

# Team project 1 - power consumption

## 1) Background research

Look through the ESP32-C3 datasheet and technical reference manual.

Make a table showing the power modes that the 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

Using the Joulescope, measure the power consumption of your entire board for the following conditions:

- While toggling a single pin at 50Hz (i.e., doing something, but not much). Don't attach anything to the pin that would substantially change your current consumption!
- When WiFi is turned on, but not connected to a network (you might need to set a breakpoint or modify the code to do this)
- When WiFi is connected to a network

## 3) Sub-module power consumption

Using some combination of the Joulescope, oscilloscope, multimeter, and your collective wits, figure out how much power is being consumed by the following components:

- Power regulator
- Reverse voltage protection diode
- USB-serial chip (SiLabs CP2102 or similar)
- Pullup resistors
- Power indicator LED
- The power consumed by each of the temperature ICs your team has.

You can use the pin toggle code from the section above as your baseline application.

A few hints:

- Schematics for the boards are available online from Espressif (<https://docs.espressif.com/projects/esp-idf/en/latest/esp32c3/hw-reference/esp32c3/user-guide-devkitc-02.html>)
- 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).
- 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 team should submit a single writeup. This should begin with a summary of your results, presented as one or more tables or charts.

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!)