

Sustain Tech – Listen Device

roundglass™

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1. Listen V1.1

Listen v1.1 was the initial device based on Teensy 3.6 which was handed in Bangalore with SARA 3G module.

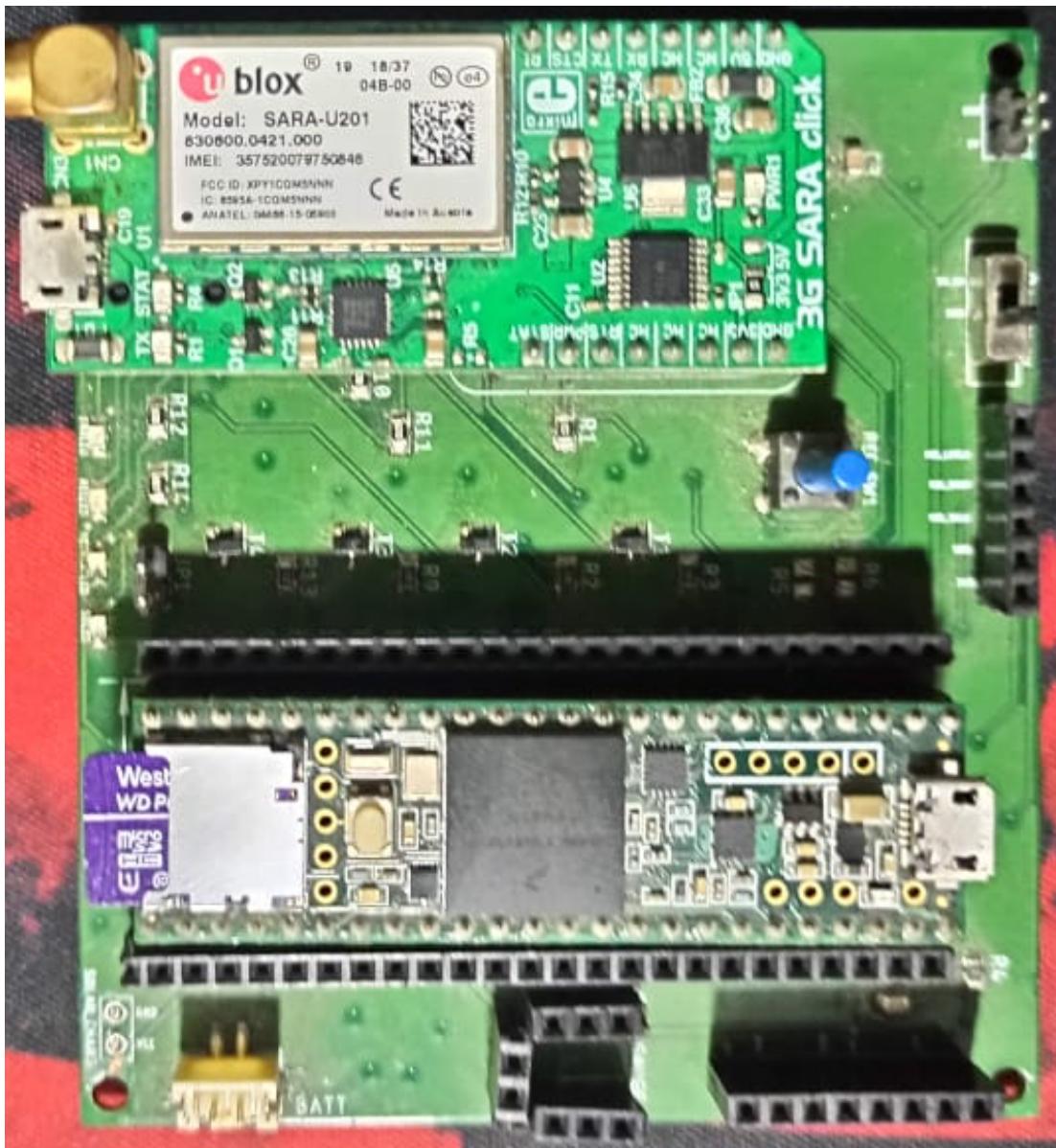


Figure 1 Listen v1.1

1.1. Hardware

Listen v1.1 was a modular design with separate connections for 3G Connection, Microphone, Teensy, Battery, Battery Monitoring, Solar charging module, Record button.

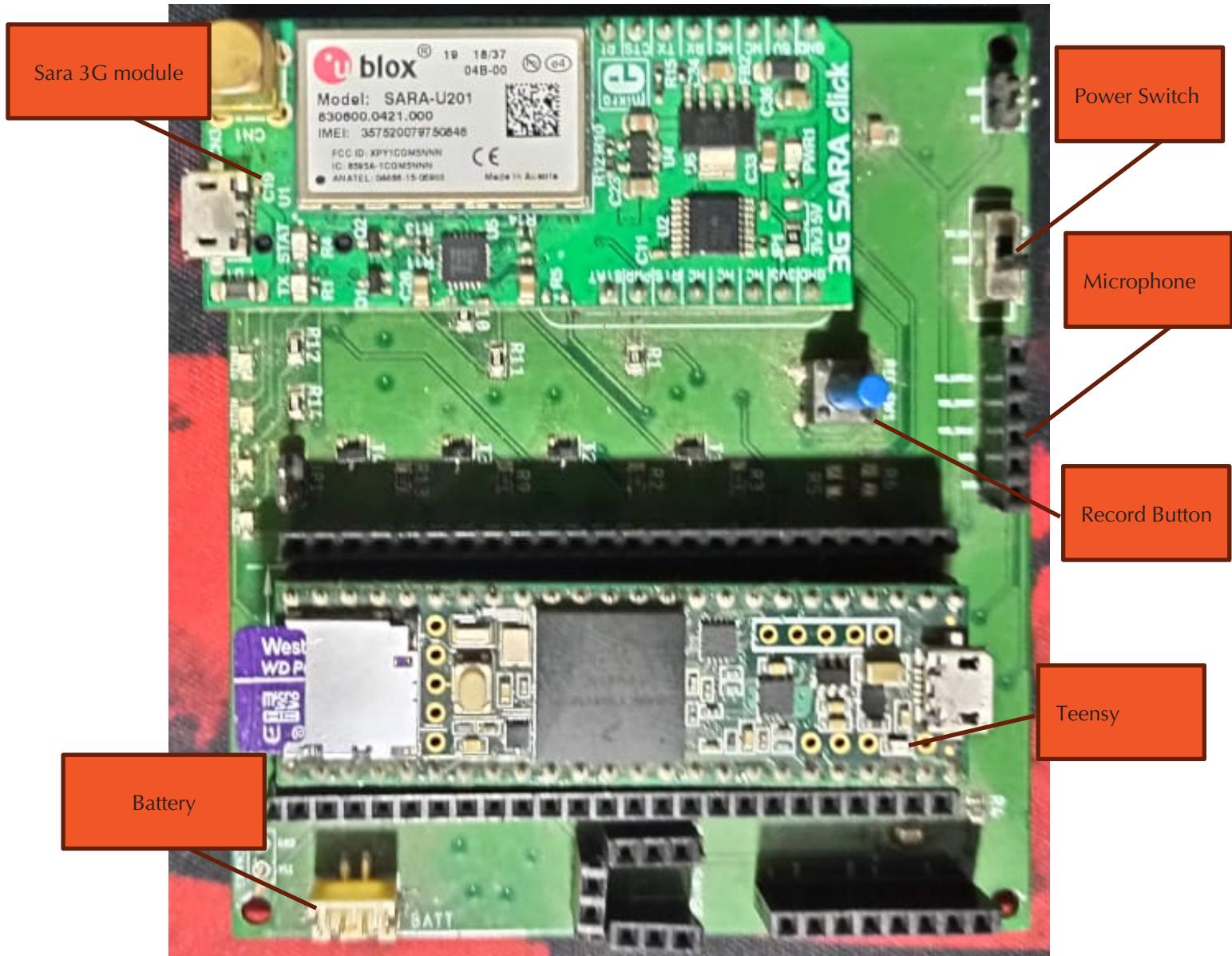


Figure 2 Listen v1.1 module

1.2. Firmware

Listen V1.1 Firmware featured only simple recording continuous recording with no support for Battery monitoring, Solar Charging.

1.2.1. Block Diagram

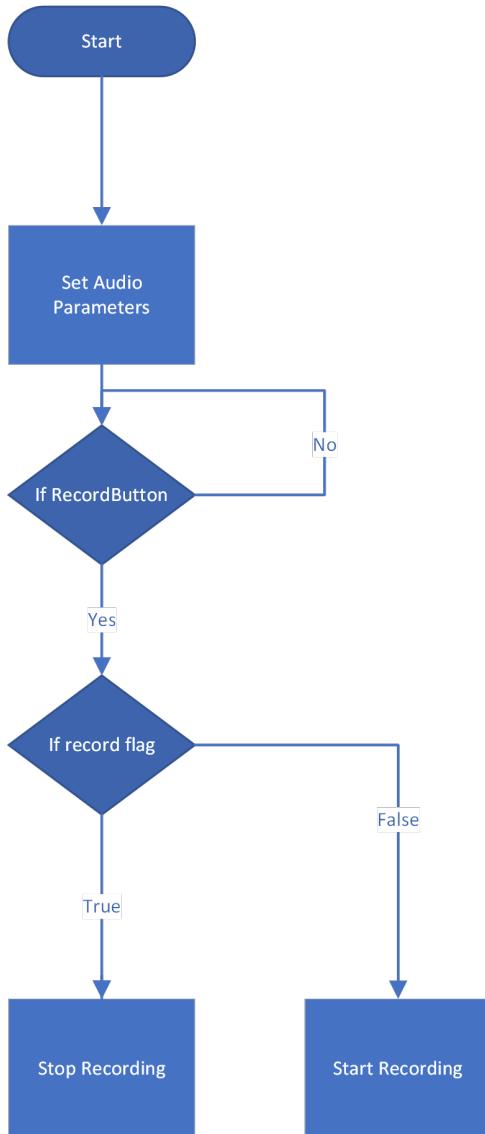


Figure 3 Block diagram for Firmware Listen v1.1

1.3. Features

Following features were planned for listen v1.1

- Recording
- FTP Upload
- Battery Monitoring
- Solar Charging

1.4. Status

Listen v1.1 device was not deployed on field due to large size for the deployment.

2. Listen V1.2

Listen v1.2 was developed in a weeks' time in Bangalore on General purpose PCB with RTC module for Real time Data and Record and sleep mode set at 2 minutes and 5 minutes respectively.



Figure 4 Listen v1.2

2.1. Hardware

Listen v1.2 includes single Li-ion 18650 cell as power, RTC for Realtime and date, Mono channel Microphone, Recording and Power LED, Push Button.

