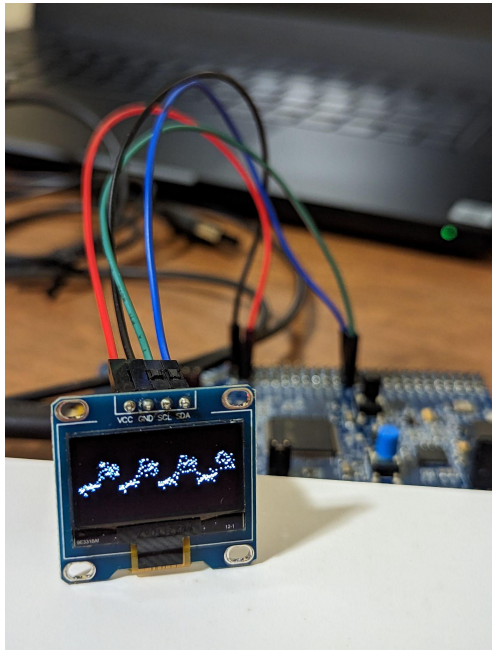
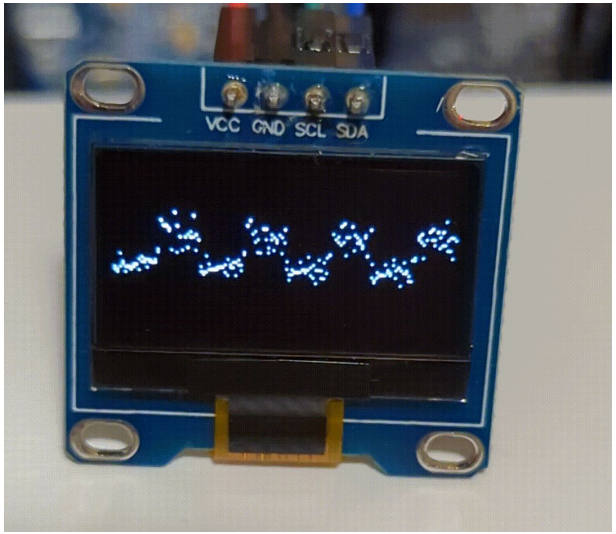
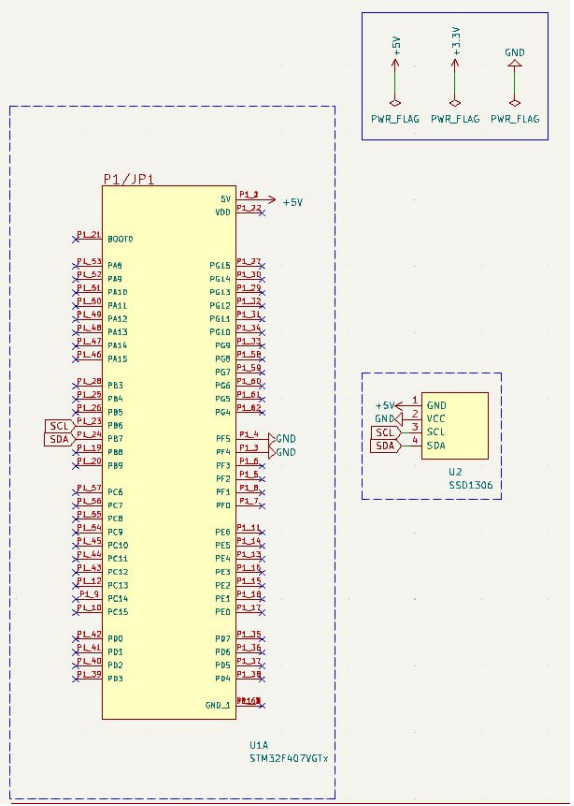
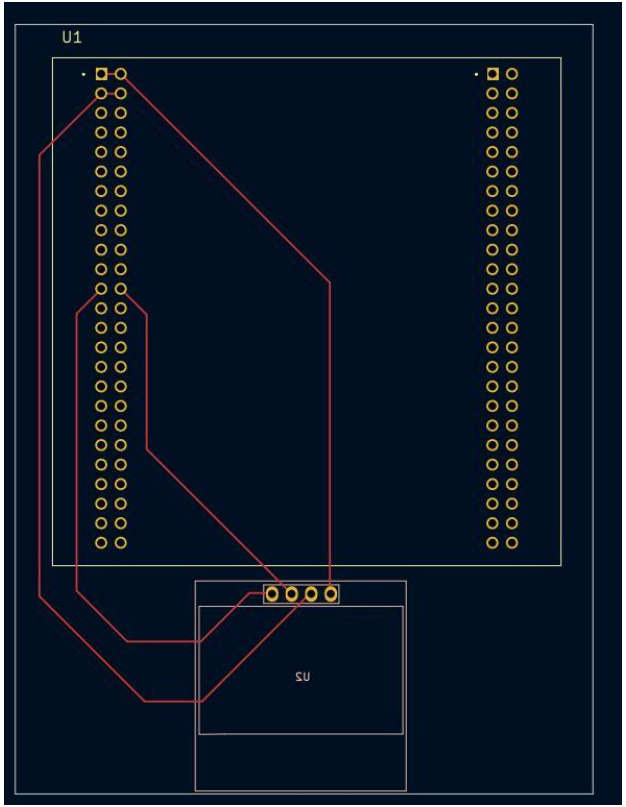
Audio Visualizer Using STM32

