Installation Instructions

Important: The firmware works only with the ESP32-S3 LilyGo T-Display S3 Touch.

Here are some links to related videos on YouTube.

https://youtu.be/HgioXrjpPSk?feature=shared

https://youtu.be/gyk2eq8ZymM?feature=shared

https://www.youtube.com/watch?v=cFctgusRfhY

Here is a link to the Espressif Flash Download Tools required for uploading the firmware:

https://www.espressif.com/en/support/download/other-tools

 Link to the firmware: https://1drv.ms/f/c/38ba1975d40552d7/EtdSBdR1GboggDh6AAAAAAABXGewSTWX4JG938piuGl--g

 To upload the firmware, please follow these steps:

1. Download the Espressif Flash Tool or alternatively use the online tool
   https://espressif.github.io/esptool-js/
2. Choose Chip Type: ESP32-S3, WorkMode Develop and LoadMode USB
3. Press the tree dots to select the files as follows:

My_Radio.bin 0x0000

Ensure all lines are marked green. If not, use the check mark on the left side.

Here is a screenshot of the flash tool:

Make sure to select your designated com port (located at the right bottom side)
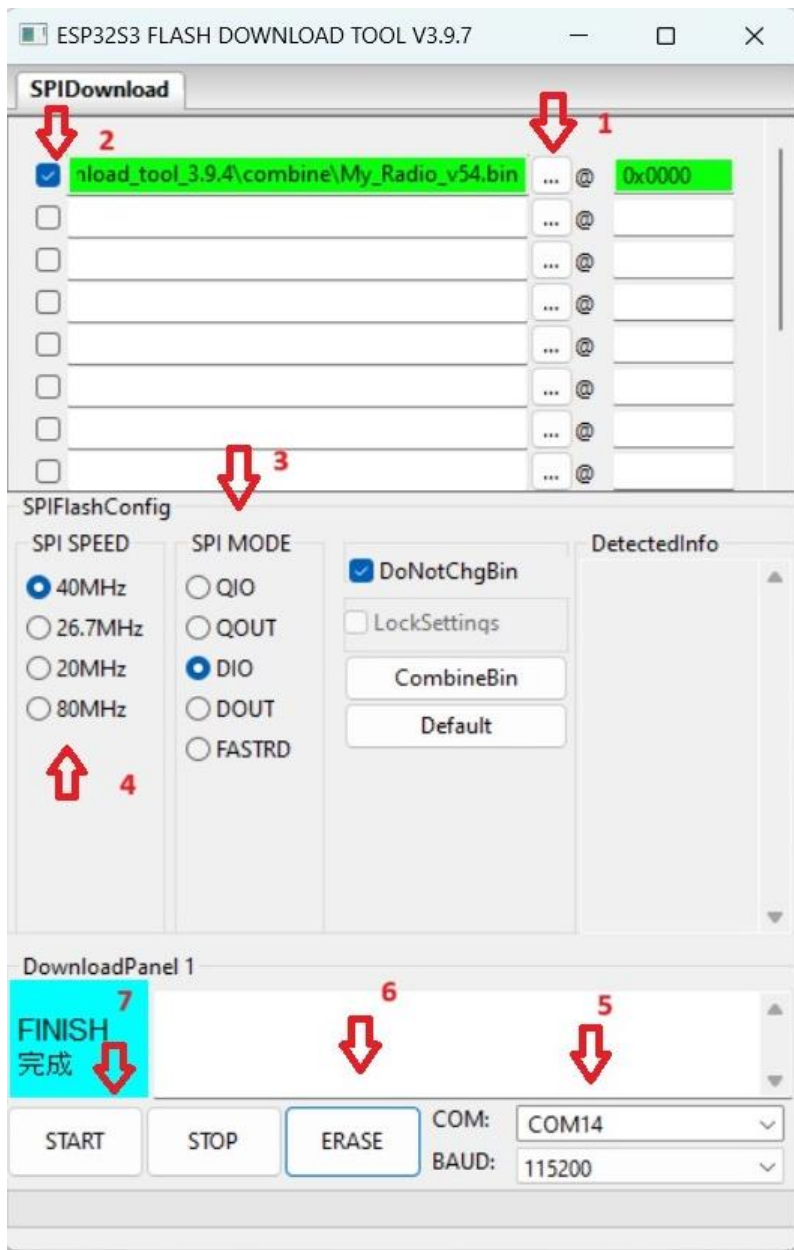
It is recommended to press first on Erase to clean the memory.

To upload the firmware, press the start button.