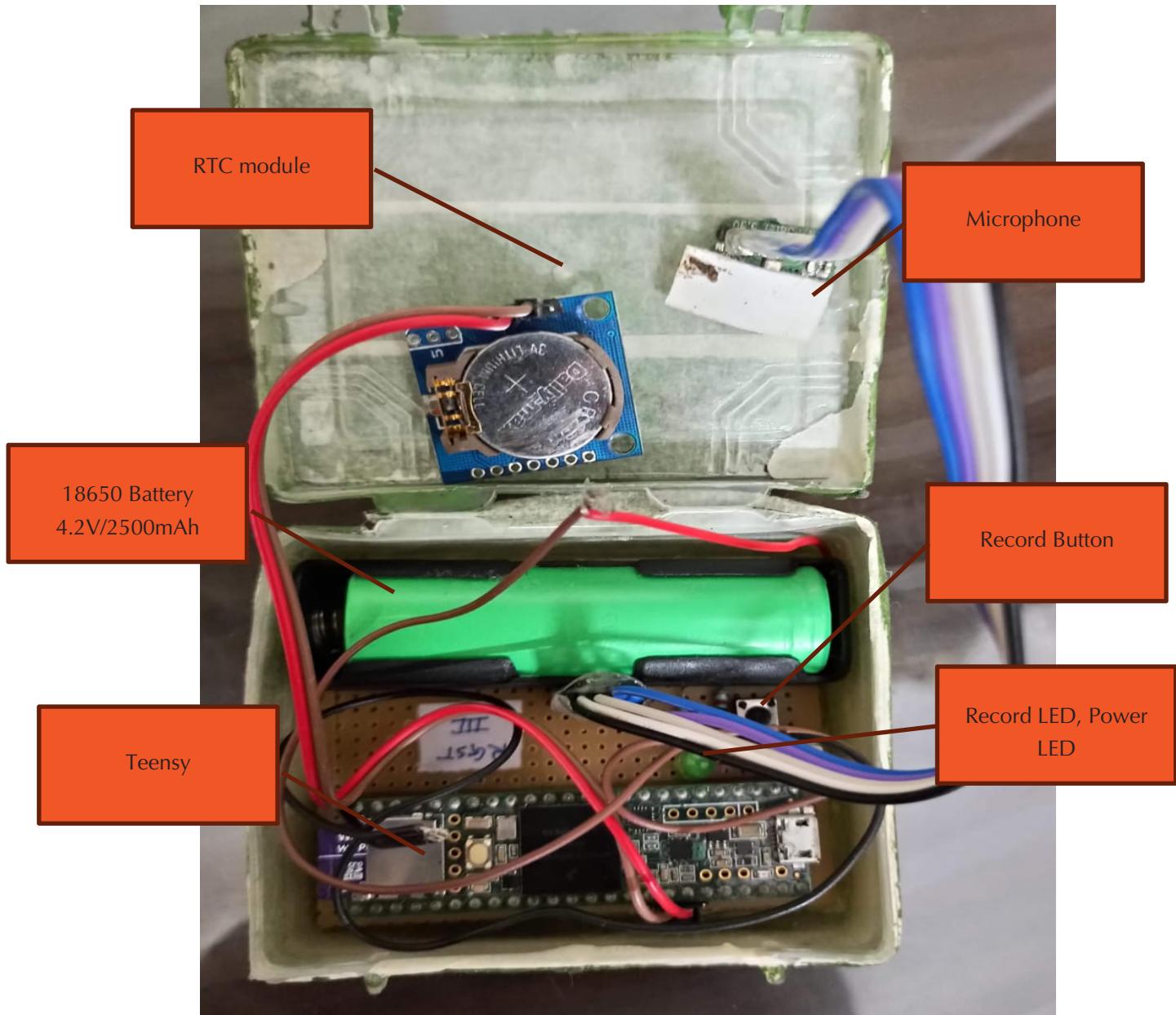


Figure 5 Listen v1.2 device.

2.1.1. Block Diagram

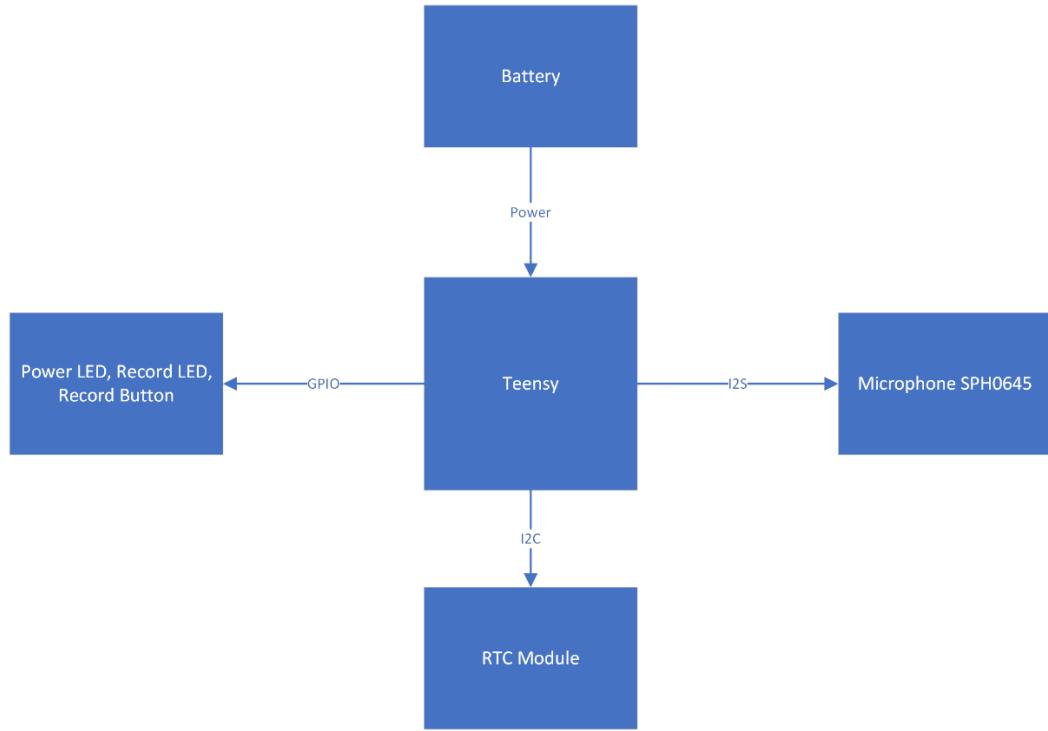


Figure 6 Block diagram for Listen v1.2

2.1.2. Bill Of Materials

PARTS	QUANTITY	PURPOSE
Teensy	1	MCU
SPH0645	1	Microphone
DS1307	1	RTC module
18650	1	Li-ion Battery
3mm LED(Red)	1	Power LED
3mm LED(Green)	1	Record LED
Push Button	1	Record Button

Table 1 Parts used in Listen v1.2

2.2. Firmware

Listen v1.2 had support for Sleep and Record Mode with File name convention as required. It also had a Power and Record indicator.

2.2.1. Block diagram

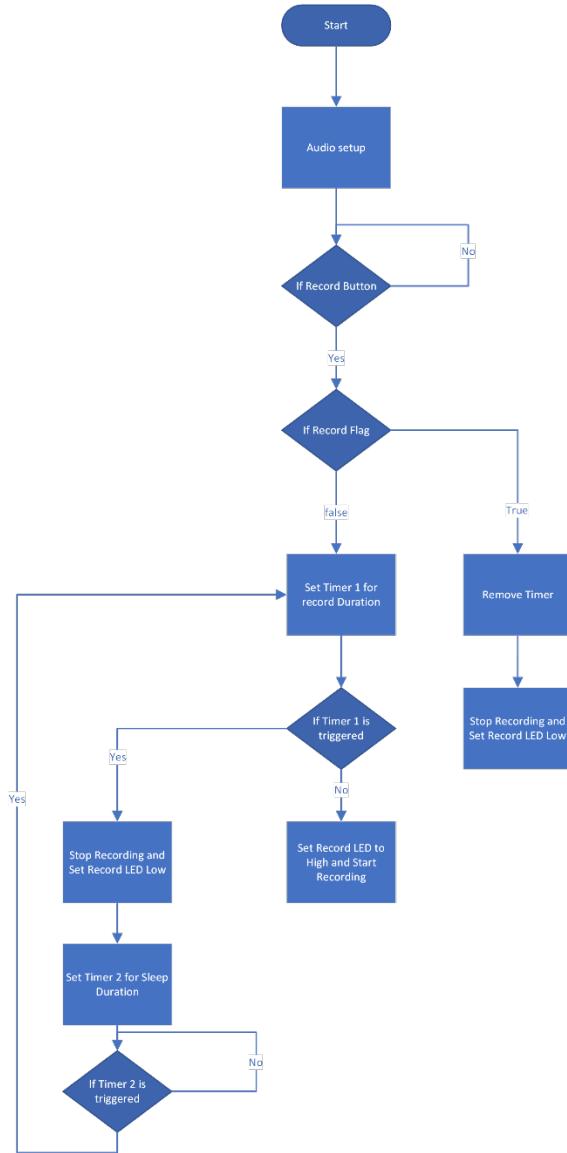


Figure 7 Listen v1.2 Firmware Block Diagram

2.2.2. IDE

Listen v1.2 firmware was coded using Arduino IDE and teensyduino which is an add on Arduino Ide for Teensy devices.

2.3. Features

Features for Listen v1.2 include:

- Record and Sleep Timer.
- Power and Record LED
- Mono Channel Recording
- File naming conventions
- Record Button

2.4. Status

This version of the Listen device was deployed and tested on site with Audio moth.

3. Listen V1.3

Listen v1.3 was a big leap in Listen device with stereo recording, Battery Charging, GUI for setting recording modes, BME280 for Environmental Sensor, Coin cell for RTC power.



Figure 8 Listen v1.3

3.1. Hardware

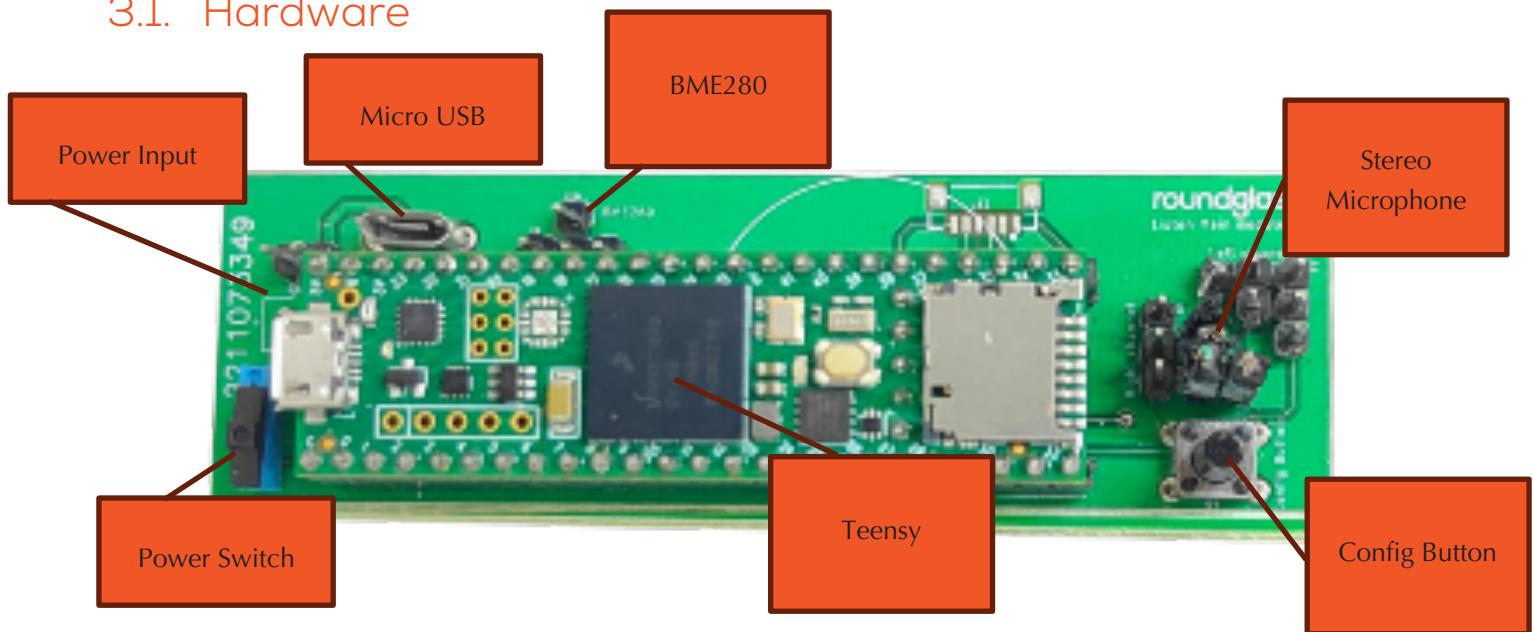


Figure 9 Listen v1.3 device.

