

What is all that stuff in front of you ?

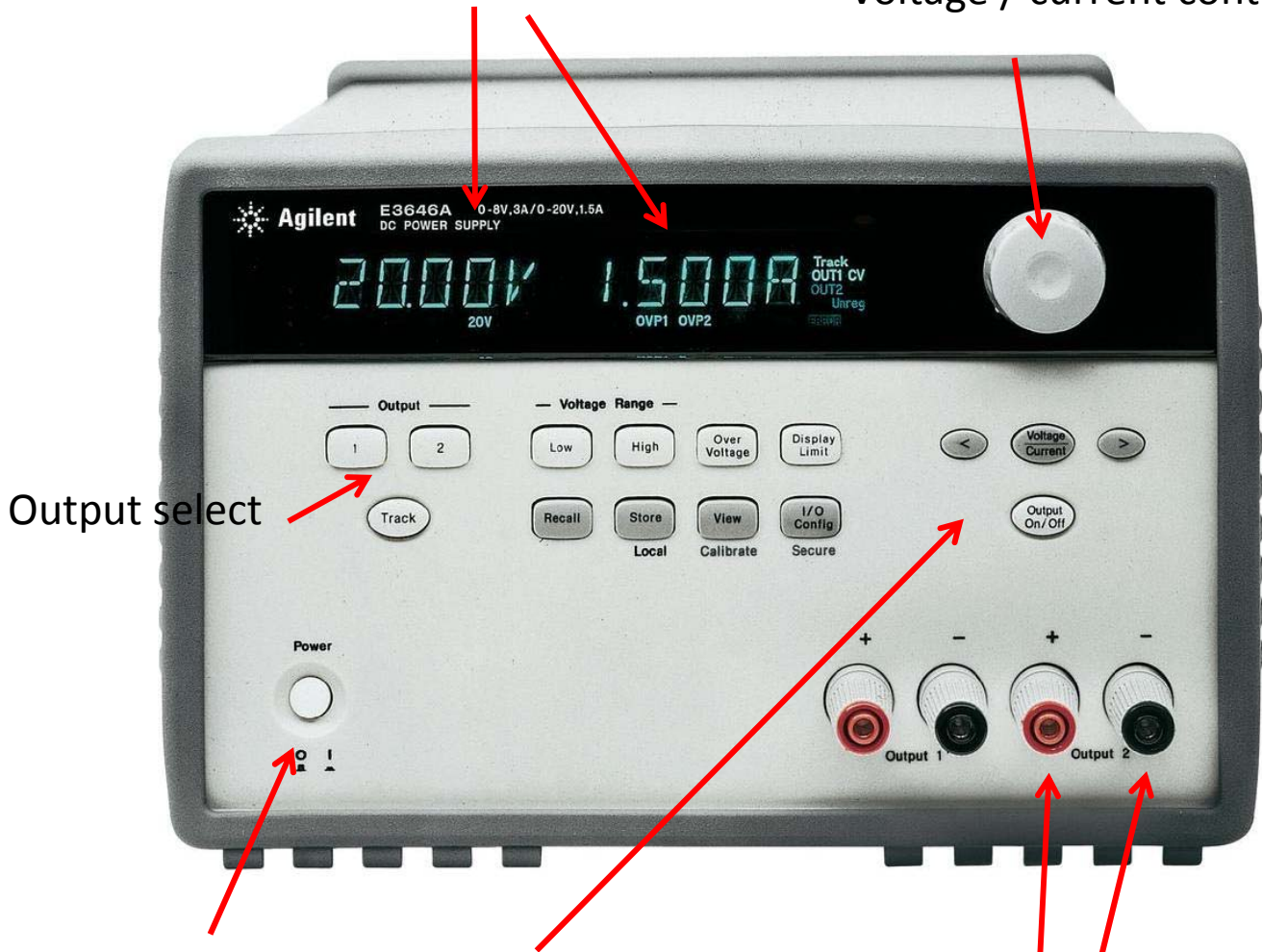
- A quick intro to
 1. Power supply
 2. Digital multimeter
 3. Function generator
 4. Oscilloscope
 - 1 and 2 for constant voltage/current (DC)
 - 3 and 4 for time-varying voltage / current (AC ??)
- Also intro to protoboard, connectors, etc

Power Supply

Full User Manual is on Blackboard

Digital voltage / current meter

Voltage / current control



Output select

On button

Output on/off (you can shut off the power without shutting off the whole instrument)

