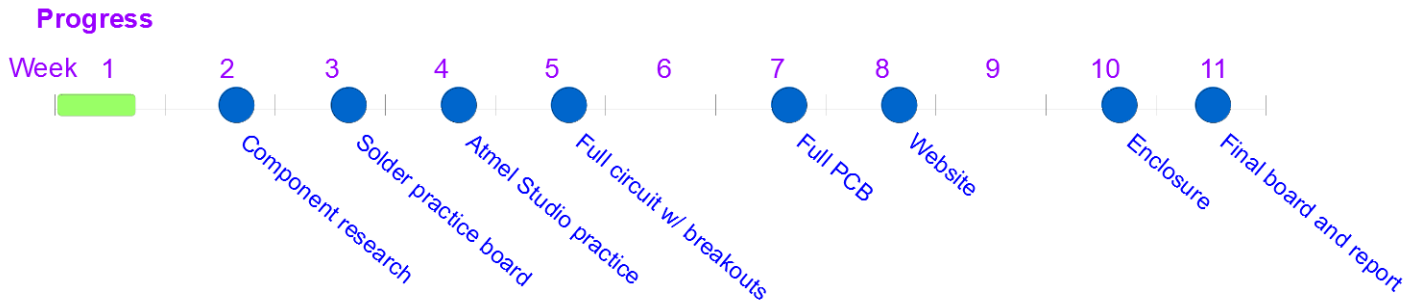


# EE 326: Electronic System Design 1

## Task 1: Component Research

Due: Jan 16, 2025



**Please complete this assignment individually and submit your work on Canvas. For any question that contains ambiguity, please write down reasonable assumptions.**

1. Find your group mate. When you have your team ready, please sign up for a group here by finding the first empty group and registering both members. If you don't know people in the class, please register for a group as a solo member. If you are looking for a partner, please find a group with one member and join it. If you have a group but no groups are empty, please let me know and I will combine some one-person groups.
2. Install the following software:
  - Microchip Studio
    - <https://www.microchip.com/en-us/development-tools-tools-and-software/microchip-studio-for-avr-and-sam-devices>
  - J-Link Software and Documentation Pack
    - <https://www.segger.com/downloads/jlink#J-LinkSoftwareAndDocumentationPack>
  - Eagle PCB
    - <https://www.autodesk.com/products/eagle/free-download>
3. For each of the three main components (SAM4S8B (64LQFP package), ESP32 (WROOM-32E module), OV2640), look in their datasheets and find their recommended operating voltage limits. Write these down. What is the minimum number of voltage levels necessary to power all three components?
4. Based on the datasheet for the MCU, find an appropriate 12MHz crystal oscillator. Include the part number and source (e.g. Digikey, Mouser).
5. Our system will get power from a 5V power supply. Based on the datasheets, what is the minimum number of standalone voltage regulators that we will need to purchase? (*Hint: look at the Atmel-42155-SAM-AT03463-4S\_schematic\_checklist\_Application-Notes document.*)
6. Based on the datasheets (i.e. power requirements of all the components), find suitable voltage regulators and write down the relevant specs (i.e. voltage supplied, how much current it can source). Include part numbers and sources. *Hint: find specifications for the worst case.*
7. Based on just these 5 components (from problems 3, 4, and 6):
  - (a) What would the system cost if you were to produce 1 unit?
  - (b) What would a single unit cost if you were to produce 5000 units?

8. Suppose you have a 500 mAh battery. For these calculations, ignore everything but the 3 main components (listed in problem 3).
- (a) If the system were constantly awake, taking photos, and acting as a server (and constantly transmitting data), how many hours would the battery last?
  - (b) If the system were in the lowest power sleep mode (not powered off), how many hours would the battery last?
  - (c) If the system were in the lowest power sleep mode (not powered off), but woke up to full power for 5 seconds every minute, how many hours would the battery last?

## FAQ

*Q. Microchip Studio is only supported for Windows platforms. What should I do if I don't have Windows? Is there an alternative?*

A. Microchip Studio is more than just an IDE for C. It also includes the ASF (Advanced Software Framework), which is essential for our projects, along with built-in proper linking. My top suggestion is to use a virtual machine or a dual boot. The other option is to use a different integrated development environment, download the ASF as a standalone library, and to perform the linking manually. I would not recommend this option if at all possible to avoid.

*Q. I have an older version of Microchip Studio (formerly Atmel Studio) / J-Link / Eagle. Which version should I use?*

A. Update to the newest version of the software. Updating ensures that any help the instructor or TA provides will be compatible with your software.

*Q. Can I use other sources than Digikey?*

A. Yes, of course! Part of the research before building a project is finding the best sources.

*Q. What parameters are important for an appropriate 12MHz crystal oscillator?*

A. There is potentially too much (and confusing) information in the datasheet about the crystal oscillator. For this assignment, assume you want a load capacitance of 18pF, and don't worry about the other parameters.

*Q. What is the difference between oscillators and crystals? Which should I use?*

A. A crystal is a passive (i.e. no power inputs), 2-lead device that needs other circuitry to get it to vibrate at its resonant frequency, thus creating a clock signal. An oscillator is an active (i.e. has power and ground as inputs), 4-lead device that creates a clock signal on its own and outputs a square wave. Most MCUs can take either one, but crystals are preferred because they are typically cheaper and smaller. For this homework, use crystals since the other circuitry will be provided by our MCU.

*Q. Does the voltage regulator's sourced current need to be precise?*

A. No, the regulators chosen must provide at least the required current but can provide more.