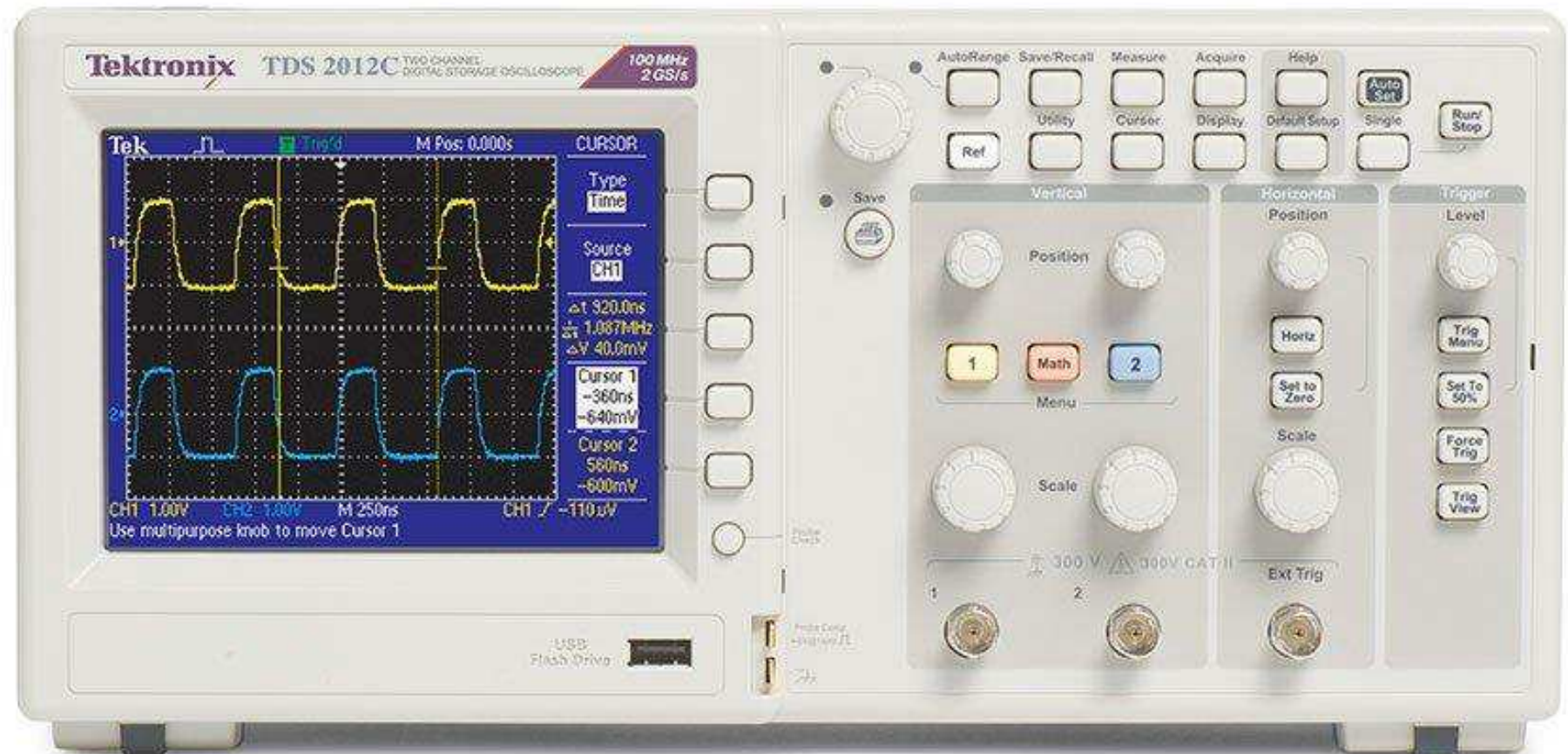

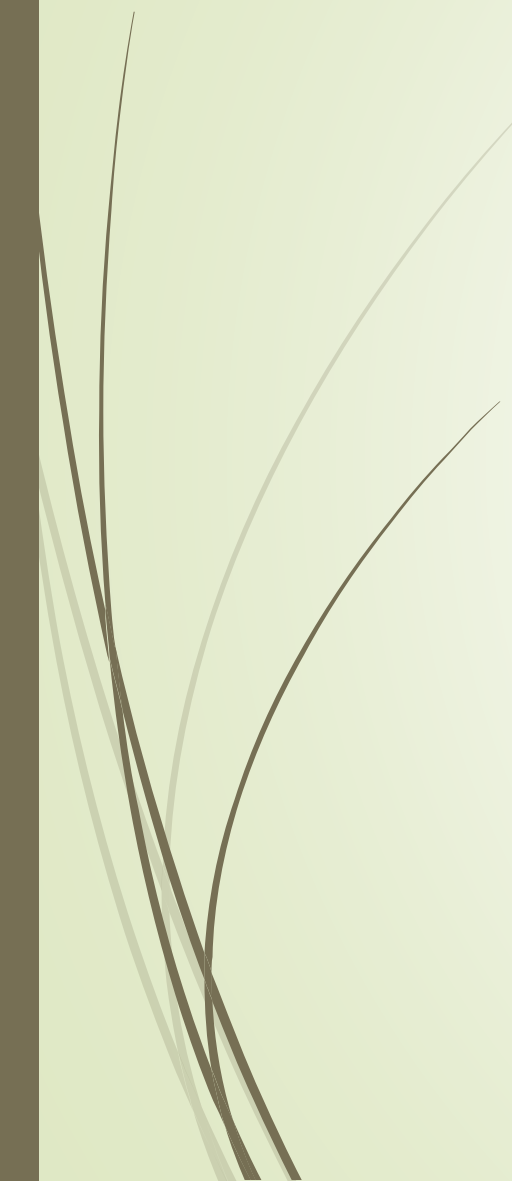


# OSCILLOSCOPES





# 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
- 