MAIN MODULE:

Listen v1.3 main module is the central module with stereo connector for microphone, configuration Button, BME280, power Input for Main Module with micro-USB for charging battery, Coin cell Connector for RTC power.

CHARGE MODULE:

Charge Module for responsible for Charging and Battery Protection. It was based on TP4056 IC module with Li-ion Battery protection from DW01A IC with provide protection against Over Charge, Over Discharge and Short circuit. For this version of Charge module, we used 4 TP4056 module in Parallel for Charging.

ICS 43434:

ICS 43434 is MEMS technology microphone with Maximum sampling rate of 48kHz and communicates on I2S protocol with microphone.

BME280:

BME 280 is an environmental sensor responsible for Collecting data regarding Humidity, Temperature, Pressure. It was set to Communicate at I2C protocol.

3.1.2. Block Diagram

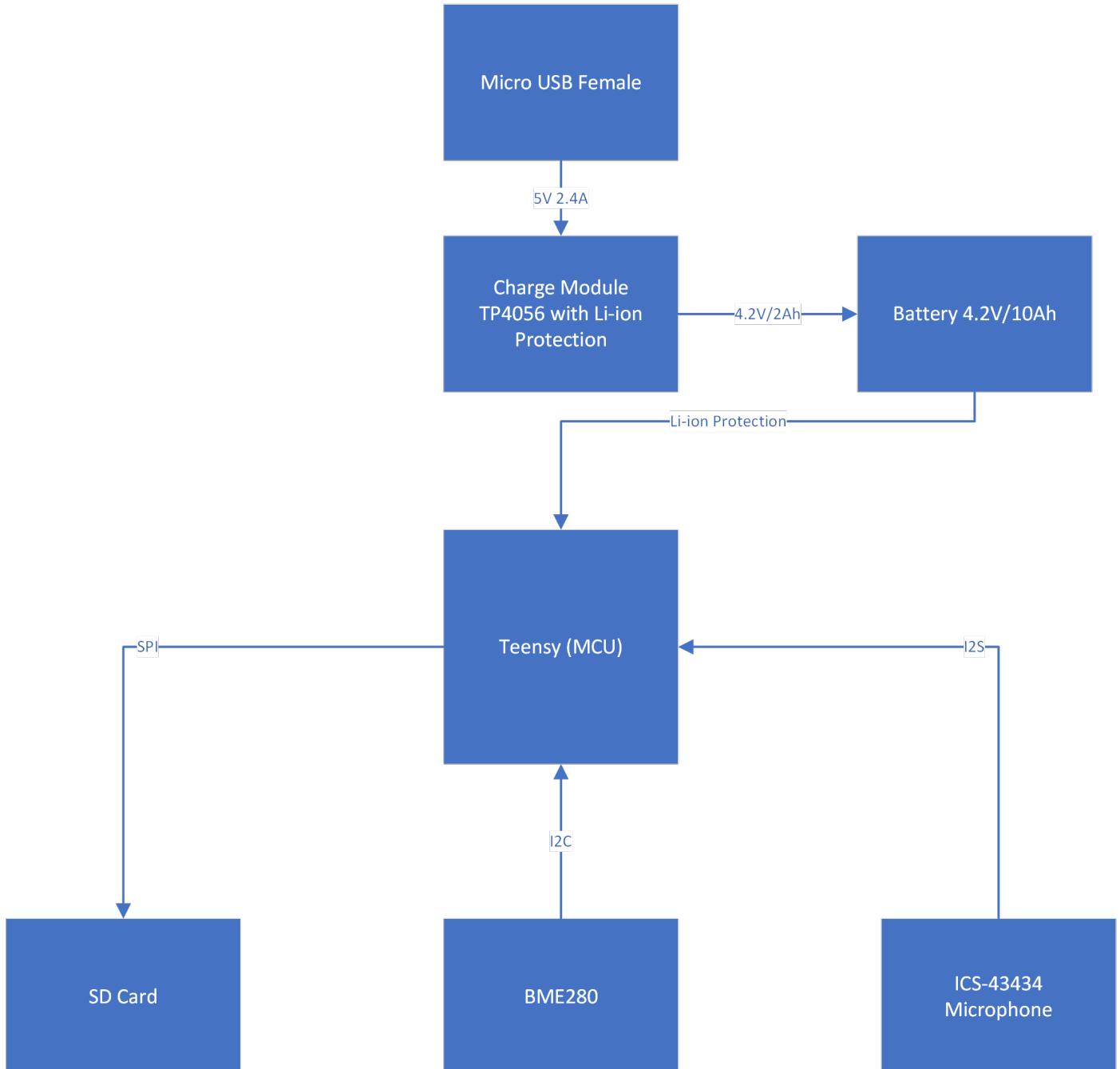


Figure 10 Listen v1.3 Hardware Block diagram.

