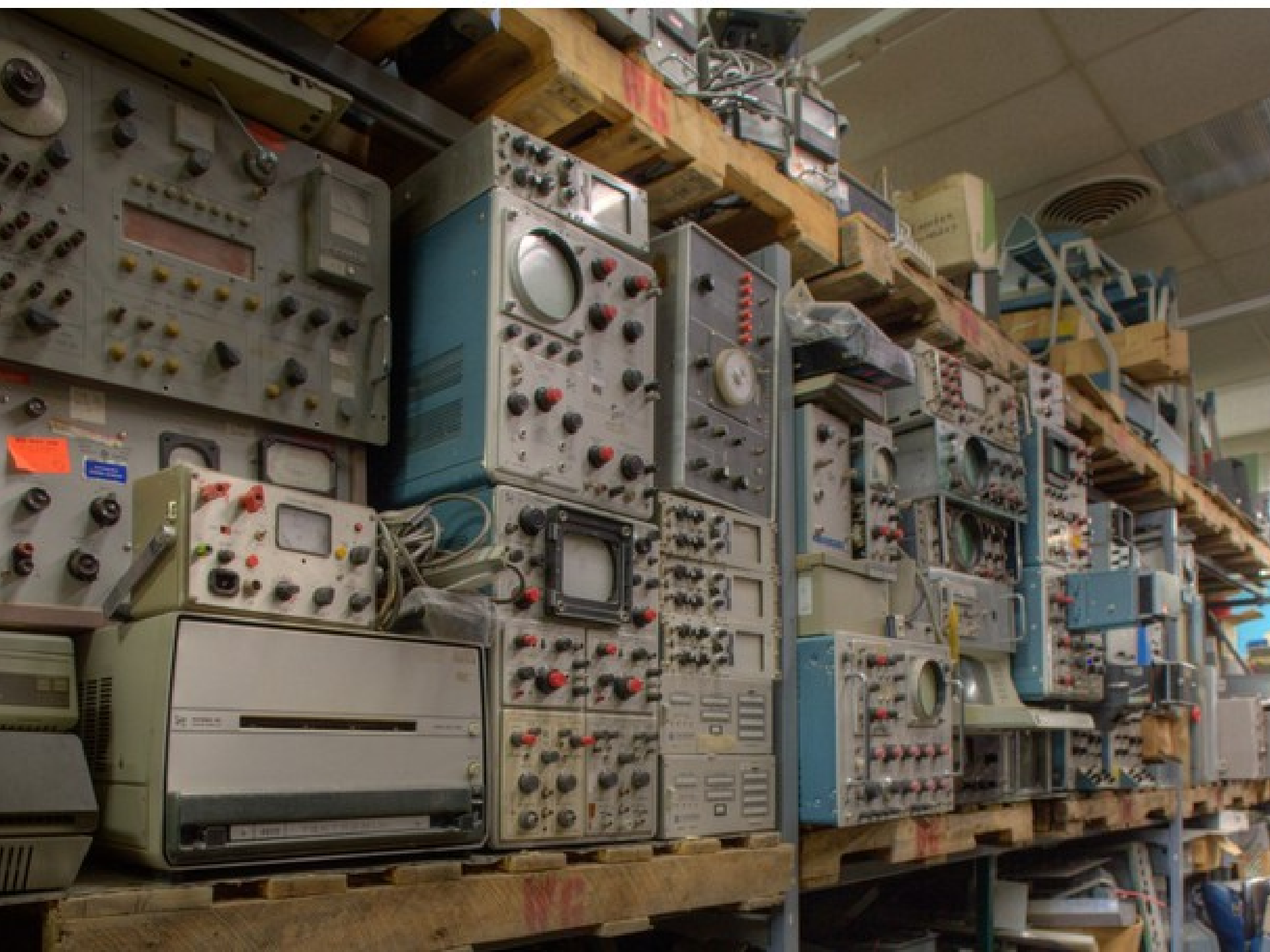


CRO Tech Talk Jan 2013

1. Laptop
2. Cleverscope
3. Cables
4. Sig gen
5. Old CRO
6. Spare Probes
7. Calibrate Screwdriver

HEATHKIT OSCILLOSCOPES