One time connecting process:

1. After successful upload press the reset button on the ESP32 or disconnect the USB cable and reconnect it.
2. Wait a few seconds until network scanning completes.
3. Open the Wi-Fi settings in your phone or computer browser and search for My_Radio network.
4. **Go to the following address: 192.168.4.1**

5. Press "Configure Wi-Fi", Find your network and connect to that network using your internet password and press the "Save" button. This connects the radio permanently to your home network.
6. Press the reset button of the ESP32 controller and wait until the Spiff file system formatting is completed (you will get a message on the LCD Screen).
   a. When complete, the LCD will display the IP address assigned by your home router.
   b. Open your computer web browser and type that IP address.
   c. Upload a single station or list of stations using the following format:

(example file with various stations can be found in the documentation folder, for testing just copy and paste that list).

Station Name 1, Station Address 1

Station Name 2, Station Address 2

Radio Ibiza, http://ibiza-smooth-jazz.vip-radios.fm:8033/stream-128kmp3-IbizaSmooth

Roma Radio, http://nr9.newradio.it:9371/stream

You can find and copy station URL's in the following web sites:

- https://streamurl.link/

- https://fmstream.org/ (search for the desired station, click on it to start playing and copy the link from the player located at the bottom of the page)

- https://www.radio-browser.info/

or alternatively search YouTube for instruction video on how to get live radio streaming URLs. You can also have a look at https://radio.garden/ .

For some stations that don't play or don't play well , and their URL starts with https:// try changing the URL to http:// and check if it is working.

7. The last step - Open the web page. At the bottom left corner of the page, you will see the following.

Your Internet Radio ID:

153963357526764

License Key

Enter your key Here: [   ]
[Authenticate]

The Station management system was tested and debugged only with Google chrome browser.

Please send me your RADIO ID to the following email **themicromaker@yahoo.com**

I will email you back the required License Key.

Radio Station Manager

Play Station

Enter Station Number: [＿＿＿＿＿＿＿]

PLAY

Play Previous **Play Next**

Current Station

Station Number: 114

Station Name: Exclusively Italy

Volume Control

Volume: ————○—— 79

Audio Equalizer

Bass (dB): ————○— -1
Mid (dB): ———○—— -1
Treble (dB): ——————○ 6

Save

Audio Mode

● Mono
○ Stereo

Apply

Screen Saver

☐ Enable Screen Saver

Save

Total Stations Stored: 115

Enter Station Name: [＿＿＿＿＿＿]
Enter Station Address (URL): [＿＿＿＿＿＿]

Save

Enter Station Number to Erase: [＿＿＿＿＿＿]

Erase

Station 149
Station Name: Classical Music
Station Address: https://stream.epic-classical.com/classical-n

Station 150
Station Name: WFMT Classical
Station Address: https://wfmt.streamguys1.com/main-mp3

Station 151
Station Name: Radio Italy
Station Address: https://sphera.fluidstream.eu/rpd_hita.mp3

Station 152
Station Name: Top Italia
Station Address: http://streaming.cst98.com:8000/tir320.mp3

Station 153
Station Name: Nostalgia Italia
Station Address: https://scdn.nrjaudio.fm/adwz1/fr/30663/mp

Enter Station List (one entry per line in the format 'Station N

Use the following format:
Station Name 1,Station Address 1
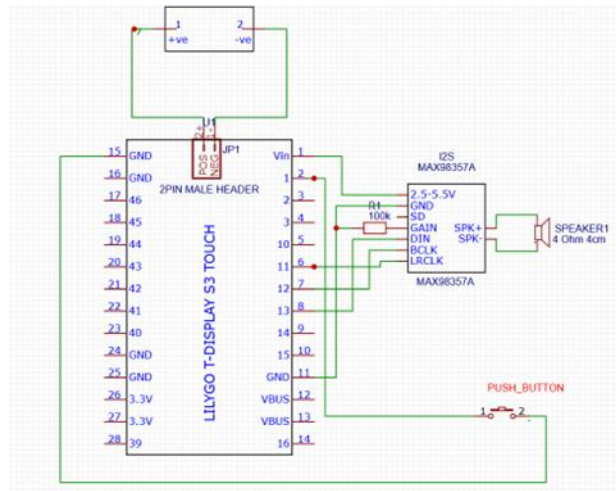Station Name 2,Station Address 2
My Favorite Station,http://123.456.789.0/stream
Awesome Hits Radio,http://stream.awesomehitsradio.com

