Pebble HF QRP Radio

Pebble HF 20m QRP Transceiver Assembly Instructions

Introduction

Pebble HF is a single band QRP Transceiver for Ham Radio. It aims to be an ultra-inexpensive radio for everyone, to encourage more people to have fun with HF and outdoor ham radio!

- Ultra-inexpensive single band transceiver for the 20m band
- CW, SSB Voice (USB and LSB), and digital modes (using an adapter)
- Built in CW key
- Built in microphone for voice
- Based on the open source uSDX open-source project, biased for cost and improvements for CW

Hardware Design: Barb WB2CBA
Firmware: Based on original uSDX firmware by Guido PE1NNZ ; adapted by Mike N4FFF

⚠️ ATTENTION:

Read through entire instructions before starting assembly to get a good understanding of the process.

Disclaimer

Welcome to the World of Homebrewing!

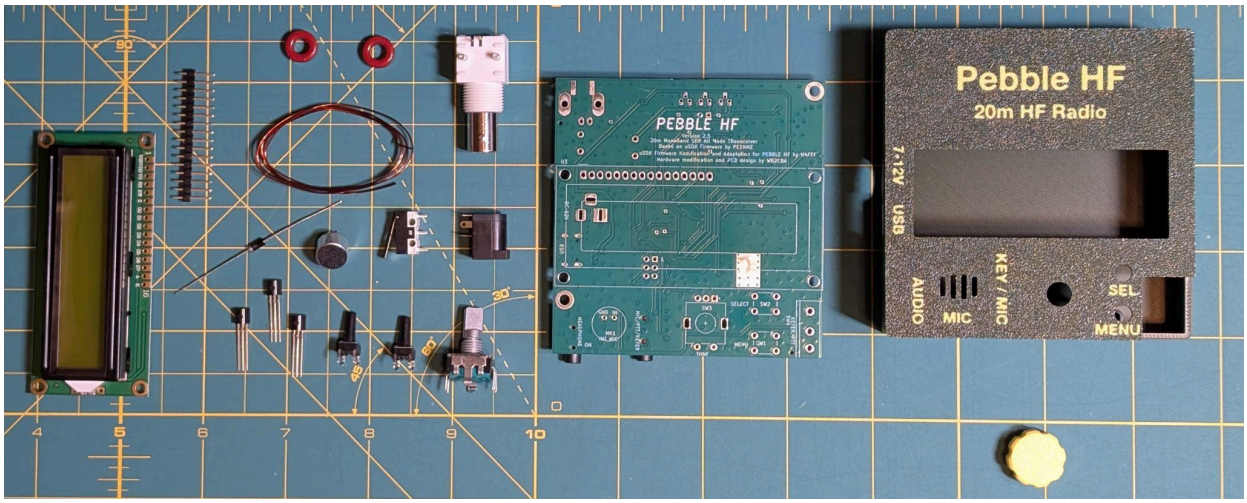
This kit is meant to be used by licensed amateur radio operators only. Please see the Legal & Regulatory Section for details.

One of the best things about being a ham is the privilege to build and experiment. Unlike most people who buy electronics, ham radio operators are legally authorized by the FCC to build, modify, and experiment with their own transmitting equipment.

By building this kit, you aren't just a consumer—you are the **manufacturer** of your station! Here is what that means in plain English:

- **A Licensed Hobby:** To press the "PTT" button on this radio, you must hold a valid Amateur Radio license. If you're still studying for your Tech or General—hang in there! It's worth it, and this kit is a great way to learn how your gear actually works.
- **The Power of Experimentation:** Because the Amateur Radio Service is rooted in technical self-improvement, the FCC allows us to build kits like this without the expensive lab testing required for consumer gear. We have the privilege of "Self-Certification."
- **Your Responsibility:** With great power comes... a little bit of homework. Since *you* are the final builder, the FCC (specifically **Part 97**) puts the responsibility on you to ensure your radio is operating cleanly. This means making sure your signal isn't "splattering" onto other frequencies or creating interference.
- **Testing:** Don't worry, you don't need a lab full of expensive gear to be a responsible ham. This design has been tested to ensure it meets the requirements. Your testing is to ensure that your radio the way you built it is working as expected. In the "Testing" section of this manual, we'll walk you through simple ways to verify your build, such as:
    - **The Dummy Load Rule:** Never transmit into an antenna during your first tests. Use a dummy load to keep your signal off the air while you check things out.
    - **The "Second Ear" Test:** Use a second radio or an inexpensive SDR (Software Defined Radio) dongle to look at your own signal and make sure it looks sharp and stays where it's supposed to.

Parts List



Pebble HF PCB board, 3D case with knob plus these parts you will solder on:

1. 6 pin (2x3) programming header - (if purchased June 2026 or later)
2. 2x toroid cores
3. Magnet wire to cut and wind around toroids
4. BNC antenna connector
5. Power jack (barrel connector)
6. 3X Transistors
7. Diode
8. Tune knob
9. 2x buttons
10. Mic PTT / CW button
11. LCD and LCD header
12. Microphone (optional for voice users)

⚠️ ATTENTION:

Double check that you have all of the parts before you get started. It could be a bummer if you get partially done and then realize you are missing a part. We do our best, but just in case 🙂

Assembly

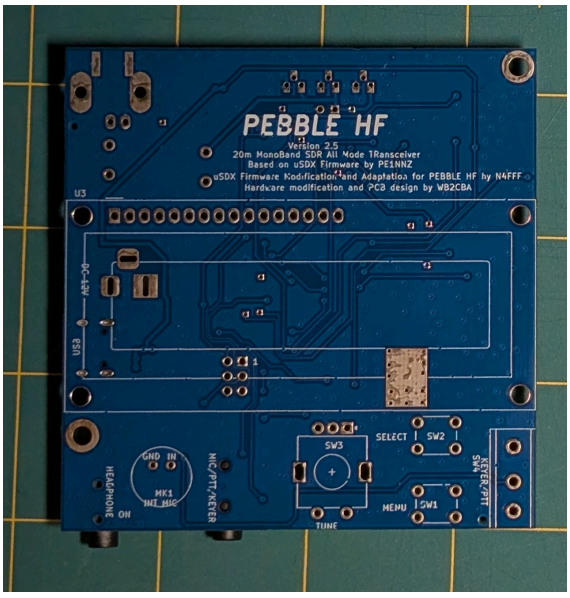
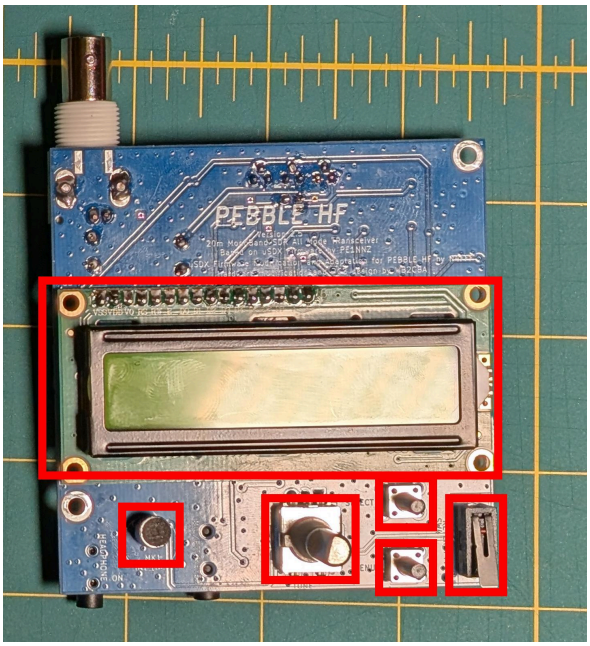
Tips

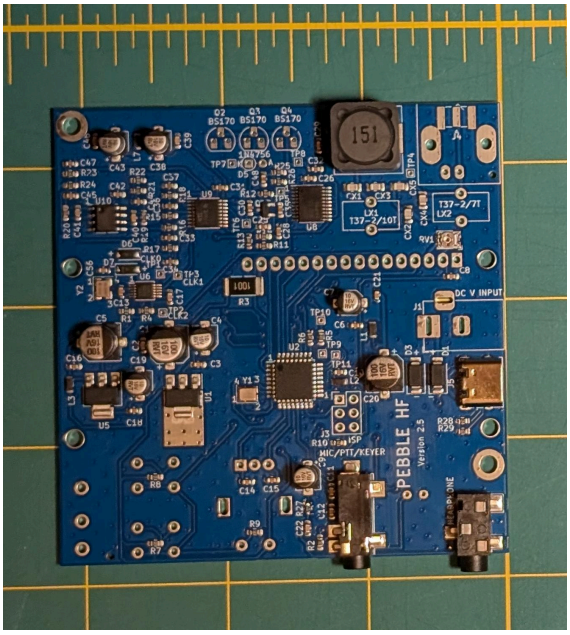
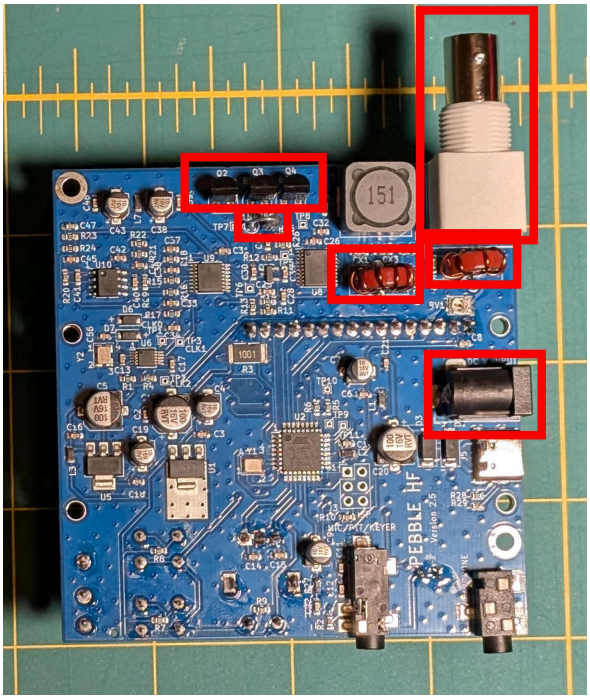
- Use a 60W or higher iron
- Use a flat tip on your soldering iron, not a tiny one, for better heat dissipation
- Use leaded soldered (not lead free) for an easier time soldering

Final Result

These images show before and after completing the build. The completed build image is on top. The parts you will be adding are highlighted so that you can see where you will be adding parts. You will only be adding 15 parts which are all through hole parts which are easier to solder. There are only 2 toroids.

Here are before and after pictures. The red boxes are around the only parts you will need to solder.

	Before	After
Front		

Back		

⚠️ Note:

If you watch the build video the order is different from this written manual. After multiple builds we found the following order to be a little easier based on part size. But, if you have trouble with a specific part you can refer to the video for that section.

We'll start by placing the parts on the **BACK** of the board and soldering them on the **FRONT**.

Programming Header

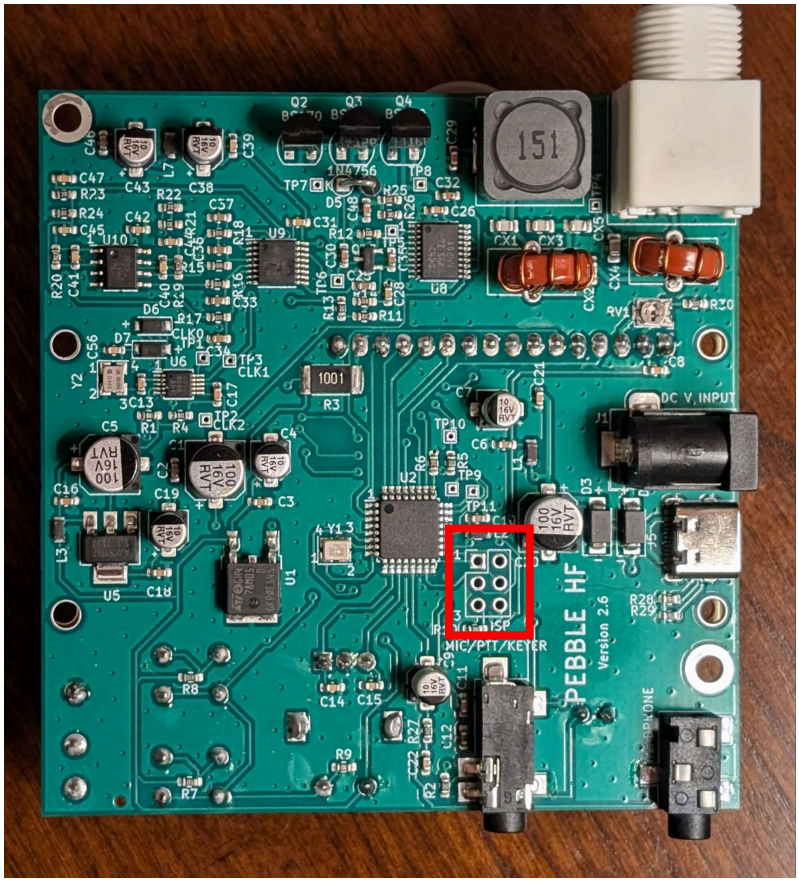
⚠️ ATTENTION:

Technically, the programming header is optional. You only need it to update the firmware. It's easy to solder on and more convenient to do it now. If your kit did not come with a 6-pin programming header (we started shipping them in June 2026), these .1 spaced headers are very common.