3.1.3. PCB's

MAIN MODULE

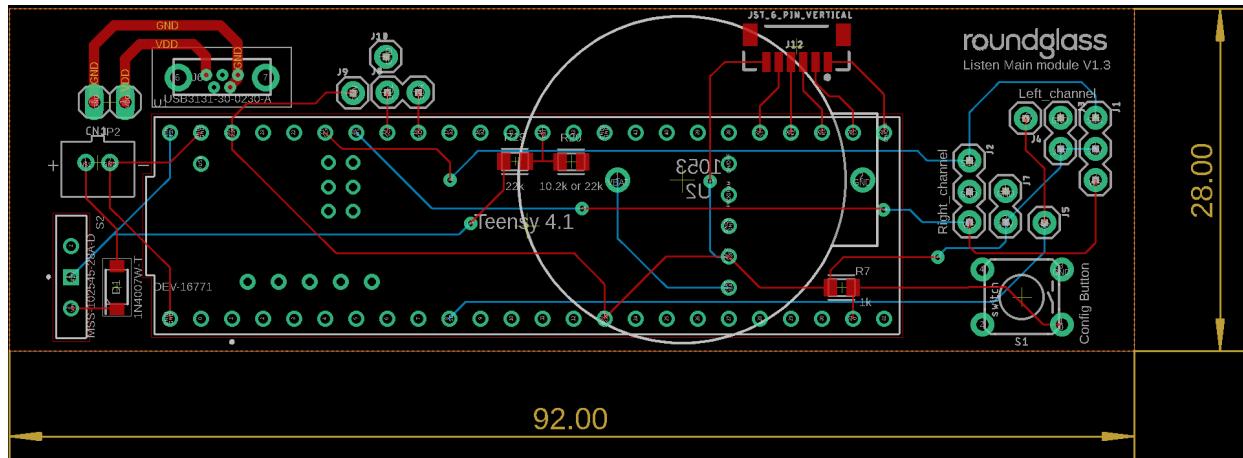


Figure 11 Listen v1.3 Main Module

CHARGE MODULE

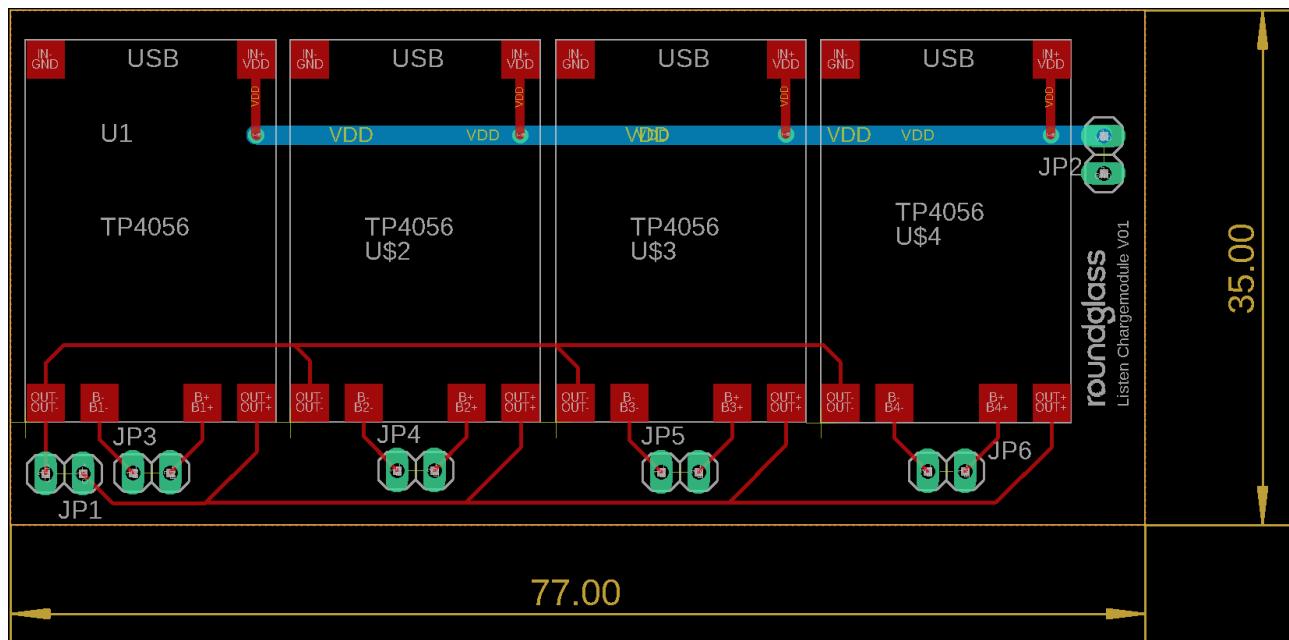


Figure 12 Listen v1.3 Charge Module

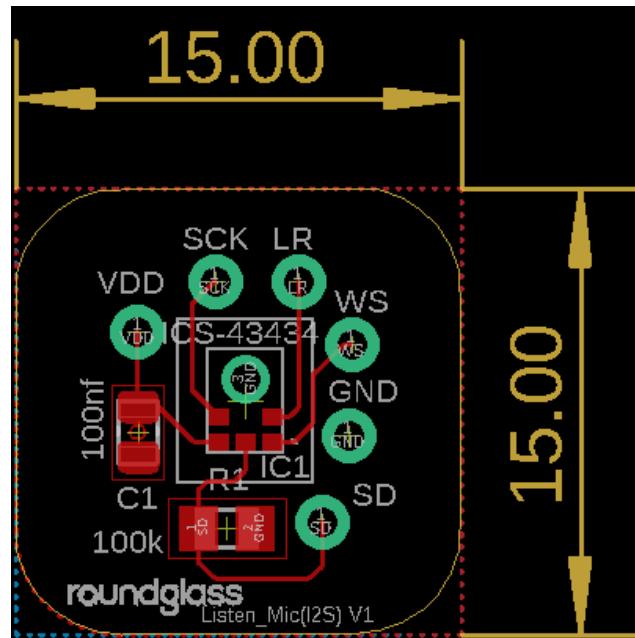


Figure 13 ICS-43434 Microphone Module

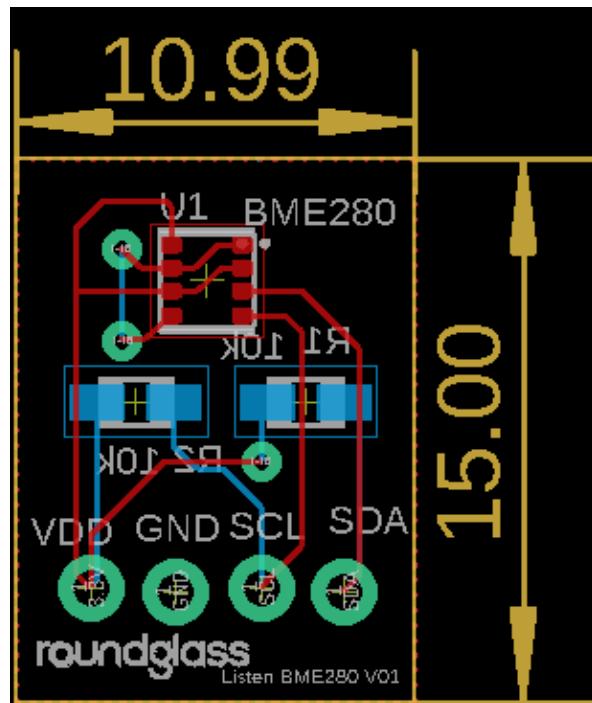


Figure 14 Listen v1.3 BME 280 Module

3.1.4. Bill Of Materials

MAIN MODULE

PARTS	QUANTITY	PURPOSE
Teensy	1	MCU
Micro USB Female	1	Charging port
Power Switch	1	On/Off Switch
Push Button	1	Configuration Button
Coin Battery	1	RTC Power Supply
2.54mm Header	NA	Connector for BME, Microphone, Power Supply

Table 2 Main parts for listen v1.3 main module.

CHARGE MODULE

PARTS	QUANTITY	PURPOSE
TP4056	4	Li-ion Charge module
2.54mm Header	NA	Input, Output Connector

Table 3 Main parts for Listen v1.3 Charge Module.

ICS-43434 MICROPHONE

PARTS	QUANTITY	PURPOSE
ICS-43434	1	I2S MEMS microphone
Register 100k	1	Resistor for noise Reduction
Capacitor 100nf	1	Voltage Protection Capacitor

Table 4 Main parts for ICS-43434 module.

BME280

PARTS	QUANTITY	PURPOSE
BME280	1	Environmental Sensor
Register 10k	2	I2C Pull up Resistors

Table 5 Main parts for Listen v1.3 BME280.

3.2. Firmware

Listen v1.3 firmware for a leap Improvement from previous version Listen v1.2 with fully operational firmware code with stereo recording, GUI, with internal RTC setup during Device Configuration.

3.2.1. IDE

Due to large Size, Multiple files with Arduino IDE was at time was not adequate so was shifted to Platform IO which was an extension in Visual Studio Code.

3.2.2. Block diagram

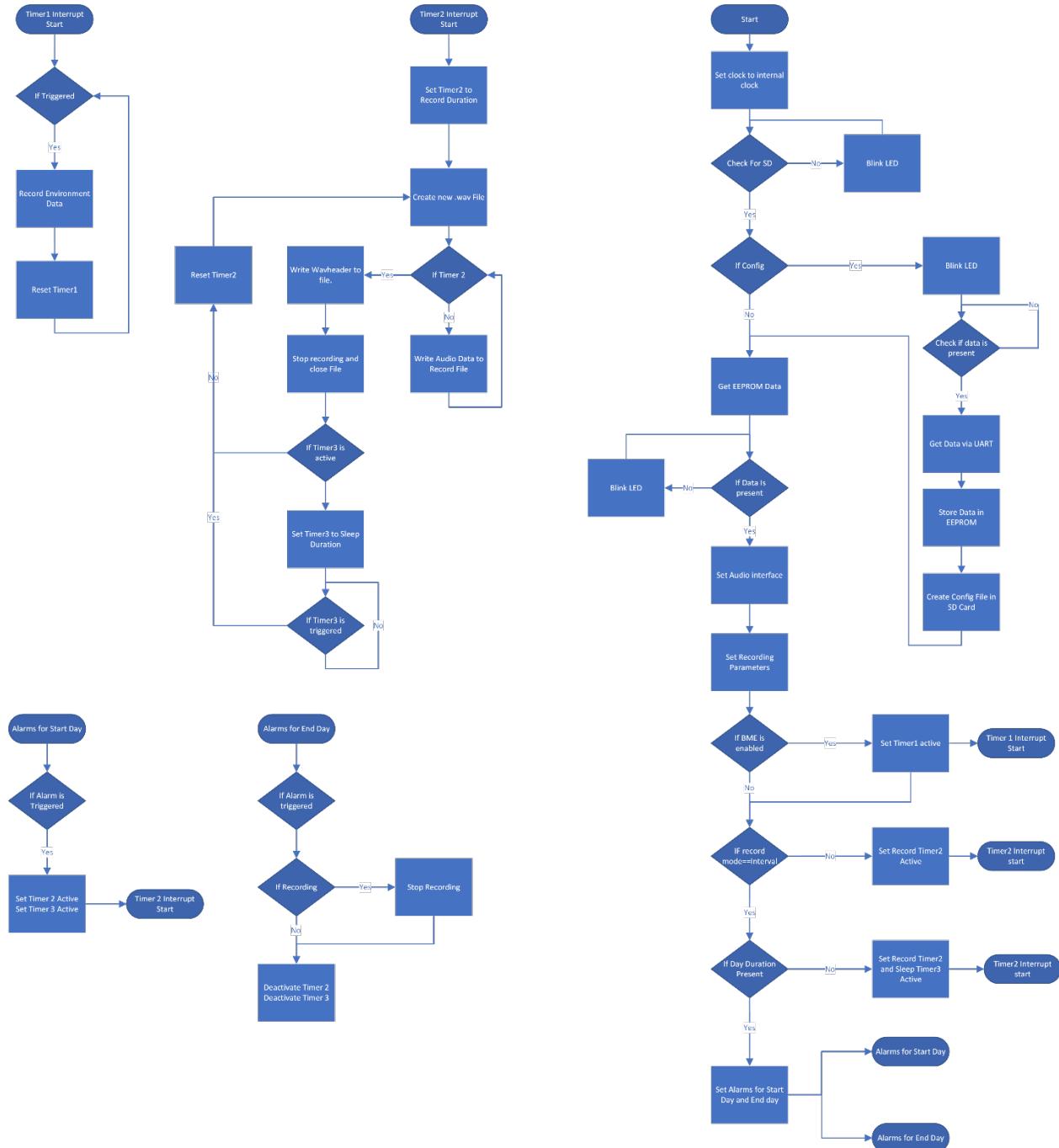


Figure 15 Block diagram for Listen v1.3 Firmware.

3.3. GUI

GUI (Graphical User Interface) to Configure Recording Parameters like Device ID, Sampling Rate, Gain, Recording Mode, Record and Sleep Duration, to enable Atmospheric Sensor (BME280) and have internal feature to provide clock data to Teensy. It is written in Python using PyQt library.

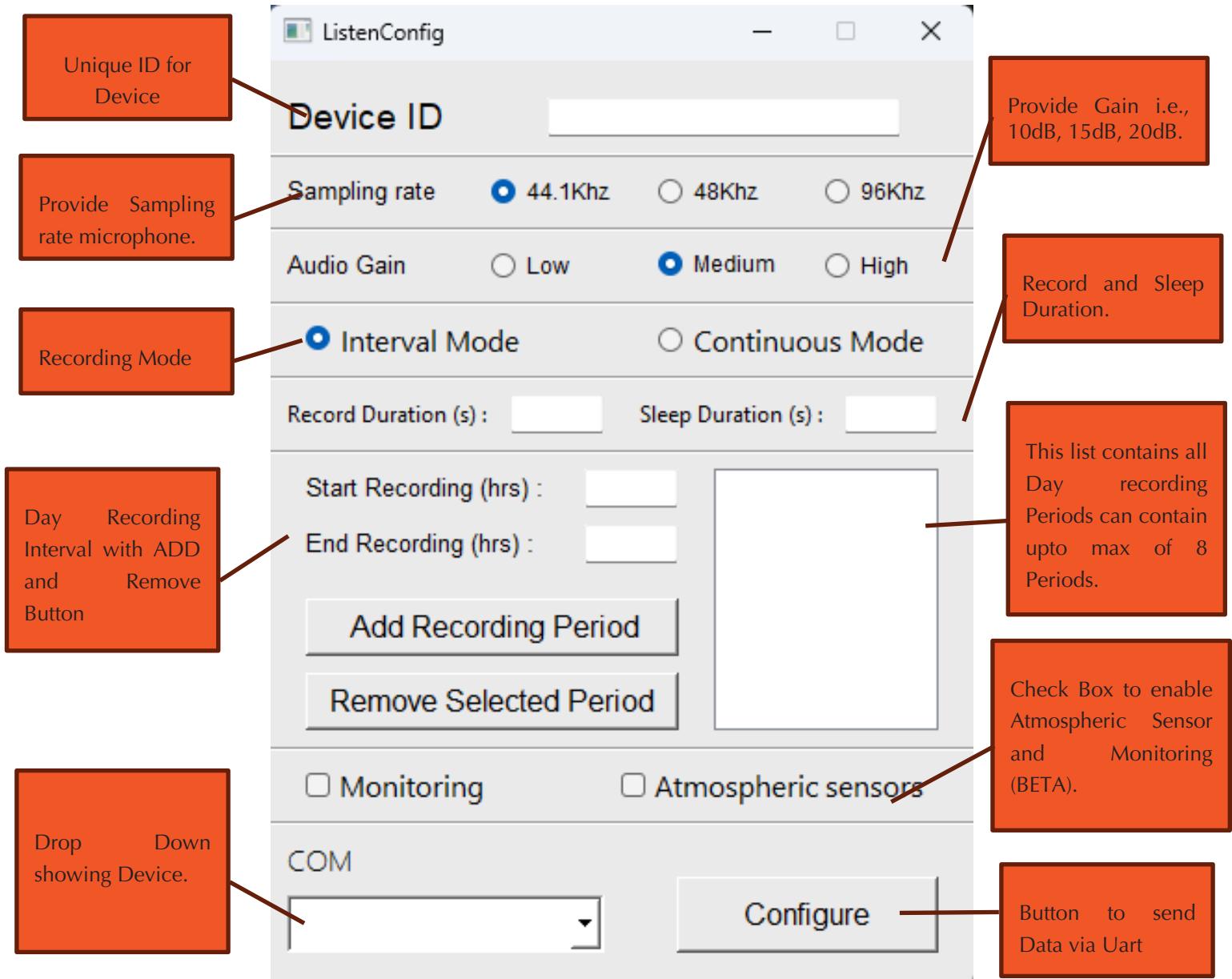


Figure 16 GUI v1.3

3.4. Features

Features for Listen v1.3 are described below:

- Stereo Recording

- Sampling Rate
- Audio Gain
- Internal RTC
- GUI
- Environment Sensors
- Different Recording modes
 - Interval
 - Continuous

3.5. Status

Listen v1.3 provided good results in the field but due to improper connectors for stereo microphone and BME resulted in difficulty accessing SD Card.