Update Stations
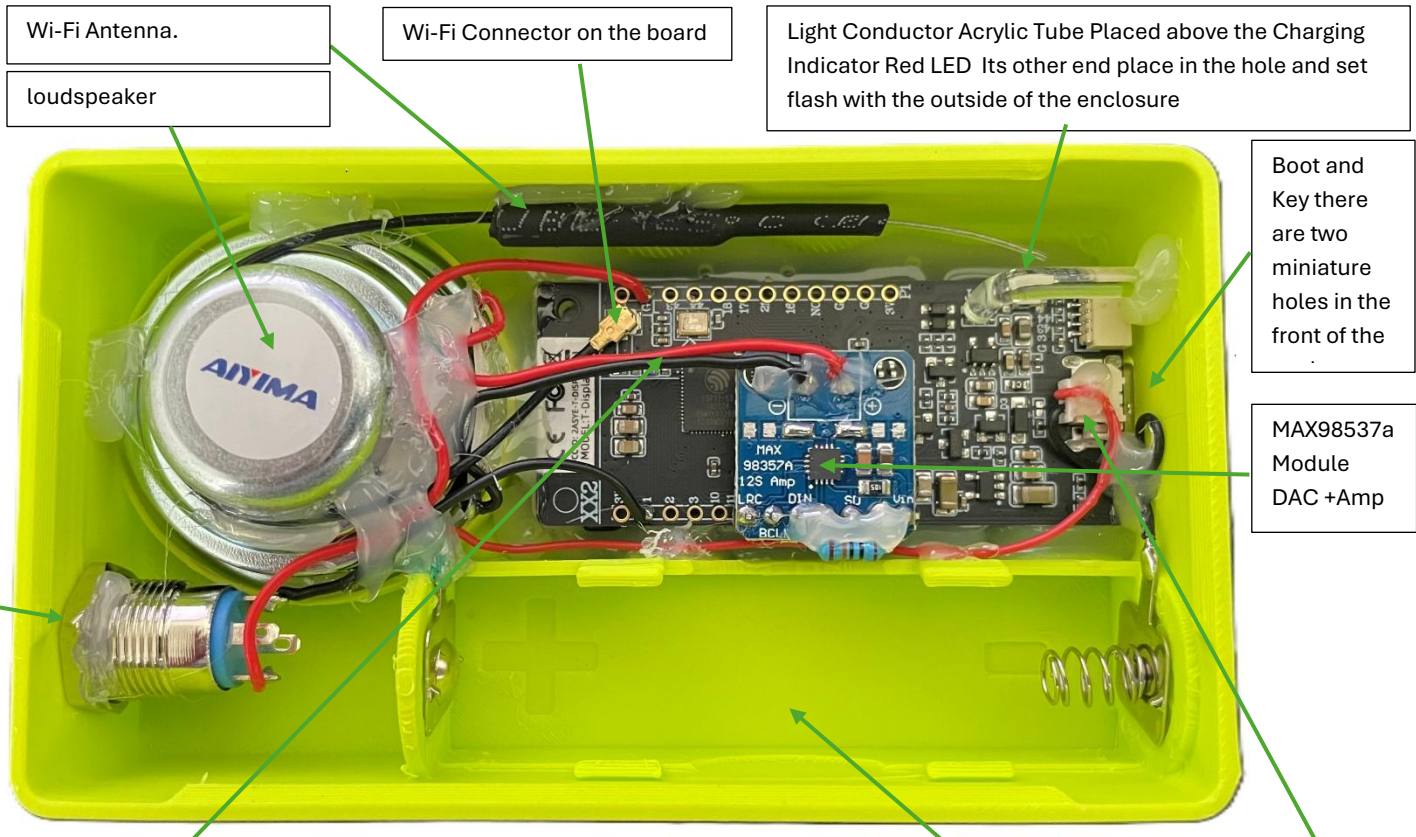
Connection Diagram

- To reset Wi-Fi settings - Press the reset button and IO14 (Key) button together. Release the reset button while keep pressing IO14 for at least 3 seconds until you get a message on the LCD that Wi-Fi setting has been erased (The Key - IO14 button is located on the left bottom side- see photo).

- To activate boot mode (sometimes required when upgrading firmware): press the boot button together with the reset button. Release the reset button while keep pressing the boot button. Now release the boot button. You will see a black screen. The radio is now in boot mode.

If you don't have access to the reset button you can press one of the above buttons (IO14 or boot buttons depend on what you need to achieve) and while pressing power on the radio.

Radio Internal Layout

Wi-Fi Antenna.

loudspeaker

Wi-Fi Connector on the board

Light Conductor Acrylic Tube Placed above the Charging Indicator Red LED Its other end place in the hole and set flash with the outside of the enclosure

Boot and Key there are two miniature holes in the front of the

MAX98537a Module DAC +Amp

On/Off Switch

Important: Speaker Cables. Connect red wire between the module + to the right side of the speaker marked with +. Connect black wire to the module – and the left side of the speaker marked with -

18650 Battery holder. There are two wires red and black with a connector at the end. That battery connector should be connected the mani board here:

Install the battery only after the radio is complete, tested with the USB-C cable and verified all cables are glued.