OSCILLOSCOPES 101

**What is an Oscilloscope or
CRO?**

**Cathode Ray Oscilloscope
And it used a Cathode Ray
Tube.**

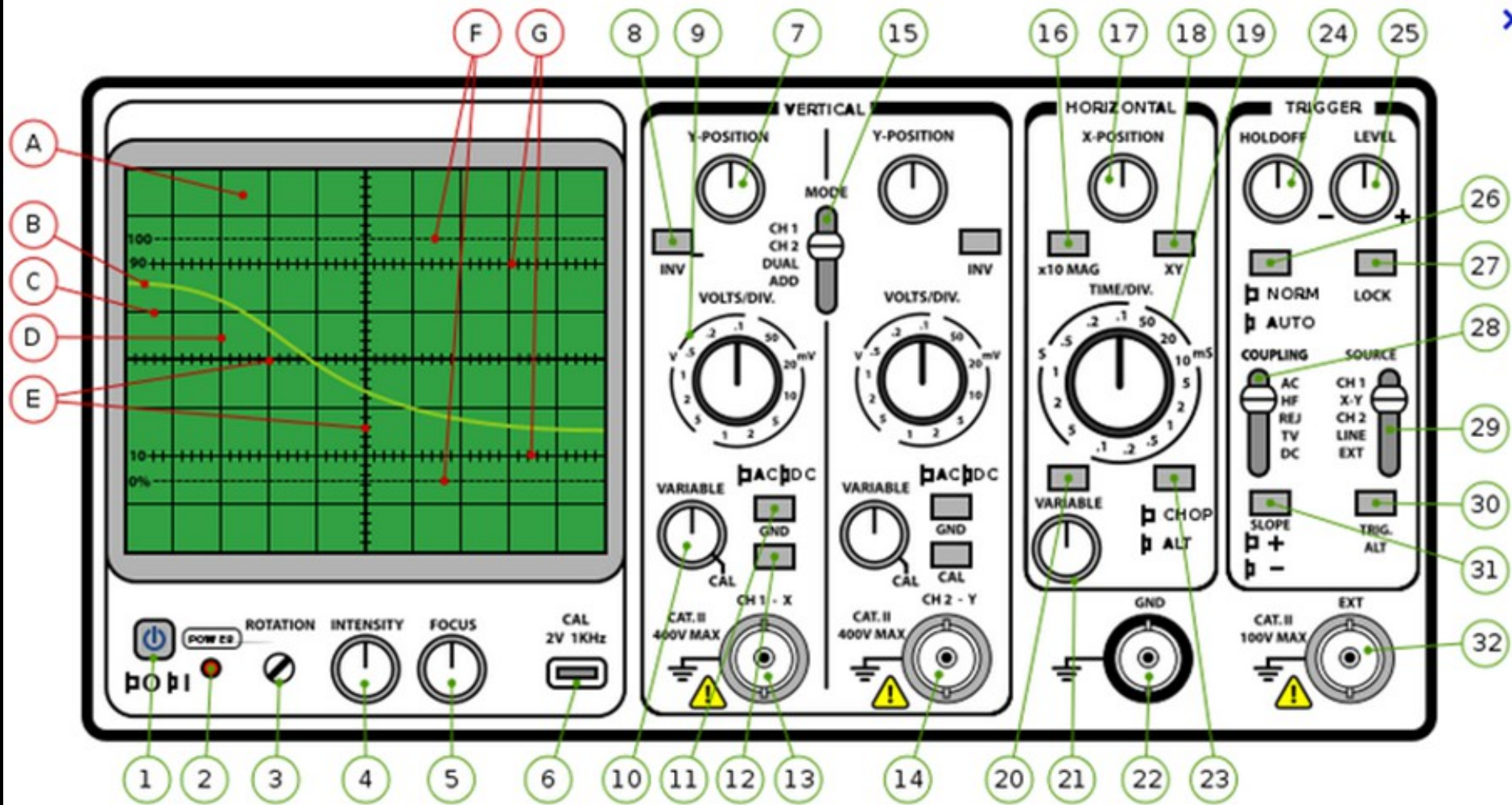
a CRO is a simple instrument!!!!

