



FAIO MULTIPLEXER INSTRUCTIONS MANUAL (V1.11)

What if you could have a switch interface that would let you perform many actions using only 4 switches?

Milad Hajihassan

https://github.com/milador/FAIO_Multiplexer

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Components List

1. ADAFRUIT FEATHER **x 1**
 - A. USB Version: ADAFRUIT FEATHER 32U4 BASIC PROTO or ADAFRUIT FEATHER M0 BASIC PROTO
 - B. XAC Joystick Version: ADAFRUIT FEATHER 32U4 BASIC PROTO
 - C. Wireless Version: ADAFRUIT FEATHER 32U4 Bluefruit LE or ADAFRUIT FEATHER M0 Bluefruit LE
2. ADDRESS LED DISC SER RGB 5MM **x 1**
3. FEATHER HEADER KIT FML **x 1**
4. RES 470 OHM 1/4W 5% AXIAL **x 1**
5. CONN JACK STEREO 3.5MM R/A **x 4**
6. HEX NUT 0.197" NYLON M2.5 **x 4**
7. MACH SCREW PAN SLOTTED M2.5X0.45 **x 4**
8. CONN HEADER VERT 5POS 2.54MM **(Optional: XAC Joystick version) x 1**
9. BATTERY LITHIUM 3.7V 350MAH **(Optional) x 1**

The FAIO_Multiplexer_BOM or FAIO_Multiplexer bill of materials can also be downloaded from GitHub repository under main directory.

https://github.com/milador/FAIO_Multiplexer/blob/master/Components/FAIO_Multiplexer_BOM.xlsx

Software

The FAIO-Multiplexer software can be downloaded from the GitHub repository under software directory.

The FAIO_Multiplexer hardware can be used along different software as input device for multiple devices. The FAIO_Multiplexer software is offered in the following flavors:

1. USB Version: [FAIO Multiplexer USB Software](#)
2. XAC Joystick Version: [FAIO Multiplexer Joystick Software](#)
3. Wireless Version: [FAIO Multiplexer Wireless Software](#)

Installing Arduino Libraries

The following instructions on how to install additional Arduino libraries helps you to get started with setting up Arduino IDE with required libraries and dependencies.

<https://www.arduino.cc/en/guide/libraries>

USB Version

Board Support Packages

You can find the official instructions to install Board Support Packages on Adafruit website using following link:

<https://learn.adafruit.com/adafruit-feather-m0-basic-proto/setup>

<https://learn.adafruit.com/adafruit-feather-32u4-basic-proto/arduino-ide-setup>

Note: Please follow the instructions depending on your Adafruit Feather board model.

Alternatively, you can perform following instructions to install Board Support Packages:

1. Open and start the Arduino IDE.
2. Go to **File > Preferences**.
3. Add following link as a new line under **Additional Board Manager URLs**
 - https://www.adafruit.com/package_adafruit_index.json
4. Restart the Arduino IDE
5. Open the Boards Manager option from the **Tools > Board** menu and install **Adafruit SAMD Boards by Adafruit** or **Adafruit SAMD Boards by Adafruit** depending on your board.
6. Wait until the IDE finishes installing the cross-compiling toolchain and tools associated with Board Support Package. This may take few minutes.
7. That's it! The installation of Board Support Packages is finished.

Required Software and libraries

The USB version of the software requires the following files and libraries:

- [StopWatch library](#)
- [EasyMorse library](#)
- [Adafruit NeoPixel library](#)
- [FlashStorage library](#) (Optional: Only Feather M0 Board)

- [FAIO Multiplexer USB Software.ino](#)

StopWatch library helps to calculate the reaction time and timeout in the morse code interface.

EasyMorse library is used to provide morse code input interface by translating morse code into characters.

FAIO_Multiplexer is using Adafruit_NeoPixel library to provide visual feedback using RGB LED.

The Feather M0 Board does not come with EEPROM support and requires using **FlashStorage** library to handle saving variables and settings.

You can use the following instructions to download and install the required libraries:

1. Visit the [StopWatch library](#) github repository page.
2. Click on **Code > Download Zip** to download StopWatch library.
3. Extract **Stopwatch_RT-master.zip** file
4. Rename **Stopwatch_RT-master** folder to **Stopwatch** folder under **Stopwatch_RT-master** subdirectory.
5. Copy or move **Stopwatch** folder to Arduino installation library subdirectory. As an example: This is found under **C:\Program Files (x86)\Arduino\libraries** in windows 10.
6. Visit the [EasyMorse library](#) github repository page.
7. Click on **Code > Download Zip** to download **EasyMorse** library.
8. Extract **EasyMorse.zip** file
9. Rename **EasyMorse-master** folder to **EasyMorse** folder under **EasyMorse-master** subdirectory.
10. Copy or move **EasyMorse** folder to Arduino installation library subdirectory. As an example: This is found under **C:\Program Files (x86)\Arduino\libraries** in windows 10.
11. Visit the [FlashStorage library](#) github repository page.
12. Click on **Code > Download Zip** to download **FlashStorage** library.
13. Extract **FlashStorage.zip** file
14. Rename **FlashStorage-master** folder to **FlashStorage** folder under **FlashStorage -master** subdirectory.
15. Copy or move **FlashStorage** folder to Arduino installation library subdirectory. As an example: This is found under **C:\Program Files (x86)\Arduino\libraries** in windows 10.
16. Visit the [FAIO Multiplexer USB Software.ino](#) raw source code file under **FAIO_Multiplexer** github repository page.
17. Right click on the source code or any place on this page and select **Save Page As...**
18. Select the directory you would like to save the software in your computer.
19. Change **File name** from **FAIO_Multiplexer_USB_Software** to **FAIO_Multiplexer_USB_Software.ino**
20. Change **Save as type** to **All Files**.
21. Click on **Save** button.
22. Open the directory you selected in **step 18**.
23. Double left click or open **FAIO_Multiplexer_USB_Software** file

24. Arduino IDE will ask your permission to create a new sketch folder named **FAIO_Multiplexer_USB_Software** and move **FAIO_Multiplexer_USB_Software.ino** under this folder.
25. Click on the **Ok** button.
26. Arduino IDE should now open the **FAIO_Multiplexer_USB_Software.ino** file automatically.