Hot Glue

Note: The enclosure is made of PLA plastic which can be melt in relatively low temperature so make sure not to touch the enclosure directly with the glue gun and also not apply to much glue at a time.

Note: The hot glue can be easily removed using 99% isopropyl alcohol but if you use it be careful that that isopropyl alcohol will not touch the back side of the display as it will destroy it permanently.

Installation

Following is the connection diagram for using the Max98357a chip (if you use pin header you don't need to connect wires as the pins are arranged correctly). Connect the I2S DAC to the following pins as shown in the picture: BCLK to pin 12, LRC to pin 11, DOUT to pin 13, VCC to 5V, GND to GND (Required by some other DACs - MCLK to pin 10).

Refer to the below photo: it is possible to solder the DAC directly to the ESP32 in the following way (the pins are already aligned)

After soldering the DAC to the pins you only need to connect a speaker to the + and - signs (speaker pins) on the DAC module.
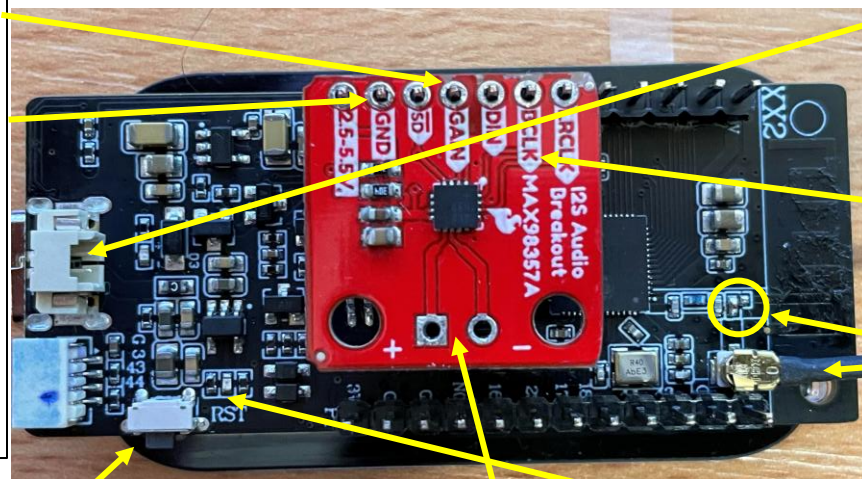
For AMP higher gain . Connect the 100K resistor between Gain pin and GND pin (see photo below)
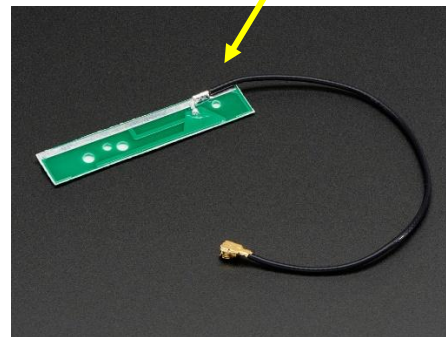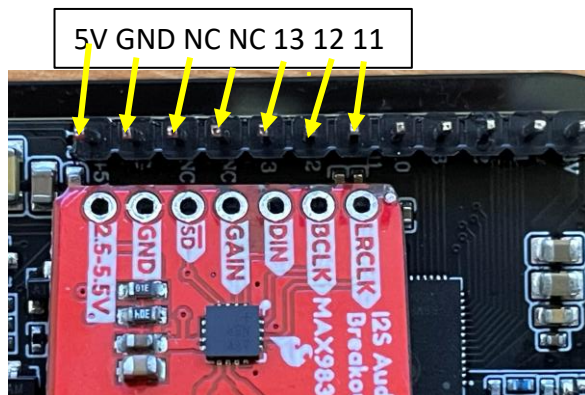
Battery connector. Female connector can be found inside the microcontroller box.

DAC+AMP Solder that way, no need for wires

External Antenna - requires switching jumper to external antenna (already done if you purchased a kit)

Reset Button

Speaker 5W Preferable

5V GND NC NC 13 12 11

Battery charging RED LED. Glue the supplied light conducting Acrylc Tube above the LED. Make sure the light is visible outside of the enclosure. Alternatively, you can replaced the onboard LED with an external LED but this requires some micro soldering skills (not recommended).