Output terminals + and - ; connect to banana cables

Digital Multi-meter

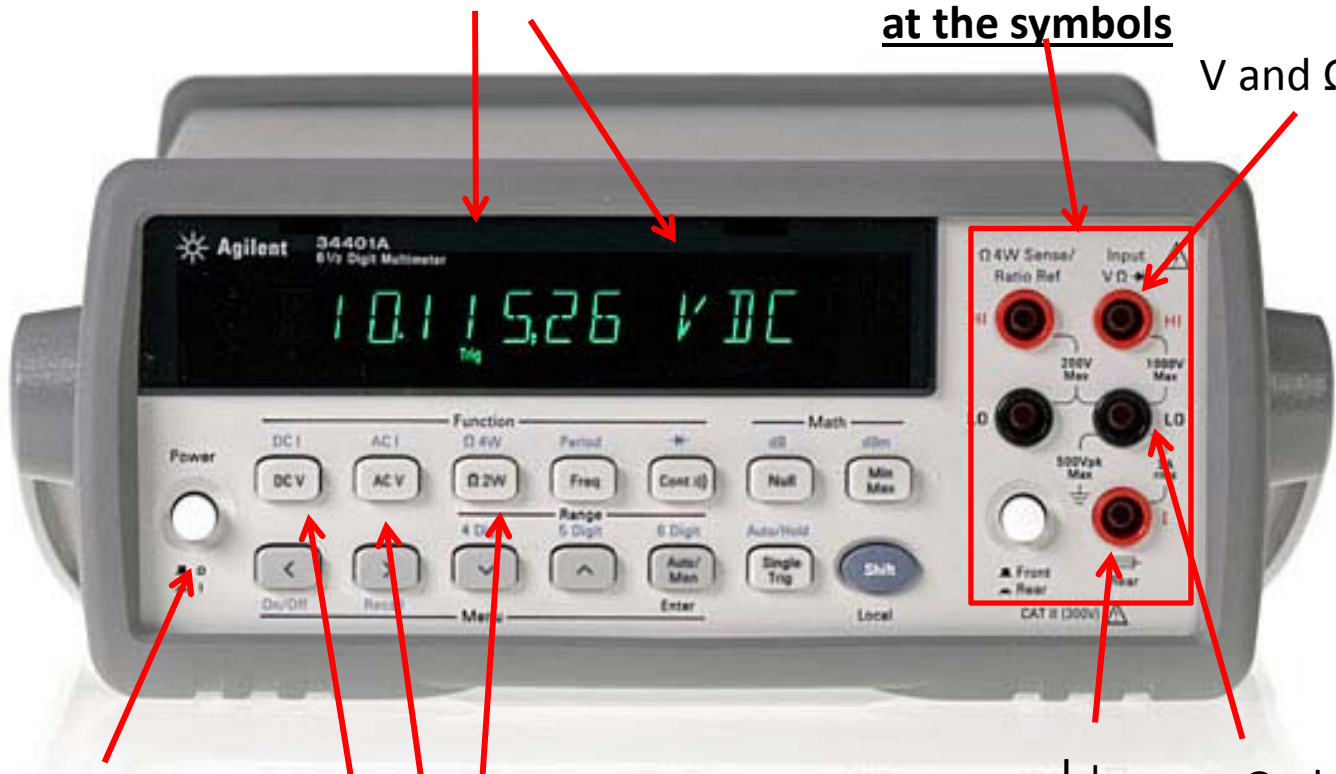
Full User Manual is on Blackboard

Digital voltage / current meter

Input terminals + and - connect to banana cables

Depends what you are measuring – look at the symbols

V and Ω +



On button

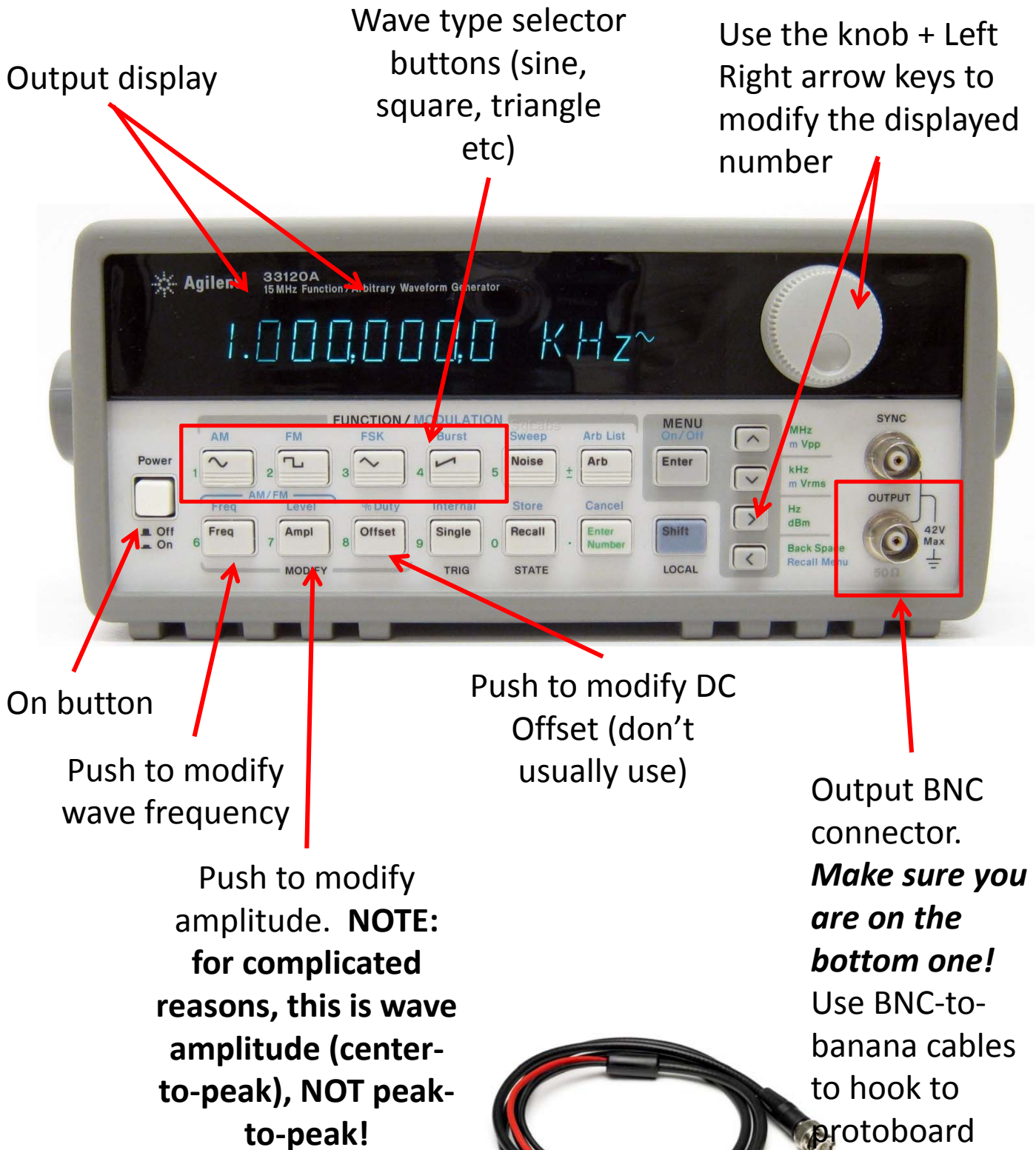
“Function” – what do you want to measure?
V-DC, V-AC, I-DC, I-AC, Ω