Uploading Software

Note: Make sure all three files are included in your local copy of Software directory before uploading it to the Adafruit Feather board. The libraries can be installed in Arduino libraries.

You can go ahead and upload the downloaded .ino software to Adafruit Feather board using Arduino IDE once all the necessary libraries are installed.

1. Select the Board under **Tools > Board > Adafruit Boards** as **Adafruit Feather 32u4** or under **Tools > Board > Adafruit SAMD Boards** as **Adafruit Feather M0** based on your board.
2. Select the correct port number under **Tools > Port** which should say **COM XX (Adafruit Feather 32u4)** or **COM XX (Adafruit Feather M0)** based on your board

Note: It's very important to make sure the correct Board and port number are selected as selecting the wrong board may result problems with bootloader of Adafruit Feather board.

3. Press the **Verify** button to make sure there is no problem with the software and libraries.
4. Press **Upload** button

Here you can see an example of my selected Board and port number.

Note: Your port number will not be the same

You can now go ahead and upload the software. Arduino IDE will show you a **Done uploading** message indicating the software is uploaded to your FAIO_Multiplexer.

The LED on the FAIO_Multiplexer main board blinks two times in green to indicate the start of initialization process has been started and it will blink again two times in green to indicate end of the initialization process.

You can also open the Serial Monitor in Arduino IDE on 115200 baud rate to read initialization information about the version of software.

XAC Joystick Version

Board Support Packages

You can find the official instructions to install Board Support Packages on Adafruit website using following link:

<https://learn.adafruit.com/adafruit-feather-32u4-basic-proto/arduino-ide-setup>

Alternatively, you can perform following instructions to install Board Support Packages:

1. Open and start the Arduino IDE.
2. Go to **File > Preferences**.
3. Add following link as a new line under **Additional Board Manager URLs**
 - https://www.adafruit.com/package_adafruit_index.json
4. Restart the Arduino IDE
5. Open the Boards Manager option from the **Tools > Board** menu and install **Adafruit AVR Boards by Adafruit**
6. Wait until the IDE finishes installing the cross-compiling toolchain and tools associated with Board Support Package. This may take few minutes.
7. That's it! The installation of Board Support Packages is finished.

Required Software and libraries

The XAC Joystick version of the software requires the following files and libraries:

- [StopWatch library](#)
- [Joystick library](#)
- [Adafruit_NeoPixel library](#)
- [FAIO_Multiplexer_Joystick_Software.ino](#)

The joystick library is used to turn FAIO_Multiplexer into a joystick USB HID device which can be supported by Xbox adaptive controller.

FAIO_Multiplexer is using Adafruit_NeoPixel library to provide visual feedback using RGB LED.

You can use the following instructions to download and install the required libraries:

1. Visit the [StopWatch library](#) github repository page.
2. Click on **Code > Download Zip** to download StopWatch library.
3. Extract **Stopwatch_RT-master.zip** file
4. Rename **Stopwatch_RT-master** folder to **Stopwatch** folder under **Stopwatch_RT-master** subdirectory.
5. Copy or move **Stopwatch** folder to Arduino installation library subdirectory. As an example: This is found under **C:\Program Files (x86)\Arduino\libraries** in windows 10.
6. Visit the [Joystick library](#) github repository page.

7. Click on **Code > Download Zip** to download **ArduinoJoystickLibrary** library.
8. Extract **ArduinoJoystickLibrary.zip** file
9. Copy or move **Joystick** folder under **ArduinoJoystickLibrary-master** subdirectory to Arduino installation library subdirectory. As an example: This is found under **C:\Program Files (x86)\Arduino\libraries** in windows 10.
10. Visit the [FAIO Multiplexer Joystick Software.ino](#) raw source code file under **FAIO_Multiplexer** github repository page.
11. Right click on the source code or any place on this page and select **Save Page As...**
12. Select the directory you would like to save the software in your computer.
13. Change **File name** from **FAIO_Multiplexer_Joystick_Software** to **FAIO_Multiplexer_Joystick_Software.ino**
14. Change **Save as type** to **All Files**.
15. Click on **Save** button.
16. Open the directory you selected in **step 12**.
17. Double left click or open **FAIO_Multiplexer_Joystick_Software** file
18. Arduino IDE will ask your permission to create a new sketch folder named **FAIO_Multiplexer_Joystick_Software** and move **FAIO_Multiplexer_Joystick_Software.ino** under this folder.
19. Click on the **Ok** button.
20. Arduino IDE should now open the **FAIO_Multiplexer_Joystick_Software.ino** file automatically.

Uploading Software

Note: Make sure all three files are included in your local copy of Software directory before uploading it to the Adafruit Feather board. The libraries can be installed in Arduino libraries.

You can go ahead and upload the downloaded .ino software to Adafruit Feather board using Arduino IDE once all the necessary libraries are installed.