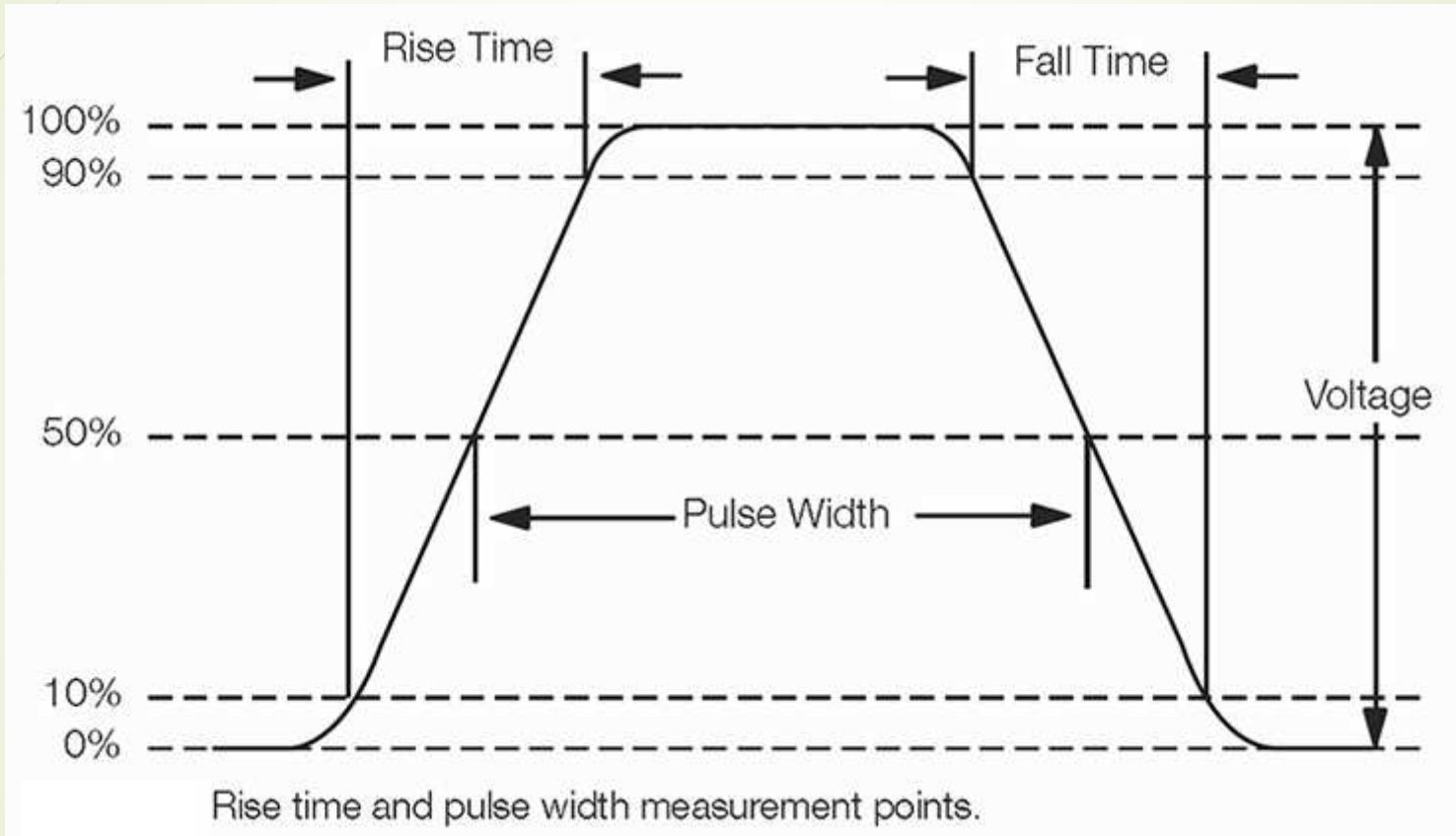
# What to measure with o-scopes

- 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,  **$T = 1/f$**
- **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