- **Its easier to learn to operate than the effort you put in learning to walk.**
- **It does take practice.**
- **Start with simple measurements**

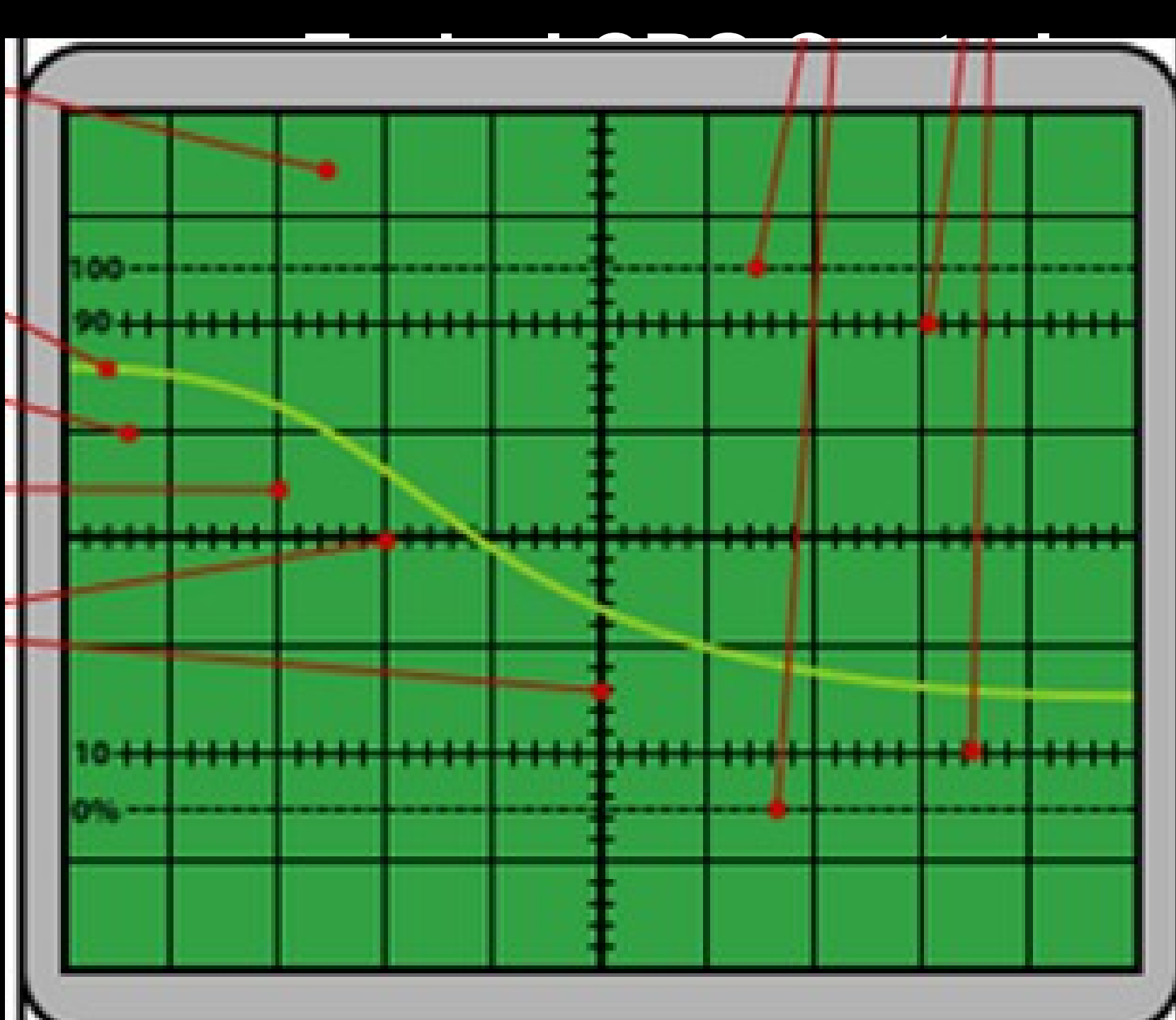
What does a CRO do?