4. Listen V1.4

Listen v1.4 is the latest device after listen v1.3 with FTP Transfer, Battery Monitoring, Stereo recording, Solar charging, and GUI.

4.1. Hardware

Listen v1.4 is a 4G module device with Main Module, Charge Module, Microphone, and I/O Module. Each module connects to each other.

4.1.1. Block Diagram

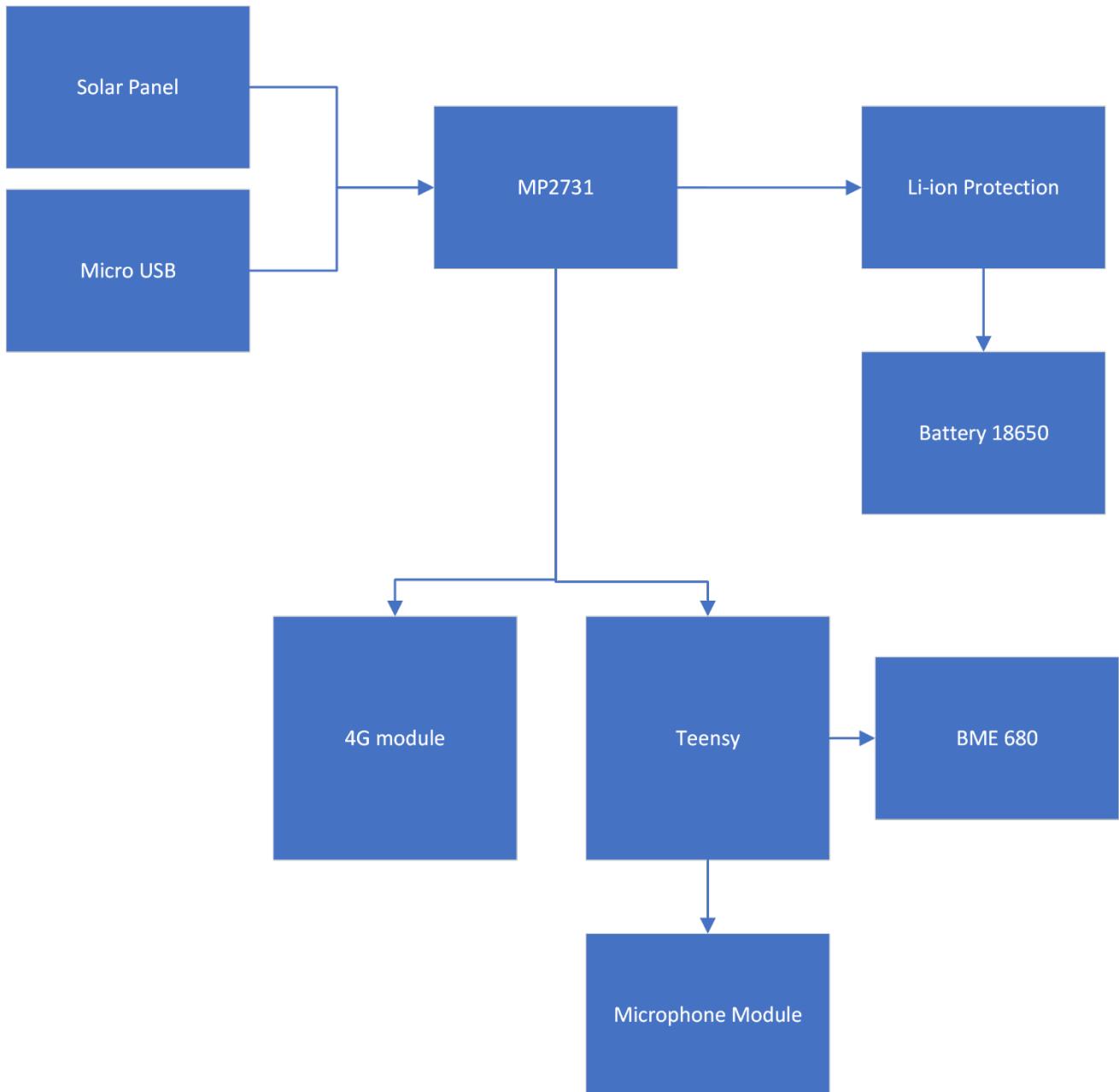


Figure 17 Block diagram for Listen v1.4

4.1.2. PCB's

MAIN MODULE

Link: [Main Module](#)

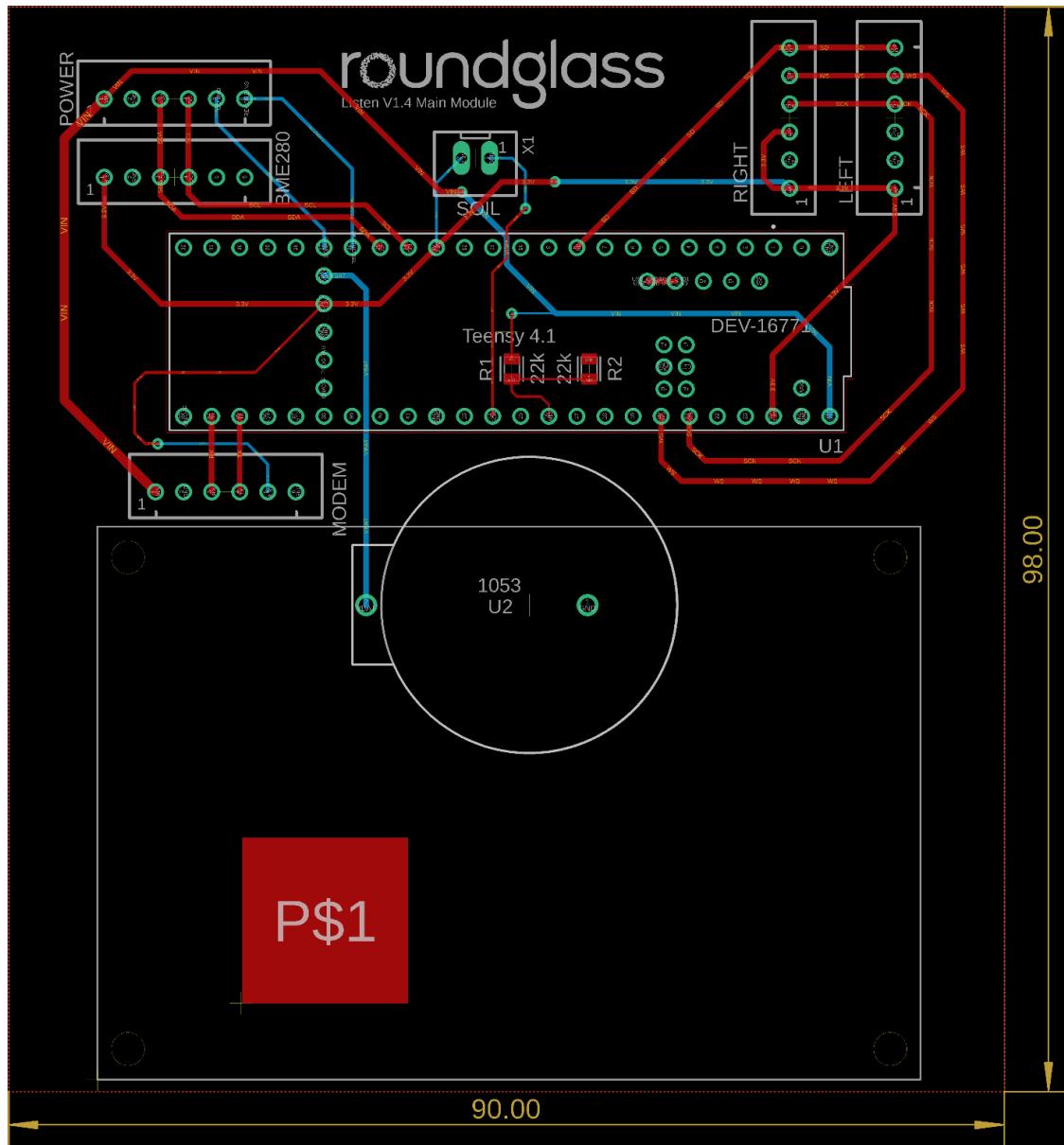


Figure 18 Listen v1.4 Main Module

CHARGE MODULE

Link: [Charge module](#)

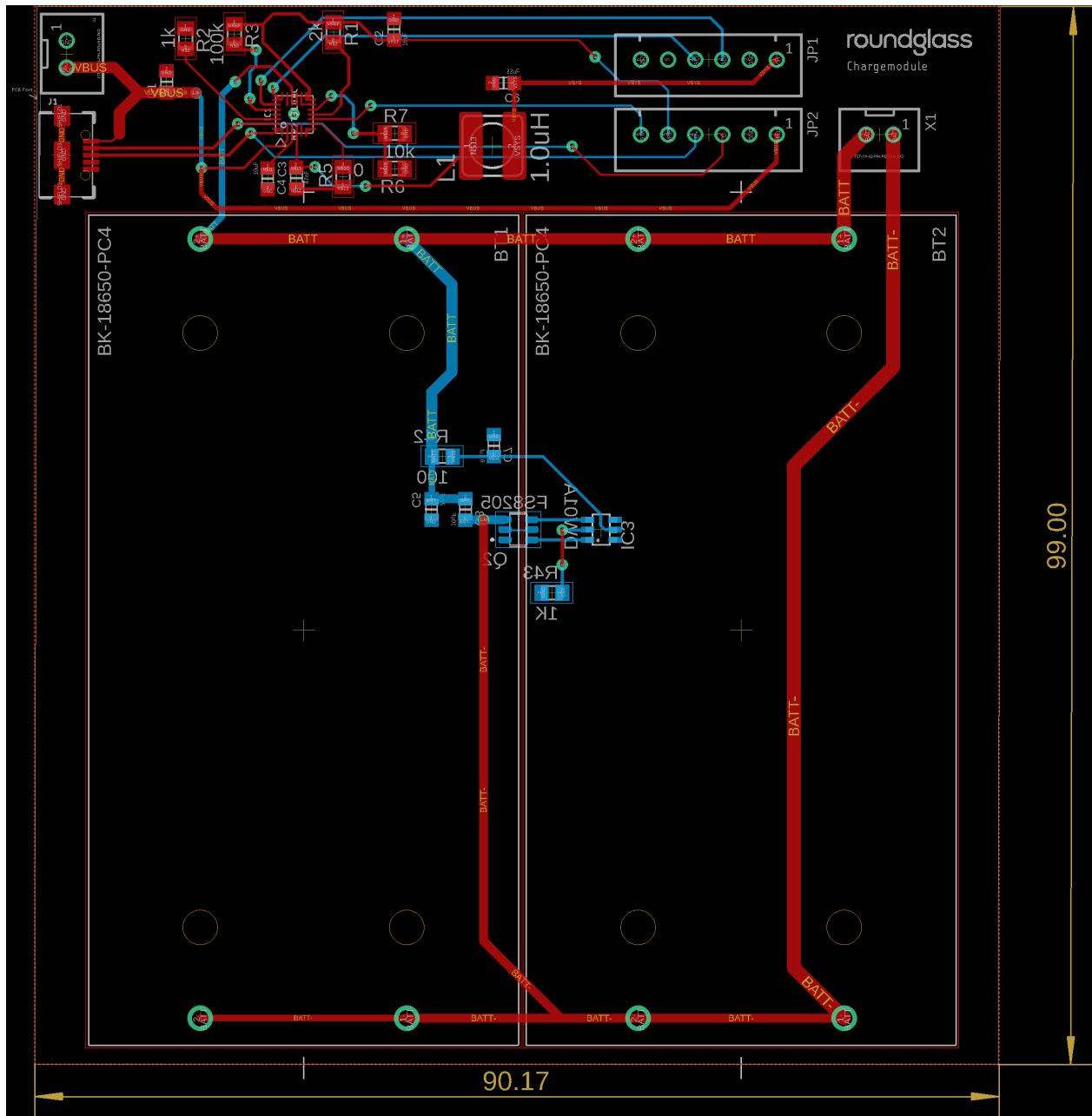


Figure 19 Listen V1.4 Charge Module

I/O MODULE

Link: [I/O module](#)