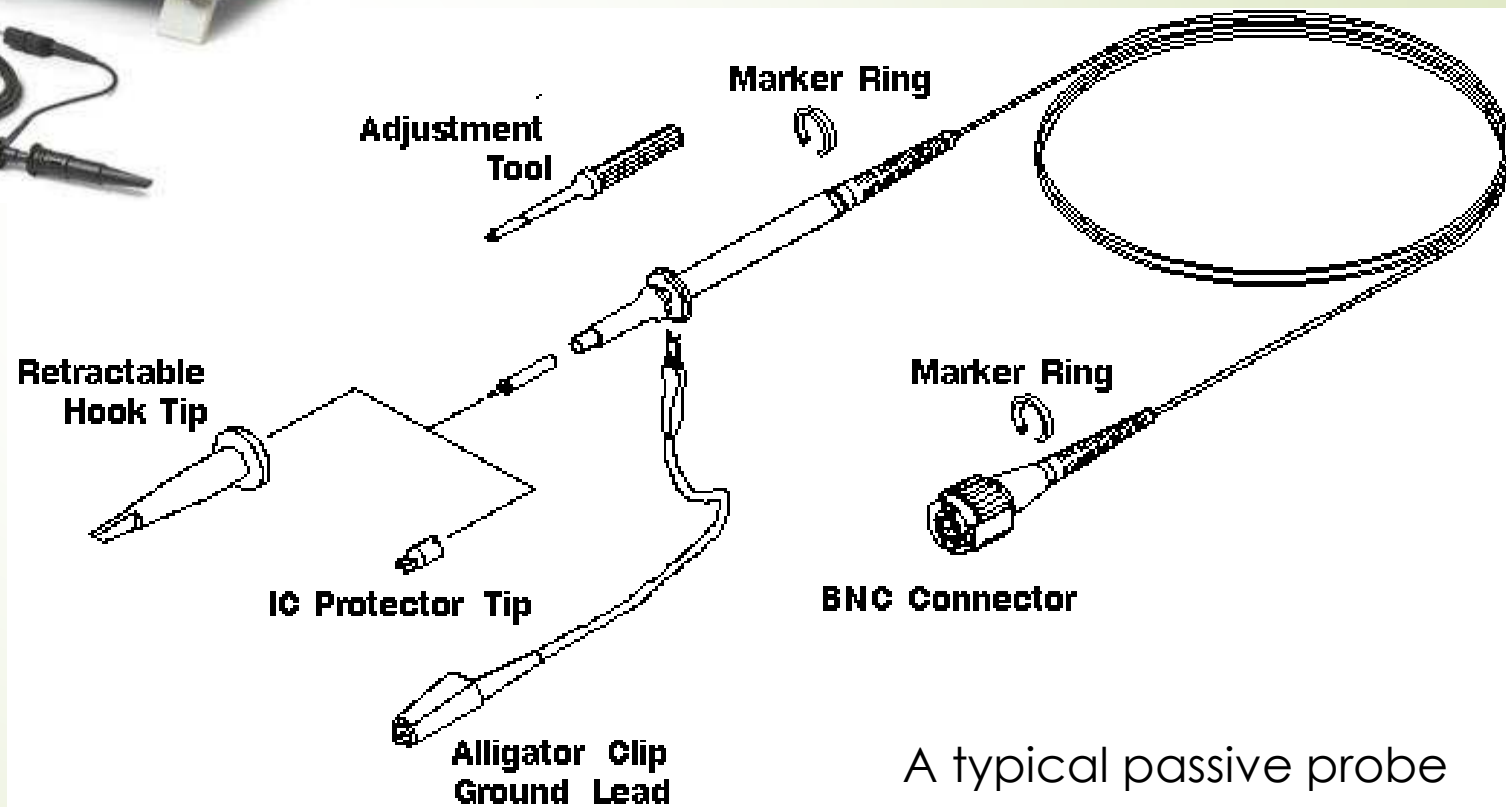






# Voltage Characteristics

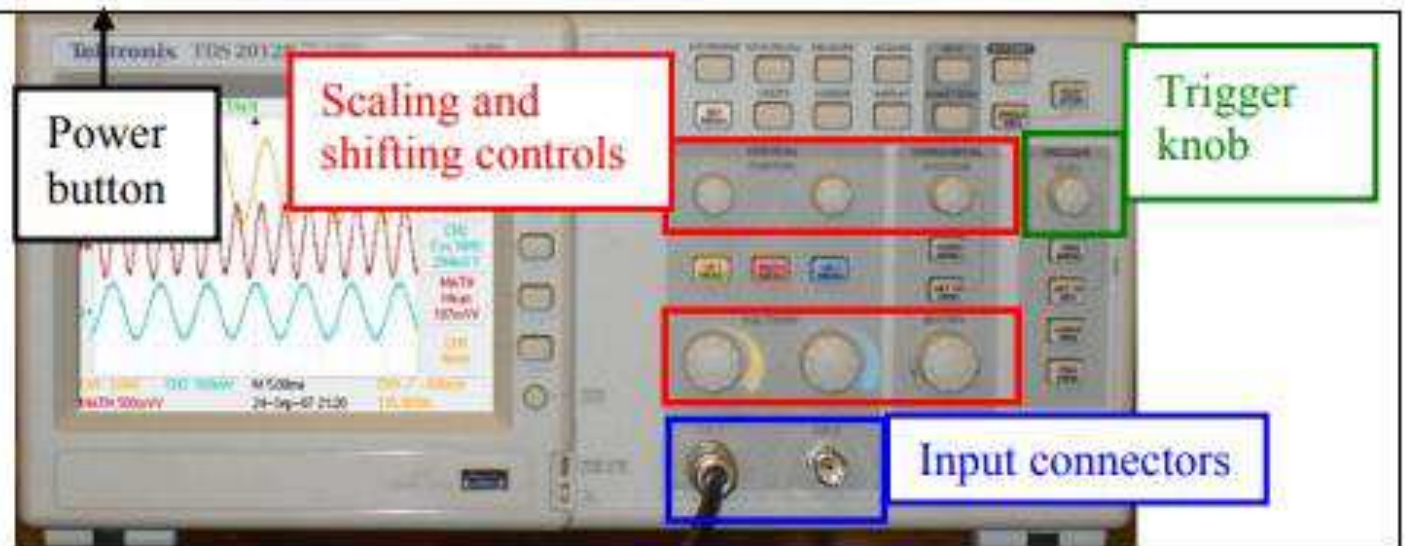
- **Amplitude** = The measure of the magnitude of a signal
- **Maximum and Minimum Voltages** = How high or low the voltage of the signal is
- **Mean and Average Voltages** = Mean/Average of signals, and average of a signal's maximum and minimum voltage