Notes:

1. An I2S DAC is required for this project, Amplifier is optional. In general, all 16 bit DACs that have the DIN, BLCK and LRC pins. PCM5102A delivers stereophonic good results.

2. For some stations that don't play, and their URL starts with https:// try changing it to http:// and check if it is working.

3. **Important Note: The WIFI Internal antenna of this LilyGo Board is not optimal. It is essential to use antenna to enhance the Radio Reception when your router is far away.**
   For the antenna to work you will need to move on the PCB the 0 ohm resistor (short) from external antenna to internal antenna (you don't need the actual 0 ohm resistor just short it). You can refer to this article for detailed explanation:
   https://randomnerdtutorials.com/esp32-cam-connect-external-antenna/
   Or YouTube video https://www.youtube.com/watch?v=aBTZuvg5sM8

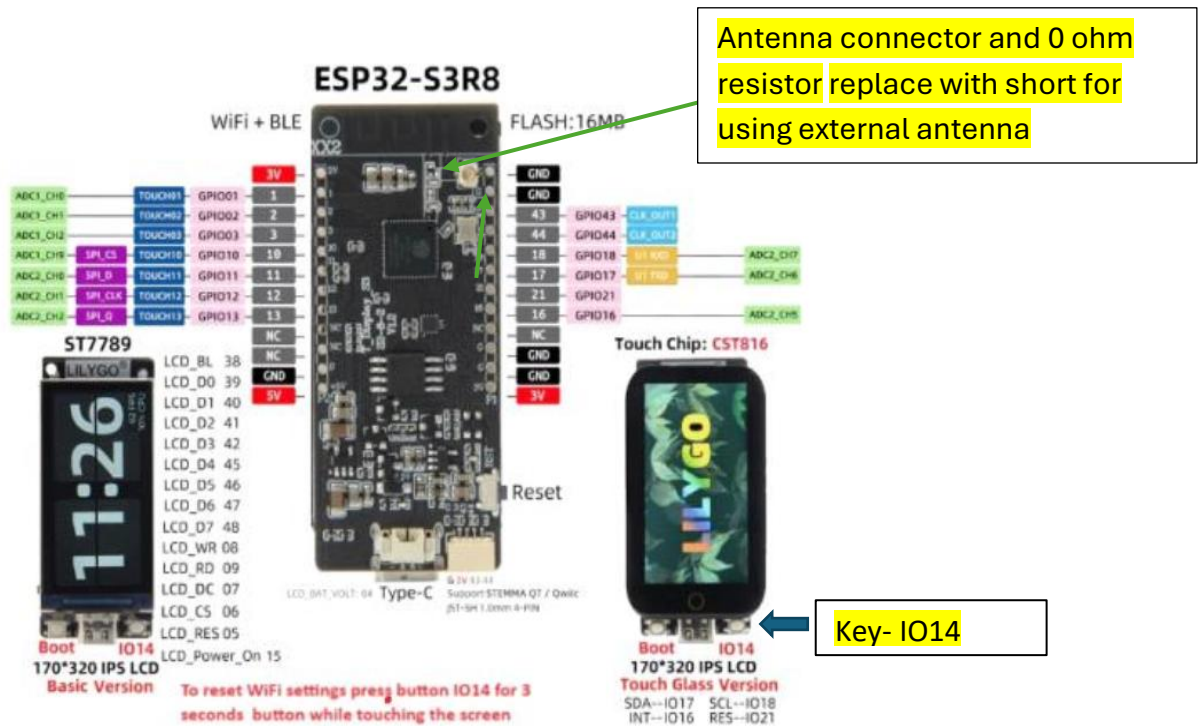   Note: If you purchased a kit the following external antenna fix has already been done, just connect the supplied antenna using the IPEX connector.