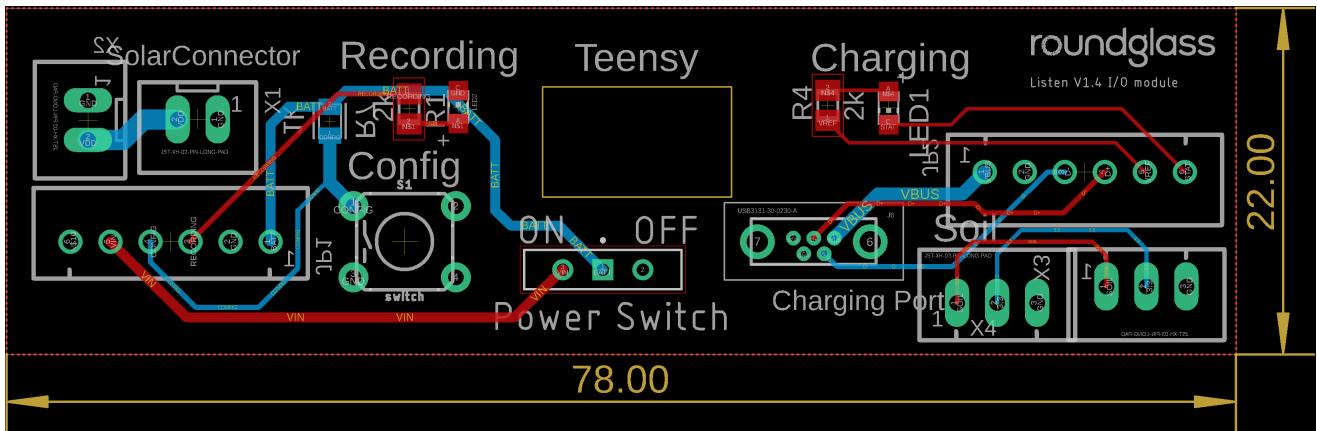


Figure 20 Listen V1.4 I/O Module

MICROPHONE MODULE

Link: [Microphone Module](#)

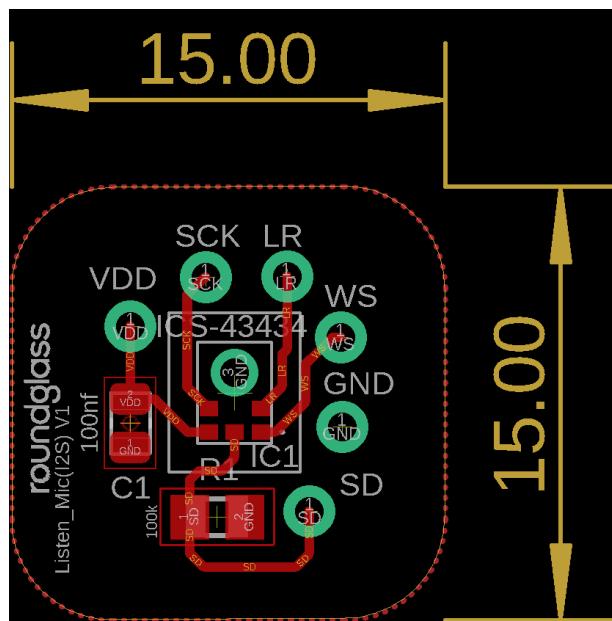


Figure 21 ICS 43434 Microphone Module

4.1.3. Bill Of material

MAIN MODULE

PARTS	QUANTITY	PURPOSE
Teensy	1	MCU
Connector 6 pin	5	I/O and Power Connector
Coin Battery	1	RTC Power Supply
2.54mm Header female	NA	Teensy Connector
Micro USB to USB	1	Configuration wire

Table 6 Main parts for listen v1.4 main module.

CHARGE MODULE

PARTS	QUANTITY	PURPOSE
MP2731	1	Battery charging and Monitoring
6 Pin JST connector	2	Outputs and Communication Ports
2 Pin JST Connector	1	Battery Extender
Micro USB Female	1	Charge Connector
2 pin screw Terminal	1	Solar Charger

Table 7 Main parts for Listen v1.4 Charge Module.

ICS-43434 MICROPHONE

PARTS	QUANTITY	PURPOSE
ICS-43434	1	I2S MEMS microphone
Register 100k	1	Resistor for noise Reduction
Capacitor 100nf	1	Voltage Protection Capacitor

Table 8 Main parts for ICS-43434 module.

I/O MODULE

PARTS	QUANTITY	PURPOSE
Micro USB Female	1	Charging port
Power Switch	1	On/Off Switch
Push Button	1	Configuration Button
Connector 6 pin JST	2	I/O ports
2 Pin JST Connector	3	Soil, Solar Connector
Solar Panel	1	5V, 9W Solar Panel
LED & Resistor	2	Charging and Record indicators

Table 9 Main parts for Listen v1.4 I/O Module.

4.2. Firmware

Listen v1.4 firmware uses multi-threading which enables it to do more tasks simultaneously as it allows microcontroller to Process Multiple Tasks.

Link: [Firmware](#)

4.2.1. Block Diagram

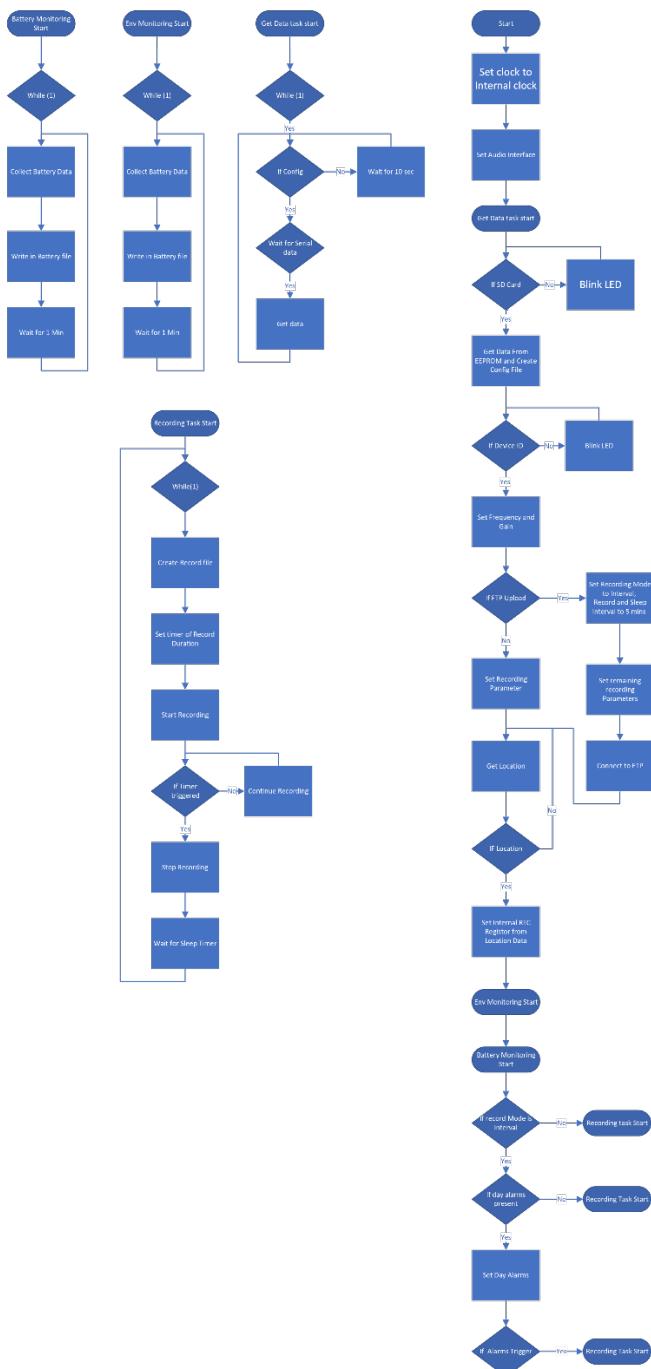


Figure 22 *Block Diagram for Listen v1.4*

4.3. Encloser

Encloser for listen v1.4 is designed using Fusion 360 Software. Rendered Design is provided below.

Link: [Encloser](#)



Figure 23 *Encloser Front View*



Figure 24 Encloser Front-Top view

4.4. GUI

Link: [GUI](#)