- **A CRO measures Peak to Peak voltages.**
- **It can measure AC and DC at the same time.**
- **It does not measure RMS or Average voltages.**
- **It does not measure current**

Typical CRO Controls

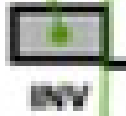
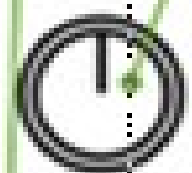


· In today's world there are now two types of CRO, Analogue and Digital



VERTICAL

Y-POSITION

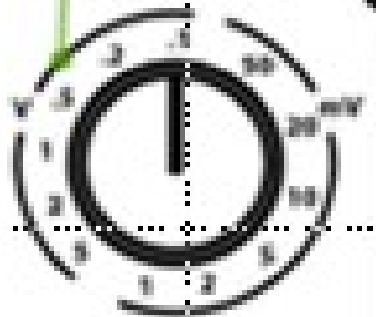


CH 1
CH 2
DUAL
ADD

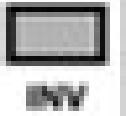
MODE



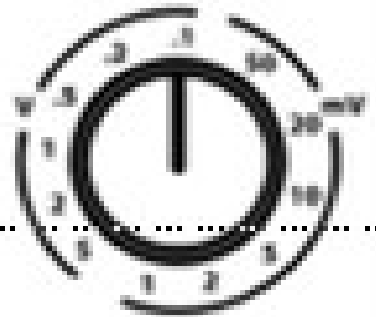
VOLTS/DIV.



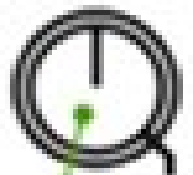
Y-POSITION



VOLTS/DIV.



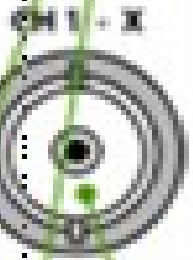
VARIABLE



AC DC

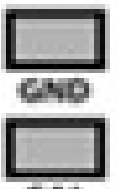
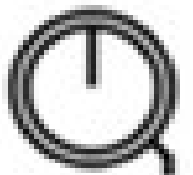


CAT. II
400V MAX

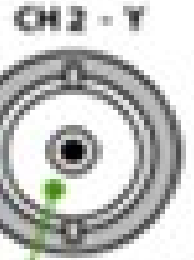


AC DC

VARIABLE

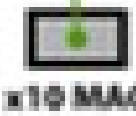
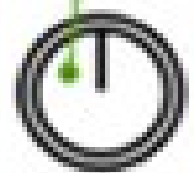


CAT. II
400V MAX

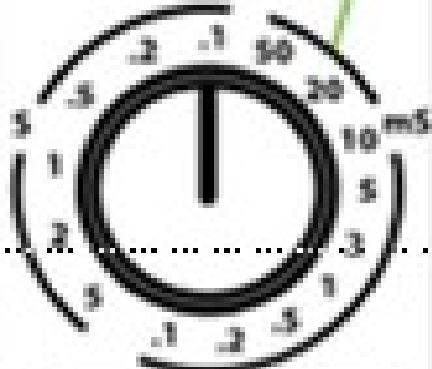


HORIZONTAL

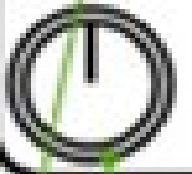
X-POSITION



TIME/DIV.



