EE 193 Homework 3

1) Background research

Look through the datasheet and/or technical reference manual for your part.

Make a table showing the power modes that your chip has, and the approximate power consumption in each mode. Note that if your numbers are coming from the *chip* documentation, they probably ignore the module and board-level information.

2) Board-level power consumption

Measure the power consumption of your entire board for the following conditions:

- While toggling a single pin at 1kHz (i.e., doing something, but not much). Don't attach anything to the pin that would substantially change your current consumption!
- Printing output to the host computer via serial (aka UART over USB) at 115200 baud
- While continuously sampling the ADC

3) Sub-module power consumption

Figure out how much power is being consumed by the following components:

- Power regulator
- USB-serial chip (SiLabs CP2102 or similar)
- Pullup resistors and indicator LEDs

A few hints:

- Schematics for the boards are available online from Epsressif / Seeed.
- Don't be afraid to look up the datasheets for these parts to get an estimate before you start trying to measure stuff.
- There's no good way to directly measure the current through the pullup resistors, but it's easy to calculate!
- You can easily bypass the 3.3V regulator by tapping directly into the 3V3 pin on the development board (if it has one).
- The power consumed by the USB-serial chip probably depends on whether it is transmitting data or not, so be sure to test both of these conditions.

4) Power modes

Measure the power consumption of the chip/module in at least two low-power modes.

A few hints:

- It may not be practical to measure the power consumption of the module by itself; in this case at least measure the power of the board minus the big power hogs (the regulator and USB-serial).
- A 1 ohm shunt resistor works well when the current is a few dozen milliamps, but you'll need a much larger one to measure currents in the microamp range. However, you can't use a large shunt while the board is on. You'll probably need to put a high-resistance shunt in parallel with a low-resistance one, and then remove the low-resistance one after the board goes into its low-power state.
- You can't program the board when it's in a low-power state, so make sure that your code waits a few seconds before going to sleep. That way, you can reset the board and reprogram it while it's still awake.

What to turn in

Your writeup should begin with a summary of your results, as a table or chart.

The remainder of your writeup should be a detailed description of your experimental setup(s) and any factors that might affect your measurements. This may include what shunt resistors you used, what multimeter/scope you measured with, what the supply voltage was, what code was running, where you measured, any hardware modifications you made, etc. If you've done a good job, someone should be able to replicate your setup and get the same results. (If you have any doubts about whether someone could replicate it, give your writeup to a classmate and ask them to try!)

You are more than welcome to collaborate with others on this assignment. Specifically, you may:

- Share any hardware you've modified (e.g., USB cables you've cut up or development boards that you've soldered extra probe wires onto)
- Share code you used to set up low-power/sleep modes

However, each person should:

- Build/flash/run the code on their development board using their own computer
- Record their own power measurements