

**University of Portland**  
**Donald P. Shiley School of Engineering**

**EE371**  
**Electronics Laboratory**  
**LAB HINTS**

**PURPOSE:** Construction and debugging of analog circuits demands a certain amount of *finesse* in the lab. The purpose of this Lab Hints Handout is to alert you to some “easy-to-do-hints” and some good lab habits and practices that you can do in the lab and with your lab kit to avoid the “pitfalls” of analog circuit layout, test and debug.

**HINTS:**

- 1) Do not attempt to build a circuit in your lab kit until you have a good understanding of what you are doing theoretically. It is much easier to debug a circuit which you thoroughly understand.
- 2) When building your circuit in your lab kit, think small and ***Manhattan*** ! Keep your wiring flat with no loops. A neat, compact and Manhattan-style layout in your lab kit is less prone to parasitic effects and is much easier to debug. Keep your lead lengths as small as possible to avoid “antenna-effects”.
- 3) Always perform DC analysis, measurement and debug **FIRST** before moving on to AC analysis and measurements. Note that your entire circuit layout and DC analysis and testing can be done at home away from the lab. This will allow you to focus your valuable lab time on the more complex AC measurements.
- 4) Never make DC or AC current measurements nor AC voltage measurements using your DMM. Instead: 1) Use your oscilloscope to measure AC voltages, 2) Use your oscilloscope to measure AC currents by measuring the AC voltage across a known series resistor and then use Ohm’s Law, 3) Use your DMM to measure DC currents by measuring the DC voltage across a known series resistor and then use Ohm’s Law.
- 5) In order to make *differential* measurements between internal nodes in your circuit with your oscilloscope, you need to make two separate, dual-trace *single-ended* measurements with respect to Ground and then *subtract* the two measurements using the scope’s Math function.
- 6) To avoid high frequency oscillations, do not locate your output node near your input node on your circuit layout. Keep your output and input nodes as far apart as possible.
- 7) Avoid “draping” scope probes and DMM probes across your layout in a “willy-nilly” fashion. This can cause unwanted noise due to inductive pick-up and feedback between internal nodes and between the output and input nodes.
- 8) Use 10X scope probes only. Avoid 1X scope probes. 10X scope probes are much better since they load your circuit with a hefty 10M $\Omega$  and a negligible 6.7pF. Whereas, 1X scope probes will load your circuit adversely with a “wimpy” 1M $\Omega$  and a large 67pF.
- 9) Before beginning AC measurements with your scope, remember to calibrate/compensate each of your two 10X scope probes using the built-in calibration square-wave output on

your bench-top oscilloscope and then adjusting the small screw at the end of each of your 10X probes.

- 10) As mentioned in class, please use a 10-to-1 attenuator circuit at your circuit input if you are required to input a very small AC signal input. This will allow you to use a nice high amplitude AC signal from your bench-top signal generator which is easy to create and then you simply attenuate it down at your circuit input.
- 11) When debugging, experience indicates that 90% of all circuit malfunctions are due to simple human error and can be traced to very simple causes. Wiring errors, incorrect component values and loose connections cause most problems. Performing good layout techniques and then checking DC bias points within your circuit are very effective debugging techniques. Nothing beats good layout and full DC testing of your circuit when debugging !! Be patient, careful, neat, systematic, precise and methodical when laying out your circuit in your lab kit and then debugging your circuit.
- 12) Finally, take good care of your lab kit. Keep both your lab kit and your lab bench area in Shiley Hall 309 neat and clean. Always clean-up after yourself. Be organized !!