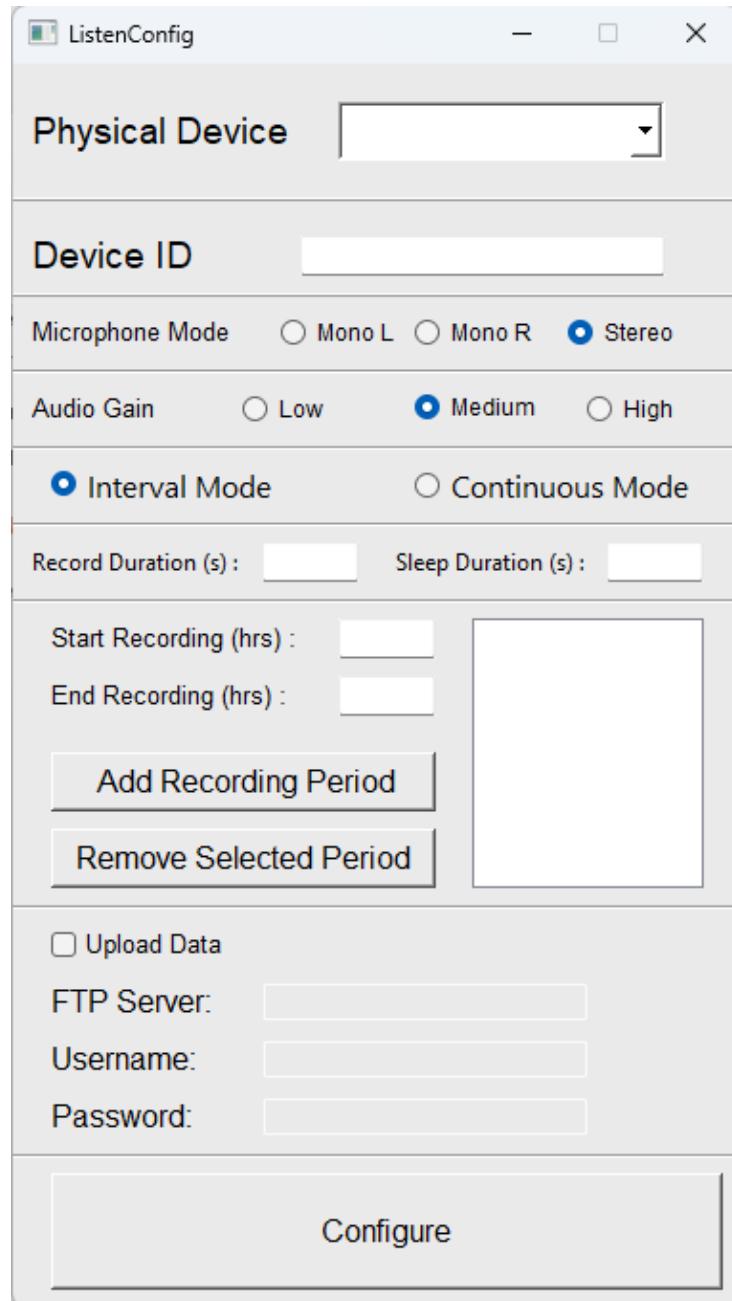


Figure 25 *GUI listen v1.4*

4.5. Features

Listen v1.4 comes with Following features:

- Stereo Recording
- 4G FTP Transfer
- Solar Charging
- Separate I/O Module for Easier Access

4.6. Status

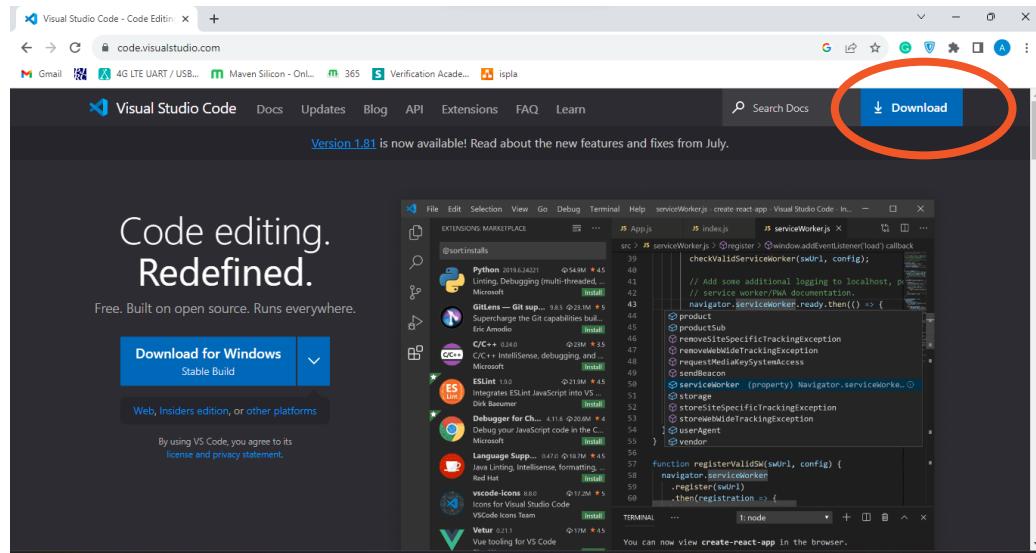
All Firmware Needs to be updated for only GPS and Firmware Testing is pending for GPS upload.

5. Appendix 1

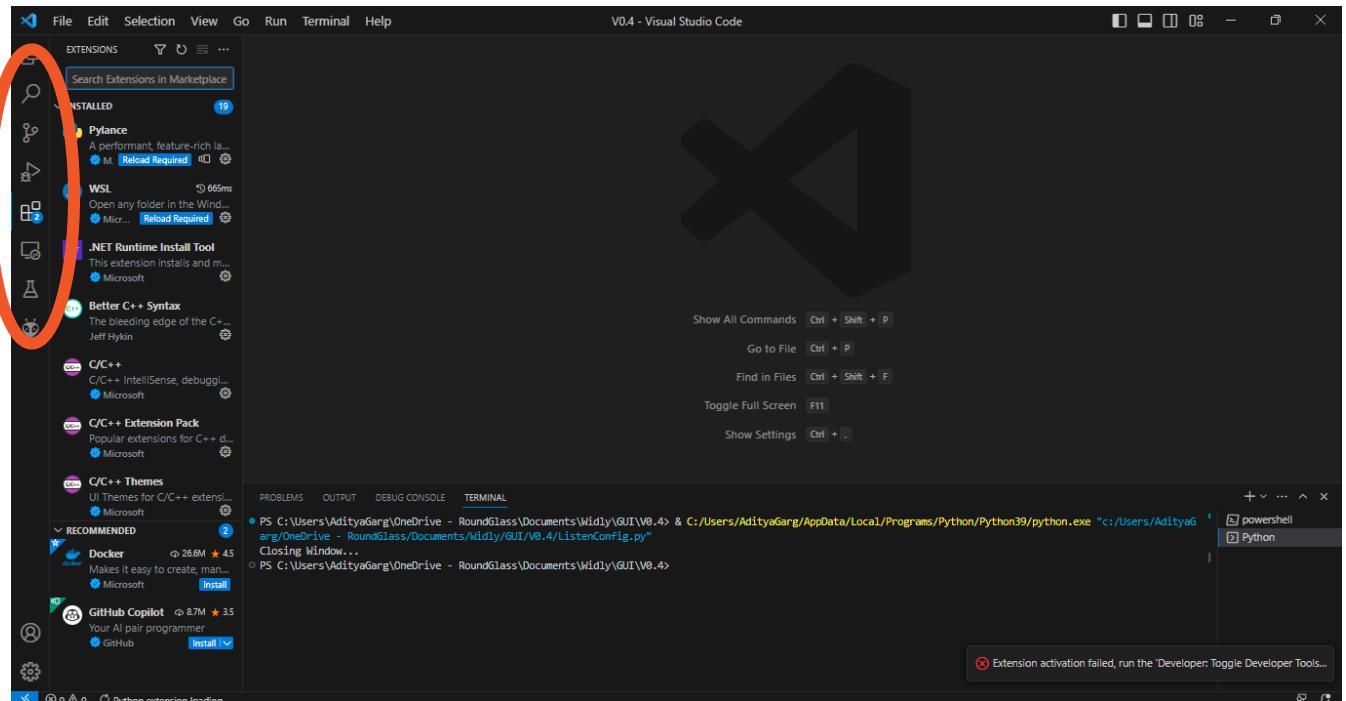
5.1. Visual Studio Code Setup

Steps to download VS Code and Installation of Platform IO

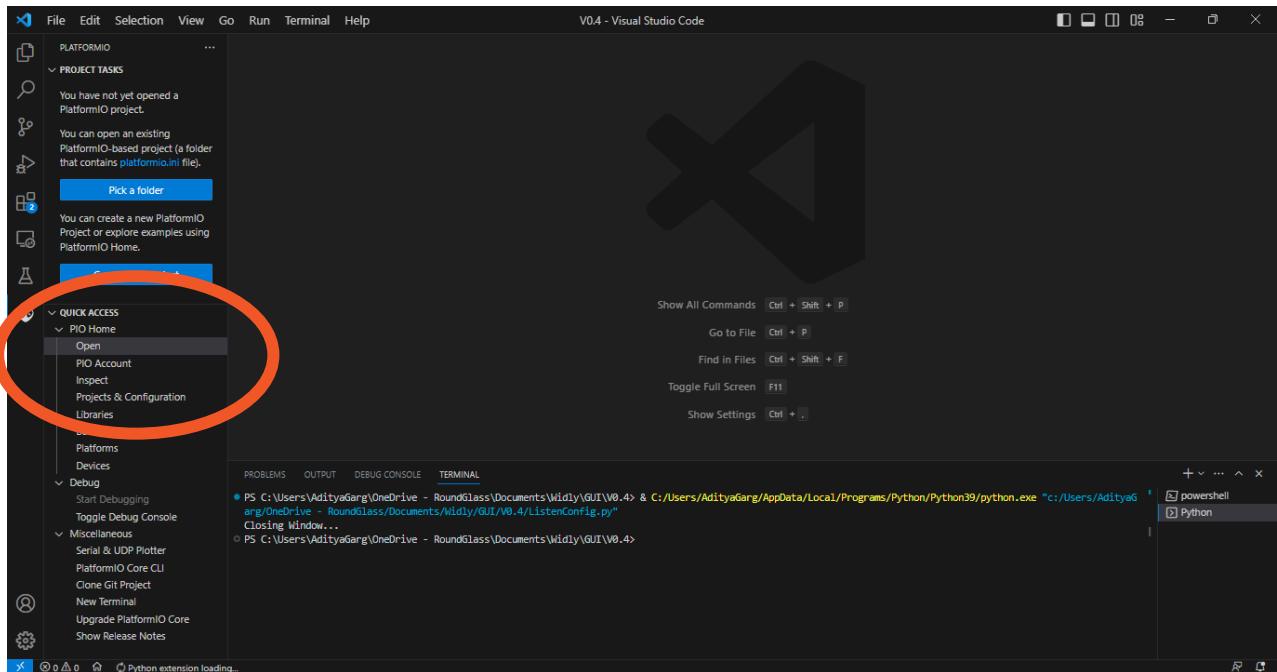
- Open Web Browser > Go to <https://code.visualstudio.com/> >click download on upper Right corner.



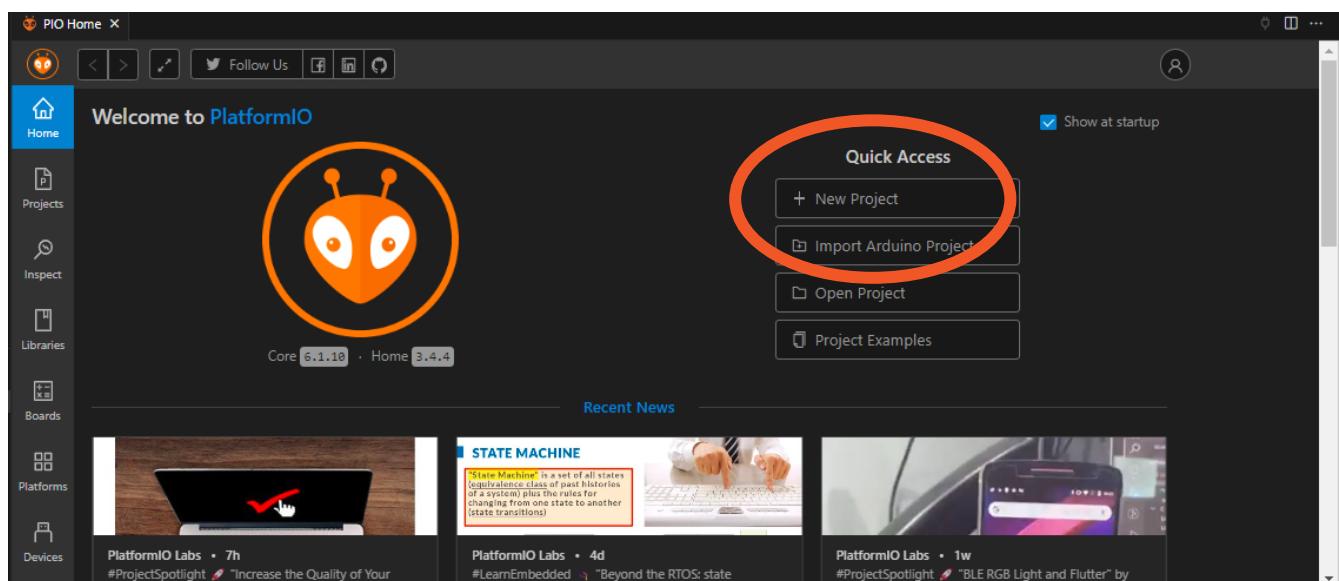
- This will download executable installation file.
- Run that file and click accept to terms and Condition.
- Open Visual Studio Code
- Go to Extensions on Left side of Screen.



