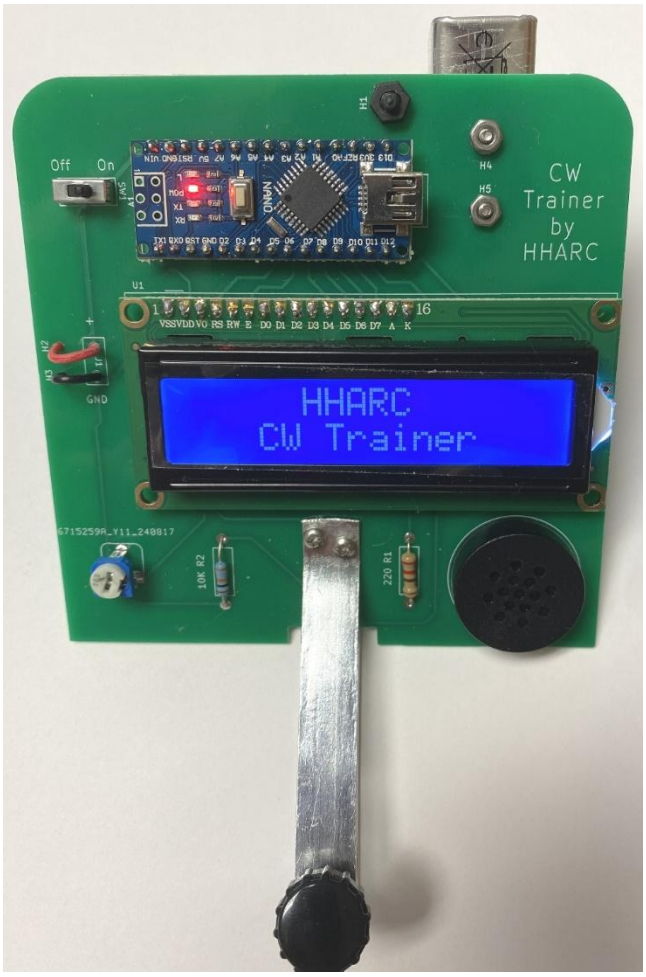
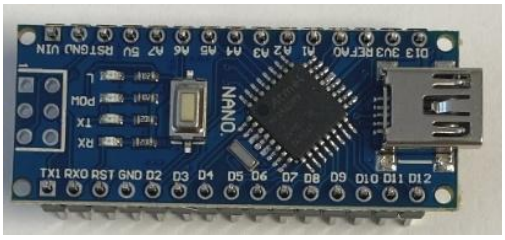
HHARC CW Trainer

This project makes a trainer to help you learn Morse Code (or as hams usually refer to it – CW, Continuous Wave.)

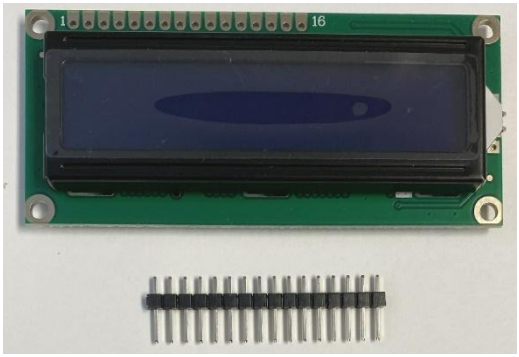


The project consists of:

An Arduino Nano microcontroller (the “brains” of this project)



An LCD (Liquid Crystal Display) with headers



A 220 Ω resistor, R1 

and a 10 kΩ resistor, R2 

A switch, SW1  and a potentiometer, RV1 

A speaker, SPKR1  and battery clip 

9 V battery holder 

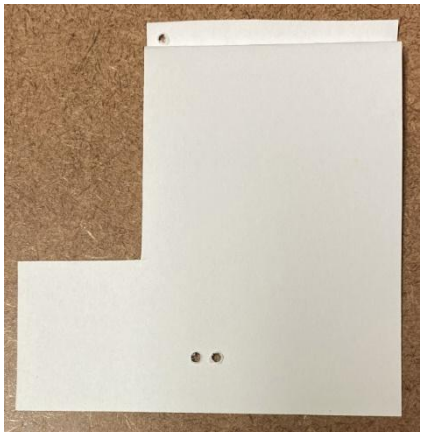
Two 3/8” bolts 

Four 3/16” bolts, 7 lock washers, and 8 nuts  (Plus one extra bolt, washer and nut, in case you lose one)