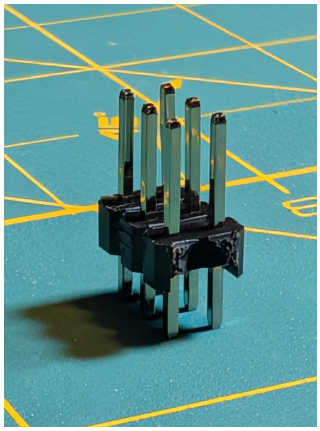
Solder the 6-pin programming header as shown. If your kit comes with one, it will already be only 6-pins. You can also get this common "breakaway" header commonly and simply break off a 6-pin section.

** The shorter side of the pins goes through the board from the back to the front so the pins do not touch the LCD placed later on the front.

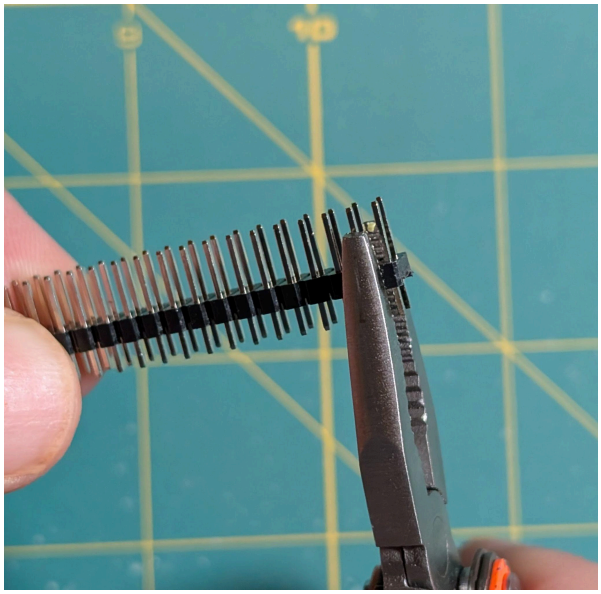
Having the header makes it easy to update the firmware for any bugs that are found and to get improvements. If you have the header and are not in a hurry, it is easier to put the programming header on now. If you build the kit without it (or already built it before we added this step), don't worry. It is also easy to solder on by tacking it onto the board on the other side after the fact. It's just easier and a little more secure to add now.



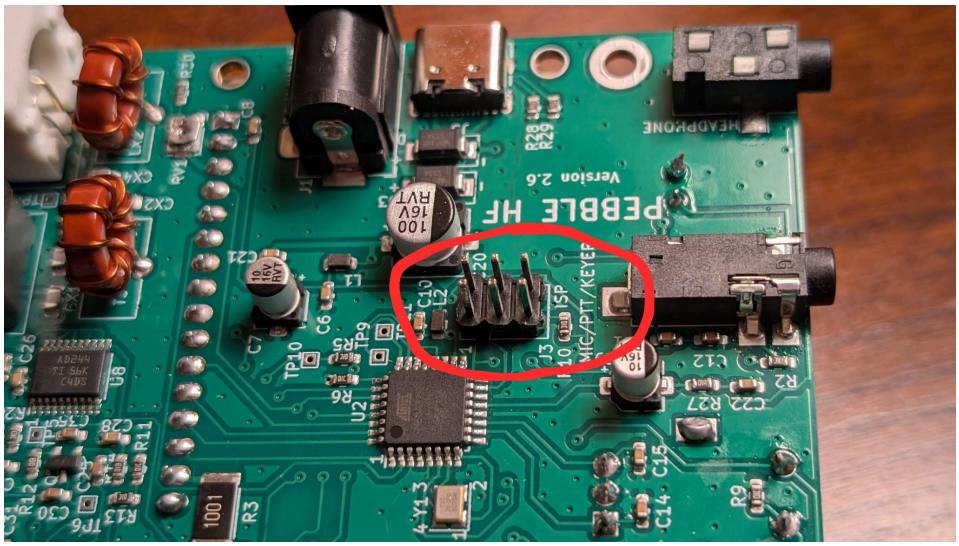
6 pin programming header (2x3)



If your kit did not come with the 6-pin header, these .1” spaced breakaway headers are very common. You can use pliers to break off 6 of the pins to use for the header.

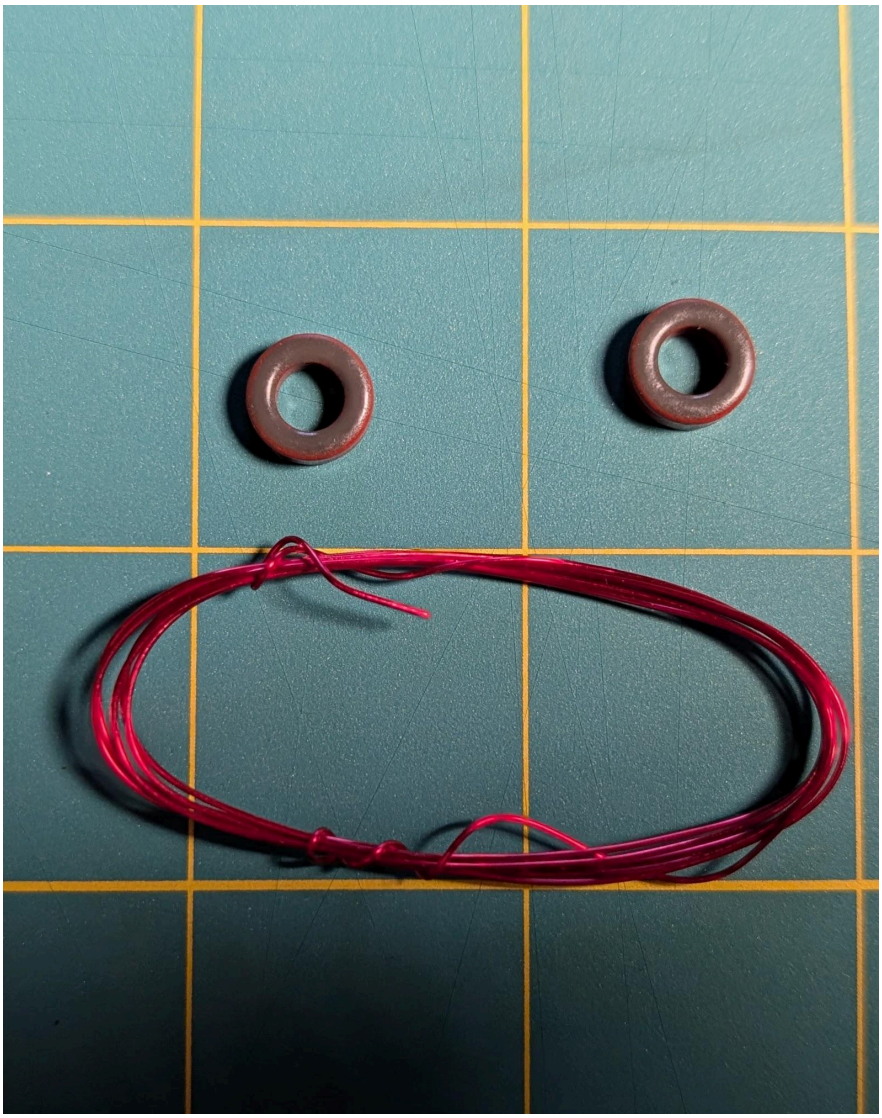


Result (long side is on this back side of the board)



Inductors (winding toroids)

Some people find winding toroids to be tedious, but it is easy. You are just wrapping a wire around a donut and counting how many times you go through the middle. This creates the inductor. We only have two to do.



Isn’t it a cute little worried face? You don’t have to be that worried.

Toroid Wrapping and Installation

⚠️ ATTENTION:

There are 2 toroids to wrap. The original instructions and board markings indicate 10 turns for one toroid and 7 for the other. **Instead of 10 turns you will want 9 turns on LX1.** We learned that with 9 turns instead of 10 you get higher power output and better efficiency!

LX2 toroid is **7** turns and LX1 toroid is **9** turns (even though marked 10 on the board). The kit comes with more magnet wire than you need for both toroids. You may want to start by cutting the wire in half so that you have less to pull through on each turn.

For LX2 toroid:

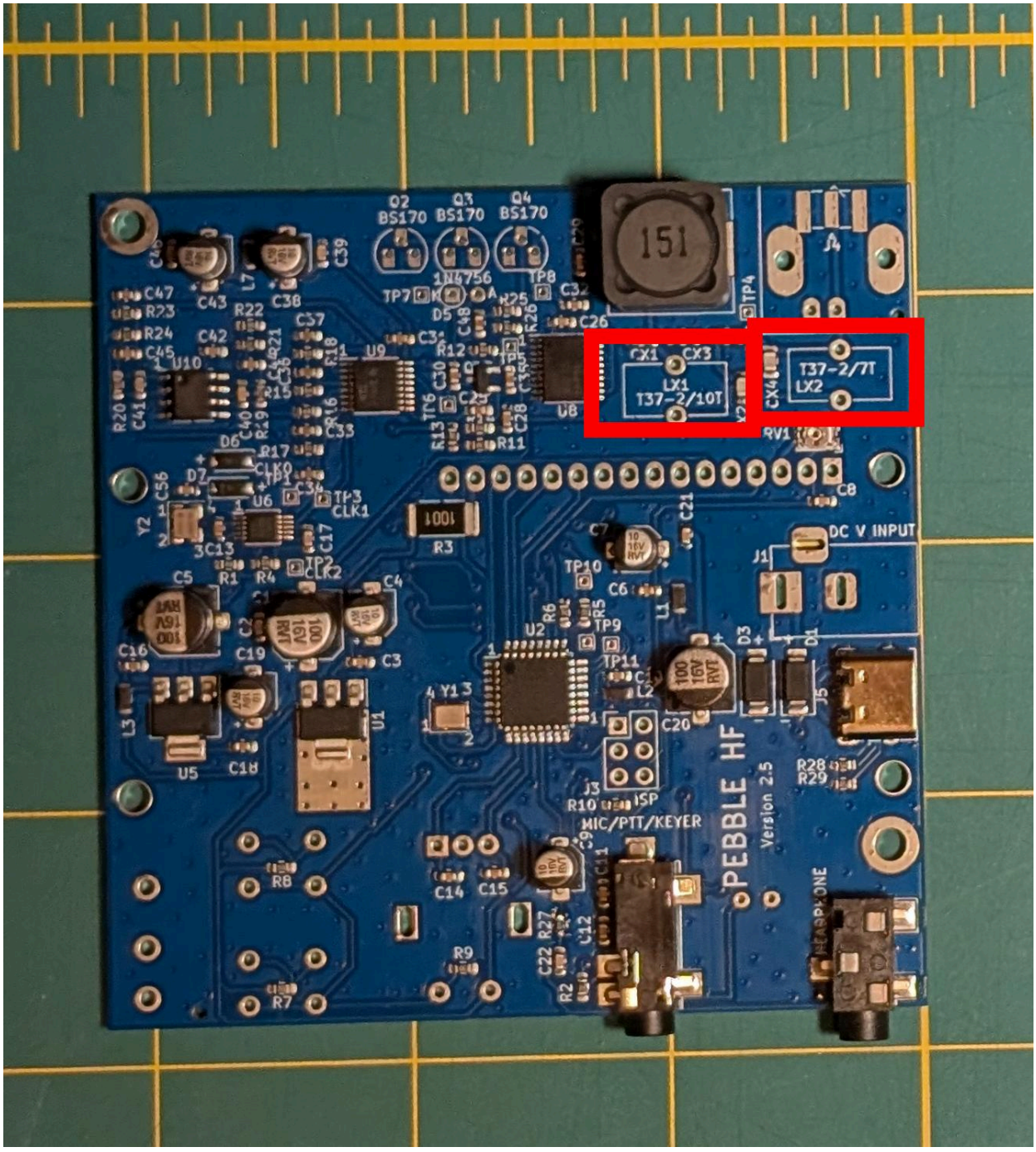
- Start by putting the wire through the middle which counts as #1. Start wrapping and counting each time the wire goes through the middle again until reaching **7**. The ends should be on either side of the toroid when you go through the last time.
- Cut it so that you have little leads long enough to go through the holes in the PCB
- Strip the enamel off with a knife or similar tool to expose the copper on the ends where you are going to solder (try to get it stripped pretty close to the toroid since it sits flush on the board)

For LX1 toroid:

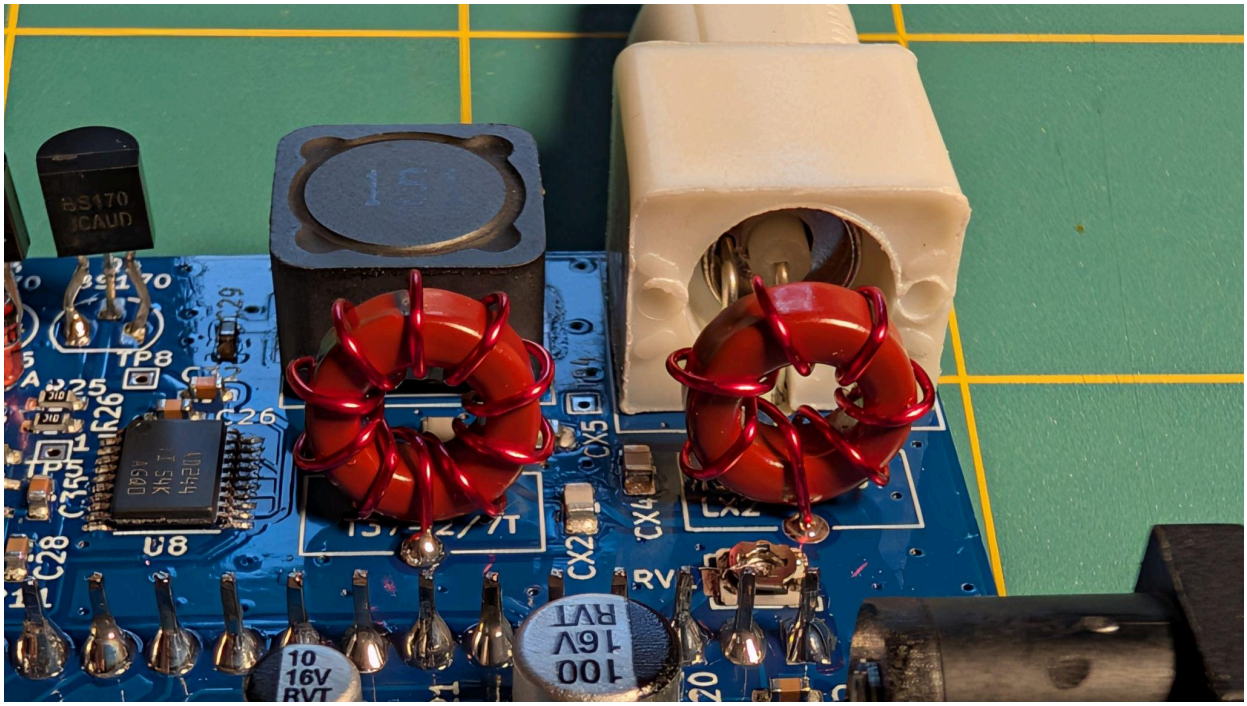
- Start by putting the wire through the middle which counts as #1. Start wrapping and counting each time the wire goes through the middle again until reaching **9**. The ends should be on either side of the toroid when you go through the last time.
- Cut it so that you have little leads long enough to go through the holes in the PCB
- Strip the enamel off with a knife or similar tool to expose the copper on the ends where you are going to solder it (try to get it stripped pretty close to the toroid since it sits flush on the board)

These parts are placed here on the back of the board – LX1 (**9** turns) and LX2 (**7** turns). Once wound, each of your toroids will have two leads. Make sure each lead is stripped and then insert them into the holes and bend them on the other side a little bit to get them to stay in place. Flip the board over and solder those two parts.

You may want to watch the build video for this part. If you haven't done this before, it may seem scary, but it is straightforward.



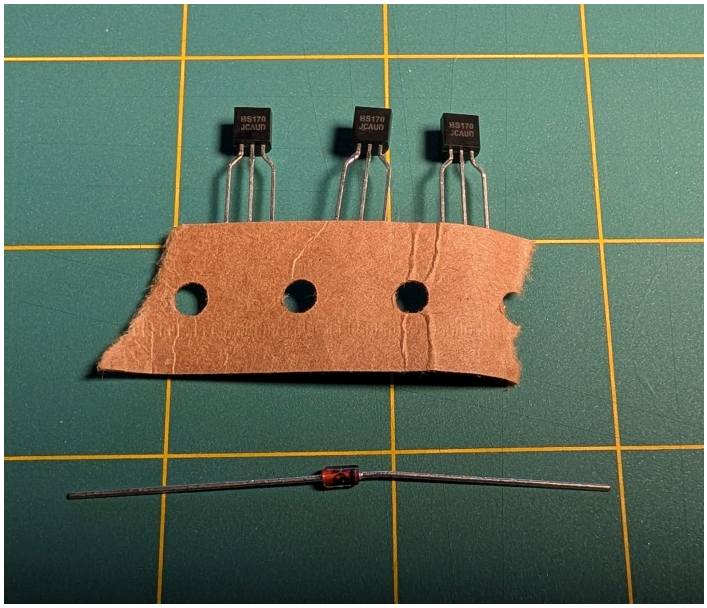
Inductor result (**9** turns on the left and **7** turns on the right) - this picture has 10 on the left from an earlier build



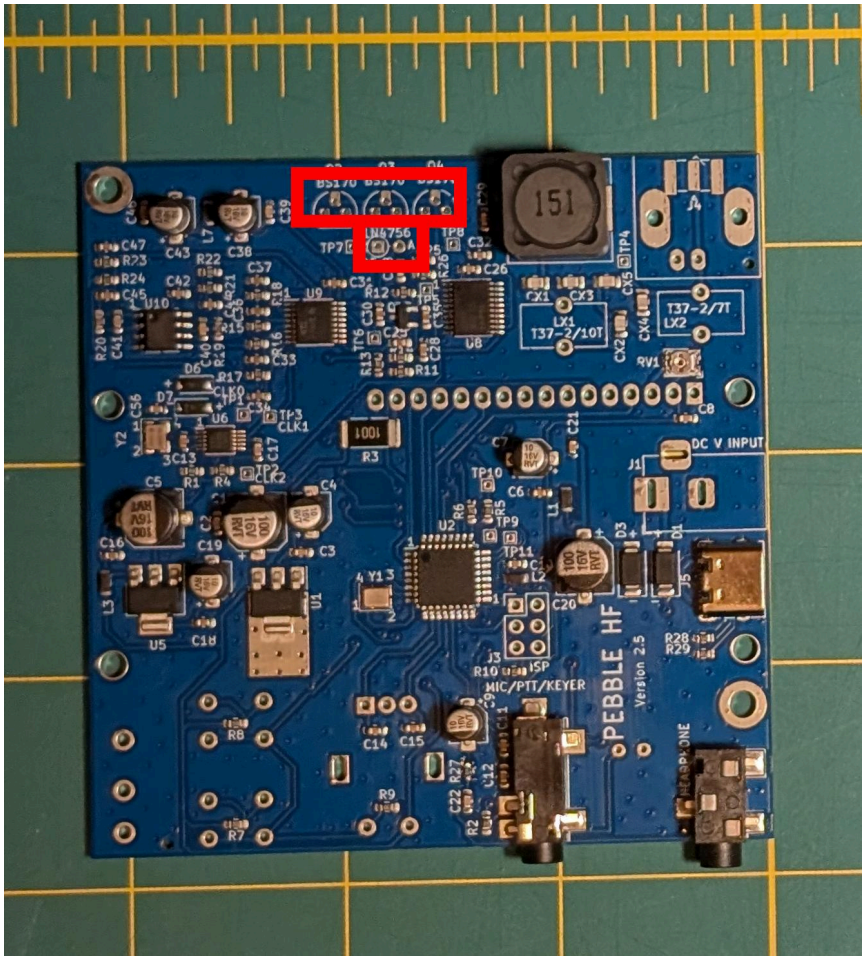
Transistors and Diode

This is what the 3 transistors and 1 diode look like. The markings on your transistors may be different, but should say BS170.

The Diode may look a little different, but will have a line around one side. Diode orientation **DOES** matter.

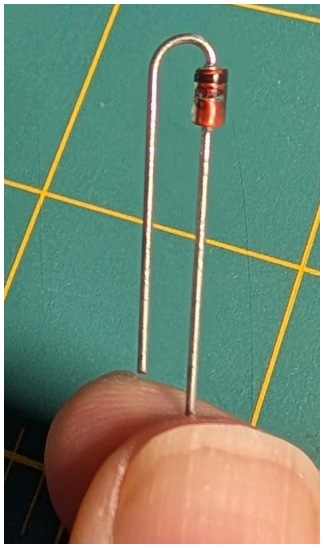


These parts are placed here on the back of the board and soldered on the front (11 pins).

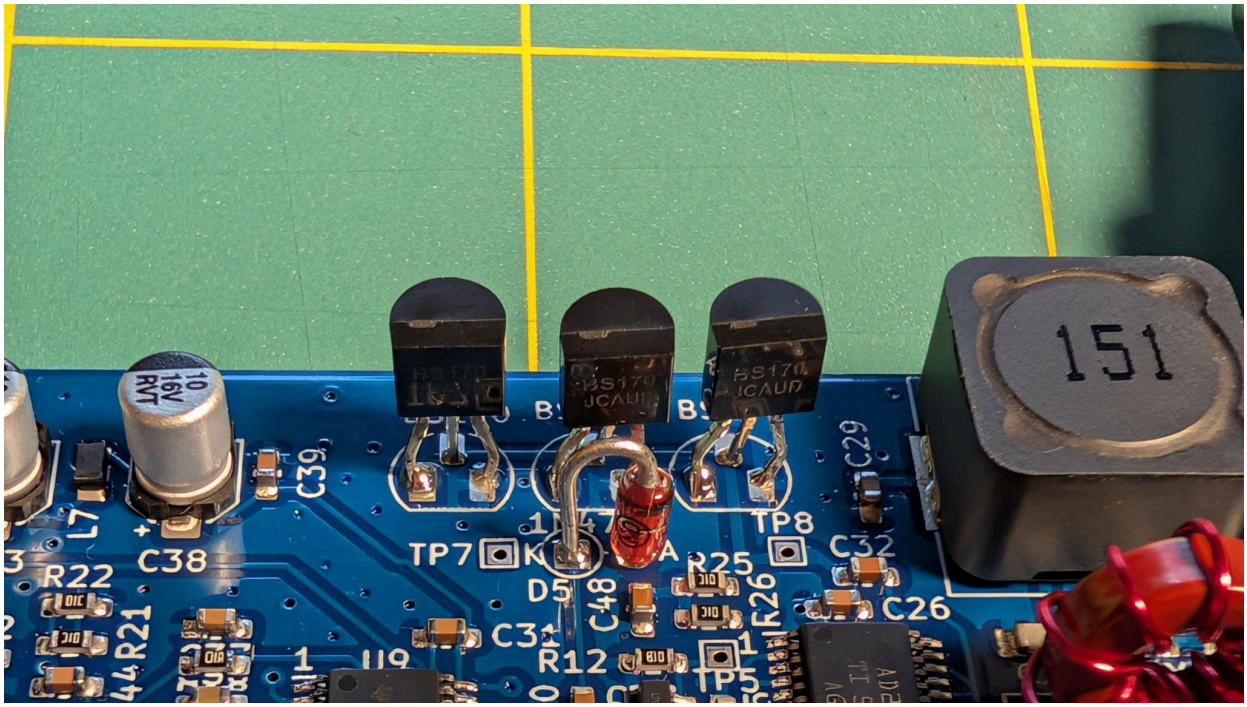


It is very important which pins go where for the 3x transistors! The flat portion should face into the middle of the board. You do not need to make these flush to the board when inserting.
(See result pic)

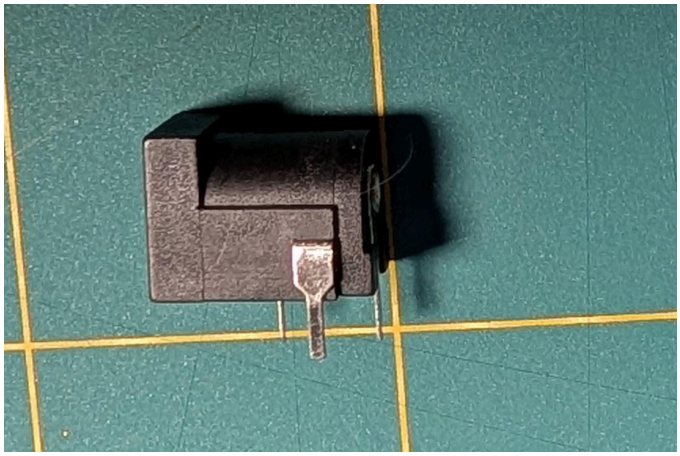
It is also very important which direction the diode goes. You can see there is a line on one side of the diode. You will want to orient it up just as shown in the picture. For the diode, start by bending the leads to make it fit as shown. Note: TP7 is left alone and the diode goes in the two holes to the right.



Result

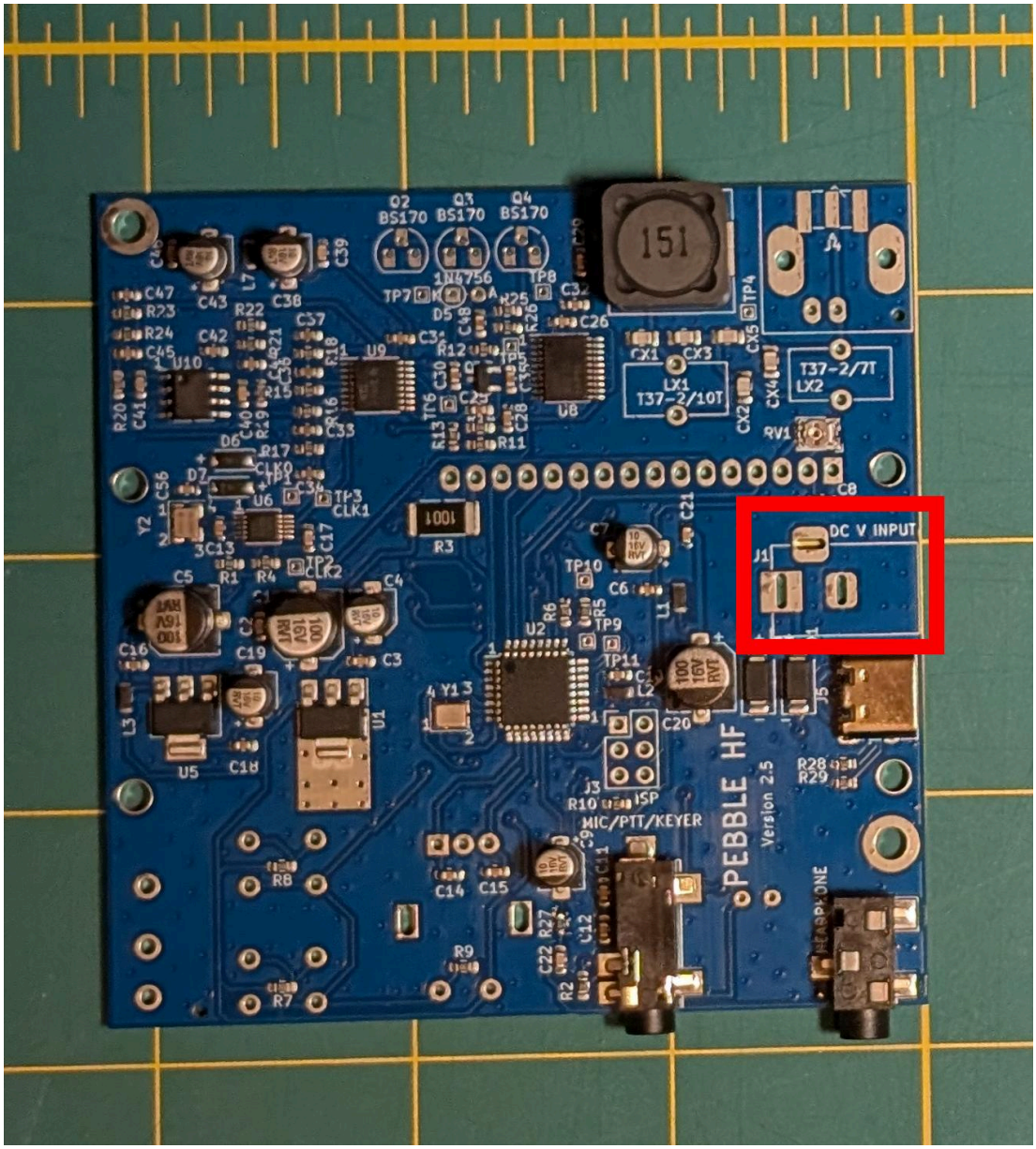


Power Jack (barrel connector)

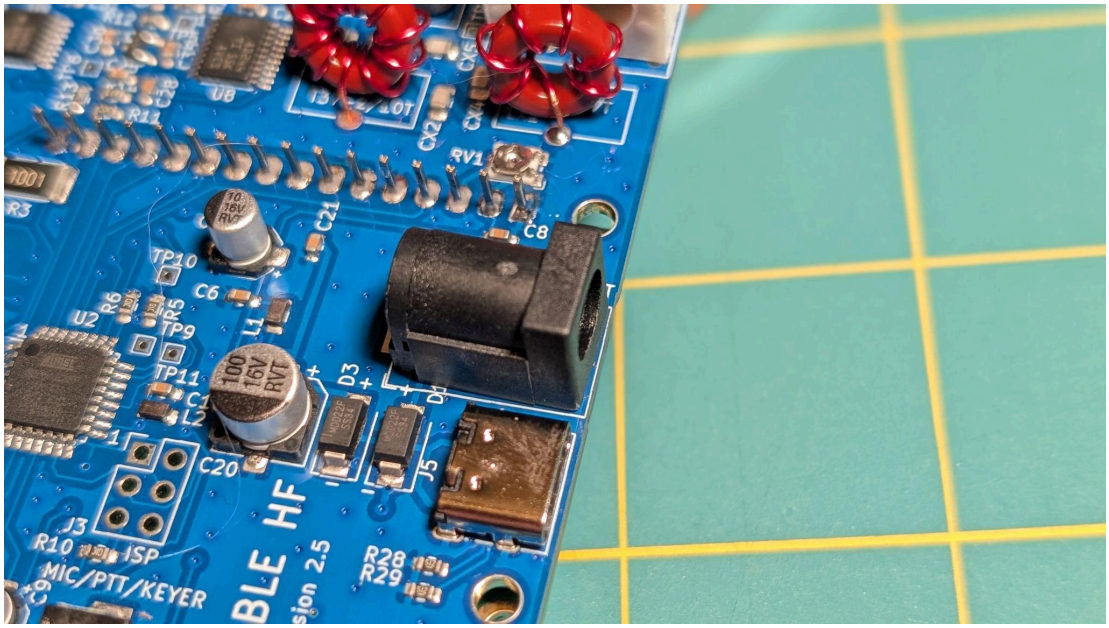


This part is placed here on the back of the board and soldered on the front (3 pins).

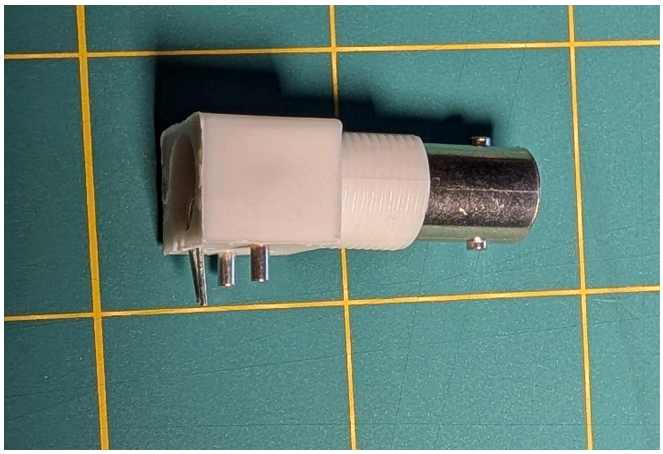
The barrel connector is 5.5 mm outer diameter by 2.1 mm inner center pin. It's actually the very common standard for qrp radios. For a compatible USB-C to 12V USB PD cable, please see the Pebble HF Accessories page.


DC V INPUT
J1
PEBBLE HF
Version 2.5
MIC/PTT/KEYER
ISP
J3
Q2 BS170
Q3 BS170
Q4 BS170
151
T37-2/7T
LX2
LX1
T37-2/10T
1N4756
TP1
TP2
TP3
TP4
TP5
TP6
TP7
TP8
TP9
TP10
TP11
CLK1
CLK2
U1
U2
U5
U6
U8
U9
U10
Y2
Y13
RV1
J4
J5