I +

Gnd

Function Generator

Full User Manual is on Blackboard



Oscilloscope

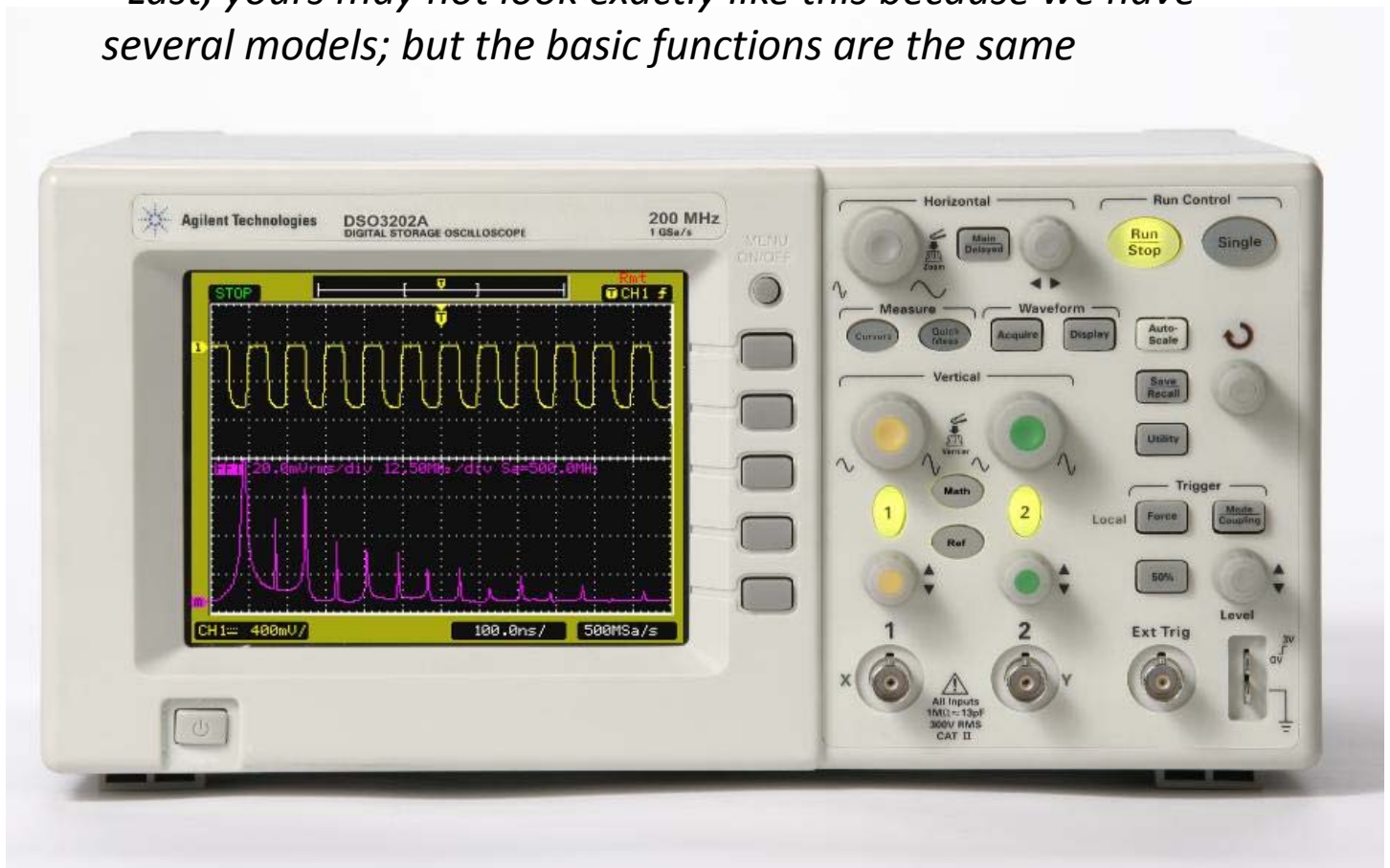
Full User Manual is on Blackboard

Note that:

-The oscilloscope is the most complicated instrument we have in the lab, so you should review the manual on Blackboard.

- Also helpful is the “Intro to Oscilloscopes.pdf” document, also on Blackboard.

