

A Quick Guide to Using Lab Equipment

A quick intro to

- Power supply
 - 1 and 2 for constant voltage/current (DC)
 - 3 and 4 for time-varying voltage / current (AC ??)
- Digital multimeter
- Function generator
- Oscilloscope

Also intro to

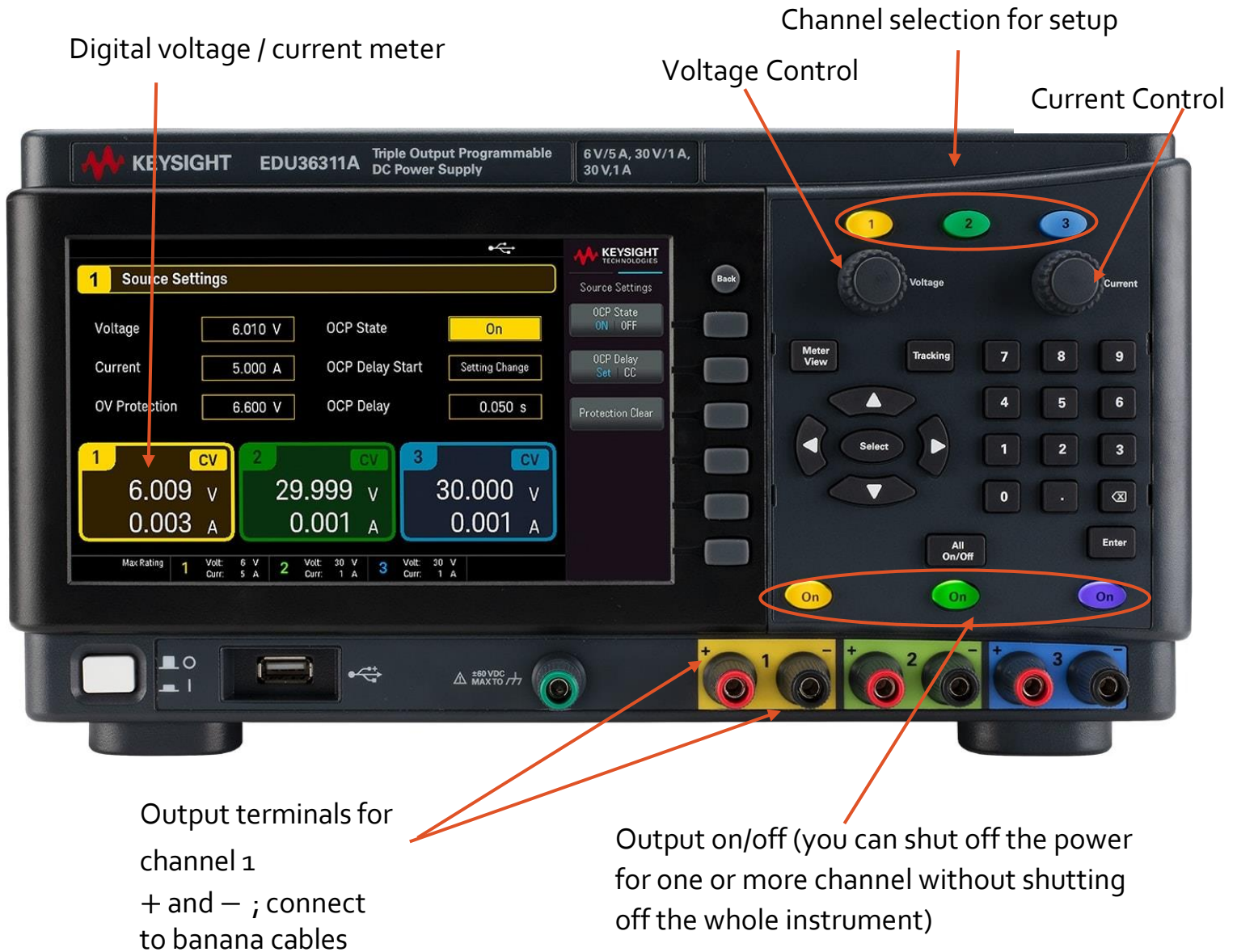
- protoboard, connectors, etc

Power Supply

Full Use Manual on Canvas

EDU36311A Smart Bench Essentials DC Power Supply

A triple-output power supply with a large display with a compact footprint enables you to view all channels simultaneously.