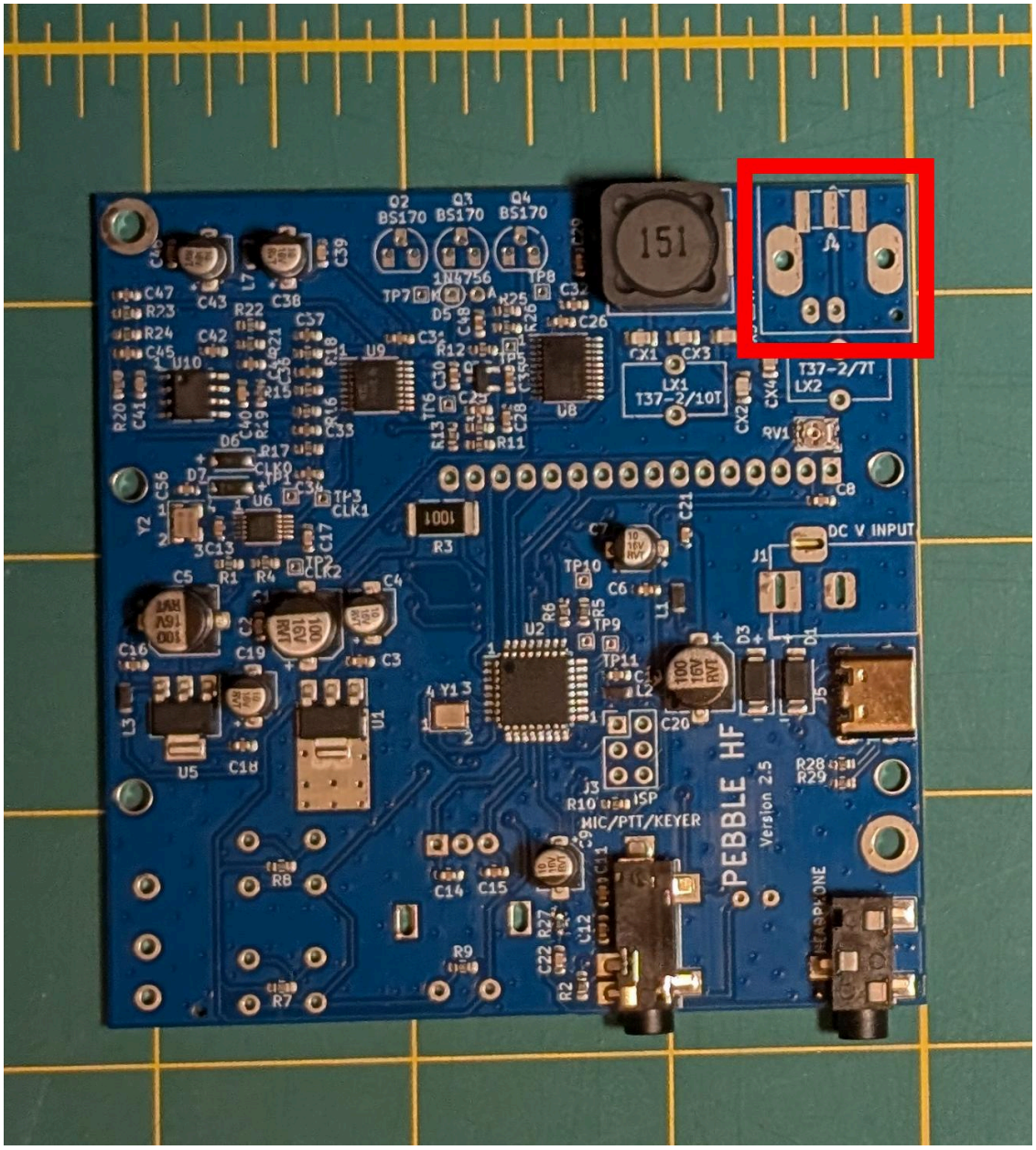
Result



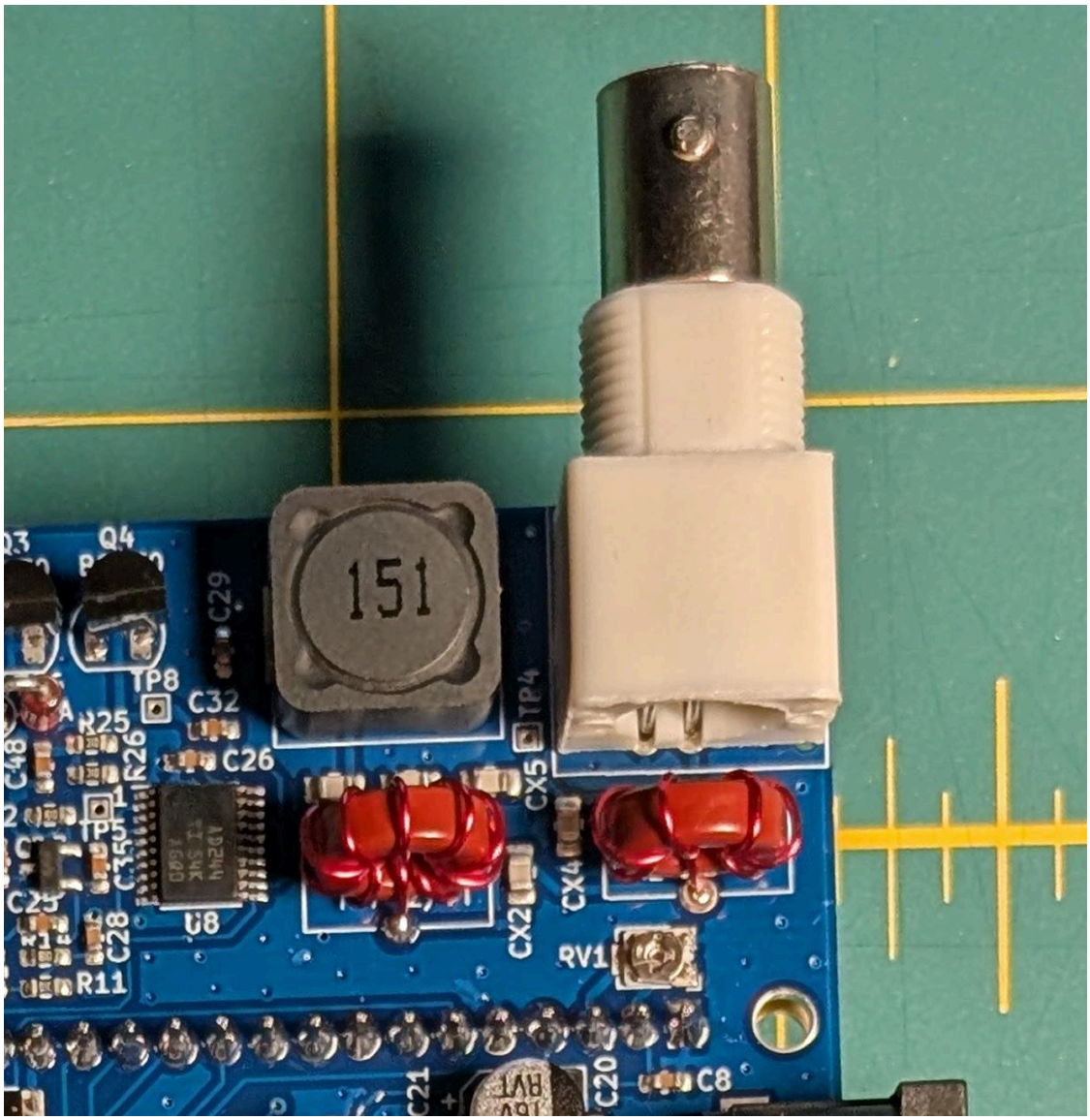
BNC Antenna Connector



This part is placed here on the back of the board and soldered on the front (4 pins).


Q2 BS170
Q3 BS170
Q4 BS170
1N4756
151
LX1 T37-2/10T
LX2 T37-2/7T
DC V INPUT
PEBBLE HF
Version 2.5
MIC/PTT/KEYER
ISP
HEADPHONE

Result

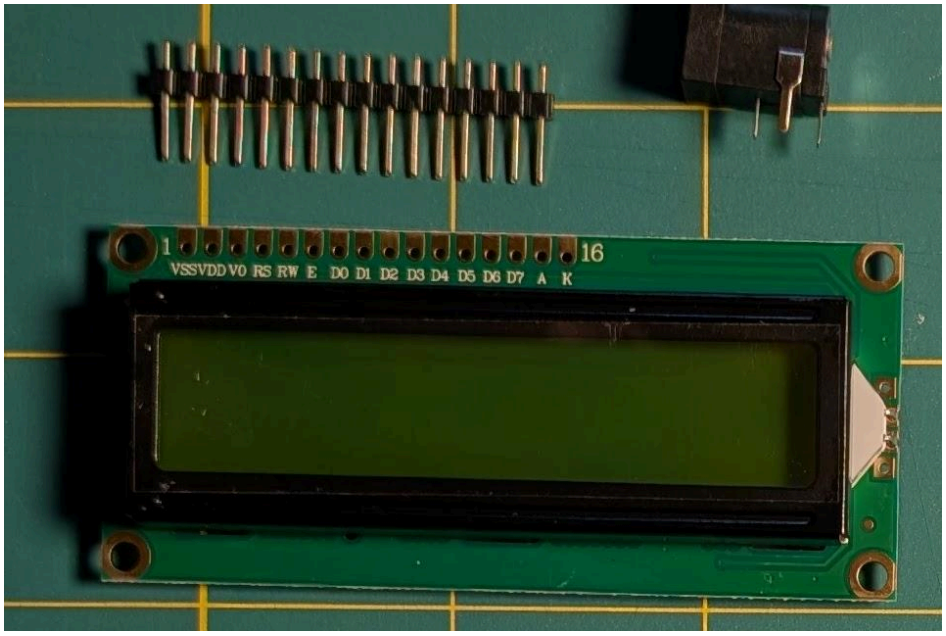


Now we flip the board over and place parts on the FRONT and solder on the BACK.

LCD

⚠️ **ATTENTION:**

The pins for the barrel power connector, which you already soldered on earlier, stick out and could touch the LCD once we solder it in place. **Before** you proceed with the LCD, you should snip those pins off to be sure they don't make contact with the LCD, or cover them with electrical tape, or both.



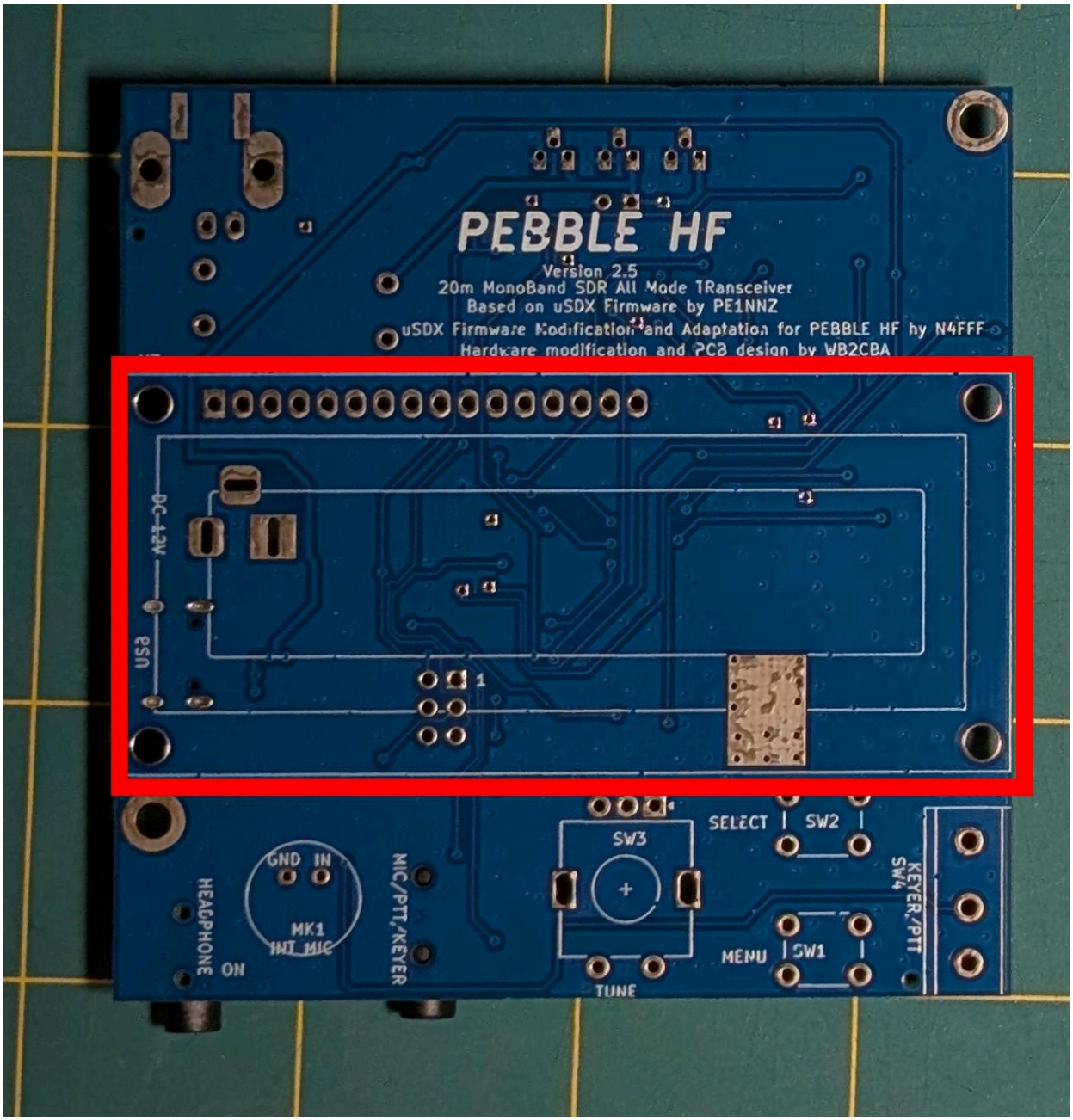
Now we install the LCD on the ***front*** of the board. Putting the LCD on before the other parts make it easier to solder in place.

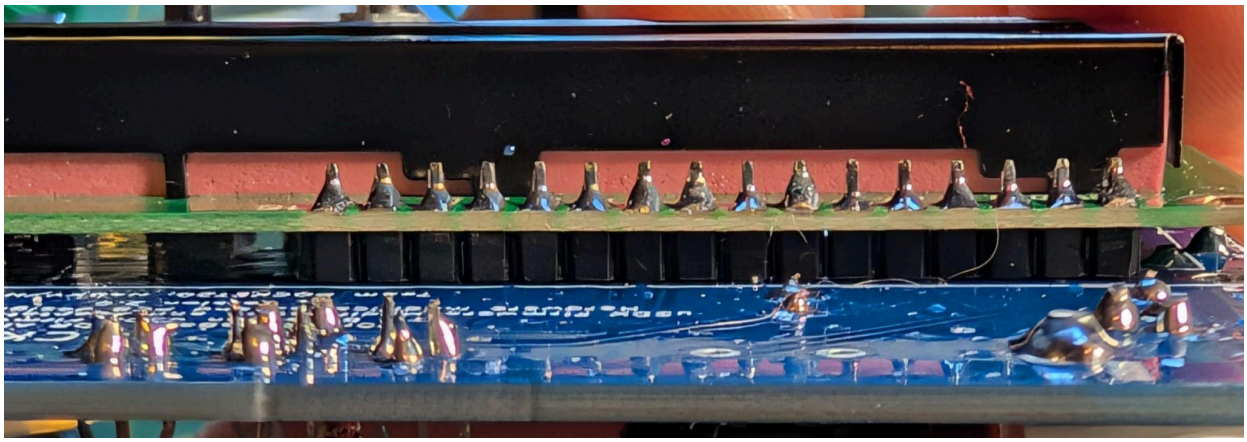
First, place the **shorter** side of the header pins through the PCB from the front to the back. This will make soldering to the board a little easier with more space on the back. Then, place the LCD on the **longer** pins (front). Solder the pins to the LCD. Because there are so many pins, sometimes it helps to solder the two outer pins on each side which will hold it in place while you solder the other pins.

With the **long** side of the header pins now soldered to the LCD, we can flip everything over to solder the **shorter** side of the header pins to the PCB.

Reminder: The barrel plug contacts will be sticking out and could touch the back of the LCD that you are about to solder. If you didn't read the warning above, this is the time to either cut off the end of the pins of the barrel plug or cover them with electrical tape or both. Once you do that, you're ready to solder the LCD in place.

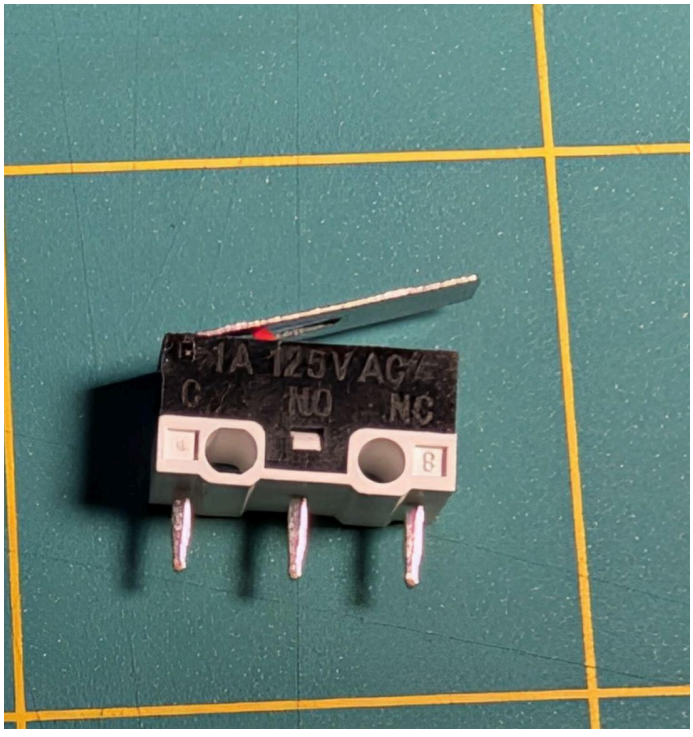
Flip over the board making sure you keep the LCD square on the board in the outlined space and solder the backside shorter pins onto the board. Helps to do one end, the other end, and then down the middle.



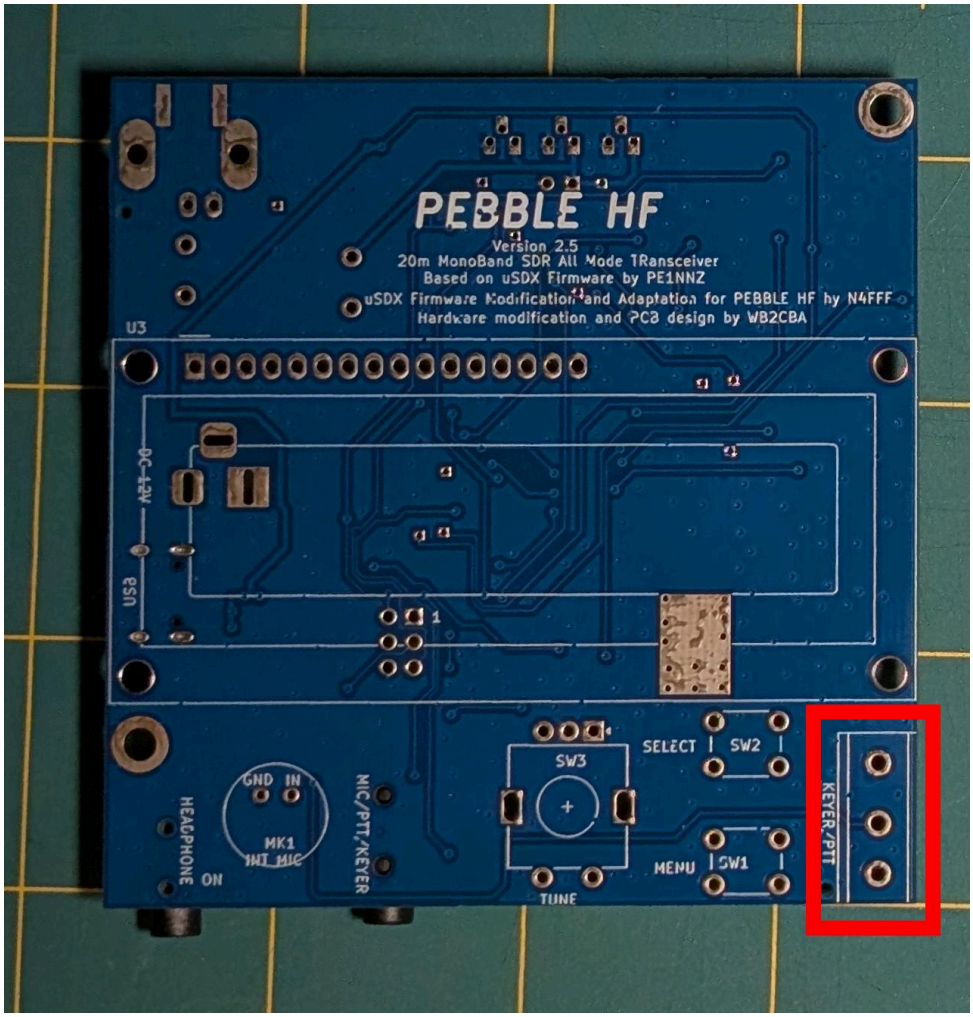


Result (do this top LCD side soldering first - header to the LCD) then hold in place to solder to the board on the back. Ensure the LCD is level and square to the board when soldering in place.

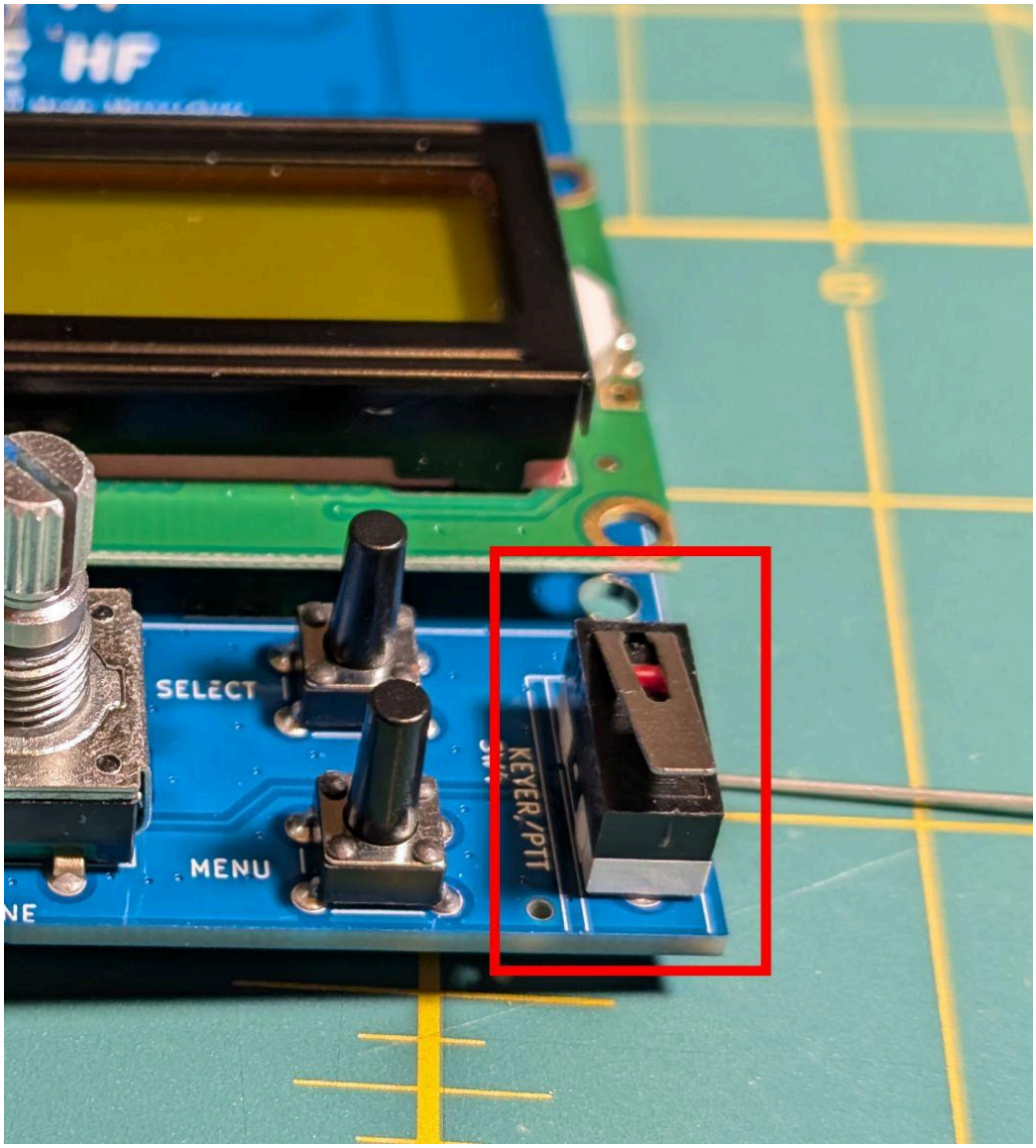
CW Key / PTT



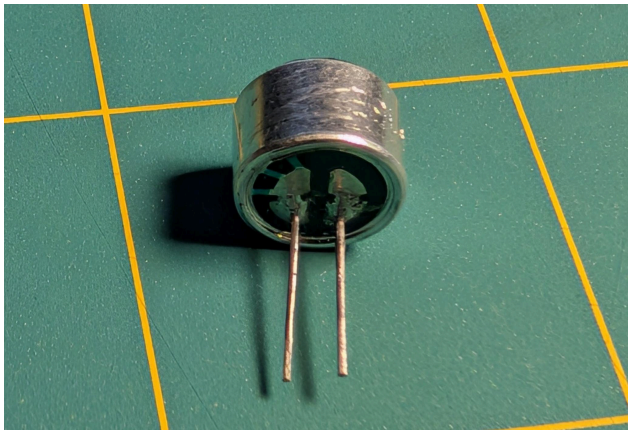
This part is placed here on the front of the board and soldered on the back.