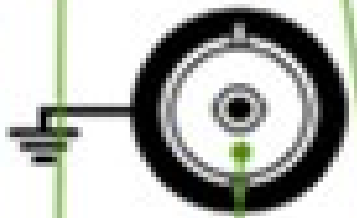
VARIABLE



CHOP

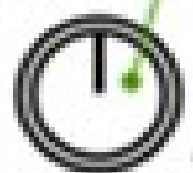
ALT

GND

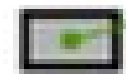


TRIGGER

HOLD-OFF



LEVEL

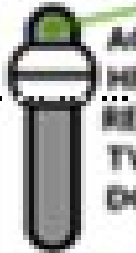


NORM



AUTO

COUPLING



SOURCE



SLOPE

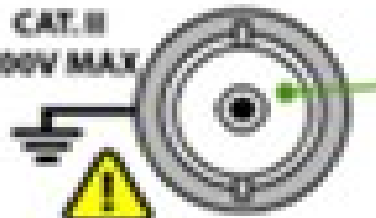
+

-

TRIG.

ALT

CAT. II
100V MAX



Typical CRO Controls

A is the display and is usually about 100mm corner to corner.

B shows the **trace**. This is the line drawn by the scope to represent the signal. On a CRO, this line is created by a bright dot moving across the screen at high. The graticule is usually 10 major divisions wide and 8 tall.

Typical CRO Controls

Power, Calibration and Display Controls

1 is the Power On/Off Button.

2 is the Power Indicator which lights when the oscilloscope is on.

3 is the **trace rotation** (TR) control.

4 is the **intensity** of the trace.

5 Focus, Most scopes can focus the beam to form a trace about 1mm wide.

6 is the calibration point. Sometimes, more than one frequency and voltage is available to give a more representative calibration. The standard calibration signal is between 0V and 2V at 1KHz.

Typical CRO Controls

7 controls the position of the trace. It can be adjusted to set the voltage relative to a ground, or it can be adjusted to separate the two signals - perhaps the first channel in the top half of the screen and the second channel in the bottom.

8 inverts the relevant channel. That is, the negative voltage is displayed, and the trace is upside-down.

9 is the vertical scale control, often called the volts/div. control.

10 is a variable height control. When set to CAL, the height is as stated on the volts/div. control.

11 is the **AC/DC toggle**. When set to AC, any DC component of the voltage is filtered out by switching a capacitor in series with the input signal

12 is the **GND toggle**. By selecting this, the input signal is ignored, and the trace shows 0V. This can be useful to measure a voltage or to eliminate one of the traces from the display.

13 is the Channel 1 signal input and **14** is the Channel 2 input.

Typical CRO Controls

19. The time base is the length of time displayed per major horizontal division on the screen

17 The position of the trace from side to side

The **×10 MAG** control, **16**, is a very useful control if you want to quickly zoom in on a feature without changing the timebase and losing your settings. This button magnifies the central area of the trace by a factor of 10 in the horizontal direction (but leaves the voltage height unchanged).

18 toggles the mode between the usual voltage vs. time format and the **XY** mode.

20 and **21** act in much the same way as **10** does on the vertical axis.

22 is the **GND** terminal of the scope.

23 toggles between **chop-mode** and **alt-mode**

How does it work

- 坛 It has a Local Oscillator
- 坛 This produces a saw tooth waveform
- 坛 The waveform causes the trace to shift left to right, horizontally across the screen at a set rate. Cm/sec if you like
- 坛 The input signal causes the waveform to move vertically (both negative and positive wrt the zero line)