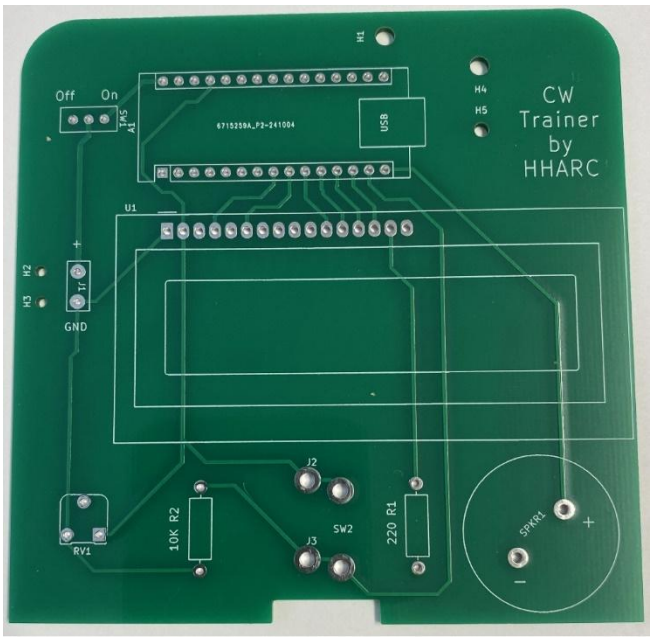
Nylon spacer and nut 

The upper half of the Morse code key  with the hole for its knob and nut 

The lower half of the Morse code key 

Cardboard backing 

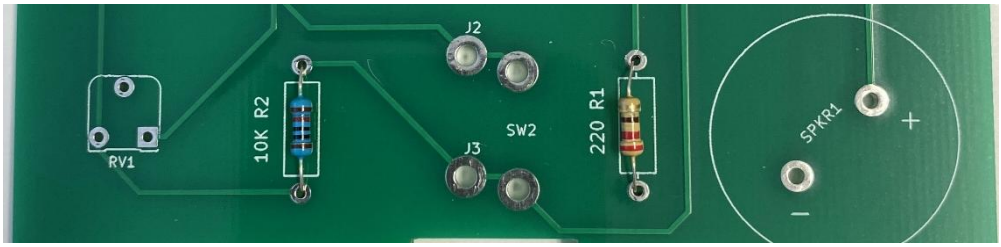
A PCB (Printed Circuit Board).



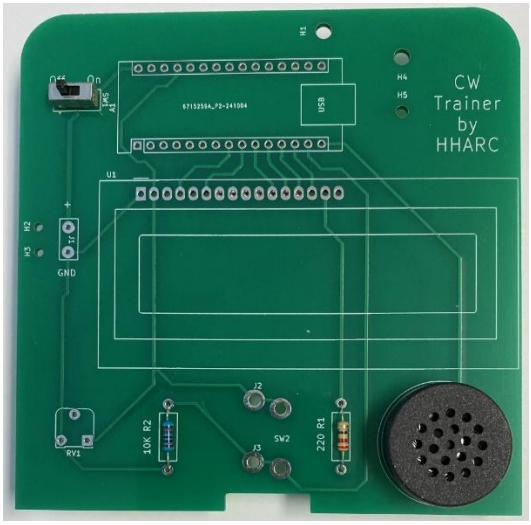
Tools you will need: small Phillips screwdriver (provided), needle nose pliers, small flat head screwdriver (for adjusting the potentiometer), wire cutters.

