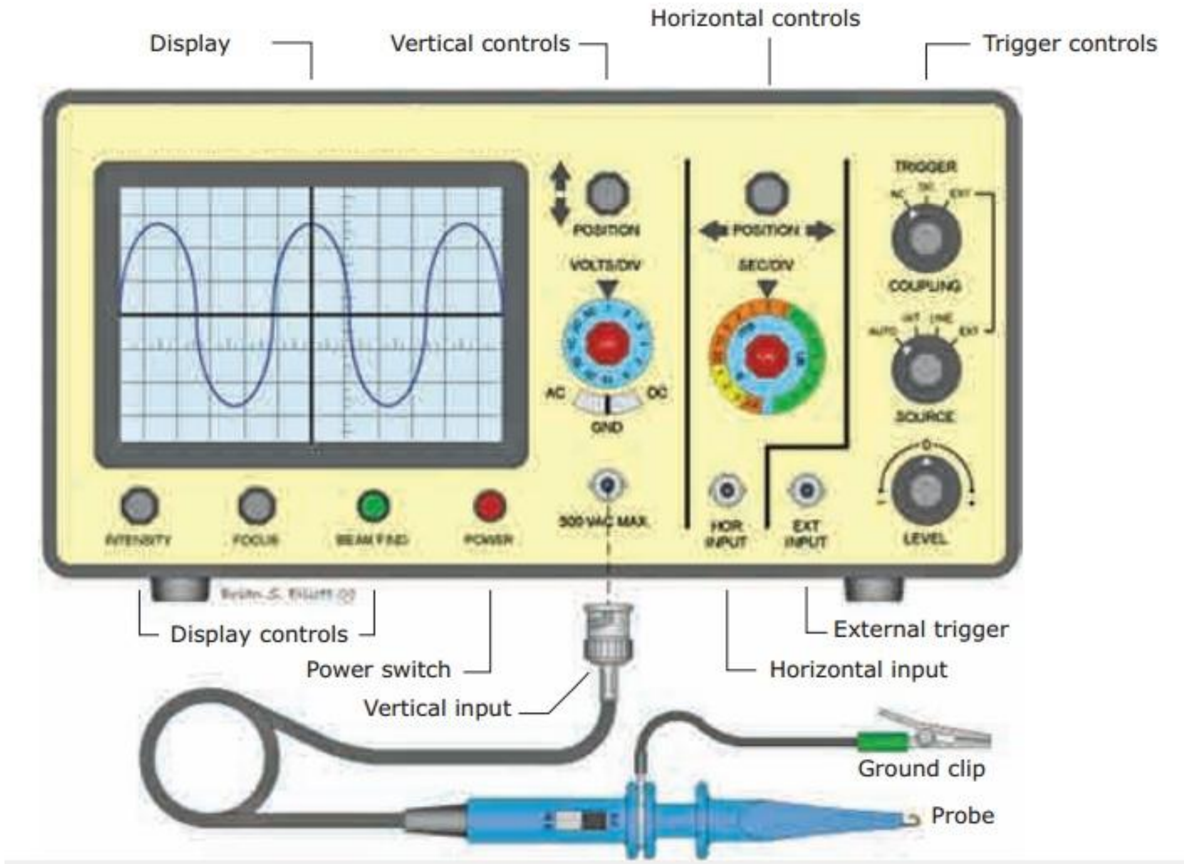
Display controls

Intensity control

An intensity control is used to adjust the brightness of the screen.

Focus control

A focus control is used to adjust the sharpness of the waveform.



Front panel of a Cathode Ray Oscilloscope

500 V AC MAX

It is the input socket, in which the waveform to be seen, should be connected through a CRO cable.

Vertical controls

● **Volts/div :**For selecting desired voltage sensitivity of the vertical amplifier to obtain the proper wave form on the screen i.e., to bring the waveform within the viewing area of the screen.

● **Vertical Position knob:** To move the waveform up or down on the screen.

Horizontal controls

Sec / division : To get distinct and stable waveform in the CRT display and correct horizontal synchronising waveform (in phase with the input waveform), this control is used.

● **Horizontal Position knob:** Controls horizontal position of waveform on the screen.