1. Select the Board under **Tools > Board > Adafruit Boards** as **Adafruit Feather 32u4**
2. Select the correct port number under **Tools > Port** which should say **COM XX (Adafruit Feather 32u4)**

Note: It's very important to make sure the correct Board and port number are selected as selecting the wrong board may result problems with bootloader of Adafruit Feather board.

3. Press the **Verify** button to make sure there is no problem with the software and libraries.
4. Press **Upload** button

Here you can see an example of my selected Board and port number.

Note: Your port number will not be the same

You can now go ahead and upload the software. Arduino IDE will show you a **Done uploading** message indicating the software is uploaded to your FAIO_Multiplexer.

The LED on the FAIO_Multiplexer main board blinks two times in green to indicate the start of initialization process has been started and it will blink again two times in green to indicate end of the initialization process.

You can also open the Serial Monitor in Arduino IDE on 115200 baud rate to read initialization information about the version of software.

Wireless Version

Board Support Packages

You can find the official instructions to install Board Support Packages on Adafruit website using following links:

<https://learn.adafruit.com/adafruit-feather-m0-bluefruit-le/setup>

<https://learn.adafruit.com/adafruit-feather-32u4-bluefruit-le//setup>

Note: Please follow the instructions depending on your Adafruit Feather board model.

The wireless version of the FAIO_Multiplexer is using nRF51 Bluetooth chip to communicate with host devices. Bluetooth communication might seem complicated but Adafruit has made the bluetooth communication process less challenging by providing Adafruit nRF51 BLE Library which you can download from Adafruit and import it to your locally installed Arduino directory under libraries directory.

https://github.com/adafruit/Adafruit_BluefruitLE_nRF51

The instructions on how to install Adafruit nRF51 BLE Library can be found in following link:

<https://learn.adafruit.com/adafruit-feather-32u4-bluefruit-le/installing-ble-library>

Alternatively, you can perform following instructions to install Board Support Packages:

1. Open and start the Arduino IDE.
2. Go to **File > Preferences**.
3. Add following link as a new line under **Additional Board Manager URLs**
 - https://www.adafruit.com/package_adafruit_index.json
4. Restart the Arduino IDE
5. Open the Boards Manager option from the **Tools > Board** menu and install **Adafruit SAMD Boards by Adafruit** or **Adafruit SAMD Boards by Adafruit** depending on your board.
6. Wait until the IDE finishes installing the cross-compiling toolchain and tools associated with Board Support Package. This may take few minutes.
7. That's it! The installation of Board Support Packages is finished.

Required Software and libraries

The wireless version of the software requires the following files and libraries:

- [StopWatch library](#)
- [EasyMorseBlue library](#)
- [Adafruit NeoPixel library](#)

- [FlashStorage library](#) (Optional: Only Feather M0 Board)
- [Bluefruit Arduino Library](#)
- [FAIO Multiplexer Wireless Software.ino](#)

StopWatch library helps to calculate the reaction time and timeout in the morse code interface.

The EasyMorseBlue library is the Bluetooth version of EasyMorse library which is used to enable the end user to use morse code or a sequence of dots and dashes as input method.

FAIO_Multiplexer is using Adafruit_NeoPixel library to provide visual feedback using RGB LED.

1. Visit the [StopWatch library](#) github repository page.
2. Click on **Code > Download Zip** to download StopWatch library.
3. Extract **Stopwatch_RT-master.zip** file
4. Rename **Stopwatch_RT-master** folder to **Stopwatch** folder under **Stopwatch_RT-master** subdirectory.
5. Copy or move **Stopwatch** folder to Arduino installation library subdirectory. As an example: This is found under **C:\Program Files (x86)\Arduino\libraries** in windows 10.
6. Visit the [EasyMorseBlue library](#) github repository page.
7. Click on **Code > Download Zip** to download **EasyMorseBlue** library.
8. Extract **EasyMorse.zip** file
9. Rename **EasyMorseBlue-master** folder to **EasyMorseBlue** folder under **EasyMorseBlue-master** subdirectory.
10. Copy or move **EasyMorseBlue** folder to Arduino installation library subdirectory. As an example: This is found under **C:\Program Files (x86)\Arduino\libraries** in windows 10.
11. Visit the [FlashStorage library](#) github repository page.
12. Click on **Code > Download Zip** to download **FlashStorage** library.
13. Extract **FlashStorage.zip** file
14. Rename **FlashStorage-master** folder to **FlashStorage** folder under **FlashStorage -master** subdirectory.
15. Copy or move **FlashStorage** folder to Arduino installation library subdirectory. As an example: This is found under **C:\Program Files (x86)\Arduino\libraries** in windows 10.
16. Click on **Sketch > Include Library > Manage Libraries...**
17. Search for the **Adafruit BluefruitLE nRF51** library and install it.
18. Visit the [FAIO Multiplexer Wireless Software.ino](#) raw source code file under **FAIO-Multiplexer** github repository page.
19. Right click on the source code or any place on this page and select **Save Page As...**
20. Select the directory you would like to save the software in your computer.
21. Change **File name** from **FAIO_Multiplexer_Wireless_Software** to **FAIO_Multiplexer_Wireless_Software.ino**
22. Change **Save as type** to **All Files**.
23. Click on **Save** button.
24. Open the directory you selected in **step 20**.
25. Double left click or open **FAIO_Multiplexer_Wireless_Software** file

26. Arduino IDE will ask your permission to create a new sketch folder named ***FAIO_Multiplexer_Wireless_Software*** and move ***FAIO_Multiplexer_Wireless_Software.ino*** under this folder.
27. Click on the ***Ok*** button.
28. Arduino IDE should now open the ***FAIO_Multiplexer_Wireless_Software.ino*** file automatically.