For External Antenna	For Internal Antenna
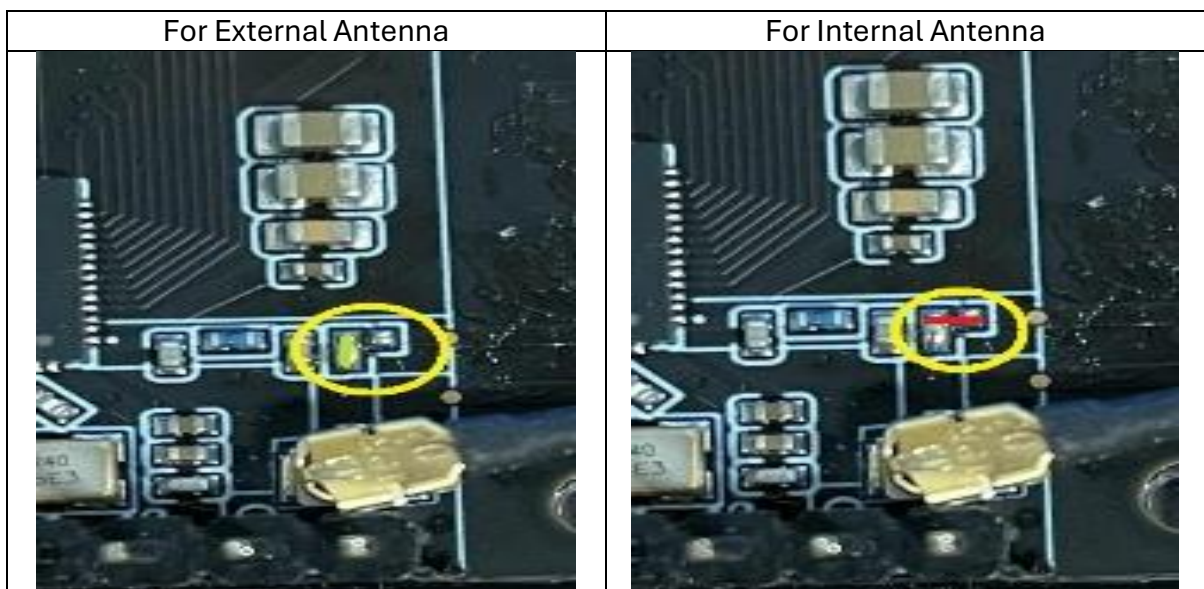
Installation & Components Layout

After uploading the firmware and soldering the MAX98357A and 100K resistor as described above, and verifying that the radio is working, you can begin mounting all the components inside the enclosure.

1. **Place the enclosure** on a flat surface, face down. Insert the LCD screen into its designated location with the screen facing downward, making sure it is flush with the enclosure surface.
2. **Secure the LCD screen** using a hot glue gun. Apply a small amount of glue along the upper and lower edges of the LCD's back side to hold it in place.
3. **Position the speaker** in the left corner of the enclosure and secure it with hot glue. **Do not** let glue enter the speaker, as this will affect its performance. (Refer to the photo for proper placement.)
4. **Connect the antenna** to the microcontroller board using the U.FL connector. Then mount and glue the antenna along the inside top edge of the enclosure. (Be sure to follow the earlier instructions for switching from internal to external antenna—this step is already done for the kit version.)
5. **Install the switch** in its designated location and screw it into place. Connect one wire to pin 1 on the controller, and the other to the pin marked **G** (ground). The wire colors do not matter.
6. **Install the battery** and connect the USB charging cable. You should see a red LED light up.
   - Locate the small **acrylic light guide tube** inside the enclosure (you can move it as it is not glued yet at this stage).
   - Position its curved end directly above the red charging indicator LED (see the enclosure photo).
   - Insert the other end into the small hole in the enclosure.
   - From the outside, check that the LED light is visible through the hole.
   - Once aligned correctly, secure the tube in place using a small amount of hot glue or superglue.
7. **Close the lid** by snapping it into place. Start by inserting one corner, then press along the edges evenly until the lid is fully seated.

ESP32-S3R8

WiFi + BLE   FLASH:16MB

ADC1_CH0		TOUCH01	GPIO01	1		3V	GND			
ADC3_CH1		TOUCH02	GPIO02	2		43	GPIO43	CLK_OUT1		
ADC1_CH2		TOUCH03	GPIO03	3		44	GPIO44	CLK_OUT2		
ADC1_CH9	SPI_CS	TOUCH10	GPIO10	10		18	GPIO18	U1_RXD	ADC2_CH7
ADC2_CH0	SPI_D	TOUCH11	GPIO11	11		17	GPIO17	U1_TXD	ADC2_CH6
ADC2_CH1	SPI_CLK	TOUCH12	GPIO12	12		21	GPIO21		
ADC2_CH2	SPI_Q	TOUCH13	GPIO13	13		16	GPIO16		ADC2_CH5

ST7789

Touch Chip: CST816

LCD_BL	38
LCD_D0	39
LCD_D1	40
LCD_D2	41
LCD_D3	42
LCD_D4	45
LCD_D5	46
LCD_D6	47
LCD_D7	48
LCD_WR	08
LCD_RD	09
LCD_DC	07
LCD_CS	06
LCD_RES	05
LCD_Power_On	15

Reset

Type-C   Support STEMMA QT / Qwiic

Boot   IO14
170*320 IPS LCD
Basic Version

To reset WiFi settings press button IO14 for 3 seconds button while touching the screen

Boot   IO14
170*320 IPS LCD
Touch Glass Version
SDA--IO17   SCL--IO18
INT--IO16   RES--IO21

LILYGO T-Display ESP32-S3
1.9 inch ST7789 170*320 IPS LCD (Basic & Touch)

Enclosure V2 and Up

Two miniature holes in the front of the enclosure Key and Boot buttons.