If you have purchased the kit that has the electronic components already soldered in place, skip to the section marked “Hardware assembly.” Otherwise:

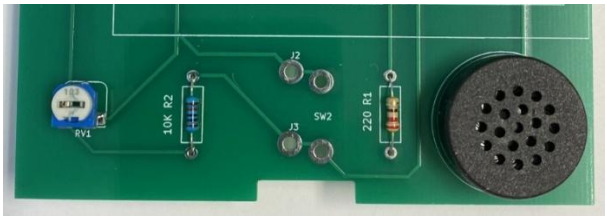
Insert the resistors, R1 and R2, in their slots (R1, 220 Ω on the right, and R2, 10 kΩ on the left), bending the leads to make them stay in place. Solder them on.



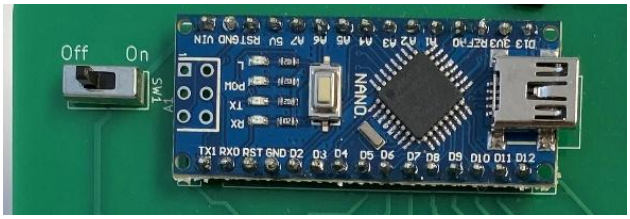
Place the speaker into the holes marked SPKR1 on the PCB with the speaker lead marked + inserted into the hole marked with an +, and insert the switch (SW1) into the PCB. Carefully turn the PCB over and adjust the placement of the components if necessary. First solder the speaker leads and then one of the leads on the switch. Make sure that the switch is properly placed in a good position and has not moved. If you need to adjust the position, now is the time. If all is well, solder the remainder of the leads of the switch and trim the excess wires on the resistors, speaker and switch.

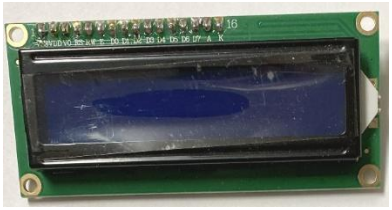


Insert and solder the potentiometer. It has two legs on one side, one leg on the opposite side, and a movable white top. Solder it with the side with the two legs toward the bottom.



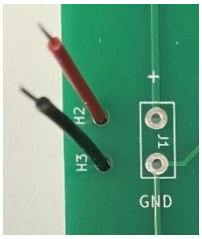
Insert the Arduino, with the USB port toward the right and solder it in place.





Next, solder the headers onto the LCD, keeping the headers at a right angle and insert the LCD and solder it to the PCB. One way of doing it would be to put the side with the longer pins of the header into the PCB, put the LCD on the short side of the pins, and solder both sides.

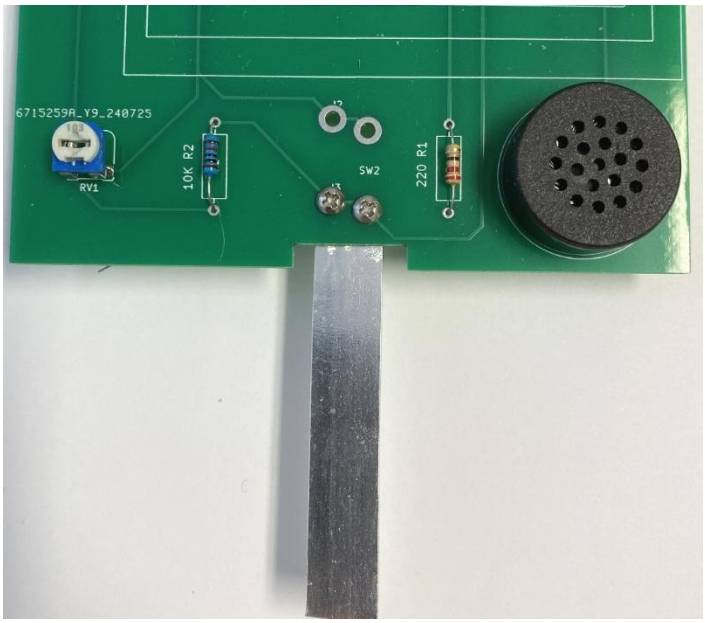
Next, look at the component marked J1. Thread the red wire of the battery clip through the hole H2 (to the left of J1) and the black wire through the hole H3.