Uploading Software

Note: Make sure all three files are included in your local copy of Software directory before uploading it to the Adafruit Feather board. The libraries can be installed in Arduino libraries.

You can go ahead and upload the downloaded .ino software to Adafruit Feather board using Arduino IDE once all the necessary libraries are installed.

1. Select the Board under **Tools > Board > Adafruit Boards** as **Adafruit Feather 32u4** or under **Tools > Board > Adafruit SAMD Boards** as **Adafruit Feather M0** based on your board.
2. Select the correct port number under **Tools > Port** which should say **COM XX (Adafruit Feather 32u4)** or **COM XX (Adafruit Feather M0)** based on your board

Note: It's very important to make sure the correct Board and port number are selected as selecting the wrong board may result problems with bootloader of Adafruit Feather board.

1. Press the ***Verify*** button to make sure there is no problem with the software and libraries.
2. Press ***Upload*** button

You can now go ahead and upload the software. Arduino IDE will show you a ***Done Uploading*** message indicating the software is uploaded to your FAIO_Multiplexer.

The LED on the FAIO_Multiplexer main board blinks two times in ***teal*** to indicate the start of initialization process has been started and it will blink again two times in green to indicate end of the initialization process.

You can also open the Serial Monitor in Arduino IDE on 115200 baud-rate to read initialization information about the version of software.

Hardware Assembly

Printed circuit Board design

The printed circuit boards (PCB) can be downloaded from GitHub repository under Hardware directory.

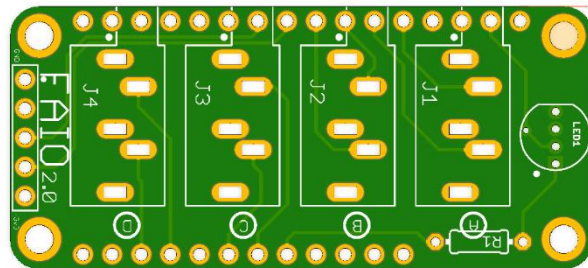
https://github.com/milador/FAIO_Multiplexer/tree/master/Hardware/PCB_design

Enclosure design

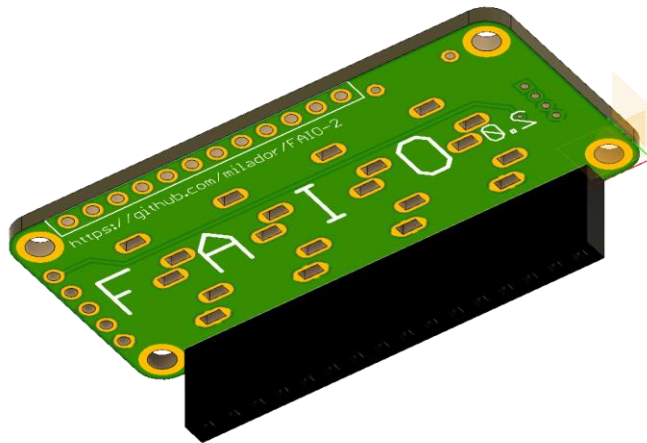
The enclosure/housing files in STL format can be downloaded from GitHub repository under Hardware directory.

https://github.com/milador/FAIO_Multiplexer/tree/master/Hardware/Housing_design

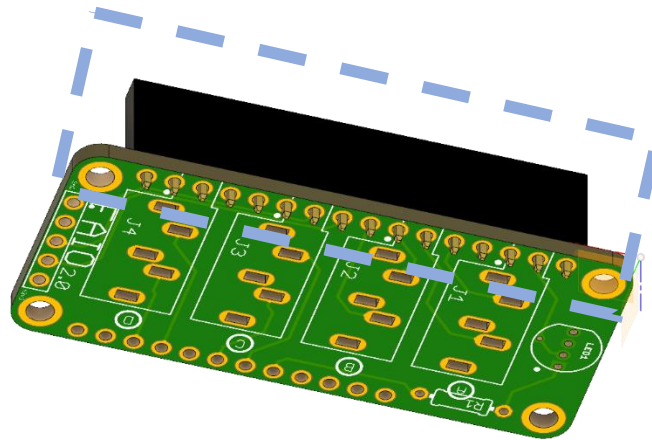
Assembly Instructions



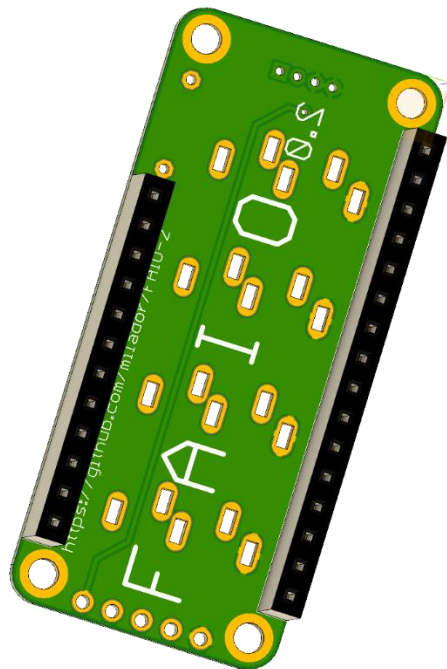
Step 1 – FAIO Switch main board x 1



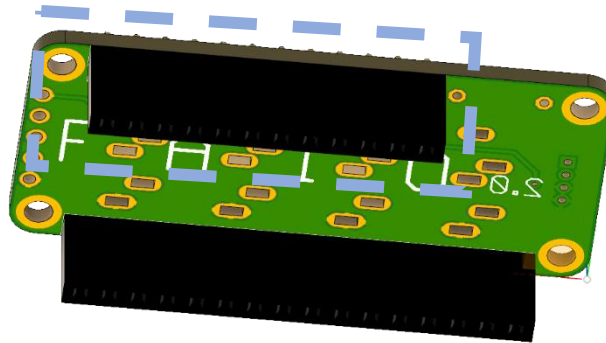
Step 2 – 16 position female header connector x 1



