

## How to build Circuits on Protoboards – some useful Hints

1. Before you start constructing your circuit, make sure you have a clear schematic of your circuit in front of you.
2. While constructing your circuit, make sure you use the same color wire for equal type interconnects (e.g. red for pos. supply, black for ground, blue for neg. supply, etc.) and keep the wires short (wires acts as antennas and pick up unwanted signals).
3. When using active elements (Opamps and transistors), make sure you check magnitude and polarity of the supply voltages (with a volt meter) both at the power supply terminals and at the pins of the active elements.
4. To keep your supply rails clean, connect a 10  $\mu\text{F}$  (electrolytic) capacitor between the plus supply and ground. If your circuit also features a negative supply, do the same between the negative supply and ground. In either case, make sure you have observed the polarity of the capacitor (the pin marked with the stripe must be connected to the lower potential).
5. Before you use a probe, make sure it works correctly by displaying a known signal (from the signal generator) on the scope (check both signal shape and signal amplitude).
6. Before you actually test your circuit, make sure you have run a few computer simulations so that you know what to expect. Always start by running a dc analysis first. The dc analysis computes all dc node voltages of your circuit. Subsequently, you typically perform an ac and/or a transient analysis depending on the nature of your circuit.
7. If your breadboard circuit does not work, you need to debug it (this happens more often than you like). You can save a lot of time if you go about this task very systematically. To do so, have the circuit schematic in front of you and begin by checking type, value and position of all your circuitry elements. Next, measure all dc node voltages of your circuit (keep the dc supply engaged and short the signal input to ground). In most cases, these 2 steps reveal the problem (e.g. wrong element values, flipped footprints, faulty wiring, etc.)
8. If your debugging procedure does not reveal the problem, ask the TA or the lab instructor for help.