Then thread the red bare wire through the padded hole marked with a + and thread the black bare wire through the padded hole marked GND (ground). Bend the bare wires which poke through the PCB to keep them in place and solder the bare wires on the back of the PCB. Now the electronics are completed, but we still have some hardware to install. (If the already soldered kit has been purchased, start here.)

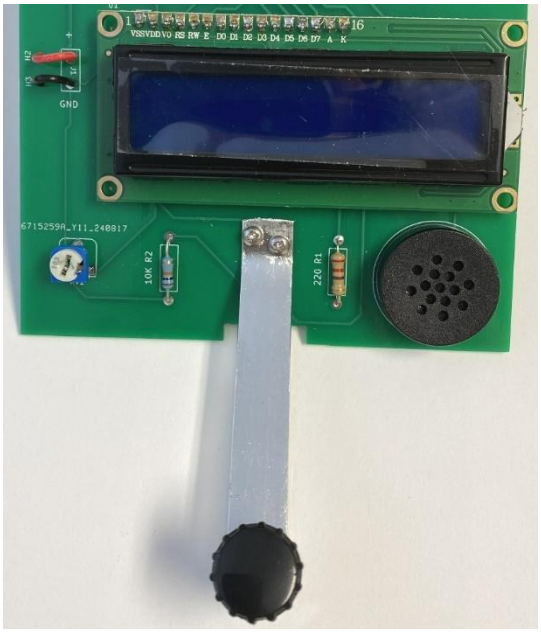
Hardware assembly – Open the Hardware Bag

First, put a napkin or paper towel underneath your workspace, in case you drop the bolts or nuts on which you are working. (Hopefully this prevents them from falling on the floor.) Put two 3/16-inch bolts (the real tiny ones) through the bottom holes on switch 2 (SW2), take the bottom of the Morse code key (the one without the hole for the knob), and place it through the bolts on the backside of the PCB. Put a lock washer and then a nut on each bolt. Tighten with your Phillips screwdriver and pliers until each nut is very secure, making sure the aluminum strip is perpendicular to the PCB and **cannot be wiggled** from side to side. The strip should not move once you are done. See picture below:



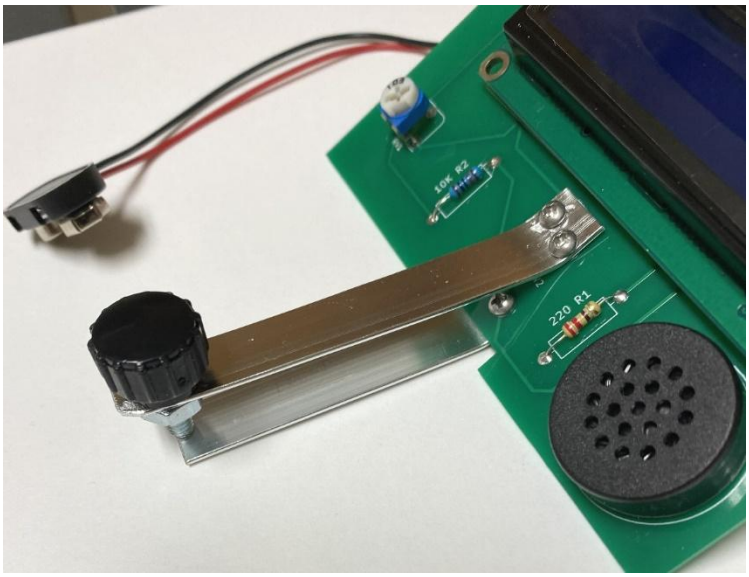
Take the knob, and insert it into the large hole in the upper half of the key and tightly screw on the large nut. [Note the orientation]

Put the two 3/8-inch bolts (the longer ones) through the holes in the upper half of the key, and place the bolts through the top holes of switch 2. Put one lock washer and then one nut on the back of each bolt and **tighten until very firm**, making sure that this aluminum strip is perpendicular to the PCB and aligns with the bottom half of the key, and that the strip **cannot be wiggled from side to side**.