PEBBLE HF
Version 2.5
20m MonoBand SDR All Mode TRansceiver
Based on uSDX Firmware by PE1NNZ
uSDX Firmware Modification and Adaptation for PEBBLE HF by N4FFF
Hardware modification and PCB design by WB2CBA
U3
DC +12V
US8
1
SW3
SELECT
SW2
GND
IN
MK1
INT MIC
NIC/PTT/KEYER
HEADPHONE
ON
MENU
SW1
TUNE
KEYER/PTT

Result

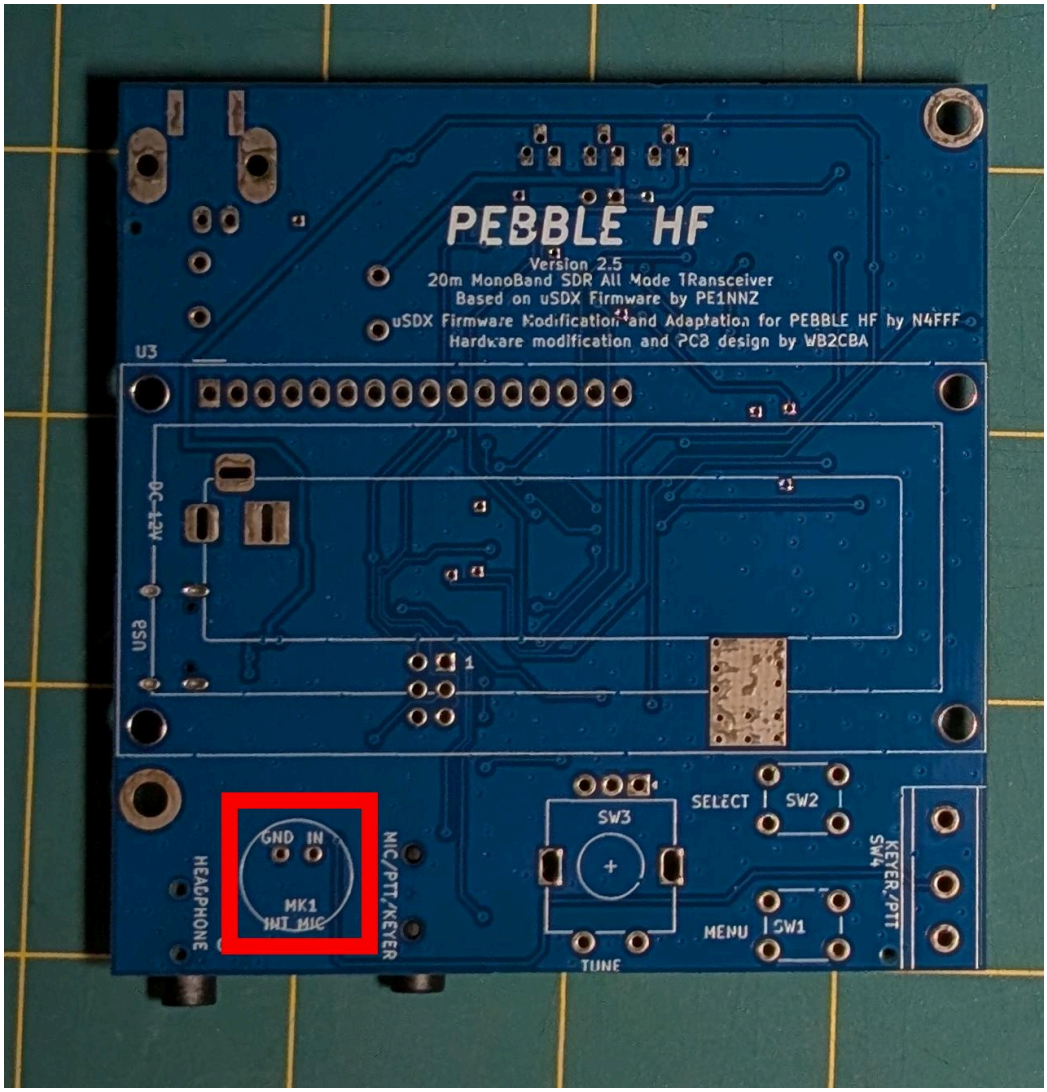


Built-in Microphone

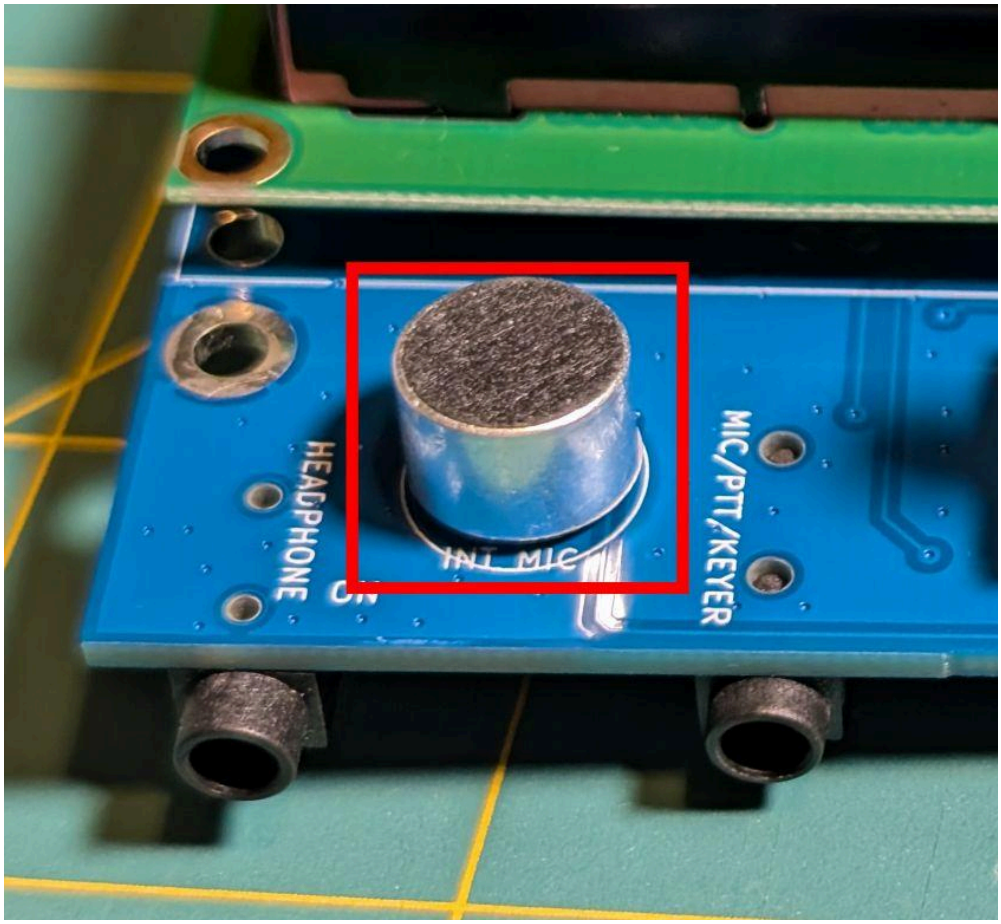


This part is placed here on the front of the board and soldered on the back. Orientation **MATTERS** for the GND and IN pins. The outline of the microphone guides you to the correct orientation.

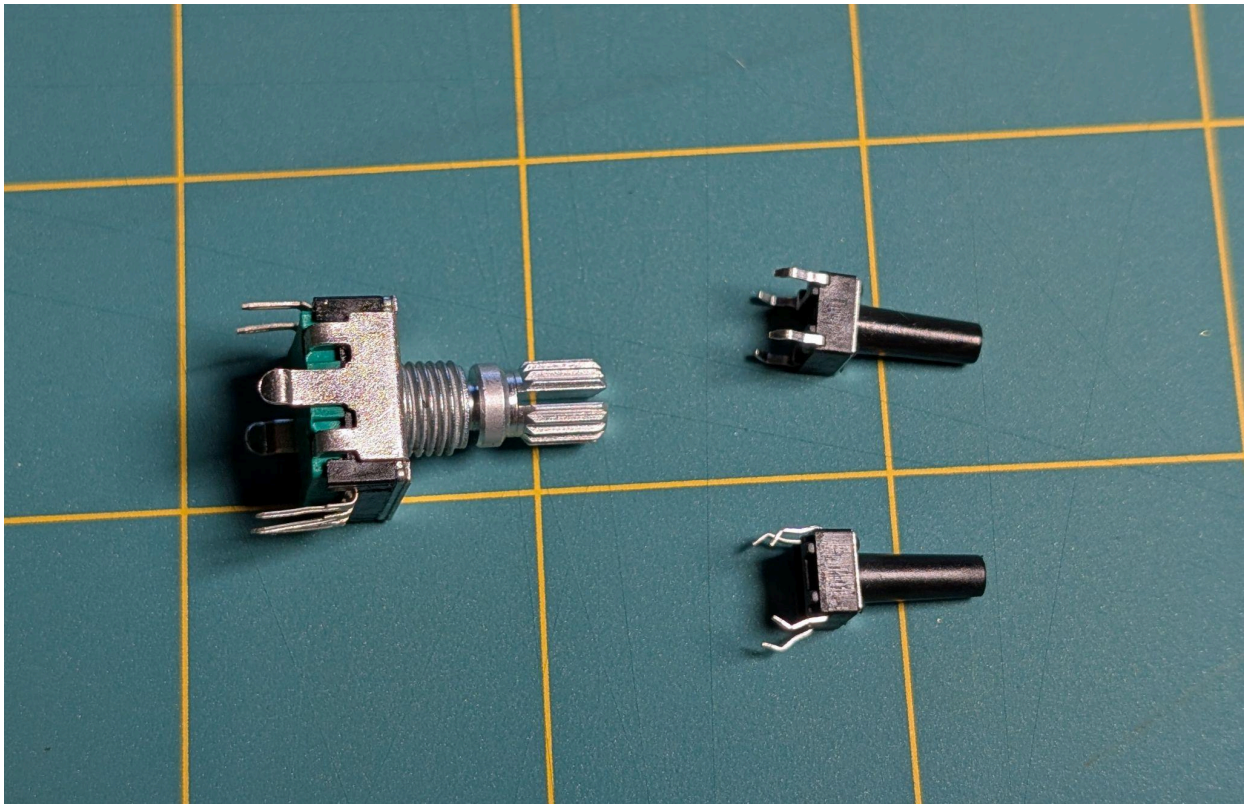
The most accurate way to be 100% sure is to use a multimeter, if you have one. You can see that there is a GND and an IN pin labeled on the two pins on the board. To find which pin is the GND pin of the microphone, use a multimeter to find which of the two pins has direct continuity with the case of the microphone (around 0 ohms).