Digital Multi-meter

Full User Manual is on Canvas

EDU34450A Smart Bench Essentials Digital Multimeter

The EDU34450A is a bench DMM with dual-display 5.5-digit-resolution digital multimeter with up to 110 readings/s measuring rate for speed-critical tests

Measurement buttons, what do you want to measure? V-DC, V-AC, I-DC, I-AC Ω , etc.

DC voltage reading displayed.



V and Ω
+terminal

Low or
- terminal

Current
+terminal

Input terminals + and
- connect to banana cables.

Depends on what you are measuring – look at the symbols

Secondary display activated by pressing 'shift', then 2nd then softkey second measurement, secondary display showing AC voltage in the picture

Function Generator

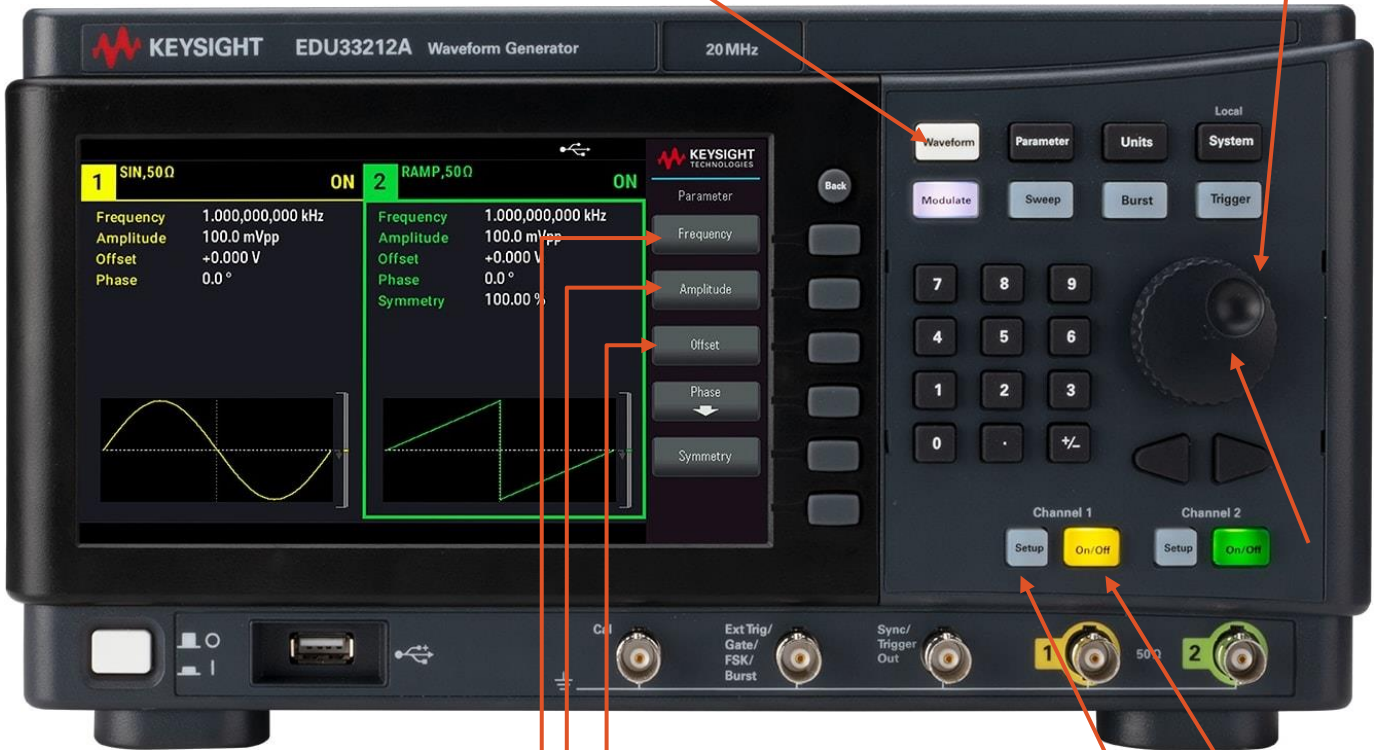
Full User Manual is on Canvas

EDU33212A Waveform Generator, 20 MHz, 2 Channel

The EDU33212A dual channel function / arbitrary waveform generator provides dual channel synchronized test output signals

Wave type selector buttons (sine, square, ramp, etc.)

Use the knob + Left Right arrow keys or keypad to modify the displayed parameter.



Push to modify waveform DC offset.

Push to modify waveform amplitude.

Push to modify waveform frequency.