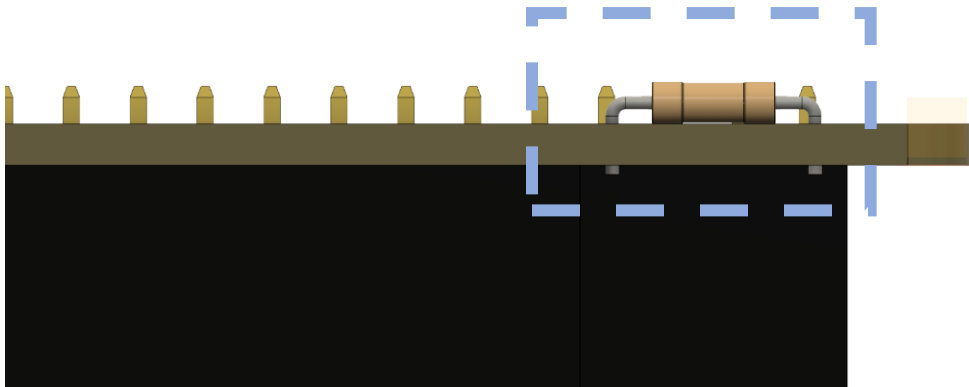
Step 3 – Solder 16 position female header connector



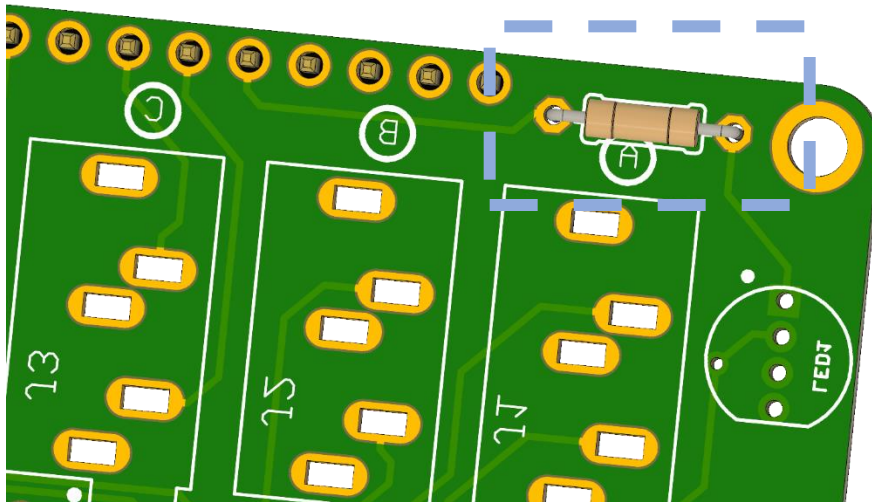
Step 4 – 12 position female header connector x 1



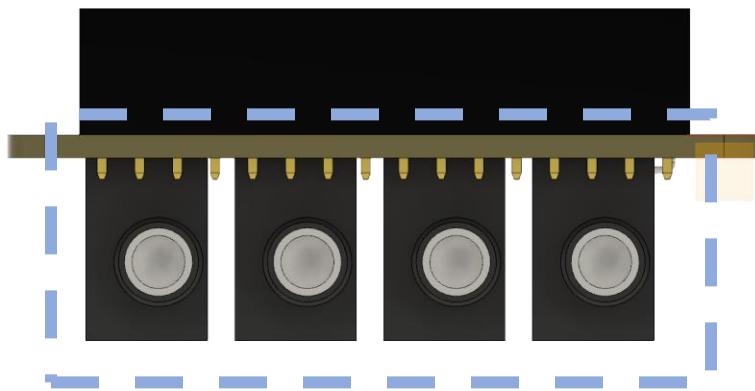
Step 5 – Solder 14 position female header connector