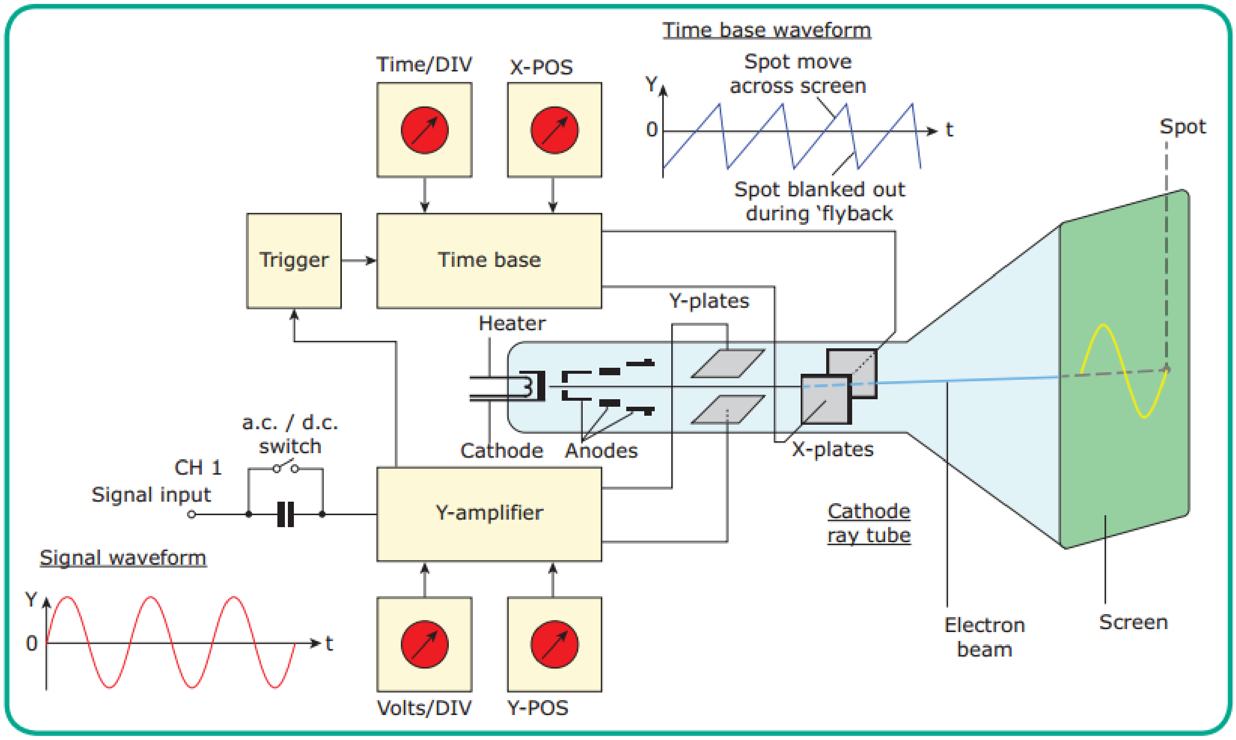
Trigger controls

The trigger control delays the time base circuit operation. This makes the moving wave appears to be static (unmoved) on the screen. The frequency, wave length and amplitude can be measured, when it is unmoved (locked).

Working of CRO

Figure shows block diagram of a CRO. As like TV Receivers, a Vacuum cathode Ray tube is employed as a screen in a C.R.O. The cathode of the CRT is heated using the filament. Due to thermionic emission electron ray emitted from cathode. This electron ray is controlled by the first grid /anode. The second grid accelerates the speed of the electron and the third grid focusing the electron ray at the centre of the screen. Next to the third grid, there are two pair of plates named as X and Y. These plates are termed as horizontal and vertical deflection plates. By giving a voltage to these plates the electron ray can be deflected. This is known as Electrostatic Deflection.The X plates are connected with time base circuits. This circuit generates saw tooth wave. This saw tooth wave makes to move the (electron ray) bright spot from left to right on the screen. This is termed as X axis on the screen. The amplifier connected with Y plates, moves the ray up and down. This is termed as Y axis on the screen. The signal wave to be measured is given at the input. The switch ac/dc must be in off state. Through the capacitor the wave is amplified by the Y amplifier and fed to the Y plates.The power of the Y amplifier can be controlled Through the Front

panel control Volts/Div. Due to this, the wave form appears on the screen can be maximized



Block Diagram of a CRO

or minimized. The trigger circuit delays the time base circuit operation. This makes the moving wave appears to be static (unmoved) on the screen. The frequency, wave length and amplitude can be measured, when it is unmoved (locked).

Classifications of C.R.O

1. Analog C.R.O
2. Digital C.R.O

Types of digital CRO

1. Digital Storage Oscilloscope
2. Digital Phosphor Oscilloscope

3. Sampling Oscilloscope
4. PC Based Oscilloscope

C.R.O Probes

A cable which is used to connect CRO and the circuit under test is known as CRO probe.

Applications of CRO

1. Various waveforms with reference to time can be measured.
2. It is used to align all the parts of TV receivers.
3. Signal voltage can be measured.
4. Used to rectify the faults in TV receivers.
5. Frequency of the Signal can be measured.
6. Faults in DVD can be rectified.
7. Phase shift of a signal can be measured.