On button Channel 1

Press setup before modifying channel parameters.



Output BNC connector.

Make sure you are on the right channel and the channel is turned on.

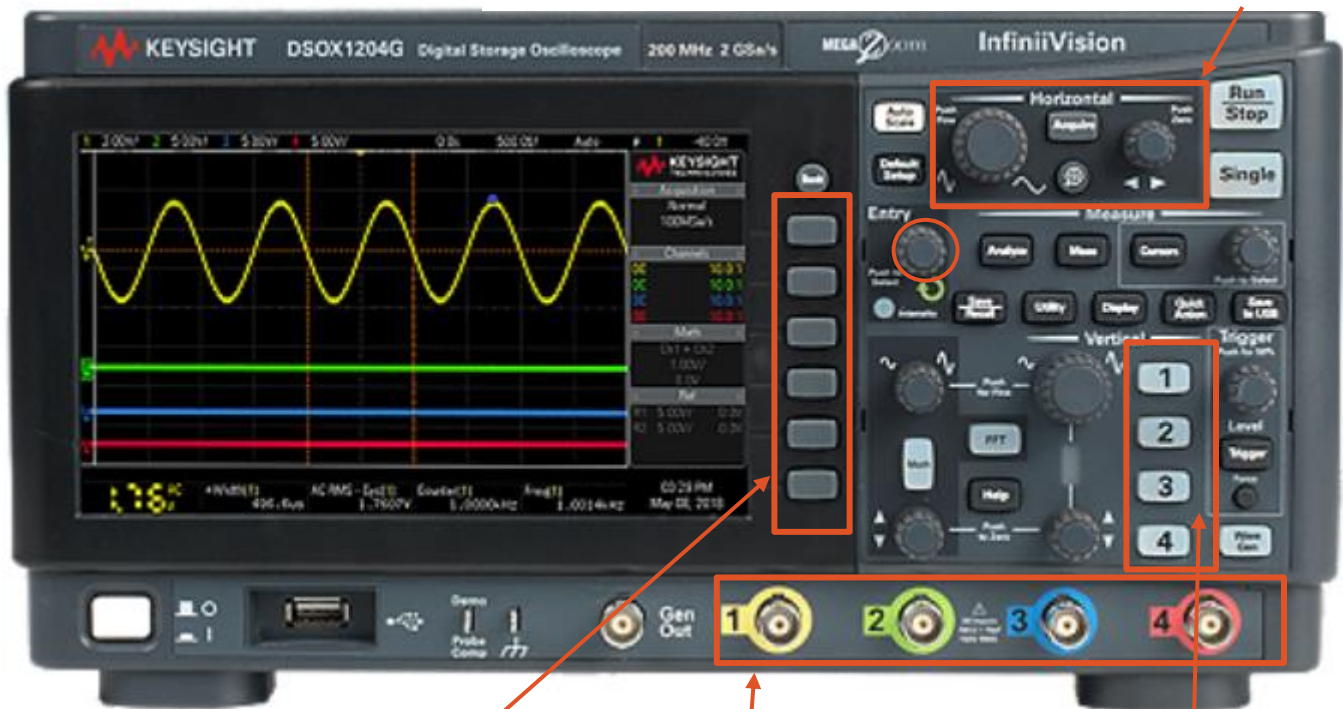
Use BNC-to- banana cables to hook to protoboard.

Oscilloscope

Full User Manual is on Canvas

Keysight Technologies DSOX1204G 200 MHz 4 channel digital oscilloscope

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 horizontal position.



“Softkeys” – change function

based on what is on the screen; use the knob to the right of the soft keys to modify an entry

Channel 1, 2, 3 and 4 BNC inputs, respectively

On buttons for Channel 1, 2, 3 and 4. Pressing a channel menu using the channel number brings up various softkey functions

Oscilloscope

Vertical axis scale – rotate the top knob to change the vertical scale, volts per division (from V to μV) of the selected channel. Allows you to zoom in or out of a signal. Select a channel by pressing the respective number. Use the lower knob to adjust the vertical position of the displayed waveform.