- Last, yours may not look exactly like this because we have several models; but the basic functions are the same

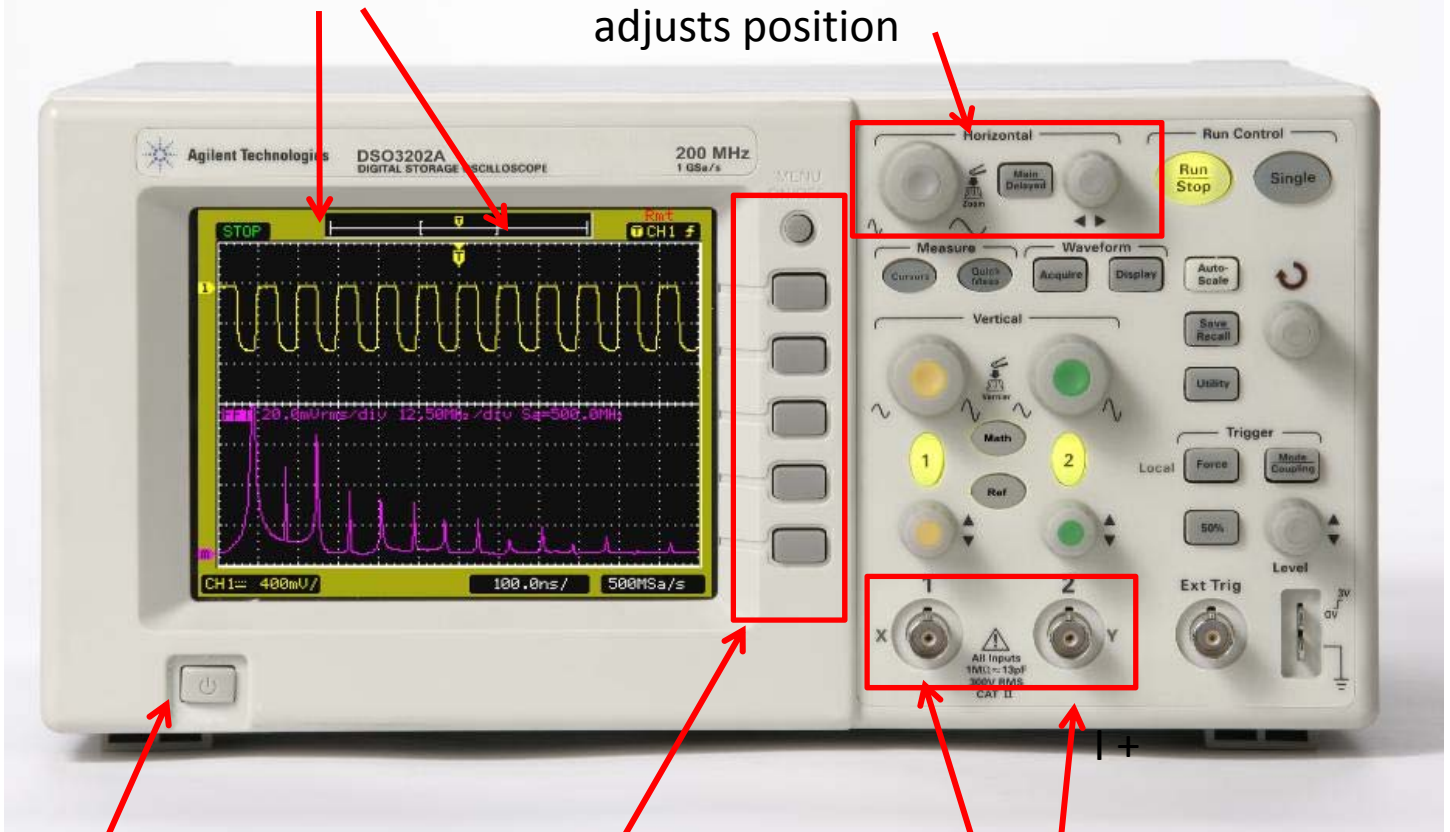


Oscilloscope

Full User Manual is on Blackboard

Horizontal – Time axis control. Rotate large knob to change “time per horizontal division” scale, from s to ns. Allows you to “zoom in and out” of signal. Small knob adjusts position