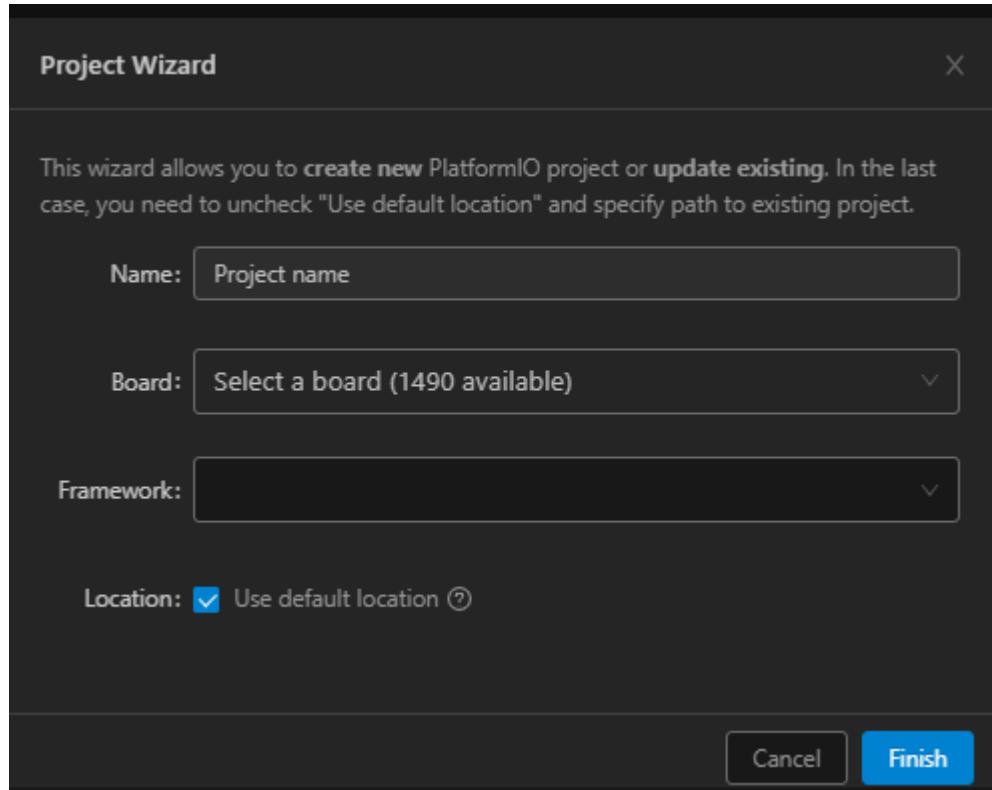
- Search for C, C++, and Platform IO in extension and install.
- After Installation an alien symbol will appear on right side.
- Click on this button and it will take you to Platform IO Home window.



- Pick Home from quick access panel.
- Click on New Project and Project Wizard will open.



- Enter project name, Select Board and for Framework Select Arduino and Click finish.

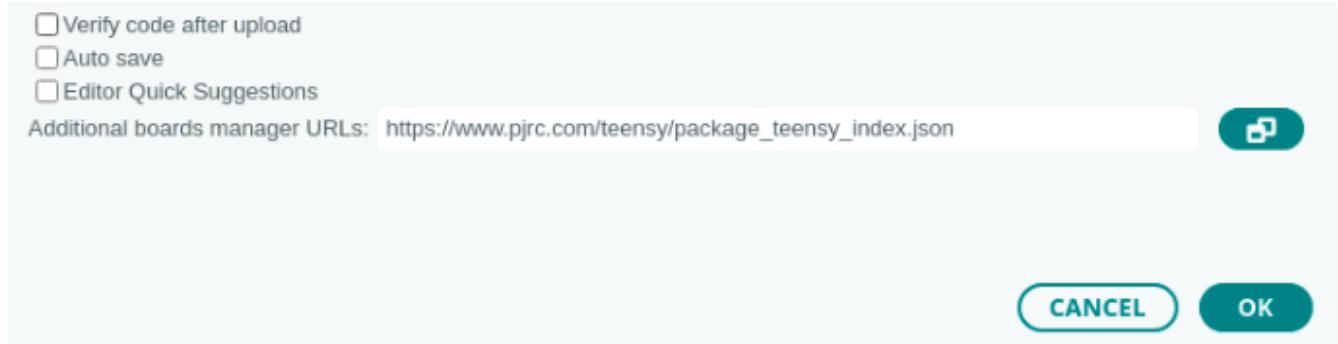


- Project folder will be created with project name and will be configured for Selected board.

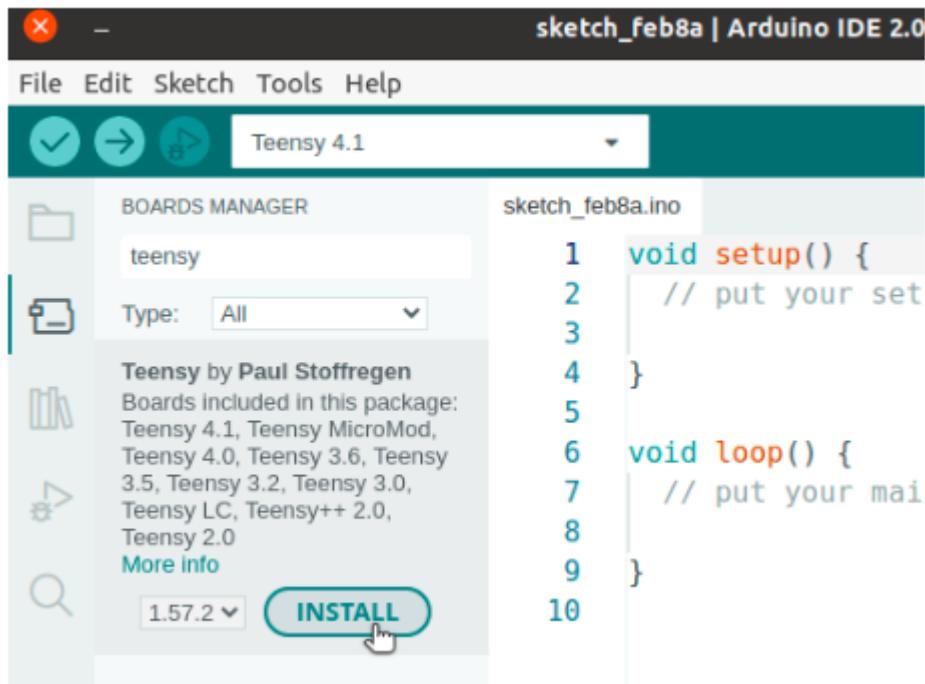
5.2. Arduino IDE setup

To setup Arduino Ide for teensy devices, we need to add Teensyduino to it. Steps for Teensyduino is mentioned below:

- First download Arduino IDE from <https://www.arduino.cc/en/software>.
- Install Arduino IDE
- Open Arduino IDE click File > Preferences. In "Additional boards manager URLs", copy this link: https://www.pjrc.com/teensy/package_teensy_index.json



- In the main Arduino window, open Boards Manager by clicking the left-side board icon, search for "teensy", and click "Install".



6. Appendix 2

6.1. Fusion 360

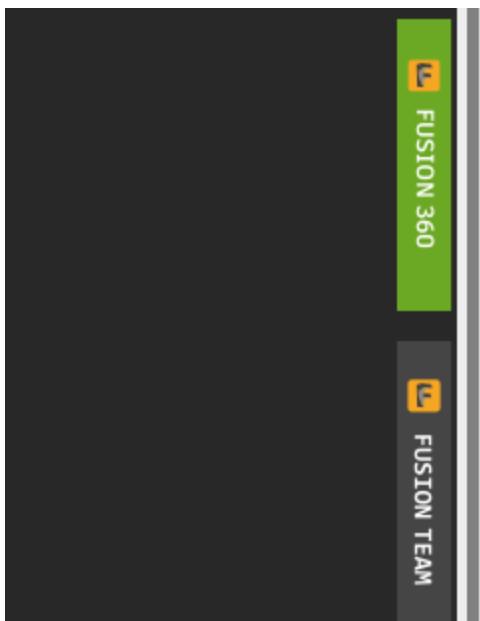
Fusion 360 is an AutoCAD software we used in encloser design developed by Autodesk and is Compatible with eagle. Which provide a great platform for PCB design and Product designing as we can upload our designed PCBs directly into Fusion 360.

Steps for Fusion 360 are provided below.

- Download Fusion 360 from <https://www.autodesk.in/products/fusion-360>
- Install Fusion 360

Steps for uploading PCB to fusion 360.

- Once you have Completed your PCB design Click on Fusion 360 Button on Right side of Broad



- Pop up Window will Open Select new Fusion design.
- Select Fusion Project Location and Click on Push.

6.2. G-Code

G-code is geometric code which is provided to 3D printer for Printing.

Steps to get G-Code for Design

- Once Designing is finished export the design as .stl format.
- Upload this design to slicer Software i.e. Prusa Slicer as we are using Prusa MK3s as 3D printer.
- Make appropriate supports for overhang and Slicer the 3D design.
- Export G-Code.

6.3. 3D printer Setup

This Printer setup is applicable for Prusa Mk3s as we currently have only this printer available with us all the initial calibrations are done by printer before starting printing. We only have to set live adjust Z attribute for first layer printing which can be calibrated by going into first layer wizard in under Setting > First layer Wizard.

Steps for 3D printing

- Insert SD Card in 3D printer.
- Go to Menu > SD card. Select Model to print.
- ADD THE VRIABLES TO TWEAK

7. Component Reference Links

- <https://www.pjrc.com/store/teensy41.html>
- <https://help.prusa3d.com/downloads/mk3s/handbook>
- https://www.monolithicpower.com/en/documentview/productdocument/index/version/2/document_type/Datasheet/lang/en/sku/MP2731GQC/document_id/6814/
- <https://hmsemi.com/downfile/DW01A.PDF>
- https://www.ic-fortune.com/upload/Download/FS8205A-DS-12_EN.pdf

- https://www.pjrc.com/teensy/IMXRT1060RM_rev3.pdf
- https://www.pjrc.com/teensy/IMXRT1060CEC_rev0_1.pdf
- <https://www.rhydolabz.com/documents/30/spec1.pdf>
- <https://www.quectel.com/ProductDownload/EC20.zip>