A typical passive probe

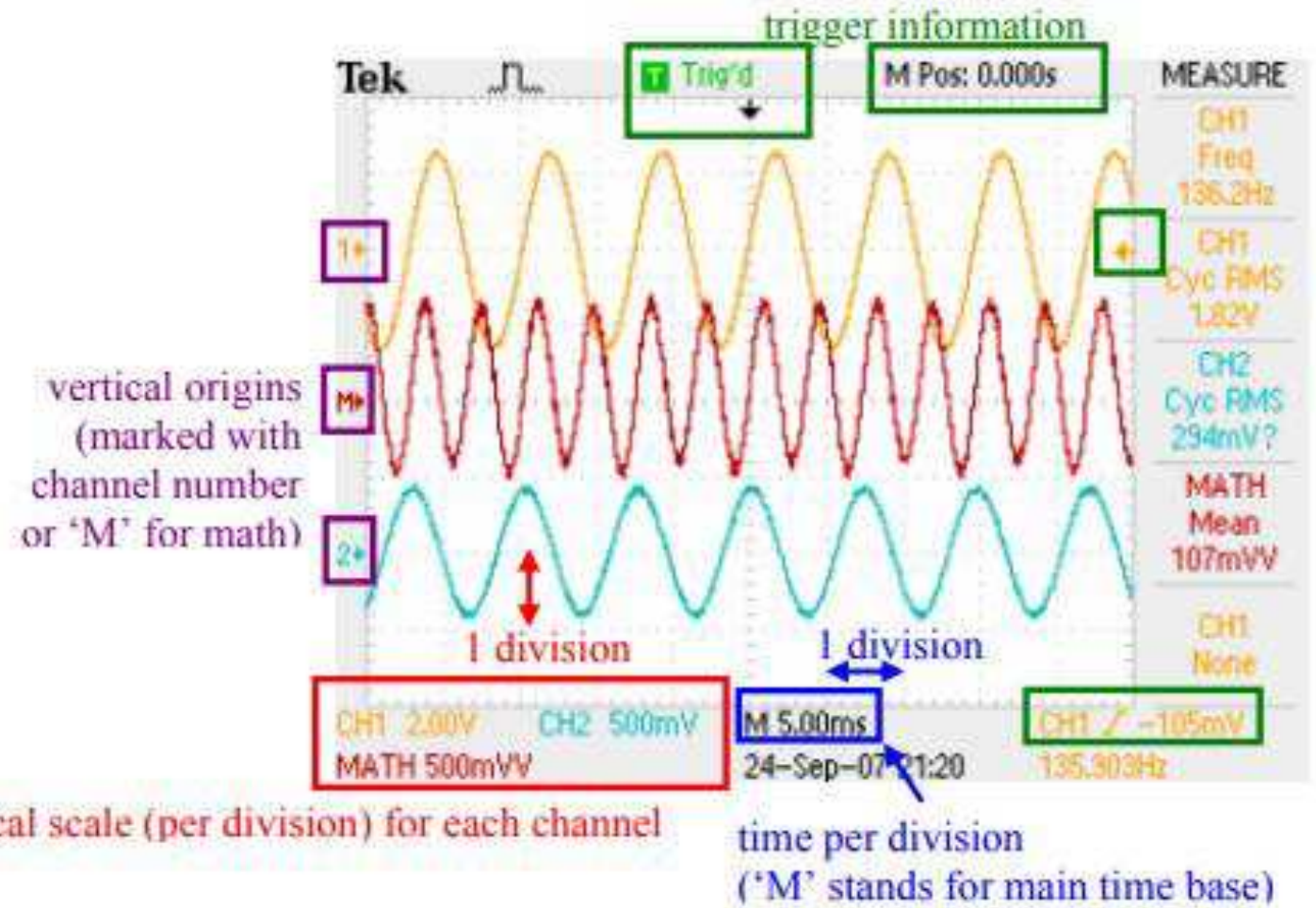
## Finding the basics