Display (screen)



On button

Channel 1 and 2 BNC inputs, respectively

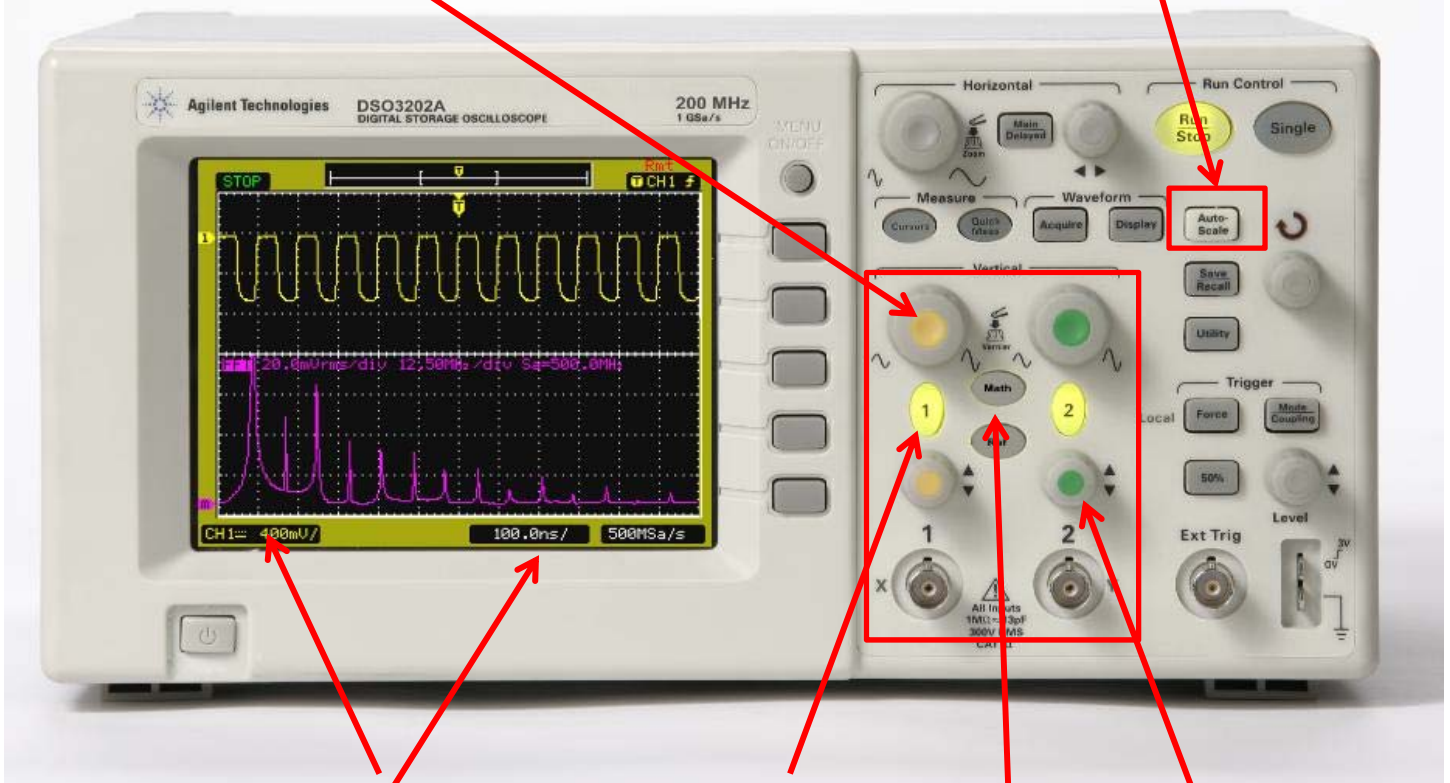
“Softkeys” – change function based on what is on the screen; also may be horizontally under the screen

Oscilloscope pt 2

Full User Manual is on Blackboard

Vertical axis scale – rotate to change volts per division (from V to μ V). Allows you to zoom in or out of a signal.

“Autoscale”. Your friend, 90% of the time. But beware the other 10%



The current V/division (vertical) and s/division (horizontal) settings are displayed at the bottom (at the top in some models)

Channel 1 menu – brings up various softkey functions.

Channel 2 vertical position

The oscilloscope has many useful built in math and measurement functions such as peak-to-peak amplitude, frequency, averaging, etc.

