

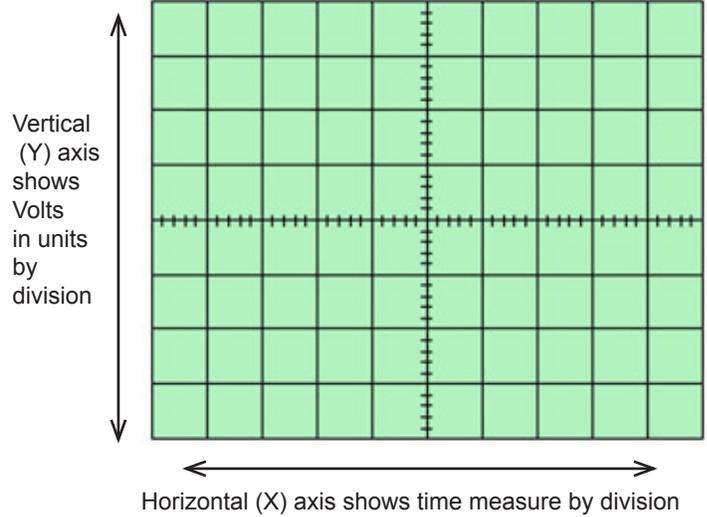
# Oscilloscopes

The oscilloscope is the most commonly used tool for analyzing and diagnosing electrical signals (rapidly fluctuating voltages.) It repeatedly draws a horizontal line called **the trace** across the middle of the screen from left to right. Superimposed on the screen is a grid of squares called **divisions** used for measuring.

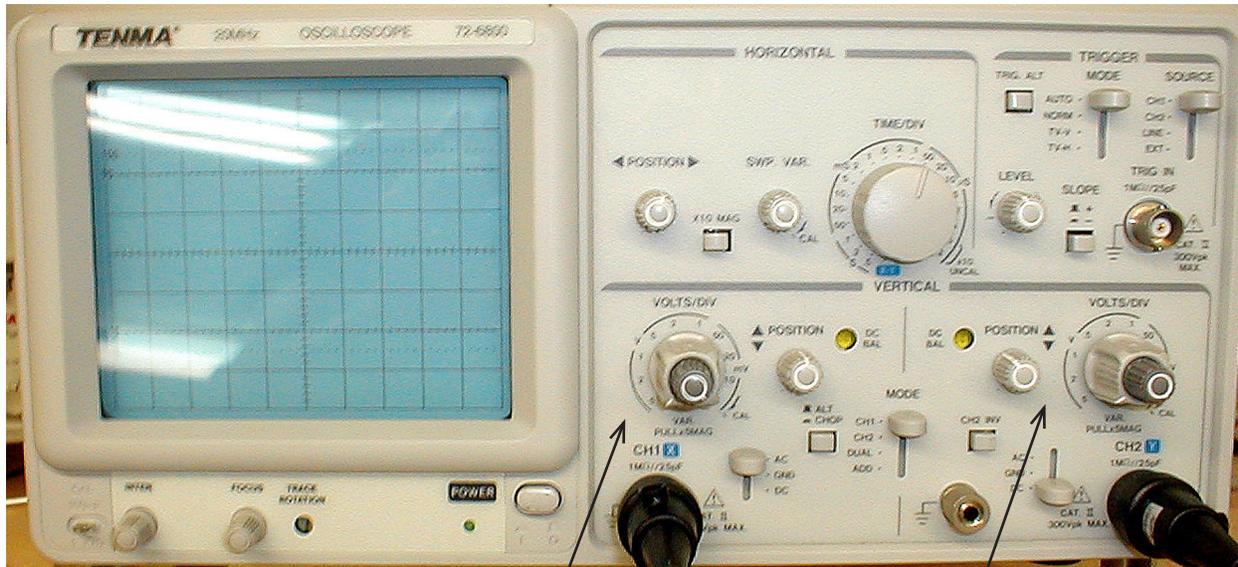
Divisions on the horizontal axis measure *time* in seconds (or milliseconds) set by the “**TIME/DIV**” control.



Divisions on the vertical axis measure *volts*, and is calibrated using the “**VOLTS/DIV**” control.



The resulting trace is a graph of voltage measured over time.



“Dual channel” oscilloscopes like this one can display two different traces in order to compare two signals being measured. They have two VOLTS/DIV controls -one for each channel, that can be calibrated separately. (They will both use the same TIME/DIV setting.) And each can separately be set to display AC, GND (ground), or DC.

For each oscilloscope channel there is a “probe” with a positive tip (spring-loaded) and a black clip lead which is attached to ground (or the more negative connection) of the signal being tested.

There is also a “X 10” switch that increases the resistance in the probe by 10 times. It dramatically *reduces* the amplitude (voltage) of the signal. (Be careful it’s not accidentally on.)



## Default settings:

The oscilloscope can be flexibly configured to measure signals in a variety of ways. In fact, if the controls are in the wrong configuration for measuring your signal, you might not get any readable trace at all. Here are some default settings to start with in measuring the output of your oscillators:

### Under the "Trigger" section:

Source: **CH1** (or CH2, if that's the channel probe you are using)

Mode: **Auto**

### Under the "Vertical section"

AC / GND / DC: Usually **DC**, but in the case of a microphone, it might be generating AC.

Mode: Probably **CH1**. Use CH2 if that's the probe you are using.  
If you are looking at 2 channels, then **Dual**

VOLT/DIV: Start with this dial set to 5. (e.g. A signal ranging between 0 and 10 volts will range over a height of 2 divisions.)

Start by selecting **GND** in the Vertical section for the probe you are using. This should just give you a flat line for the trace. Use the vertical positioning pot to adjust it's position so it is centered. Then set the switch to the appropriate current setting DC or AC.)

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## Notes:

The human hearing range is from approximately 20 vibrations per second (hertz (hz)) up to 20 thousand (or 20 kilohertz (khz)). If you are using the 555 to create a synthesizer of some kind you will most likely want to stay in this range. The specs on the 555 say that it can (depending on the circuit and operating voltage) produce frequencies up to 2 megahertz.

If you are planning on plugging your oscillator into an amplifier, remember that you should adjust the signal to match what the amplifier circuit is expecting in order to not damage anything. If the jack you are plugging into is labeled: "Mic", then the circuit is designed to be amplifying a microphone with a signal of only a few millivolts (thousandths of a volt.) If the connector is labeled "CD", "Tape" or "Line", then the circuit is designed to be amplifying a signal of "Line Level" (between 0 and 1 volt.) If your signal is way too "hot" for the amp you are plugging into, you can lower the voltage by creating your own custom voltage divider. -Consult your handouts on the voltage divider: the positive and ground leads of your signal is "Vin". Do the calculations to figure out the correct resistor values for "Vout"...