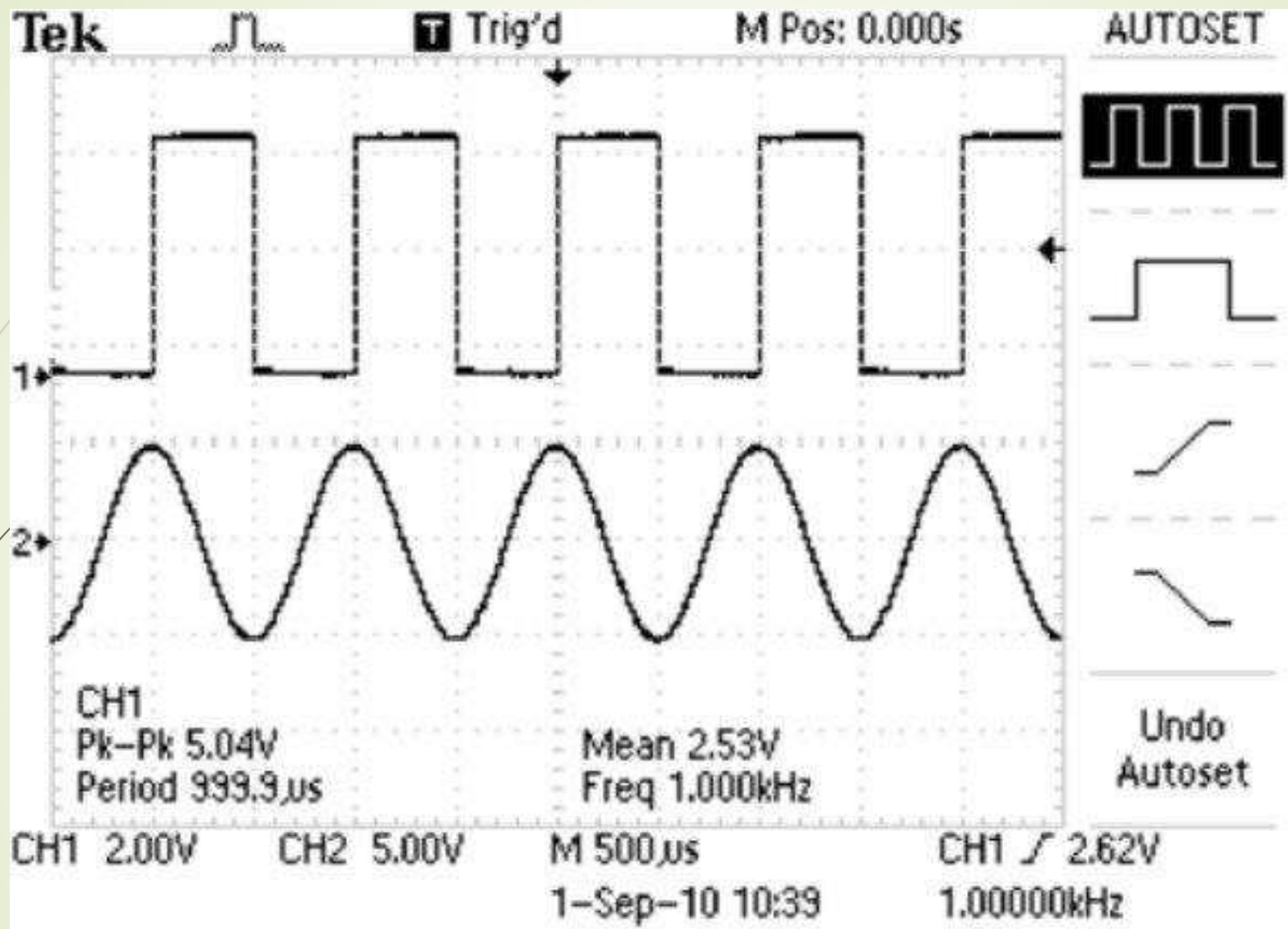
If you're not familiar with these, find a beginning oscilloscope tutorial.





## Reading the scales





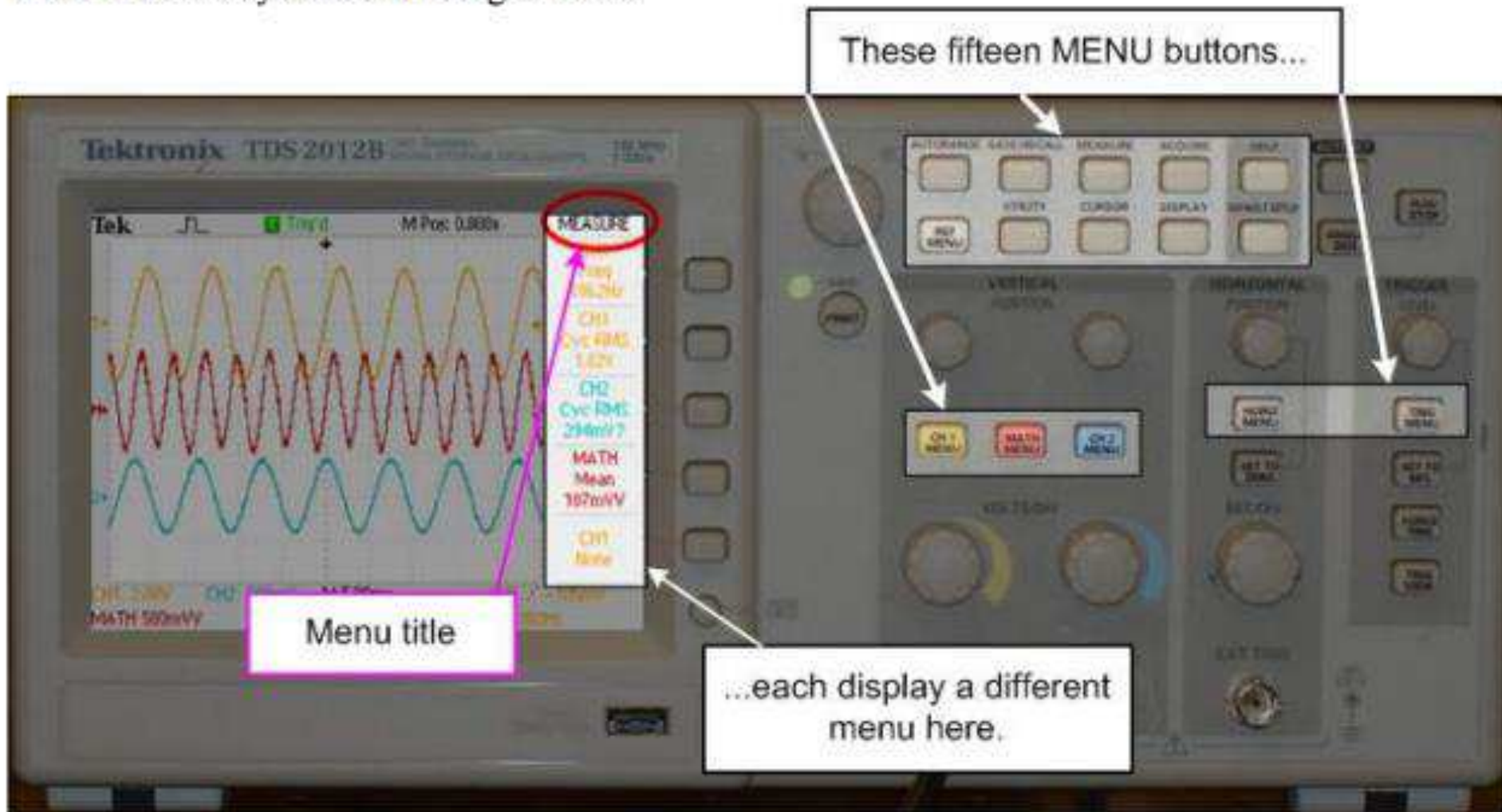
Example graph on oscilloscope



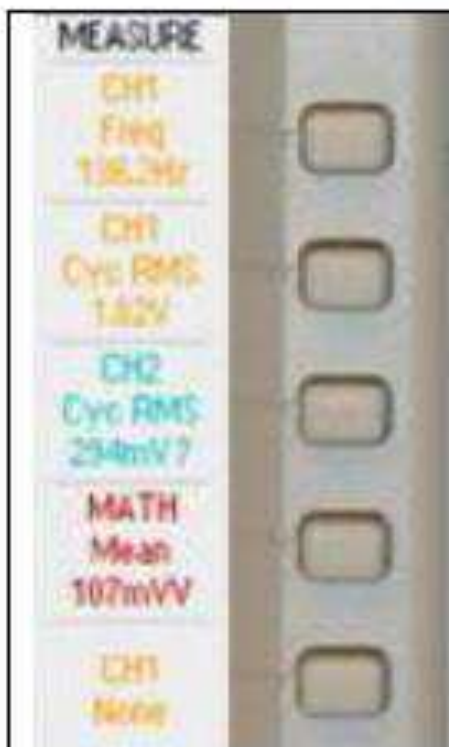
## How do I control the display?

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?

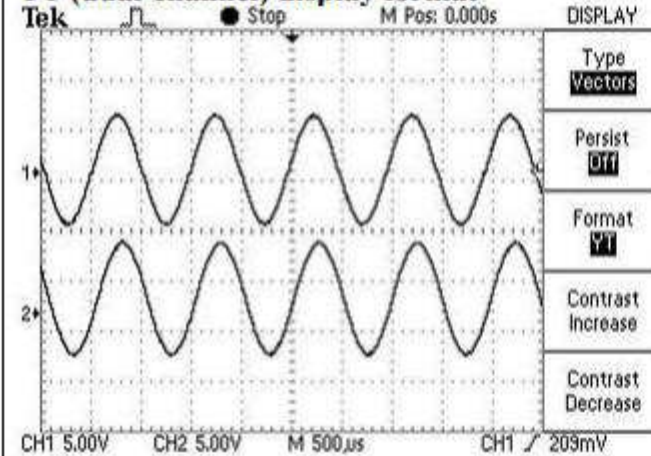
Factory default settings are available by pressing the **DEFAULT SETUP** button.  
Then try **AUTOSET**.

## A few more things:

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

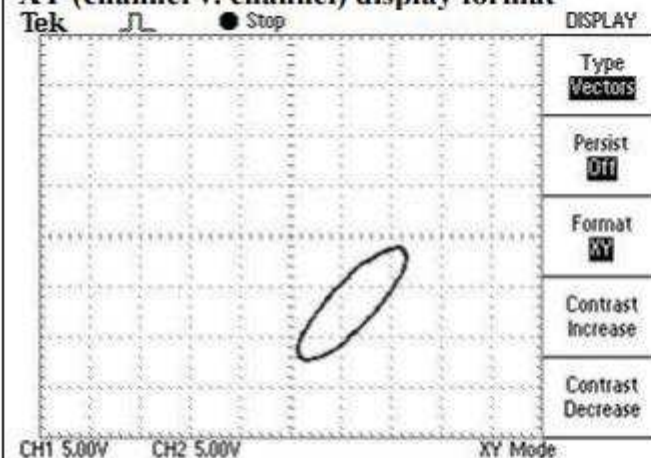
**CH 1** MENU (or **CH 2** MENU)  
→ Probe (cycle through choices)