Cables and connectors



Banana connector



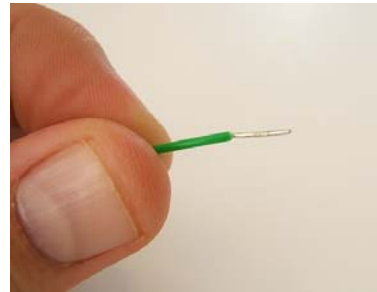
Alligator connector
(can grab a bare wire)



IC hook connector
(can hook a bare wire)



BNC connector



Bare wire /
stripped wire



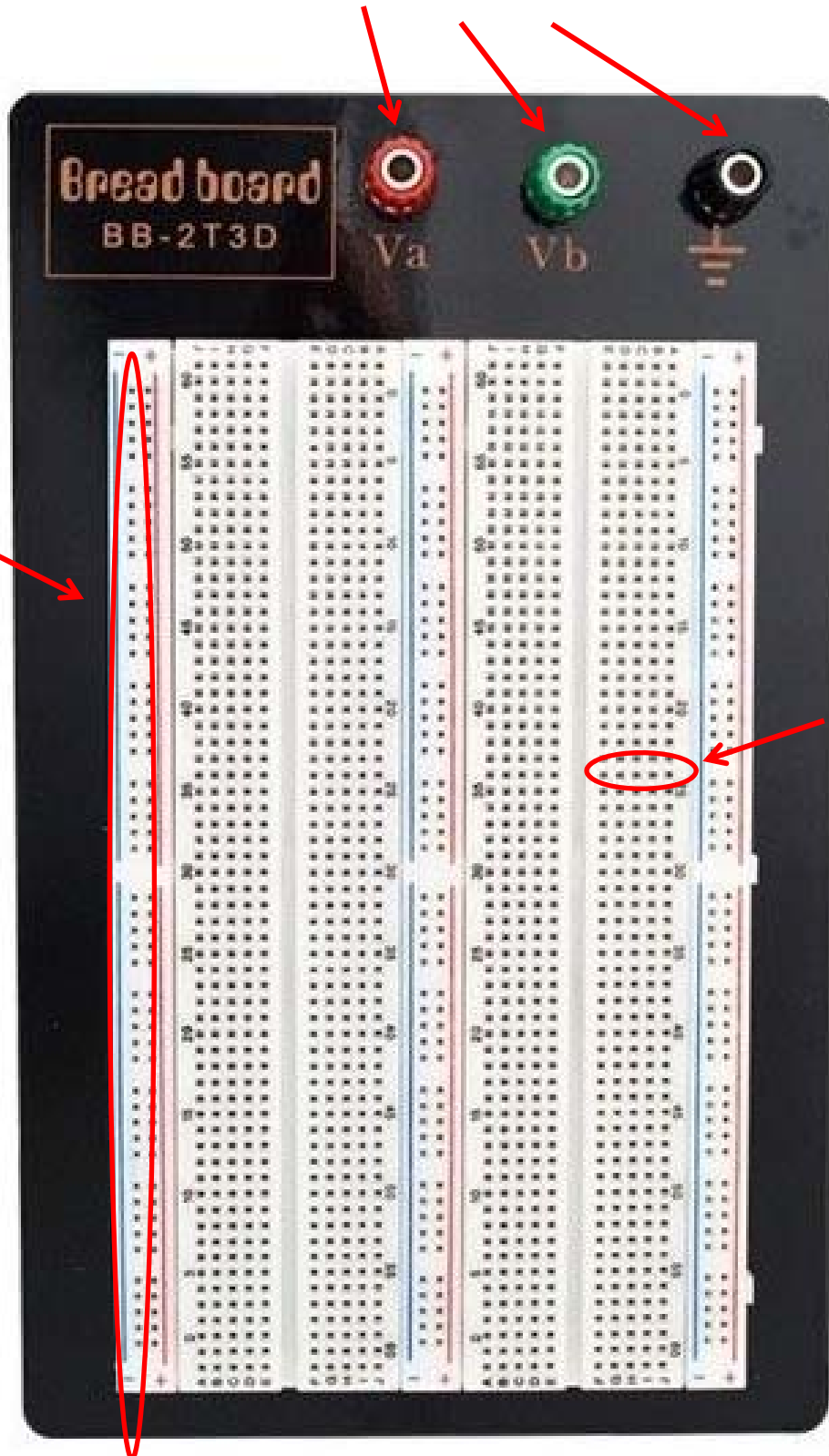
Wire Stripper 420190



In your lab kit you will find cables with various useful combinations of connectors

“Breadboard” or “Protoboard”

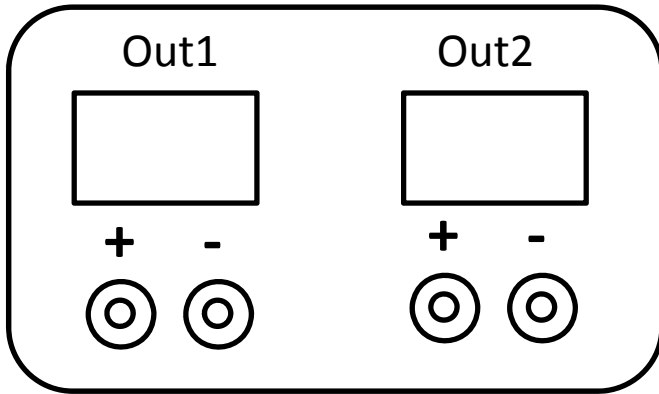
“Binding Posts” – not connected to anything, but easily connect to banana connector or bare wire (color coded)