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



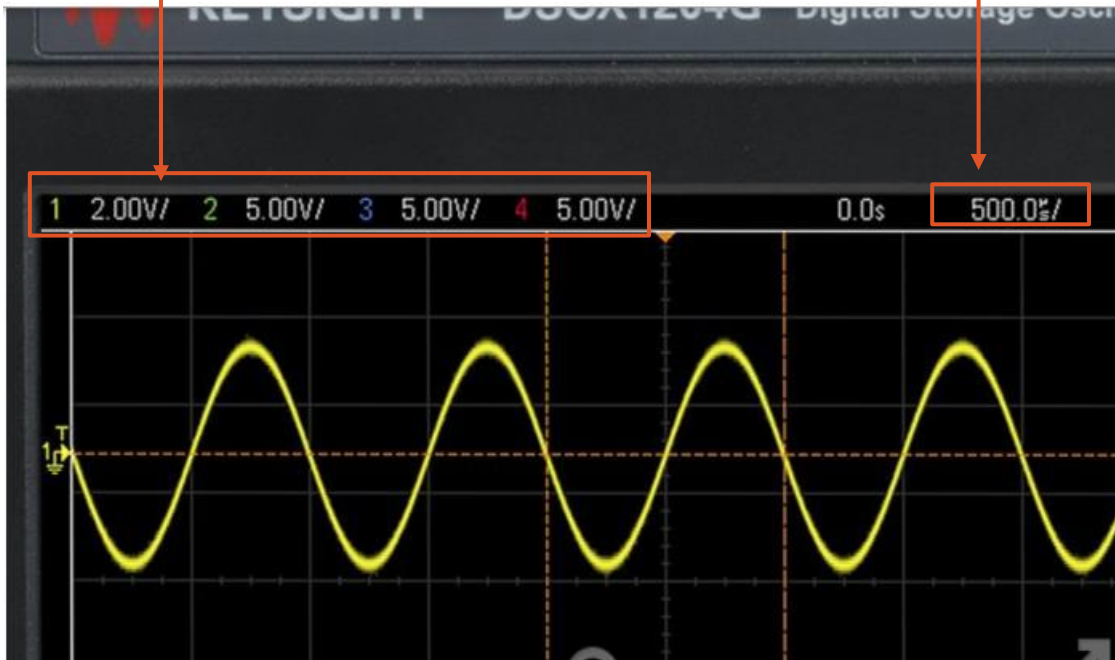
Measurements

Press the measure key to access 32 built-in automatic measurement such peak to peak, frequency, average, etc.

Cursors Custom measurements are easily accomplished by cursors. Measure any value or the difference using four powerful cursors

The vertical scale (Volt/division) is displayed for each channel separately,

The horizontal scale (Times/division) is displayed here.



Cables and connectors



Banana connector



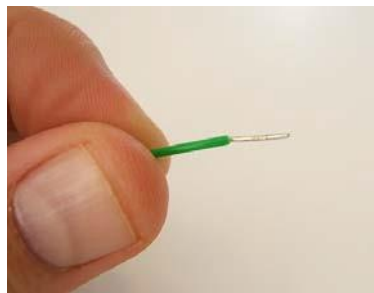
Alligator connector
(can grab a bare wire)



IC hook connector (can hook a bare wire)