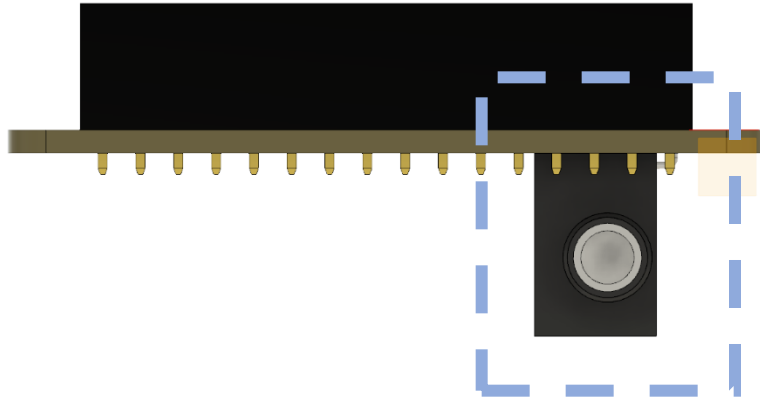
Step 6 – 470 OHM Resistor



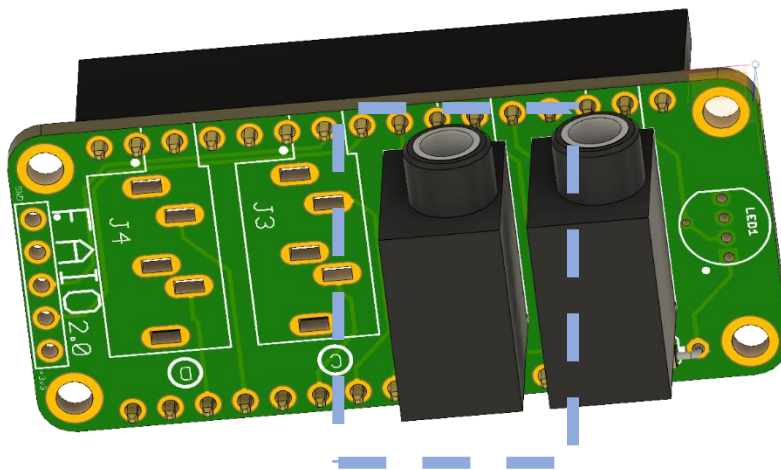
Step 7 – Solder 470 OHM Resistor



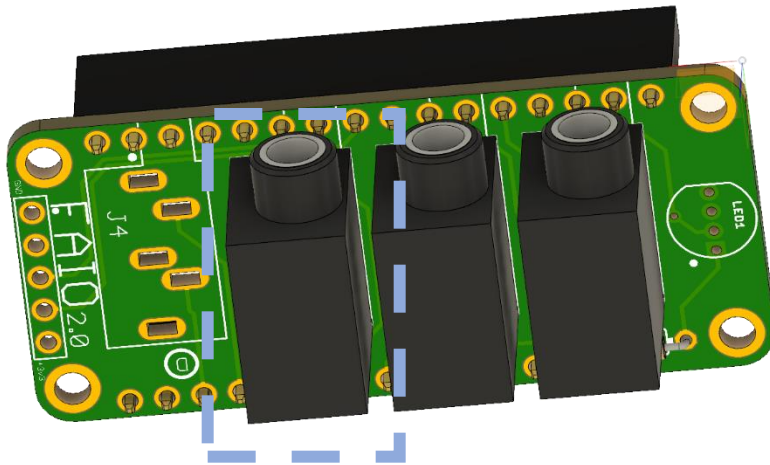
Step 8 – 3.5 mm stereo audio plugs x 4



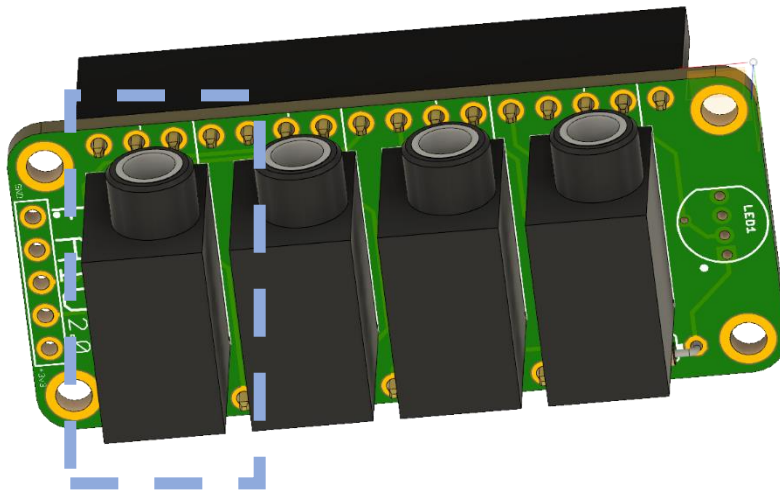
Step 9 – Solder 3.5MM plug A



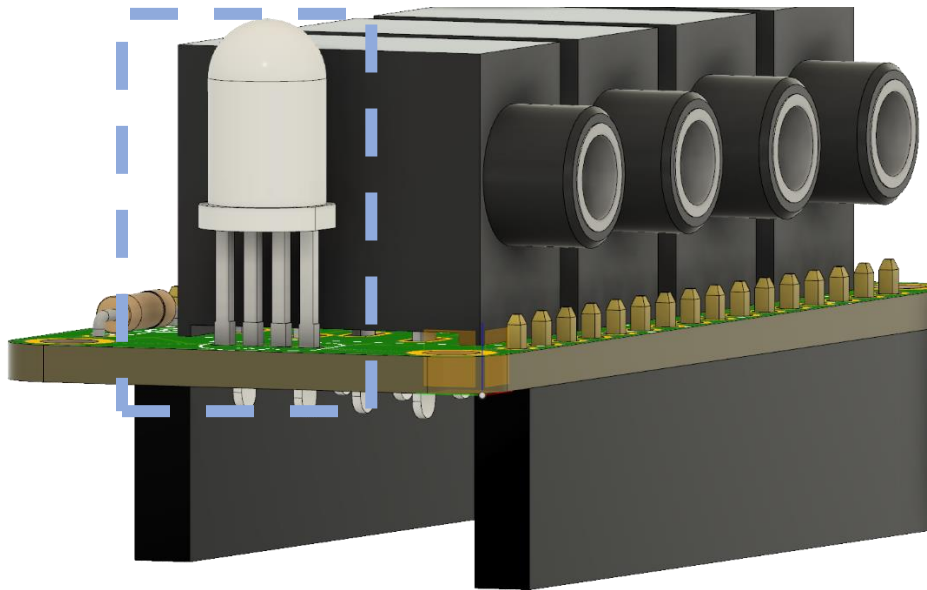
Step 10 – Solder 3.5MM plug B



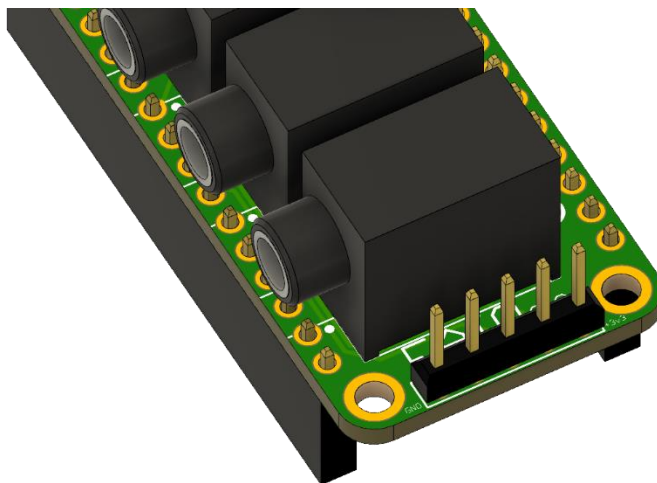
Step 11 – Solder 3.5MM plug C



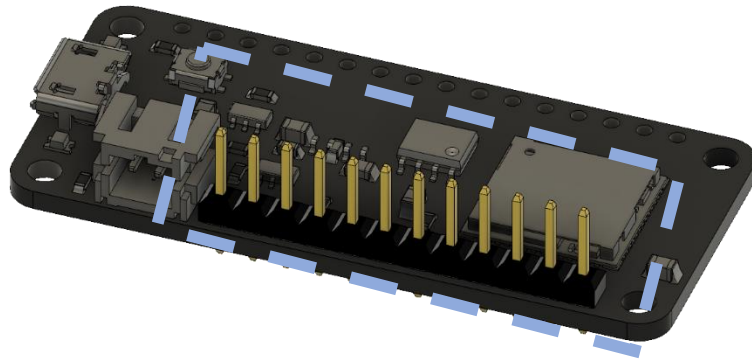
Step 12 – Solder 3.5mm plug D