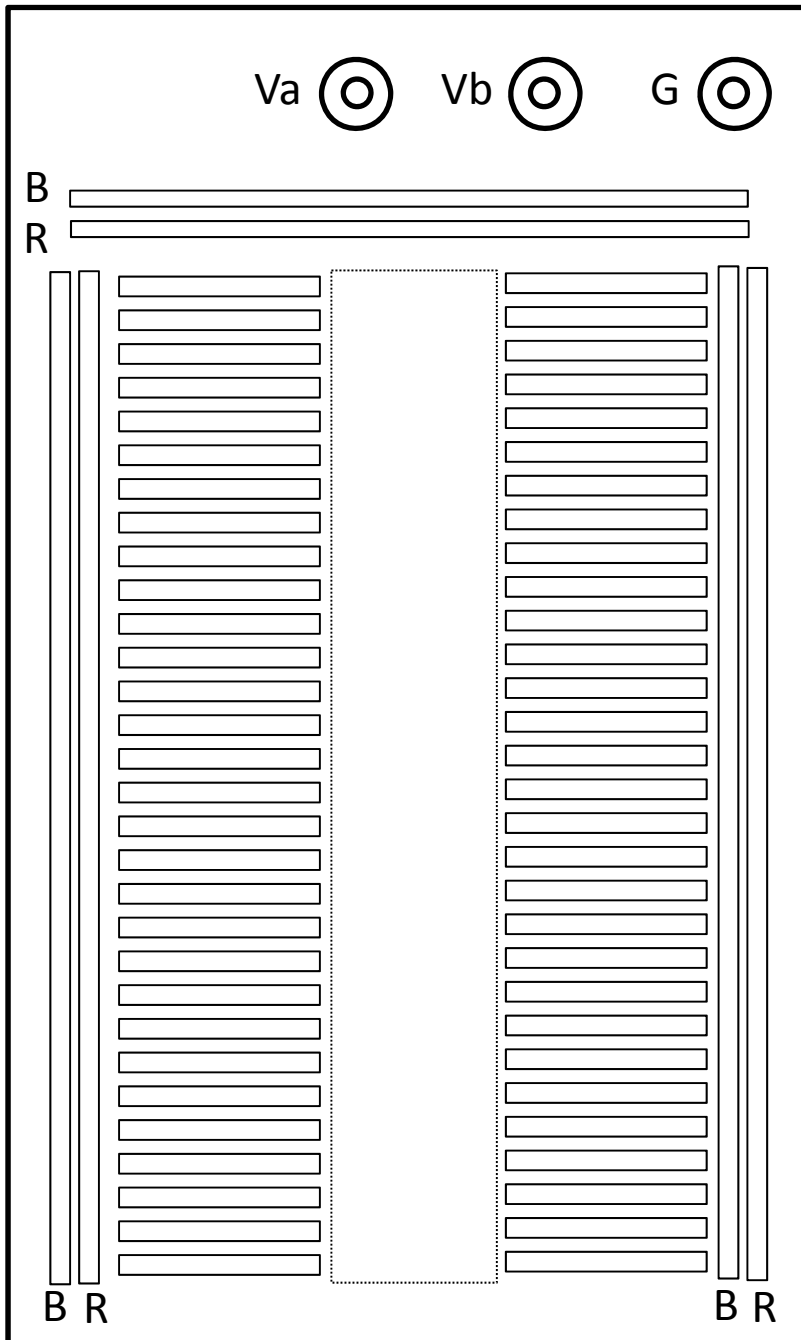
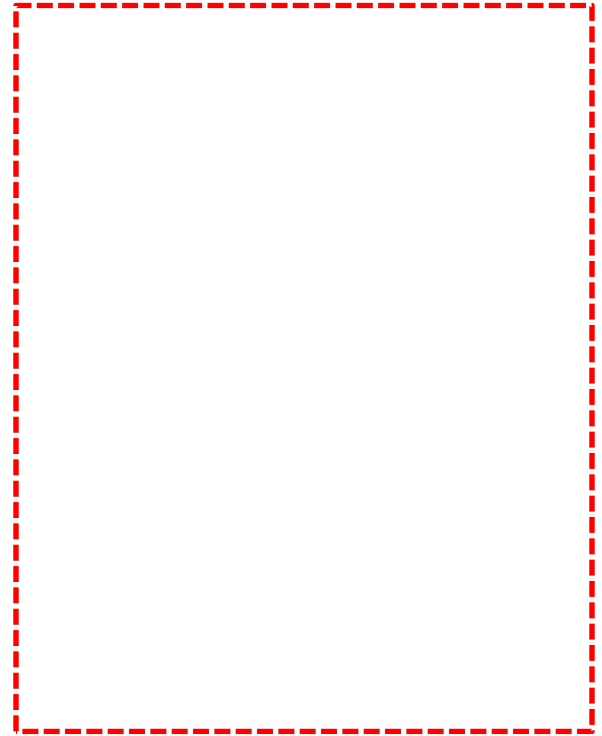
“Busses” – connected lengthwise