BNC connector



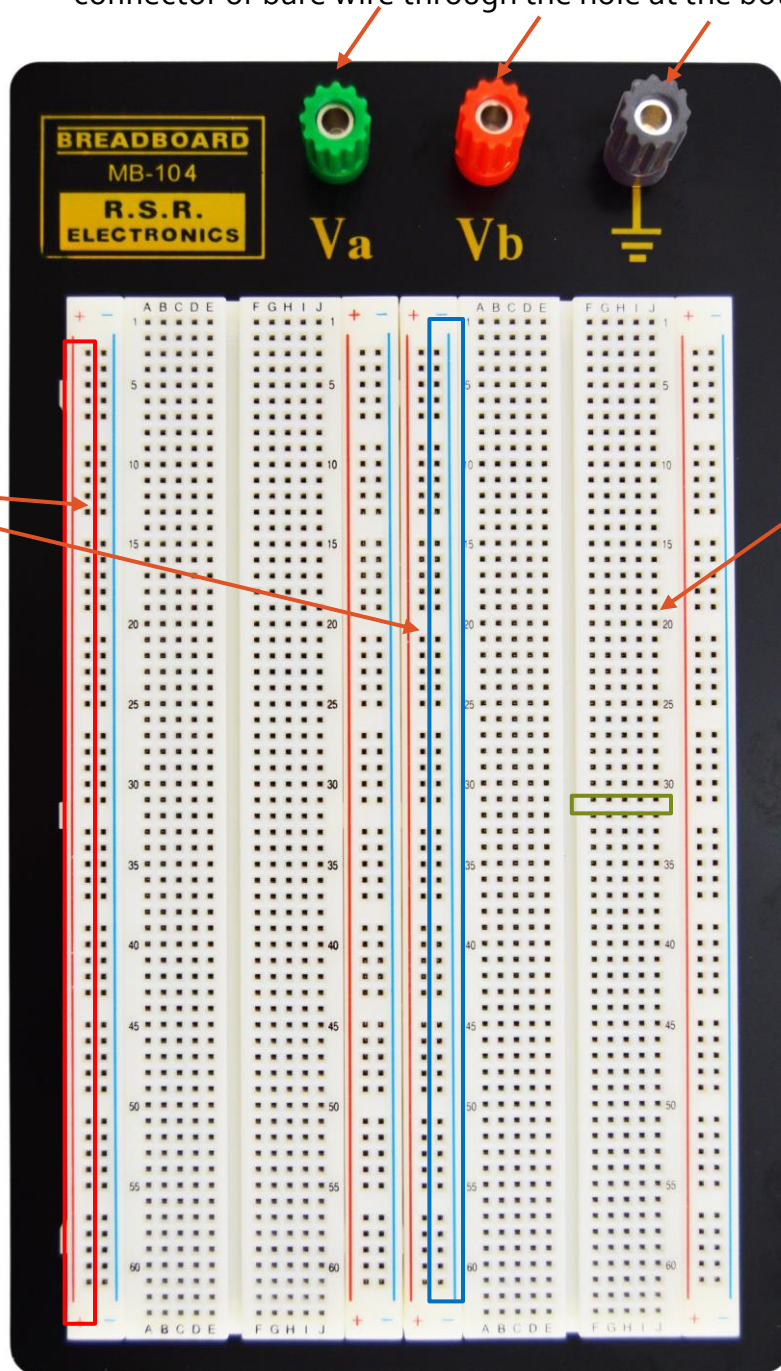
Bare wire / stripped wire



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 through the hole at the bottom. Also (color coded)

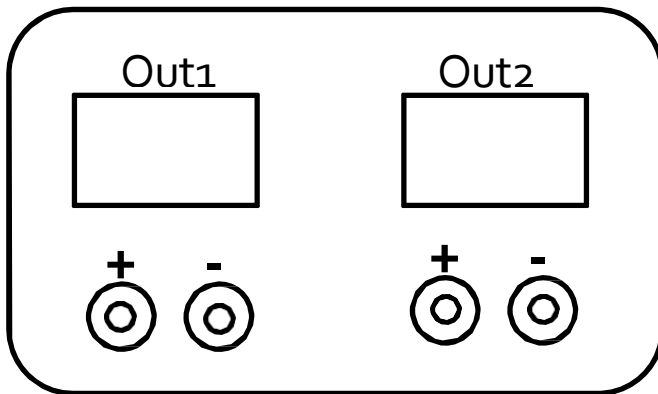


'Buses' connected length wise, all points along the same column are connected.

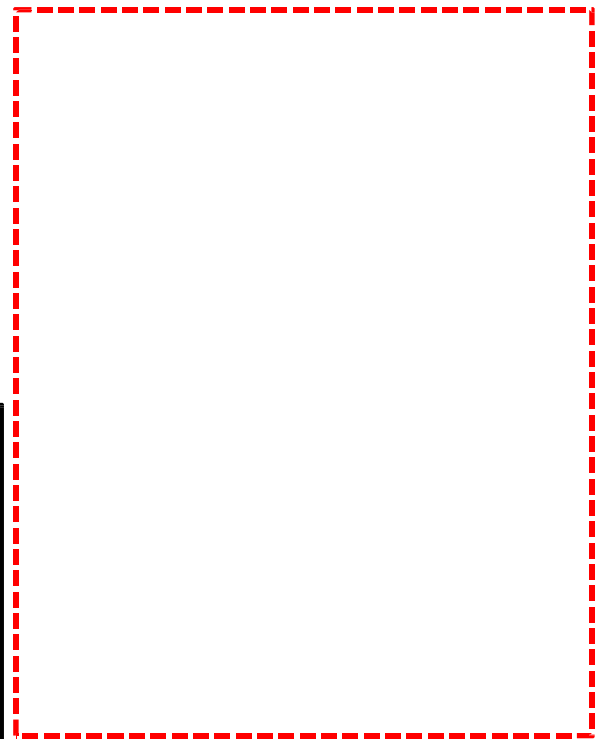


Connected horizontally (groups of 5)