Voltage Range

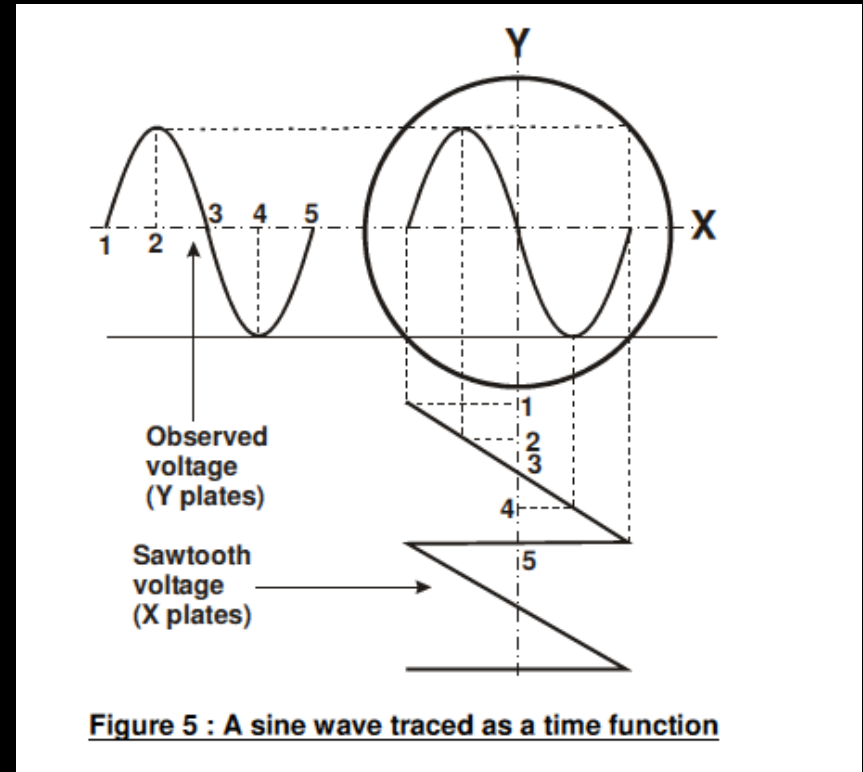
The main scale (graticule) is typically scribed in cm squares and may be subdivided into 10ths.

Range may be from volts to millivolts (mV) or even microvolts (μV) per cm.

坛 Time Range

坛 The time range sets the speed of the trace across the screen.

坛 The time can be set in seconds (per division) and high speed scopes will be in milliseconds (mS), microseconds (uS) or nanoseconds (nS) or femtoseconds (fS)



BASIC CRO

A simplified diagram of a CRO arrangement is shown below in Figure 6.