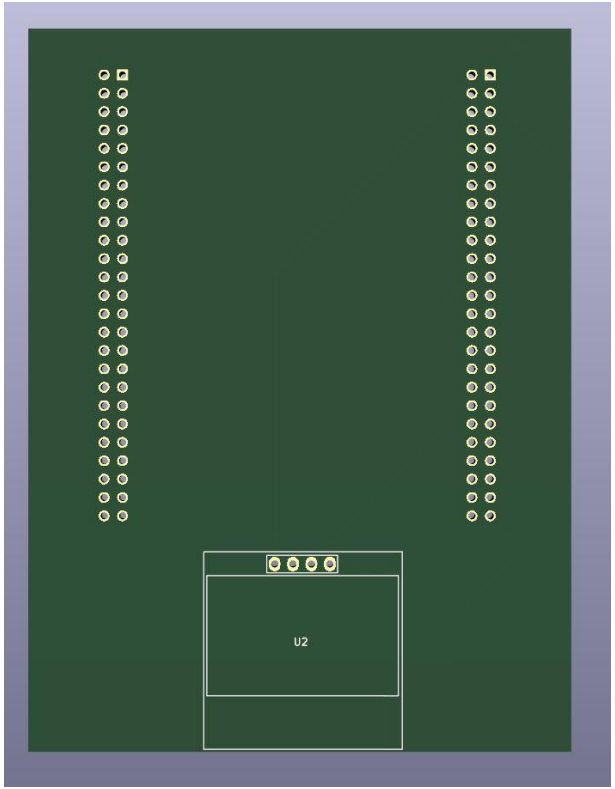




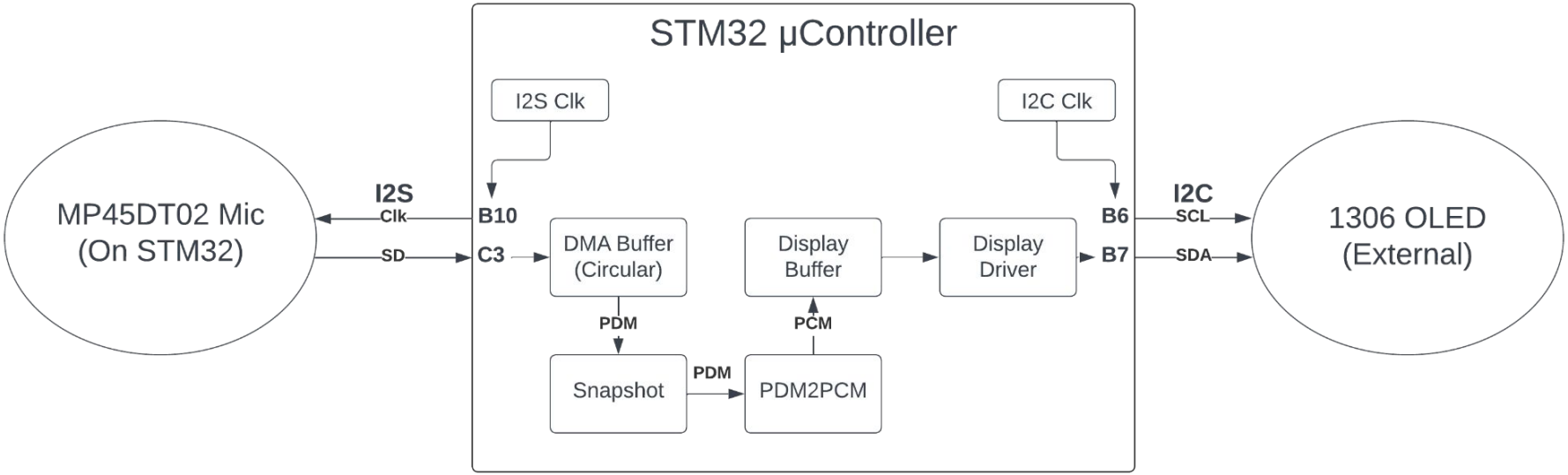
Schematics and PCB Layout







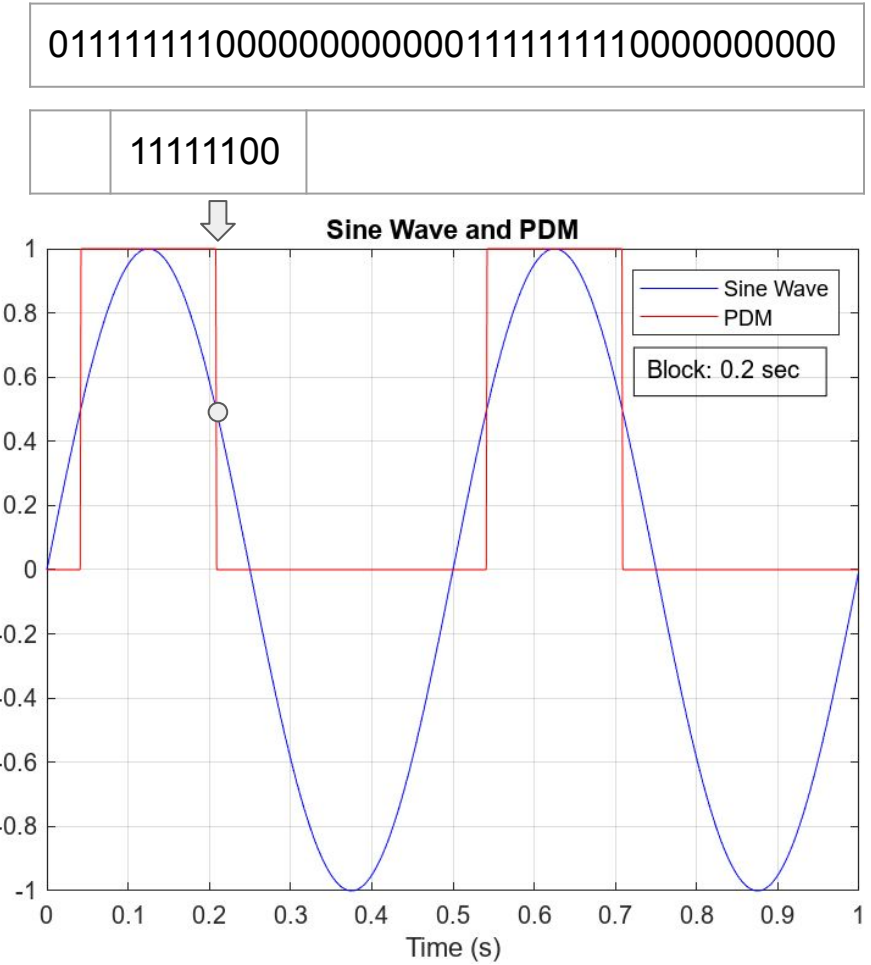
Block Diagram



Data Processing

- The microphone sends data in the PULSE DATA MODULATION (PDM) format

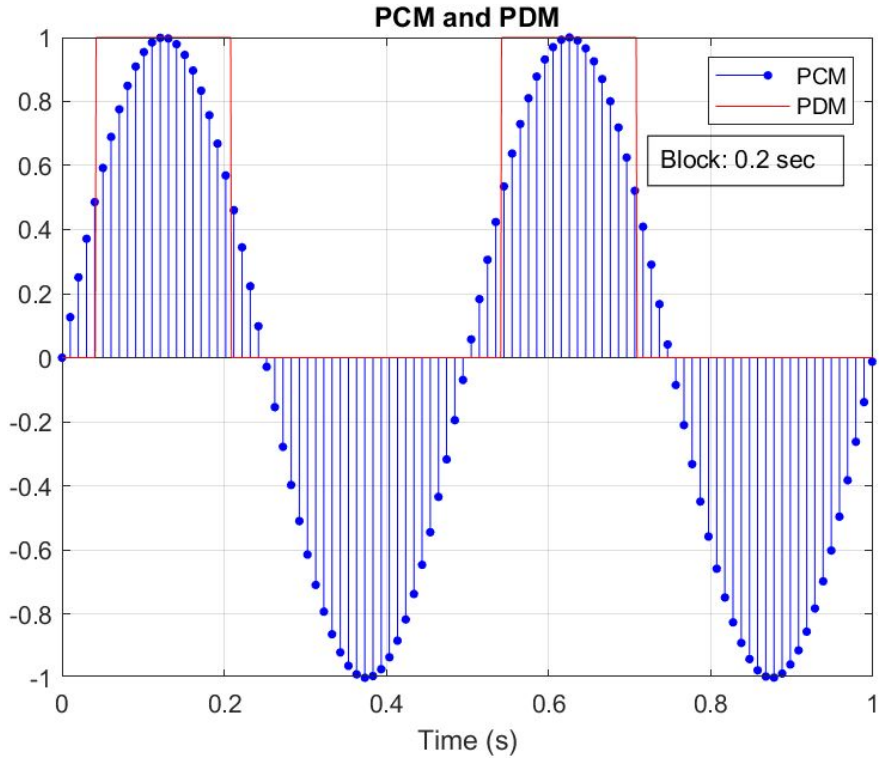
- PDM is a continuous binary signal
- It is read in blocks
- Then count the number of 1s in the block
  - If the entire block is 1s that is the max amplitude
  - If 1s makeup half than the amplitude is 0
  - If the block is 0s that is minimum amplitude



Data Processing 2

- The PDM signal is converted to Pulse Code Modulation (PCM)