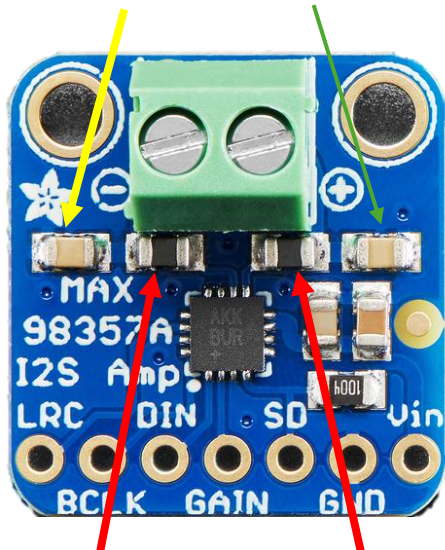To read more about the functionality of these buttons go to the Connection Diagram chapter.

The back lid is held in place by two grooves on the left and right sides of the enclosure. To open the enclosure, simply pull up the back lid from the middle and pry it until the lid comes off. To close the enclosure, insert one side first and then push in the second side.

MAX98357A Module Sound Improvement (Optional)

For slight clearer sound (already done for kit users)

Remove these 2 capacitors

For increasing the MAX98357a amplification connect the **Gain** pin to the **GND** pin for additional +3db.

OR

Connect 100k ohm resistor betwenn **Gain** to **GND** for additional +6db.   (kit users need to do that step)

Remove these 2 ferrites and solder short between the peds instead.

Gain Selection	
GAIN_SLOT	GAIN
Connect to GND through 100kΩ resistor	+15 dB
Connect to GND	+12 dB
Unconnected (Default)	+9 dB
Connect to VDD	+6 dB
Connect to VDD through 100kΩ resistor	+3 dB

# Using a Standard Of The Shelf Stereo PCM5102A DAC Instead of the MAX98357a

The standard, of the shelf PCM5102A I2S DAC Module can be used instead of the Max98357a module but this module provide only headphone output. A separate amplifier is required. Power supply (VIN) is 5Vdc or connect the A3.3v to the 3V3 Pin of the microcontroller.
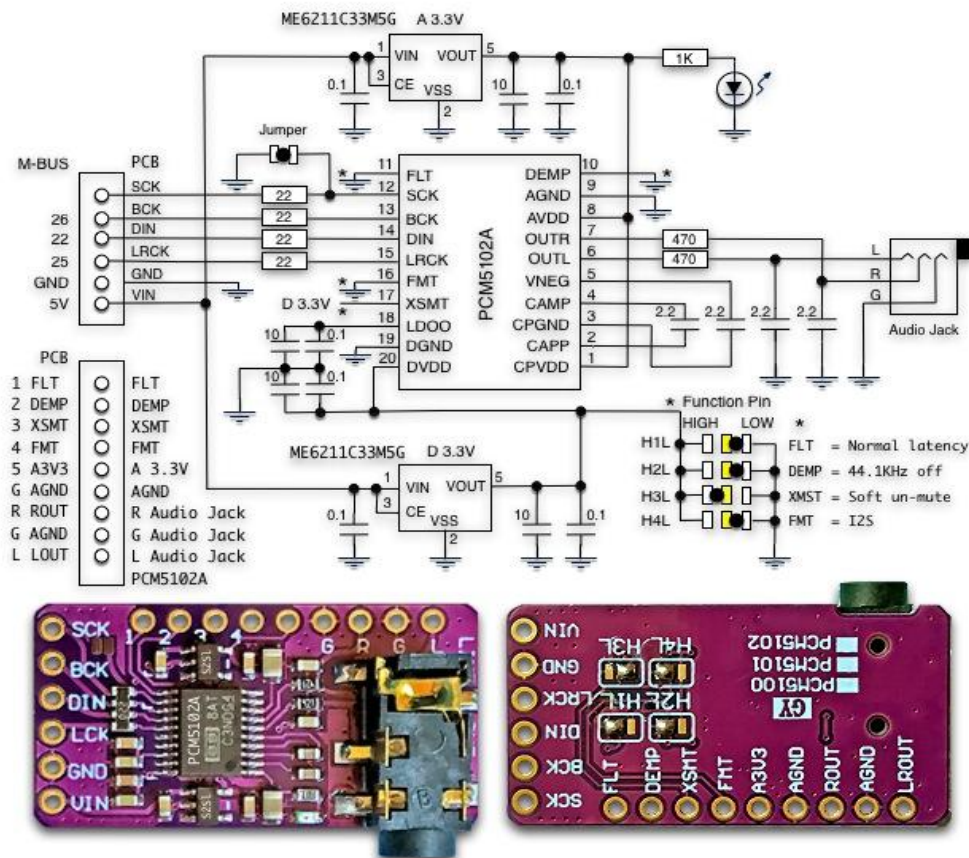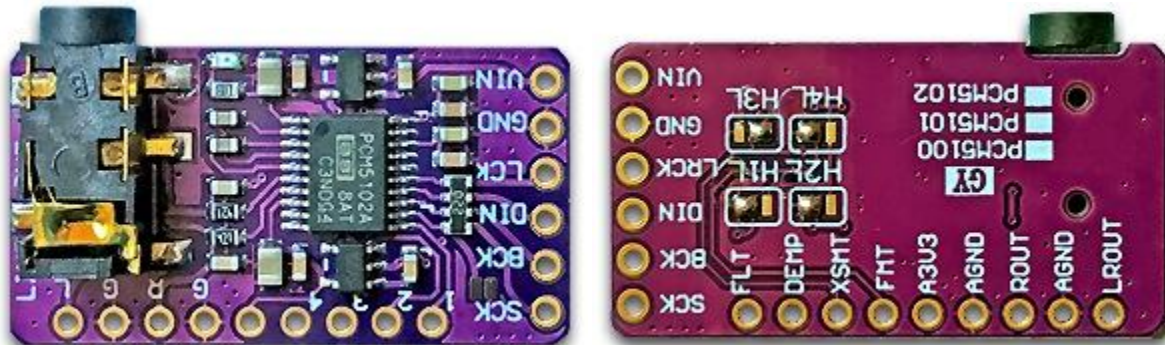

