OSCILLOSCOPES
Use an o-scope to:

- Troubleshoot and find more information than what you can obtain from a multimeter
- Debug inputs and outputs of circuits
- Identify noise and its effects in your circuit
- Determine the shape of an electronic waveform
- Calculate the phase differences between two different signals
- Find the frequency and the minimum and maximum voltages of a signal
What to measure with o-scopes

- Timing characteristics
- Voltage characteristics
Timing Characteristics

- **Frequency** \((f)\) = The number of times per second a waveform repeats itself

- **Period** \((T)\) = The number of seconds it takes for a waveform to repeat itself, \(T = \frac{1}{f}\)

- **Duty Cycle** = The percentage of a period when a wave is positive or negative (how long a signal is on versus how long it’s off each period)

- **Rise Time** = How fast a circuit responds to signals, i.e. the duration of a wave going from a low point to a high point on a curve. Fall time is the opposite of rise time
Rise time and pulse width measurement points.
Voltage Characteristics

- **Amplitude** = The measure of the magnitude of a signal
- **Maximum and Minimum Voltages** = How high or low the voltage of the signal is
- **Mean and Average Voltages** = Mean/Average of signals, and average of a signal’s maximum and minimum voltage
A typical passive probe
Finding the basics
If you’re not familiar with these, find a beginning oscilloscope tutorial.
Reading the scales

vertical origins (marked with channel number or ‘M’ for math)

vertical scale (per division) for each channel

time per division (‘M’ stands for main time base)
Example graph on oscilloscope
How do I control the display?

Once you understand the front panel, using the oscilloscope is fairly intuitive.

First make sure you’re in the right menu:

Try the **MENU buttons** to watch the display change as you press each one. (Exceptions: **AUTORANGE** and **DEFAULT SETUP** may change your setup as soon as you press them.)
Five control buttons are located just to the right of the display. If you want to change a menu item, press its control button.

Multipurpose knob: Use when menus prompt you to adjust values.

PRINT button: sends output to a printer or USB flash drive, depending on the settings in the SAVE/RECALL menu.

What if I don’t see anything?
An AUTOSET button (upper right) usually finds your waveform. (Note: AUTORANGE is similar to AUTOSET, but continuously adjusts the display.)

What if I still don’t see anything?
Factory default settings are available by pressing the DEFAULT SETUP button. Then try AUTOSET.
### A few more things:

**Probe Settings** - Some probes attenuate the signal passing through them. Check that the oscilloscope setting matches your probes.

<table>
<thead>
<tr>
<th>CH 1 MENU (or CH 2 MENU)</th>
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<tbody>
<tr>
<td>→ Probe (cycle through choices)</td>
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#### YT (dual-channel) display format

- **Display** Menu
- → Format (cycle through choices)

#### XY (channel vs. channel) display format

- **Display** Menu
- → Format (cycle through choices)
<table>
<thead>
<tr>
<th><strong>MEASURE</strong></th>
<th>allows you to display quantities the 2012 can calculate from your waveform (frequency, rms amplitude, etc.)</th>
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<tr>
<td><strong>CURSOR</strong></td>
<td>displays vertical or horizontal cursors you can position manually and displays the time or voltage between them.</td>
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Some useful sites and videos:

https://learn.sparkfun.com/tutorials/how-to-use-an-oscilloscope?_ga=1.171970599.529458105.1355161158#resources-and-going-further