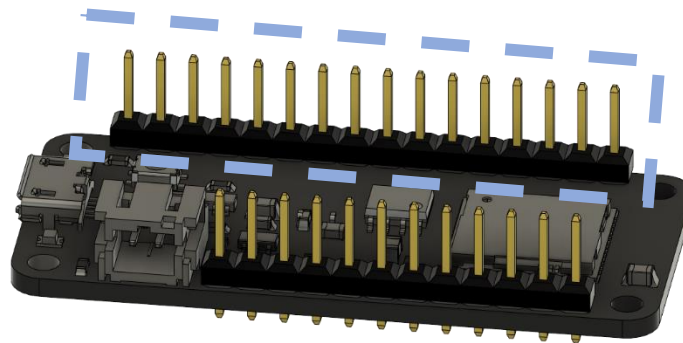
Step 13 – Solder RGB LED x 1



Step 14 – Solder 5 position male header connector on feather board



Step 15 – Solder 12 position male header connector on feather board



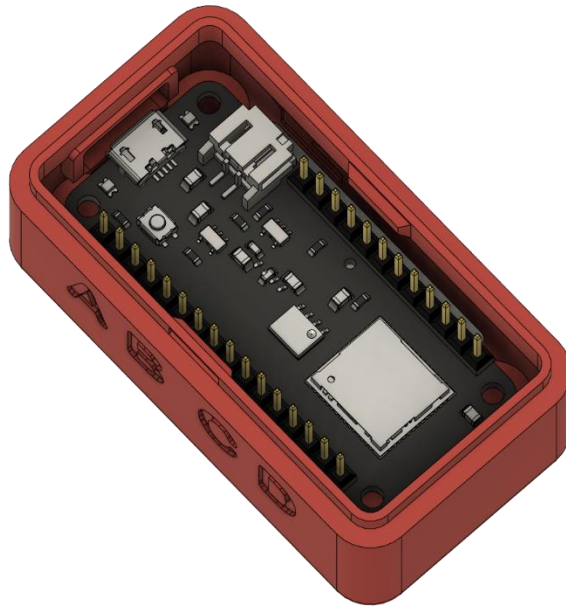
Step 16 – Solder 16 position male header connector on feather board



Step 17 – 3D Print FAIO Multiplexer enclosure bottom part



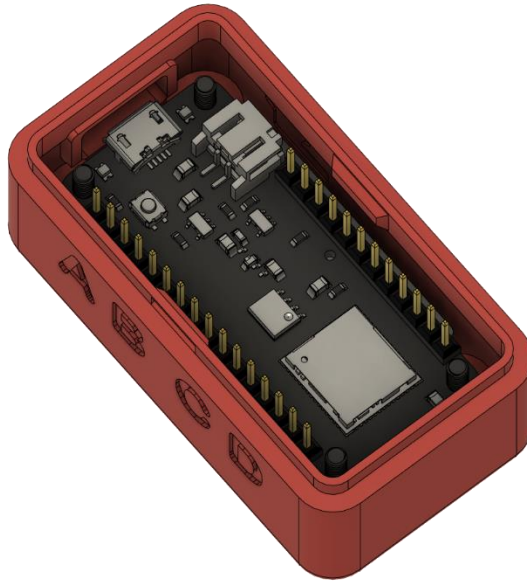
Step 18 – 3D Print FAIO Multiplexer enclosure battery holder part and insert it into the enclosure