PIN FUNCTIONS: Select = RED: Selected state at time of purchase.

Make sure the soldered jumpers are set as in the photo below.

H	Name	Description	LOW (GND)	HIGH (D 3.3V)
H1L	FLT	Filter select	**Normal latency**	Low latency
H2L	MUTE	De-emphasis control for 44.1kHz sampling rate	**Off**	On
H3L	XMST	Soft mute control	Soft mute	**soft un-mute**
H4L	FMT	Audio format selection	**I2S**	Left justified
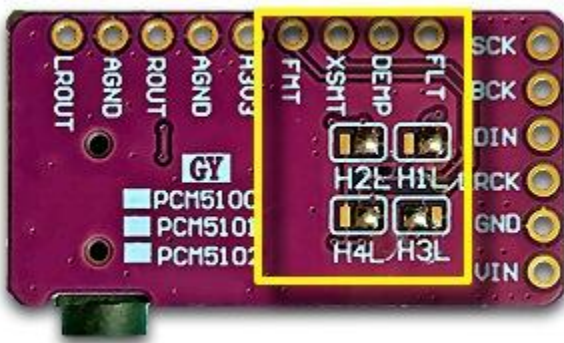
Connecting SCK-GND on the board with the wiring below. Generate the system clock using the PCM5102A's internal PLL. This is required to Prevents dielectric noise (if exist). It might work fine even if not connected.
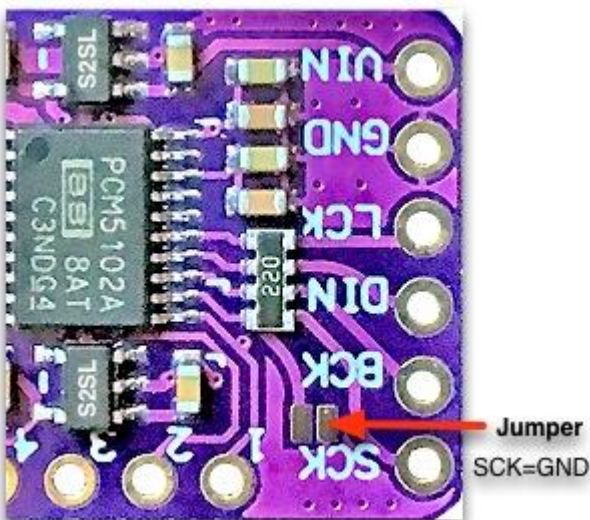
Note that this DAC doesn't have an internal amplifier. It only has an internal pre-amplifier that can drive headphone. In order to use speakers you will need to connect it to an external amplifier or amplifier module.