Result and orientation

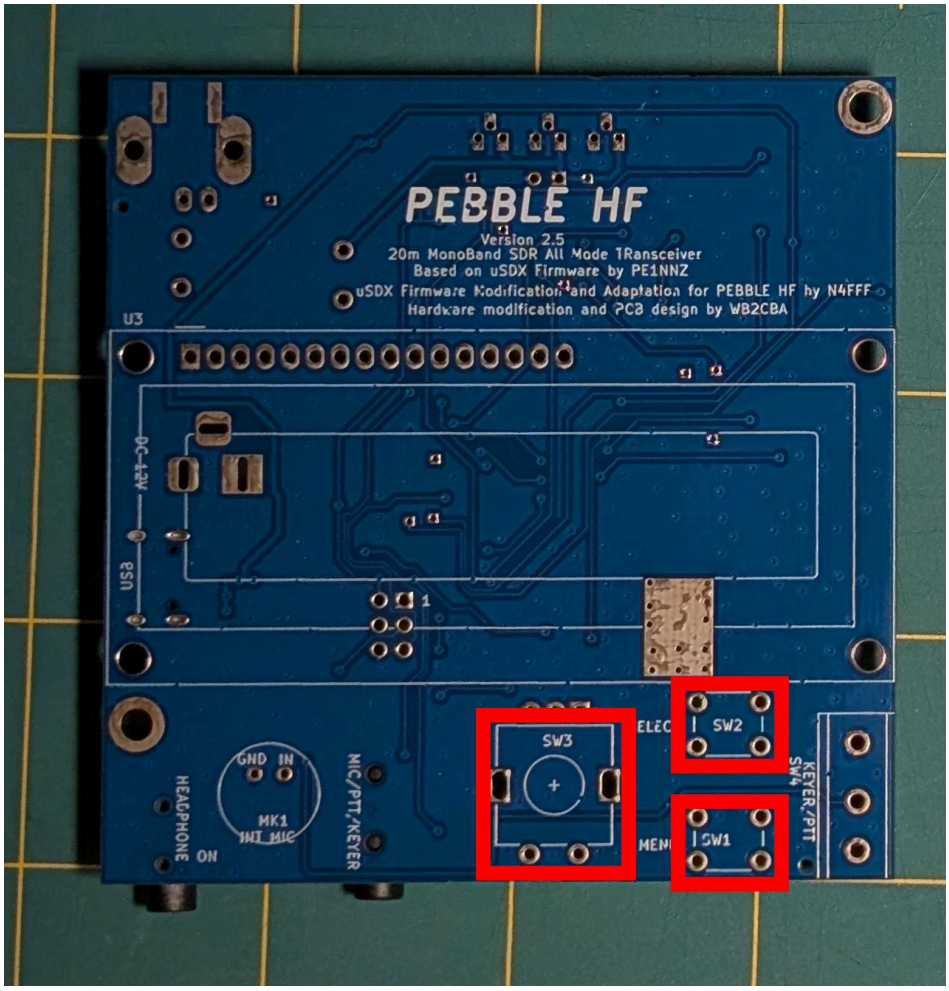


Tuning Knob and Buttons

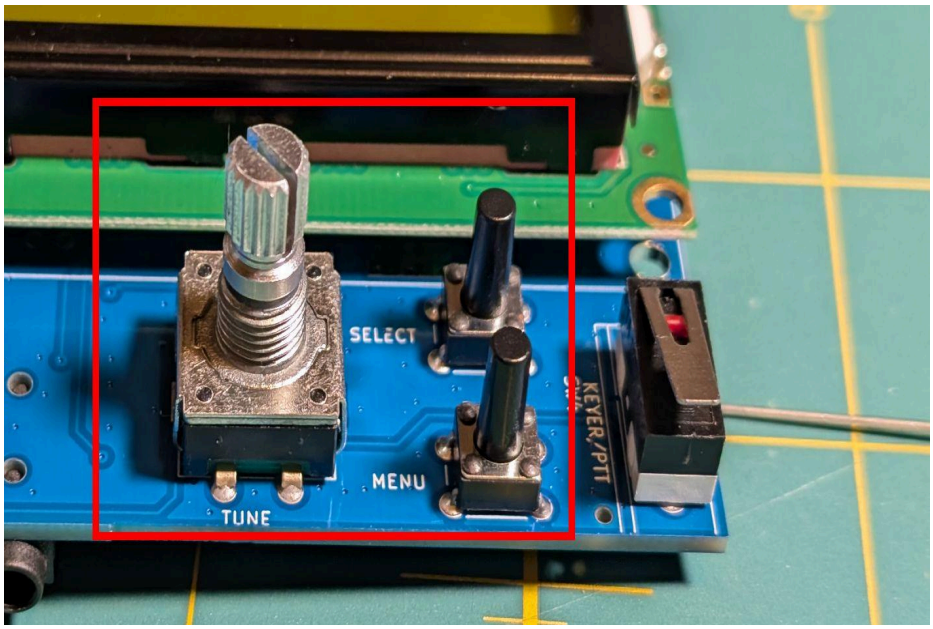


These parts are placed here on the **front** of the board and soldered on the **back**.

You may need to squeeze the side pins a little on the knob to get it to go in and sit flat.


PEBBLE HF
Version 2.5
20m MonoBand SDR All Mode TRansceiver
Based on uSDX Firmware by PE1NNZ
uSDX Firmware Modification and Adaptation for PEBBLE HF by N4FFF
Hardware modification and PCB design by WB2CBA
U3
DC-12V
US3
SW3
SW2
SW1
GND IN
MK1
INT_MIC
HEADPHONE
ON
MIC/PTT/KEYER
KEYER/PTT
SW4

Result



Powering On and Testing

Note: The radio should work with a 7-14V power input. 12V is the sweet spot for power and efficiency.

⚠️ ATTENTION:

Double check all of your solder joins carefully before powering on the radio. Make sure that you have no solder bridges (where the solder goes from the pin you intended to a nearby pin) or pins that don't have a good solder joint.

Find the small VR1 trimpot potentiometer (pictured below near the toroids) and use a magnifying glass to ensure you have a small screwdriver that you can use to adjust this. It should turn easily.

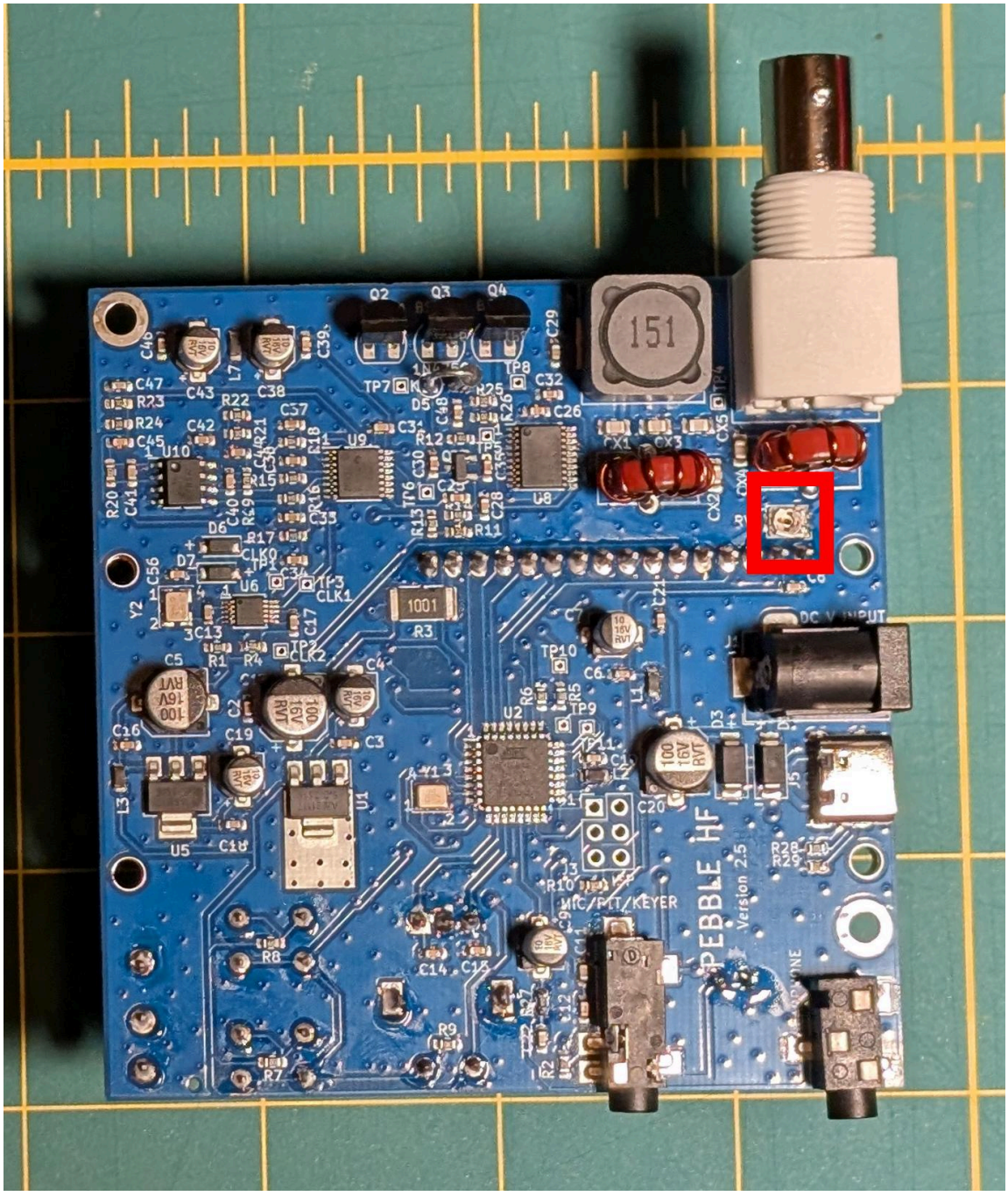
You will need to adjust this in order to see anything on the LCD screen after adding power.

Power on tests

- Ideally, plug in a dummy load ($20 amazon)
    - If you do not have a dummy load, be careful not to accidentally hit the morse code key and transmit without an antenna plugged in.

- Power on using either a 7-12V power source in the barrel jack (ideally) or using the 5V usb port into a USB charger

- Adjust the VR1 trimpot potentiometer (pictured below) until you see characters on the LCD. Note that there will be a **tiny** spot of adjustment that will be just right for being able to clearly see what is on the LCD. It is best to use a non-conductive plastic screwdriver if you have them. If not, just be careful not to touch any nearby pins.



Basic operation

- There are 3 main controls - a knob and 2 buttons.
- The knob is used for tuning when not in the menu. When in a menu (carrot visible), it can be used to change options.

- Press menu to enter the menus and configuration. Press menu again to go into any menu and change the value with the knob. Hit select to go back out of the menu. Press select again or menu to go to the main tuning screen.

Transmit tests

- If you have another radio nearby, you can transmit tests into a dummy load and still pick them up on an antenna to verify. If your other radio has a spectrum waterfall display, it will make this even easier.
- In CW mode, test to ensure you can hear a tone and do not hear or see any spurious emissions.
- In SSB (USB mode), test to ensure you can transmit and both TX and the mic are working. It may be very faint, but you should hear something.

Receive tests

- Plug in a real antenna (not just a dummy load).
- Tune around in both CW and USB mode and listen to signals - requires external speaker

Other tests

- You may want to connect an antenna with a good SWR and listen to yourself transmitting on another radio or use a web SDR to listen to yourself.

⚠️ ATTENTION:

When using Iambic A or B mode, always plug in your external key **before** powering on. The default is straight key mode, which requires no external connection. Without a key plugged into the key/mic jack, the internal microphone will be detected as an iambic paddle and cause unintended transmissions. Note that anything plugged into the key/mic jack will disconnect the internal microphone.

⚠️ ATTENTION:

Turn off AGC in CW mode. Weird things happen.

⚠️ ATTENTION:

Using a high volume of 14-16 can cause sudden loud tones and noises. If this happens, try keeping the volume lower and/or increasing the ATT2 setting.

⚠️ ATTENTION:

Some headphones and external speakers will work better than others. If you have difficulty with a particular headphone or speaker try another one. We found that speakers with built in volume control work well to avoid having your PebbleHF volume too loud which can sometimes cause a loud noise.

Legal & Regulatory Notice

1. FCC Compliance & Amateur Radio Service This product is sold as an unassembled electronic kit intended for use by licensed Amateur Radio operators only, as governed by **FCC Part 97** regulations.

- **Builder as Manufacturer:** Under FCC rules, the individual who completes the assembly of this kit is considered the "manufacturer" and the responsible party for the station. It is the builder's sole responsibility to ensure that the finished radio meets all technical standards (including spectral purity and harmonic suppression) before transmitting.
- **Station License Required:** Operating this device requires a valid Amateur Radio license. You must operate within the privileges of your license class and adhere to all local, state, and federal laws regarding radio frequency emissions.
- **Part 15 Notice:** This kit contains digital circuitry. While it has been designed to minimize unintentional emissions, the builder must ensure that the final device does not cause harmful interference to other services.

2. Limitation of Liability By purchasing and assembling this kit, you agree to the following:

- **As-Is Sale:** This kit is provided "as-is" for educational and hobbyist purposes. The development team (Barb and HamRadioDuo) makes no warranties, express or implied, regarding the fitness of this kit for a particular purpose or the success of the builder's assembly.
- **Limited Remedy:** The seller's sole liability is limited to the replacement of defective or missing components within 30 days of purchase. (Barb and

HamRadioDuo) shall not be liable for any incidental, consequential, or punitive damages (including but not limited to damage to other equipment, loss of data, or fines from regulatory bodies) resulting from the use or failure of this kit.

3. Safety Warning & Chemical Exposure

- **Low Voltage Only:** This kit is designed for low-voltage DC operation (typically 5V–13.8V). Do not attempt to power this device from AC mains or high-voltage sources.
- **Assembly Hazards:** Soldering involves heat and chemicals. Use in a well-ventilated area and wear eye protection.
- **California Proposition 65: ⚠️ WARNING:** This product contains lead and other chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm. Wash hands thoroughly after handling solder or internal components.