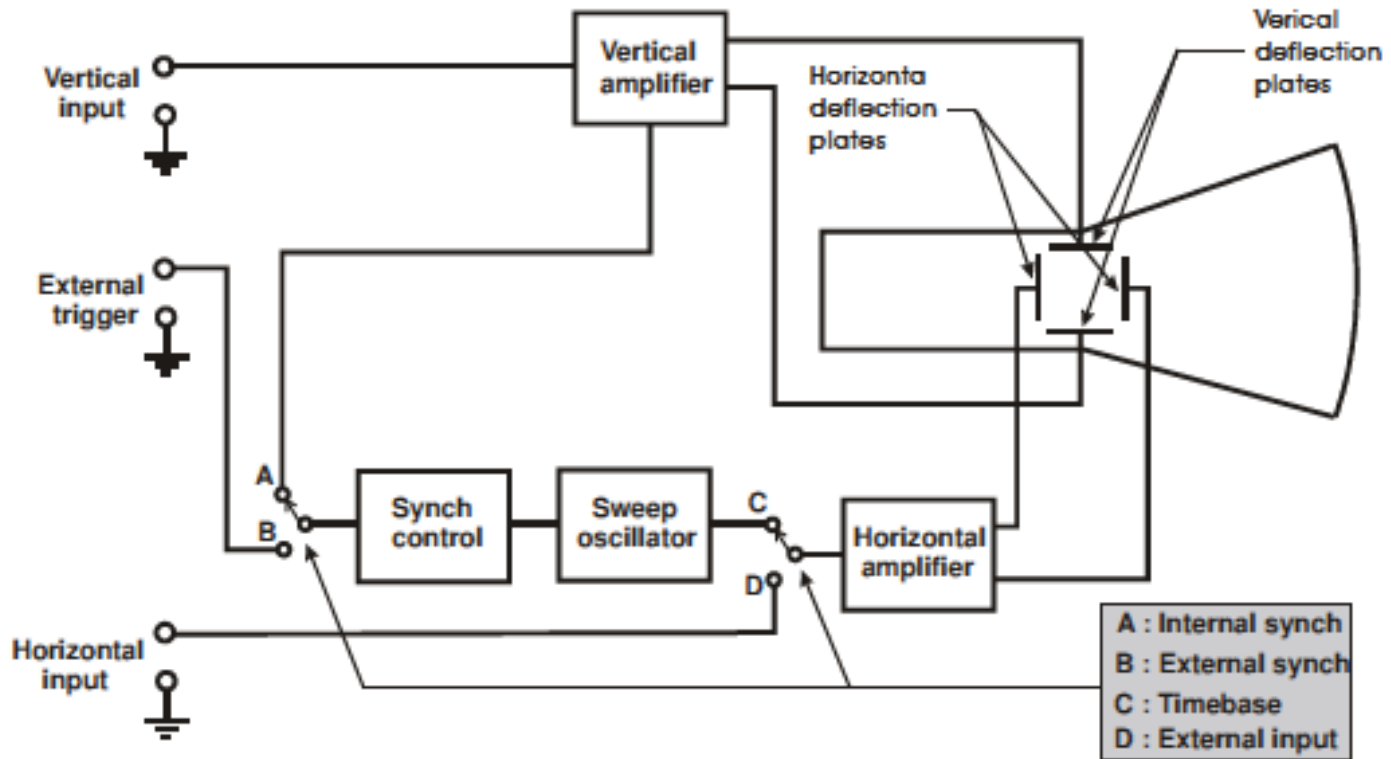


Figure 6 : Cathode ray oscilloscope simplified block diagram

Diagrams thanks to Alan VK4KZ and the Advanced Course Notes

Probes

The connecting lead between the oscilloscope and the DUT (Device Under Test) is not a simple cable.

**Normally it has a switch that sets the voltage range between,
Off – Calibrate**

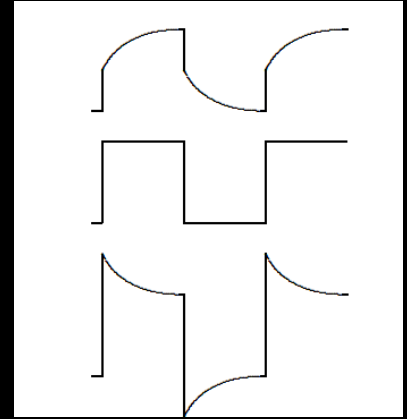
x 1 – Actual measurement or

Calibrating a Probe

坛 Look for a screw driver slot in the connector at the CRO connector.

坛 Connect the probe to the square wave calibration output. Yes they typically have a calibration signal. Usually about 1 KHz.

坛 A screw driver adjustment changes the probes COMPENSATION.



Triggering & Demo

The skill in using a CRO is being able to set up the triggering in such a manner that the CRO shows the waveform you are looking for – CORRECTLY!!

Sounds simple but sometimes the waveforms are very complex

Methods of Connection

- 坛 Direct – probe point to circuit
- 坛 Capacitor pF range (divider network)
- 坛 Resistor M Ohm range (divider network)
- 坛 Loosly coupled (1 or 2 turn loop)
adjust amount of pickup by closeness to the circuit under test

The First Time

坛 Set Volts/Cm to max

坛 Set probe to x10

坛 Connect probe to DUT.

坛 Set triggering to low volts or auto (free run).

坛 Adjust V/cm until waveform seen

坛 Adjust trigger to stabilise waveform

How to make a BAD measurement

坛 The skill of measurement lies with the probe and its earth lead

坛 Worst - Don't connect the earth lead at all !!!
Uses a capacitive ground to somewhere



坛 Good connect earth lead to a close ground.

坛 Best – connect the probe earth (silver ring) to the test point ground. Take the clip lead off.



Question Time

坛 You ask it

坛 Somebody will answer it – correctly!

Playtime

坛 Feel free to come and play.

坛 Its the only way I know to become familiar with a CRO.

When is A cro a spectrum analyser

A CRO measures signals in the time domain.

That is Voltage v Time

**A Spectrum Analyser (SpecAN)
measures signals in the**

CRO Specifications

**Show Specs for some modern
Oscilloscopes
Word document**

**Question how much time is
100 Femtoseconds??**

-15

Hint it 10 times smaller than an