Steps for our project

1. Understand physical circuit characteristics
2. Get a simulation of the buck converter circuit using state space equations
3. Get simulation to be more accurate by adjusting values of ESR and C
4. Implement real-world construction of comparator to predict circut failure
5. Analyze results to identify accuracy and ability to replicate process

* Compare Ideal and measured - figure out certain circuit conditions (C, L) and consider whether they have failed
  + What are the assumptions of ESR failing
  + Capacitance drop
* Use machine learning to train an ideal and measured waveform to determine how close we are to the failing condition

Week 10/24/2023

Goal: Get the entire shape of the waveform and not just the peak which can then be transmitted by ADC to format we need.

Operating range: 10kHz - 500kHz between 10 and 100 times

Multiple samples in that period

1. Research how an oscilliscope is built (yes)
2. Research if parallel ADCs exist (very briefly look at)
   1. Pipelined ADC - popular ADC architecture for sampling rates from a few mega samples per second (Msps) up to 100Msps+
   2. The highest sampling rates (a few hundred Msps or higher) are still obtained using flash ADCs
   3. Oversampling sigma/delta ADCs
3. Examine ADC from old project to determine if it can be utilized and C-2000 (yes)
4. Research slow sampling multiperiod sampling (yes)
   1. Noise could be an issue
   2. Scalability check
5. Research how we can do data collection with FPGA and issues (oprion but not ideal)
   1. Memory - will it be an issue
   2. Offloading how will we get that to work
   3. Sample rate - confirm that it will work with data sheet
   4. We will need to reduce voltage not to destroy it
6. Look at digikey (yes)
7. Research our fall back: High pass filter -> peak detector -> raspberry pi
   1. This works for our circuit, and deals with our sampling rate issue but will not be scalable
   2. Research how to just use peak detector (get rid of DC offset) but still get delta by measure (yes)

Things that need to be calculated/examined:

* Check nyquist minimum sample rate
* Communication of sampling could be too slow on the back end as well
* RESOULUTION needed
* Circuit is up to 500 kHz-10kHz

Things we need to specify in our paper the following things accounted for / assumptions

* Temperature (sampling approach throughout the day to see if similar between days)
* humidity (yes, consider)
* Air pressure - assume normal pressure
* Radiation - not in outer space
* Vibrations - believe negligible
* Assume enclosed and sheilded

ADC options

* Pipelined ADC - popular ADC architecture for sampling rates from a few mega samples per second (Msps) up to 100Msps+
  + Data latency is a part of it, but I don’t think that would be an issue for us
  + Lower power consumption than flash, but ultimately flash will be faster
* The highest sampling rates (a few hundred Msps or higher) are still obtained using flash ADCs
* Oversampling sigma/delta ADCs - great for high resolution and high accuracy keeping noise from impacting too much. Very slow sampling rate.
  + Often used for industrial applications and in some oscilloscopes and data acquisition systems
* Typically it seems like microcontrollers use SAR (successive approximation register ADCs)
  + These will typically be too slow for us, so we can completely get rid of this type of ADC

10/25/2023

* Kit DSO138 - 1MS/s oscilloscope
* 50$ amazon oscilloscope
* Oscilliscope Hackaday <https://hackaday.com/tag/diy-oscilloscope/>
* ADC08100 - this was the ADC Ethan originally found that we would need a prototype
  + 200$ something ADC08200EVM (email TI-University and see if we can get it for free) - [Alecea Grosjean](mailto:grosjeab@miamioh.edu)
  + <https://www.ti.com/tool/ADC08200EVM#description>
  + <https://university.ti.com/en/students/design-inspiration>
* Jimmy’s/Ethan’s solution - early solution #1
  + Breadboard highpass and peak detector
  + DC offset issue - measure before highpass filter and move the results based off of that (Average this)
  + Peak detector - low voltage
  + Simulate with LTSpice - Ethan
  + Make note to include explanations of the importance of shape and delta of ripple voltage for report
* Simulation in C++ / Waveform - Alecea
* Using arduino as a peak detector by programming it - Alecea
* Report / PPT - Alecea

11/1/2023

* Prove that our concept makes sense
* Parts that we need to order:
  + 0.1 picofarad polarized capacitor
  + NMOS
  + Check electronic cookbook for peak detector circuit
  + Higher roll off frequency (~1MHz) op-amp (rail to rail)-> envelope
    - Try with lower frequency
    - Bipolar ps, high cutoff and bw opamp - > quick result
    - Changes in type of cap change delta size, which can make it harder to detect
    - Hackaday oscilloscope
* Alecea
  + Report
  + Oscilloscope Hack-day
  + Reminder: delta is ultimately just peak to peak value, shape is an actual representation of the complete wave
  + Look @ cookbook smthn
* Jimmy
  + Statistical random sampling
* [Ethan Barnes](mailto:barnese6@miamioh.edu)
  + Work on the Op-amp solution

11/8/2023

* Discuss using ADC -> FPGA to get the shape
* Oscilloscope project
* Classification problem
  + Digital twin comparison
  + Go to statistical comparison focus
* Shape why? How?

11/15/2023

* Plan to meet in ECE 168 on 11/29 for a practice run of our presentation
  + Send PPT before then
  + Add slide numbers
  + Have times for presentation for them
  + Practice getting a presentation in 102
  + What’s the project, what did we do (SIMPLE)
* Order parts for
* Report: answer why the black pill microcontroller makes sense instead of an arduino

Blackpill stuff

* Talk about sampling circuit here - GIVE SO MUCH DETAIL ABOUT THE BLACK PILL HERE (Jimmy/ Ethan)
  + 2 necessities for the ADC
    - moderately high sampling rate 500 kHz was the absolute minimum but not ideal at all. 5 MHz was a good compromise for price and complexity/ accuracy)
    - Resolution of the ADC voltage range (12 bits ADC, range of 6.6 volts range 1.6 mV steps)
  + Talk about STM32 mc on the black pill board that seemded ideal in its abilities to sample quick enough and resolution was supposed to be good
    - The ADC on the board
    - It can process DMA and sending data to a computer (github code)
  + JUSTIFY why the blackpill is the best implementation of STM32 and why the board itself should be used over other microcontrollers such as Raspberrypi/arduino

12/3/2023 - Final To-do List ECE 448

* ~~Practice Presentation~~
  + ~~ECE 168 on 11/29 normal meeting time~~
  + ~~Have printed PPT for each teacher (with given times of the presentation (7 min presentation, 2 minutes questions, 1 minute transition))~~
  + ~~Double-check slide numbers~~
  + ~~Run through with team (11/28)~~
  + ~~Check that it works in 102~~
  + ~~Are we in the time range? (7 minutes for Presentation)~~
* ~~Report~~ 
  + ~~Proofread~~
  + ~~More than 12 pages~~
  + ~~Get values for the one table~~
  + ~~Update all # values for equations, tables, and figures~~
* ~~Final Presentation~~
  + ~~Print evaluation form~~
  + ~~Double-check slide numbers~~
  + ~~In time range?~~
* ~~Peer Reviews~~
* ~~Project reflections~~
* ~~Pre-Break~~ 
  + ~~Order the blackpill & all parts from Github~~
  + ~~Raspberry pi~~
  + ~~Perf board / PCB for highpass~~
  + ~~Breakout board for swapping pieces~~
  + ~~Possibly get more cheap amplifiers~~