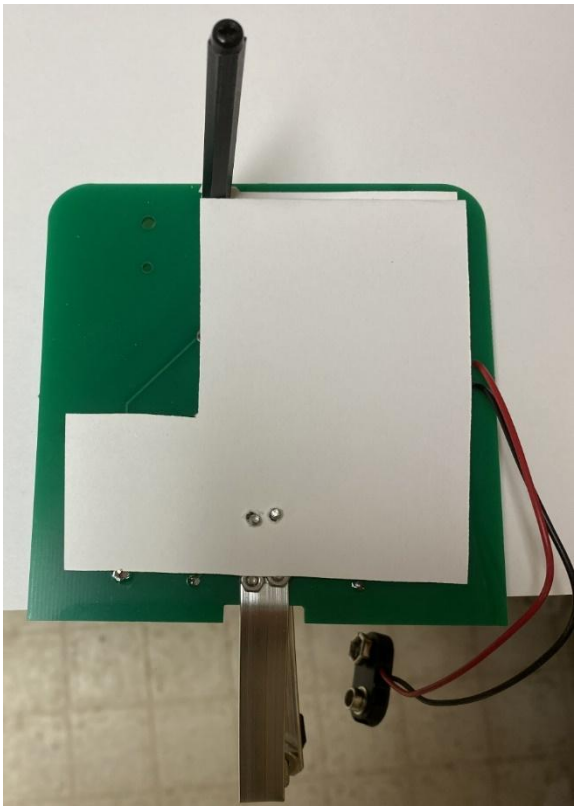
Then take the black nylon spacer and put it through hole 1 (H1) at the top of the PCB. Tighten with its nylon nut.

Adjust the lower half of the key by bending it forward, right at the edge of the PCB. If the trainer wobbles from side-to-side, it means that the bend is below the bottom edge of the Printed Circuit Board; in which case, readjust the position of the lower half of the key.



If necessary, adjust the angle of one or both halves of the key so that the bottom half lies flat on the table and the top half has only a small space between the end of the knob's bolt and the bottom half. (No more than 1/8 inch.) IMPORTANT! When manipulating the aluminum strips, be sure to put your fingers on both sides of the bolt; don't just hold the PCB, which may put too much strain on the PCB.

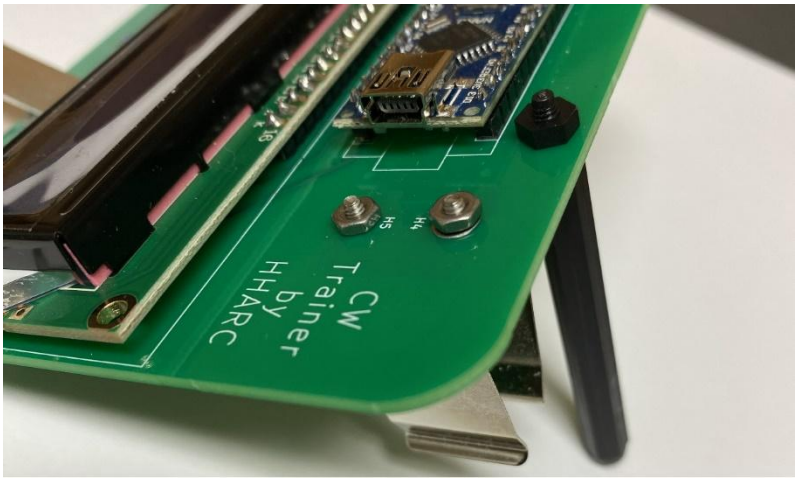
Temporally, remove the spacer. Put the topmost hole in the cardboard backing through the spacer's bolt, and again, put this bolt through H1 and tighten with the nylon spacer nut. [You may want to place the bottom of the PCB by the edge of the table and let the aluminum strips hang over the edge.]