### YT (dual-channel) display format



**DISPLAY** MENU  
→ Format (cycle through choices)

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

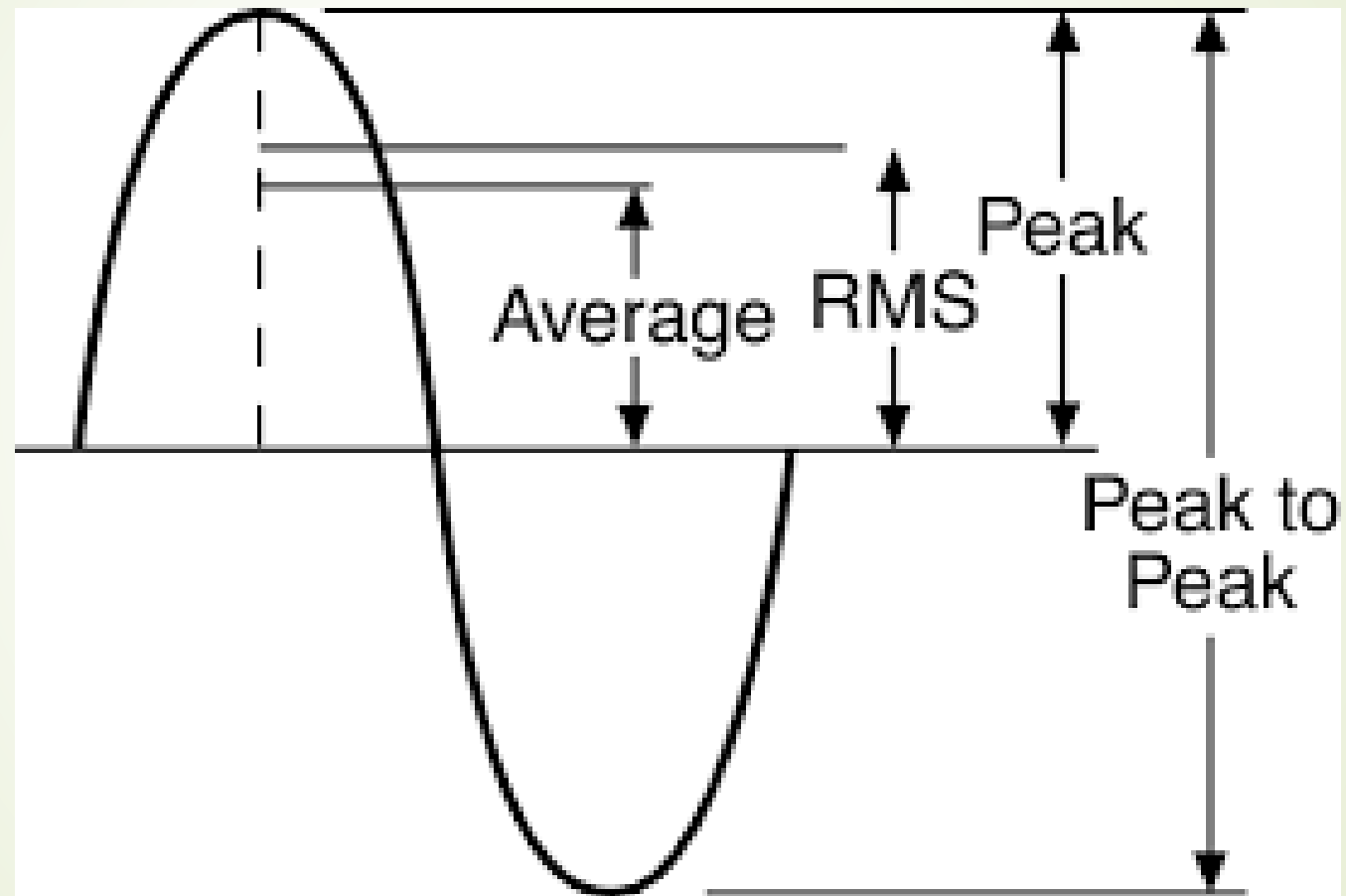


**DISPLAY** MENU  
→ Format (cycle through choices)



**MEASURE** allows you to display quantities the 2012 can calculate from your waveform (frequency, rms amplitude, etc.)

**CURSOR** displays vertical or horizontal cursors you can position manually and displays the time or voltage between them.





## Some useful sites and videos:

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

<https://www.manualslib.com/manual/498235/Tektronix-Tds1000b-Series.html?page=120>