Overview of Cables & Test Leads
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1. Banana to Banana Cable
2. Banana to Test Hook Cable
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4. Multimeter Leads
5. Oscilloscope Probe (With detachable Test Hook)
6. USB A to B cable

1. **Banana to Banana Cable** – This cable is used to connect the power supply (PS) to your prototyping board. Be sure all of your connections are completed before you turn on the PS. Also, if making circuit changes, be sure to turn off the PS. There are actually three separate supply sources in the one PS. Two of these are variable and one has a fixed voltage. They are numbered in reverse – the source on the right is #1 (master supply) and on the left #2 (slave power supply). The binding posts on the far right bottom are a 5 VDC source for TTL and CMOS circuits. The first two have variable voltage and current limiting switches. When placed in “series mode” for a dual power supply source, the negative half (relative to ground) is on the left, and the positive half on the right. The negative voltage value is slaved to the positive voltage setting (see below). The current setting controls should be no greater than a ¼ turn clockwise in order to limit current flow.

**Setup for a single supply:** Connect the red (positive), green (ground) and black (negative) cables to their respective color matched binding posts on PS #1 and the prototyping board. The PS is “floating” and not connected to earth ground (green) until you wire it as such.
Locate the #22 gauge insulated solid copper hookup wire in your project box (or dispenser). Loosen the red binding post (positive) and at the bottom fasten one end of a stripped piece of red wire. Connect the other end to one of the breadboard rails marked with red. Connect it to the black binding post with black wire and run to at least one of the rails marked with blue on the prototyping board. The blue rail also serves as a ground in your circuit (and may also be attached to the green binding post to eliminate noise). Cross jumper to other rails on the breadboard as needed.

Using the multimeter confirm that the correct voltage is present at the binding posts and individual rails. **Failure to power the rails is the most common reason circuits do not work when otherwise wired correctly.**

**Setup for a dual power supply:** If you are running a dual PS (e.g. plus and minus 12 volts), then you need to make the following changes. Notice the two push buttons between the supplies. Configure for a dual supply (instead of independent supplies) by pushing “in” the left hand button. This internally connects the negative side of the master PS with the positive side of the slave power supply – placing them in series (green arrow below). The center point is obtained off either of these jacks. Connect the red cable to the master positive post, and the black cable to the slave PS negative post. The voltage on the slave follows your setting on the master supply.

To bring the center to earth ground, connect a small jumper cable (any color) from either the unused positive or negative post to “GND” as shown (either “GND” is fine). Confirm with your multimeter that you have a plus voltage between the red and green, and a negative voltage between the green and black. If you measure between the red and black, you should have the sum of the settings on the two PS.

With a dual PS note that the blue rail on the prototyping board will now be negative relative to earth ground. You will need use a different rail to bring your actual circuit ground con-
connections together. This is easily done by designating a different blue rail as ground, and connecting it only to the green binding post. (It helps to label this rail.)

**Caution:** Do not connect earth ground (green) directly to the outer plus or minus sides of the dual supply output or you will short the respective power supply. You will need to double check that you have isolated the ground from the negative side of the dual power supply on your prototyping board. When done, be sure to reconfigure the switches as independent supplies for the next user.

**Setup for the Dedicated 5 VDC Supply:** When running TTL or CMOS digital circuits it is convenient to have a non-variable supply. **Careful though – there is no current limiting control.** You may instead use either of the other power supplies, just remembering to keep the voltage at 5 VDC.

2. **Banana to Test Hook Cable** – This cable allows you to connect the PS to a circuit directly, without using the prototype board binding posts. Follow the same instructions above. **Note these are relatively low current carrying leads.**
3. BNC to Test Hook Cable – This cable connects to the function generator (use signal output one) and to your circuit directly. Make sure everything is connected properly before turning on the function generator. The black lead should go to ground.

Caution: When using the function generator as a low current AC power source to study a bridge rectifier and/or other DC regulator, make sure you do not have the triple PS connected to your circuit!

4. Multimeter Leads – The multimeter can be used for measuring AC and DC voltages, resistance, continuity and current. For all readings except current, the red lead should be connected on the right hand side (as shown on the left below). Current readings are taken with the red lead on the left hand side of the meter (as shown on the right below).
Caution: When taking a current reading you place the leads in series in your circuit. Be sure to judge correctly the amount of current that will flow through the meter, and select the appropriate range. To be safe, always use the “A” (amp) setting. (The decimal place may be different than you expect if you use the mA range.) Always return the red lead to the right hand side (voltage) when done.

5. Oscilloscope Probe (With detachable Test Hook) – The probe is used to measure signals in your circuit. Be sure to connect the black alligator clip to a ground lead – e.g. a little green wire from your prototyping board. Note that the probe may read either 1x or 10x (actual circuit voltage divided by ten) based on a setting you make with the oscilloscope menu.

6. USB A to B cable – This cable is used to connect the Arduino microcontroller to your computer. It provides both power and data. When connected, do not connect the external power supply (AC adaptor) to the Arduino. You will use this cable later in the semester.