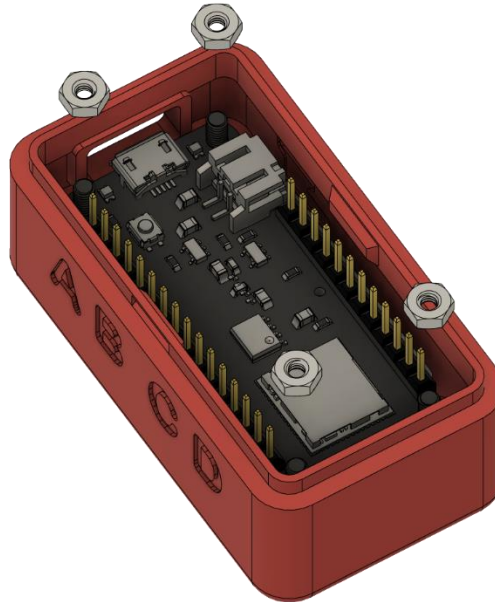
Step 19 – Insert the Feather board into the main enclosure.



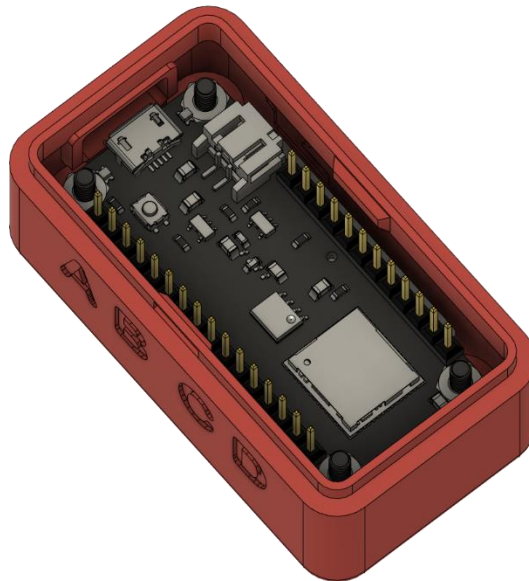
Step 20 – Insert the four M2.5 machine screws in Feather board drill holes



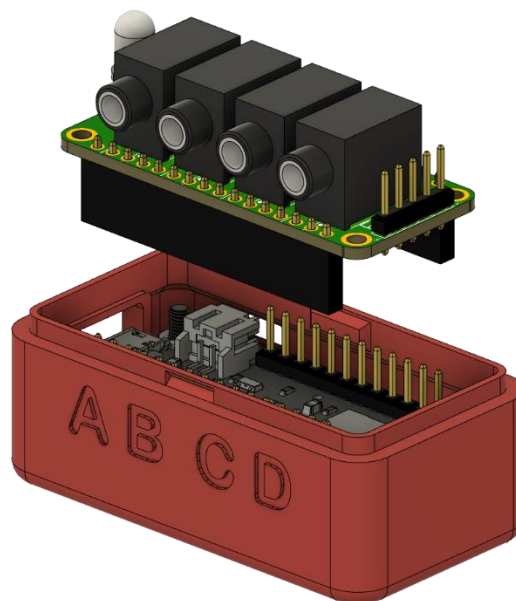
Step 21 – Make sure the Feather board is seating flat inside the enclosure.



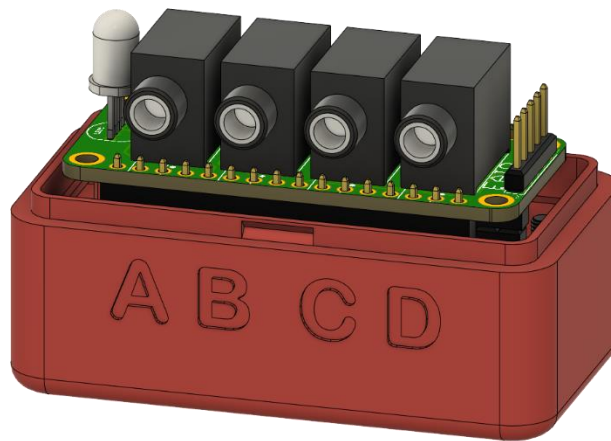
Step 22 – Insert the four M2.5 Machine screw nuts at the top of the enclosure into Machine screws.



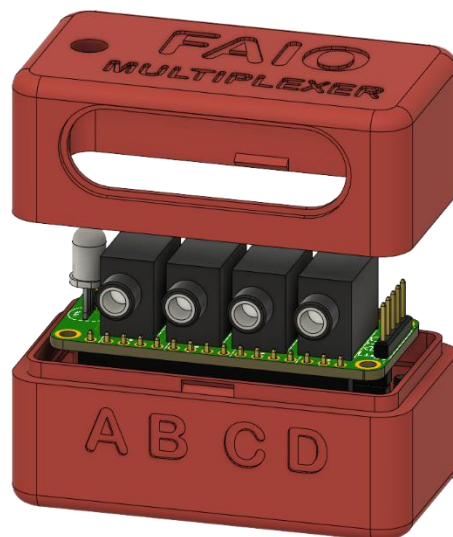
Step 23 – Hold the screws still while you spin the nuts.



Step 24 – Stack the FAIO Multiplexer PCB Board into the Feather board inside the enclosure.



Step 25 – Make sure the FAIO board has been stacked correctly and the 3.5mm Audio plugs are accessible.



Step 26 – 3D Print FAIO Multiplexer enclosure top part and insert it into the enclosure



Step 27 – That's it! Your FAIO Multiplexer is fully assembled and ready to use.