ECE348 Circuit Debugging Tips

These guidelines may be useful to you if your circuits are not working as planned:

Check the Microcontroller Control Register Settings

Sometimes you have to configure multiple control settings before you can enable a pin for a particular purpose (input, output, A/D conversion, etc). Section 2.3.2 of the MCU datasheet describes the control registers related to various ports. Sometimes you may have to look in other parts of the datasheet (for example, the A/D section) for more details on enabling / setting a particular peripheral.

Check Your IDE Settings

- Verify that the file you are editing is the same one the compiler is set to compile and the debugger/serial monitor is set to load to the correct target. This can be a problem if you have multiple targets or multiple projects open.

Check Your Debugger

- Remember that you have to press the Green Arrow / F5 / Run > Start command in the debugger before the program you've loaded will begin executing.

Point-to-point Wiring Check

Wiring mistakes are easy to make. If possible, have someone other than the person who wired the circuit check it for mistakes. This procedure will give you a methodical way to check the wiring. This method is more reliable than tracing wires, especially if there are a lot of overlapping wires on your board, or many that are the same color.

- Start with a schematic of your circuit. If you don't have a circuit, draw one out. No circuit is "too simple" to need a schematic. If the circuit is simple, the schematic should be easy to draw.
- Verify each connection on the circuit using the multimeter. Some multimeters have a continuity checker which will ring when a low-resistance connection is made. Even if your multimeter doesn't have this feature, set it for the lowest resistance setting. If you read 0 (or very low number of ohms) between the test leads, they are wired together.
- Use a highlighter to mark each connection on the schematic as your verify it.
- When you check connections to ICs, put your test lead on the pin of the IC, not another wire in the breadboard. Double check that you are counting the pins correctly. Double check that you are using the right IC.
- Check all connections, even the power/ground connections.
- Check continuity between data pins and power and ground to ensure that you did not accidentally connect something to ground/Vcc.

Once you have finished checking all connections, you should have a reasonable assurance that your connections are correct. If in doubt, have someone else repeat the point-to-point connection. Use a new copy of the schematic or a different color highlighter.

Check Physical Inputs / Outputs

If your program is not setting outputs or reading inputs, verify that the voltage on the physical pin is correct.

- If you are writing data to a certain output port, use the debugger to step through to just past the instruction which sets to the output value.
- Use a multimeter to measure the voltage between the output pin on the MCU and ground and verify that it is the value you expect. You can also check this value at multiple points (for example, check the pin on the standalone module, and check it at the input of the device it is wired to).
- If you are interfacing to an IC that has control and data lines, verify that all the inputs are set according to the datasheet. Beware: some ICs have multiple enable pins that must be set to a certain value.
- You can perform similar checks for inputs. Measure the value at the input pin just before or just after the port is read in the debugger.

Take a Break

- If you've been debugging for a long time and can't find the problem, take a break. It's very difficult to find a problem if you are frustrated and convinced that "you've already tried everything". Spend some time thinking about something else and come back later. You'll often find the problem quickly when you approach the problem from a fresh perspective.

Check your Documentation

Not often, but occasionally, the datasheet / documentation can have a mistake. This is relatively rare, and if we are aware of an error, we will make you aware of it. Here are some tips:

- Double check that you have the right datasheet. You may need to look for an updated version.
- Look for consistency errors in the datasheet. For example, if the device pinout is listed in two different places, check to make sure the suspect pins are labeled the same in both places.
- Make sure you understand what the pin labels mean. Sometimes multiple names may be used to refer to the same pin. Occasionally, the same name will mean different things on different ICs.

Usually, the problem is somewhere other than the datasheet. If you've tried *EVERYTHING ELSE* and you are convinced there is an error in the documentation, notify a TA. If you are notifying us by email, please be specific about the problem and attach a copy of the datasheet to the email.