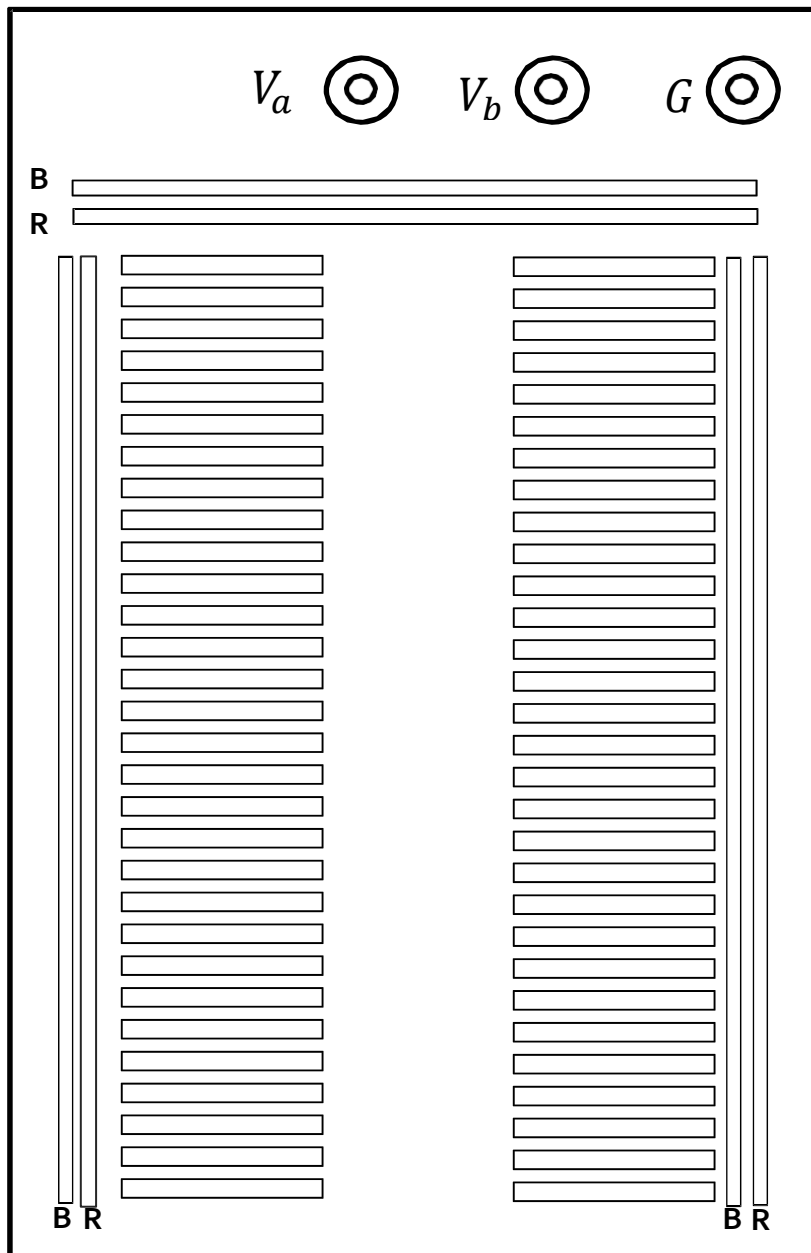
Power Supply



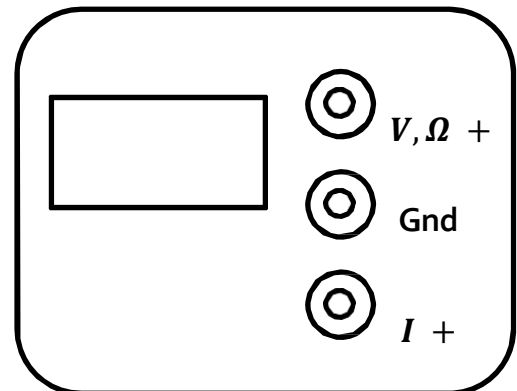
Circuit Diagram



Breadboard



Multi-meter



- Use color 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:

1. A 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 buses connected to the correct binding post? Do you have a complete circuit? Do you have any un-intended short circuits? Use your protoboard worksheet.

1. B 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.

1. C 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.

1. D 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 Center-Peak, not Peak-to-Peak as displayed (refer to your notes).
- Check that the BNC is connected to the right output (there are multiple outputs).
- 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.