Connected horizontally (groups of 5)

Power Supply

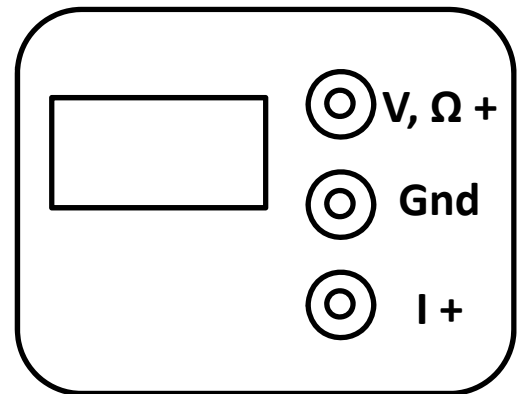


Circuit Diagram



Breadboard

Multi-meter



- Use colour coding!
- Keep wires as short as possible!
- Make sure wire connections are snug and tight!
- Strip $\sim 1/4$ inch of insulation from wire for breadboard connections; ~ 1 inch of insulation for binding post connections.

Circuit Troubleshooting Checklist

1) Check Your Protoboard and Circuit:

1A) Make sure your circuit is built correctly:

- In general you should build in steps, checking each one as you go (baby steps!) Are components connected correctly? Are the busses connected to the correct binding post? Do you have a complete circuit? Do you have any un-intended short circuits? Use your protoboard worksheet.

1B) Check Binding posts:

- Make sure binding posts are securely screwed into the protoboard (they should not be wobbly or loose).
- Make sure wires are snugly wrapped around the post with good electrical contact.
- Make sure the post screw is snug (finger tight) and not moving.

1C) Check Components:

- Make sure component pins are securely pushed into the protoboard in the right positions. Nothing should be loose.
- Check the orientation (direction) of diodes, LEDs, Transistors, op-amp chips
- Make sure DIP chips are correctly powered, with +Vcc and -Vcc supplies to the appropriate pins.

1D) Check Wires:

- Check your wires should be as short as possible to minimize interference. You should strip about 1/4 inch insulation from the end, which should be pushed snugly into the protoboard. *Good electrical connection is absolutely critical!*

2) Check Your Power Supply:

- Make sure the output is enabled ("on")
- Make sure banana cables are connected to the correct outputs (Supply 1, Supply2, Positive, Negative)

3) Check Your Digital Multimeter (If applicable):

- Make sure Banana connectors are connected to the right input positions. These are different when measuring current, voltage, resistance etc.
- Make sure the DMM is connected to the circuit correctly. When measuring *current*, the DMM should be in *series*. When measuring *voltage*, the DMM should be in *parallel*. When measuring *resistance*, you must unhook the component or you will be measuring the equivalent resistance of the whole circuit.
- Make sure you have the correct function selected (DC-V, DC-I, AC-V, AC-I etc.)

4) Check Your Oscilloscope (If applicable):

- Check that the BNC is connected to the right input channel.
 - Make sure that the other end of the cable is "probing" (i.e. connected to the circuit) correctly.
- Check your horizontal and vertical axes which are displayed on the screen. **Autoscale does not always work** and you may have to manually adjust these. For example, if you are looking for a 0.1 second signal, your time scale should be ~ 10 ms/division. If it is set to 1 μ s /division, you will miss it! Likewise, check your vertical axes. If you are looking for a 1V signal, your vertical axes should be ~200 mV / division. If it is set to 1 mV/division, you will miss it! -For AC signals it is often helpful to use the "AC Coupling" setting on the inverse to "find" your signal. This removes the DC offset, and lets you see your signal centered on 0V (vertical)

5) Check Your Function Generator (If applicable):

- Remember that the amplitude is actually Center-Peak, not Peak-to-Peak as displayed (refer to your notes).
- Check that the BNC is connected to the right output (there are 2, it should be the lower one).
- Make sure the output is enabled ("on")
- Make sure that you have the correct output function selected (type of wave, amplitude, frequency, DC offset etc.)

6) Use the DMM or Oscilloscope to Check Voltages and Signals in the Circuit at Various Points:

- If you still can't find the problem, you should use your DMM and/or the Oscilloscope to check various quantities in your circuit. This takes some practice and experience, but, poke around! Use a wire probe (connected to an alligator or hook clip) to test that the voltages are what you think they should be. You might think there should be +10V on the +Vcc pin, but are you sure? Check it with a probe. Are you sure the bus is at the right voltage? Are you sure that pin is grounded? Do you see a sinewave at the right frequency and amplitude where it should be? etc.