    - This is just amplitude vs time (discrete)

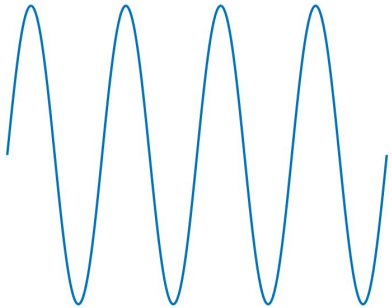
- The signal is converted using the built in PDM2PCM library for the STM32
- The library reads the 1s from each block to find the amplitude
- A high pass filter is then used to remove any DC offset from the mic
    - A constant signal (theoretically) has a frequency of 0



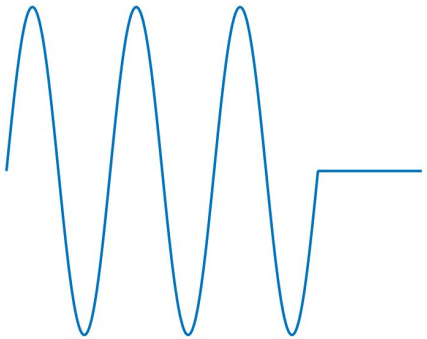
Data Processing 3

- The PCM data is added to a display buffer
- The display buffer is shifted forwards by the length of the data being added.
- The data is inserted at the end of the wave

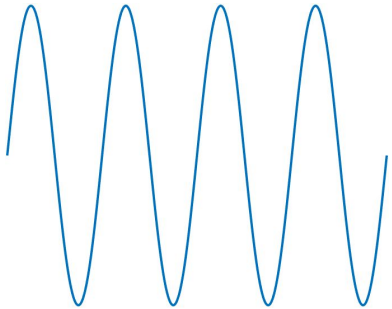
Initial Buffer



Shifted Buffer



New Buffer



Output

- Communication to the 1306 OLED is handled by a driver*
- The driver has a 1-d Array for writing to the OLED
    - Off is 0x00. On is 0xFF
- The driver takes the position (x,y) of the pixel to change and maps it to this array
- Updating the screen involves writing the array to specific chunks of the memory
- For each chunk a series of setup commands are issued and then the memory is written

(0,0)	(0,1)	(0,2)	(0,3)	(0,4)	(0,5)	…	127,63
Off	Off	On	Off	On	Off		Off

0	1	2	3	4	5	…	8191
0x00	0x00	0xFF	0x00	0xFF	0x00	…	0x00

* from https://github.com/4ilo/ssd1306-stm32HAL

End