Put another lock washer on each of the 3/8-inch bolts of the upper half of the key; put the holes in the cardboard backing through the bolts and secure with a second pair of nuts. Use the needle nose pliers to tighten the nuts, using the screwdriver to hold the bolts in place. At this point, the bolts should not be able to move; if they do, retighten the first nut.

Place two more 3/16-inch bolts into the battery holder  , then put them in holes H4 and H5. Put a lock washer on the top bolt and secure it with a nut,

making sure that the battery holder is vertical. Put the spare lock washer on the lower bolt (if you still have a lock washer left) and secure with a nut.



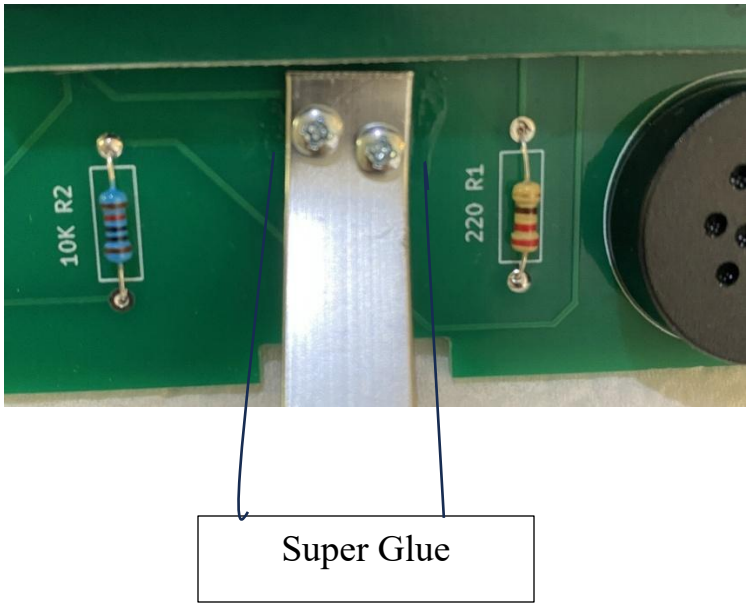
Place the battery clip on a 9-V battery and put it in the holder, taking care so that the battery is not inserted too far down, thus causing the trainer to wobble.

Flip the switch to ON; adjust the contrast of the LCD with the potentiometer as needed. The LCD will display “HHARC,” “CW Trainer” for 3 seconds, then the lower row will disappear and you can begin sounding out your characters.

Troubleshooting the trainer:

Sometimes the display of the characters on the LCD and the sounding out of the characters is erratic, meaning the speaker sometimes doesn’t sound a beep when the knob is pressed down on the bottom half of the key, or the beep starts to sound and then it stops even though the key remains pressed. Try cleaning the surfaces of the key with alcohol to remove oils or dirt. If either the lower or upper half of the key can be wiggled from side to side, you need to retighten the nuts, particularly the first nuts. A loose connection of the key to the PBC is the most common reason for this erratic behavior, and the upper half of the key is usually the problem, since it is this part of the key that is repeatedly moved up and down.

If you have retightened the nuts on the problematic aluminum strip and it still tends to wiggle loose, retighten them again and try applying a squirt of super glue on the PCB on both sides of the strip to help solidify the position, as below:



If you don’t hear ANY sound coming from the speaker when the key is pressed, try keeping the key pressed down for over a second. This puts the trainer into “Receive” mode, in which the microcontroller sends characters to be displayed on the LCD and the speaker produces corresponding beeps. If the LCD is displaying a succession of characters but no sound is coming from the speaker, the problem is with the speaker. Try adding more solder to the pins of the speaker.

Schematic of CW Trainer: