FMT MK4 Feature rich CW Trainer

This is new version of the FISTS Morse tutor project, this time after many requests it is offered as a cased kit. I addition a few new features have been added too.

Now the FMT will support BOTH Paddle and Straight keys in practice mode and an additional fixed low level SINEWAVE output is provided. This output can be connected to a PC for use in a number of ways, the first is when its used with a software package such as CWGet, FLdigi etc you can check your own sending in practice mode, the FMT doesn't have a Morse decoder built in but this way you can see how good (or Bad!) your sending really is. Another useful use for this output is to use the practice oscillator over Zoom or other internet streaming type services.

The kit is easy to build and due to coming with pre-punched front and back panels a better finished product is assured (no more cutting out holes for the large LCD display)

Designed for the FISTS CW Club this tutor offers a wide range of features that you will find hard to beat.

Now with a built in Koch 39 lesson tutor and POW Tap code sender too. (Read the FMT MK4 User guide)

The Standard FMT tutor modes are:

Random Letters, Random Numbers and Mixed Modes which is the standard from the old type of tutors, but this tutor also offers much more;

Random Prosigns, Random Callsigns, Random common words and abbreviations, Contest mode (More on that later) and even a practice oscillator and session timer.

The tutor is very simple to use, no pages of menus to navigate your way around, just one push button that changes the mode and 3 knobs, one for character speed, one for the gap between characters and finally a volume control.

Learning the code can be hard and you do need to stick to it, but don't spend too long per session, it's not beneficial. I suggest keeping to a 10 min session once a day, every day. To help you know when a session is up the tutor will illuminate a LED for 10 secs every 10 Minutes. This is a sign that you may need to take a break.

Now a note about the contest mode, ok what is contest mode? Well the tutor will send a typical contest type 'Over'. It will send a random callsign followed by a three digit serial number, finally a short random message ending such as 'GD DX', a 4 digit locator (Not necessarily the one for the callsign !) , RST Report, or 'QRZ' etc.

That's all well and good but to add to the realism as much as possible the pitch between overs and also the speed will change randomly if you select the 'ACM' (Advanced Contest Mode) on the tutor's board (a two pin jumper enables it). You may want to start with the standard contest mode but you can change to ACM at anytime. (I activate it all the time on mine)

The tutor will generate code from about 11 to nearly 30 wpm, if this gets too tame for you then you can push the tutor up to about 50WPM, another jumper on the main PCB selects this 'Hyper' mode.
In addition there is now a control on the PCB that allows the user to change the default tones pitch to their own liking.

Select practice mode and plug either a straight or Paddle key in and you have a practice oscillator to play with too. (Paddle key option is new in this MK4 version)

Please note, the FMT acts has a simple practice oscillator for straight keys AND normal Iambic dual paddle keys, as such it is fixed in Iambic 'A' Mode and doesn't have Dit and Dah memories. Sorry no squeeze sending! This will force you to learn to send correctly and not rely on 'software enhanced' sending.

Runs from a standard PP3 9V battery.

How to build the FMT?
Read ALL the following instructions BEFORE you start.

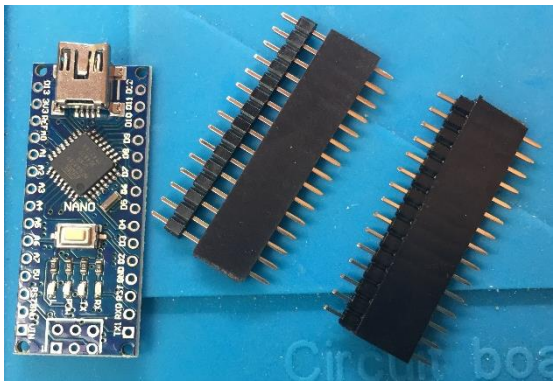
Let's start.
Check you have all the parts before you start.

PARTS LIST

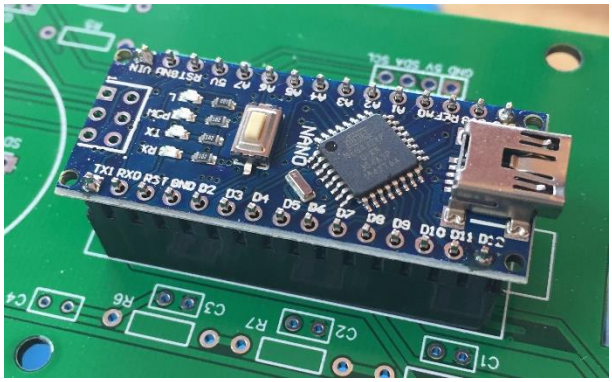
FMT PCB ☐
Mini Controls PCB ☐
FMT case ☐
Front and Back Punched/Screen Printed Panels ☐
4 x Stick on feet ☐
2 x 15 way Socket Strips ☐
DC Power Socket ☐
3 x 3.5mm PCB Sockets ☐
PCB 8 Ohm Speaker ☐
9V Battery holder ☐
3 x Battery holder fixing screws ☐
4 x PCB fixing Screws ☐
D1 x 1 Amp Diode ☐
R1, R5, R9 2K2 Ohm ¼ watt Resistor (RED RED RED) ☐
R2 39 Ohm ¼ watt Resistor (ORANGE WHITE BLACK) ☐
R3 Block Resistor Network ☐
R4 1K ¼ watt Resistor ☐
R6, R7, R8 22K ¼ watt Resistor ☐
C1, C2, C3 0.01uF disk Capacitor (Marked 103) ☐
C4 0.1uF disk Capacitor (Marked 104) ☐
T1 2N2222 (OR 2N2222A) ☐
U1 Pre-Programmed NANO Module ☐
2 x 10K potentiometer ☐
1 x 10K potentiometer with integrated switch ☐
1 x PCB Push Button ☐
3 x Control Knobs ☐
1 x 3mm Alarm Blue LED ☐
1 x 4 Core connecting cable ☐
1 x 5 Core connecting cable ☐
5 x 2.54mm jumpers ☐
5 x 2.54mm 2 Pin Headers ☐
1 x 2.54mm 4 Pin Header (to be fitted to main PCB for display wiring) ☐
1 x 2.54mm 5 pin straight Header (fitted to main PCB for Control board) ☐
1 x 2.54mm 5 pin 90 degree Header (fitted to small control PCB) ☐
1 x 25 turn blue trimmer ☐
1 x Mounting Spacers/Hardware pack ☐
1 x 2 line LCD Display ☐
1 x I2C Board ☐ (This may already be fixed to the display)

The build of the Morse Tutor is straight forward and shouldn't present much in the way of problems. Many people have built the MK1, MK2, MK3 FMT's as a first project and this new version should be just as easy to build.

First let's fit the sockets, you have 3 headphone type sockets, fit these and make sure that they are flush to the board.
Next fit the external power DC socket, there is only one place for this so you can't go wrong. Make sure its flush to the board.

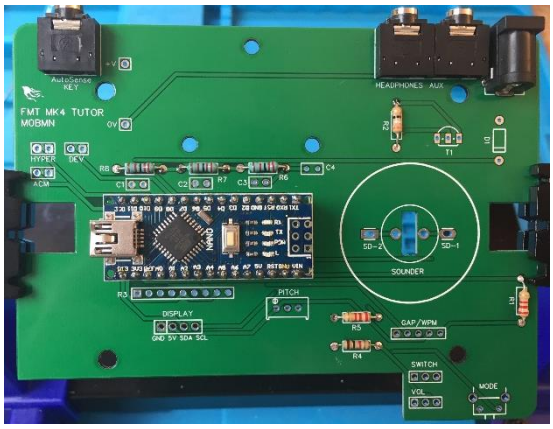


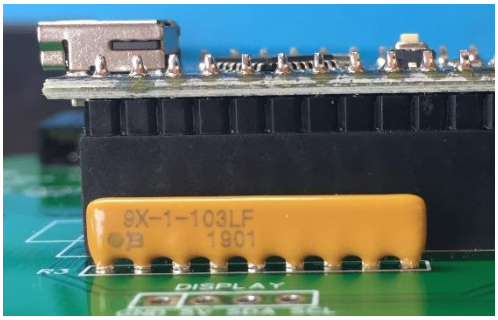
Next find your FMT Nano Module and its 2 x 15 way pin header's, Carefully push the socket strips onto the Nano's pins, put the Nano with its sockets in place on the PCB, make sure you are fitting it the right way round (look at the outline on the PCB), solder the two strips into place.



Just solder the 4 corner pins first and check the socket is sitting flush before soldering all the pins on top of the chip and under the board. You could just solder the two socket strips without the Nano being plugged in but this way make's sure the angle between the PCB and the sockets is right.

Next fit the resistors R1-R9 as indicated on the PCB silk screen and making reference to the parts list above to check the values. Please Note R9 and its jumper H/S are not shown on the pictures here, it's a late addition to the board (see notes at the end of this document). The resistor can be either 4 of 5 band type so use the supplied chart to confirm their value or better still check them with a test meter.



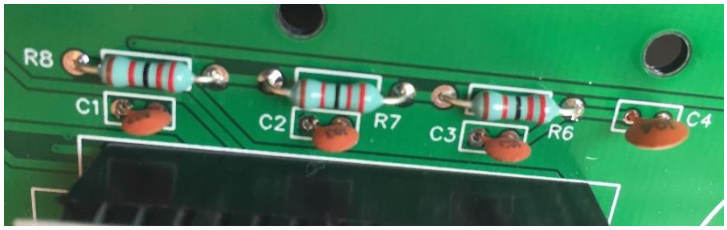


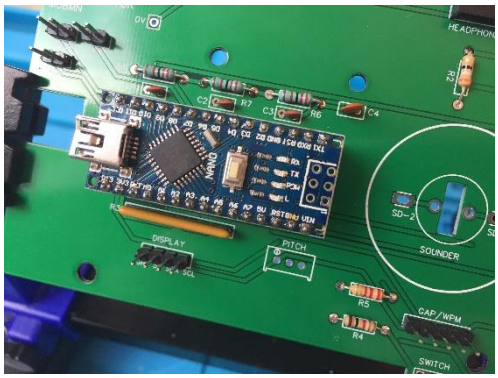
Note R3 is a bank of network resistors and must be fitted the correct way round.

If you look at the bank of resistors you will see that one side as some printing on it. This side must be nearest the DISPLAY connector position on the main PCB. (yours may be different colour and markings)

Now fit the capacitors C1, C2, and C3, these are all small ceramic disks, they will be marked 103 on one side, they can be fitted either way round.

Next fit C4, this is a 0.1uf Disk, it's a little larger than the other capacitors and its marked 104.

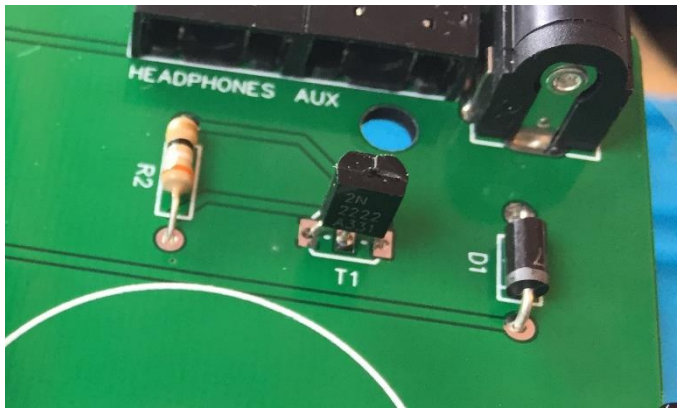




Now fit the five 2 Pin headers and the 4 and 5 pin headers too. Make sure they sit straight up on the PCB. (Note the H/S header is not shown on this picture)

Now fit the pitch adjustment control, the little blue trim pot. This control as a small brass adjustment screw, look on the PCB layout for this part and you will see which way this control should be fitted.

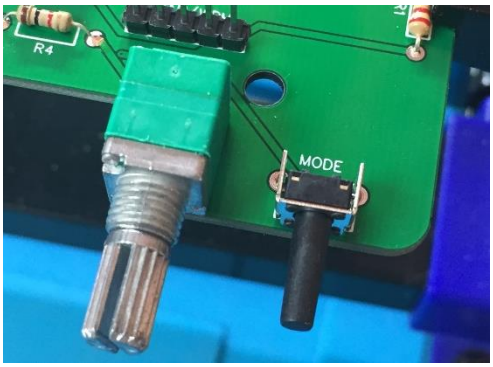
Next fit the transistor, it is marked 2N2222. The board shows which way round to fit this so make sure you follow the outline. You don't need to push this right down flush to the board, that



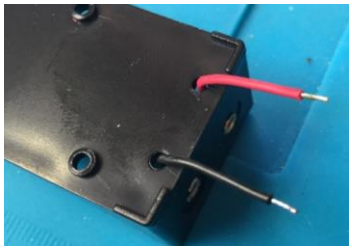
Now fit the 1Amp Diode, D1. Note the direction of the band in the picture.

We still have a few more parts left now but the main board is almost done.

You will find a combined volume and power switch this should be fitted onto the main PCB but before you do you will need to remove the Tab from the body of the pot, it will snap off easy, I use my cutters and try and bend the tab, it will snap off without much effort.

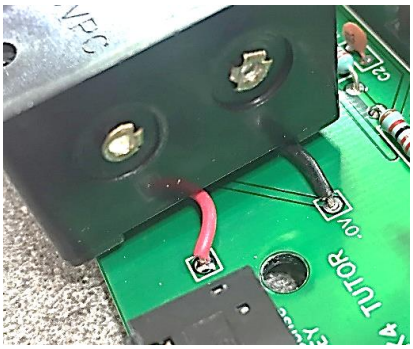


Now fit the mode switch, this fits next to the volume control on the PCB.

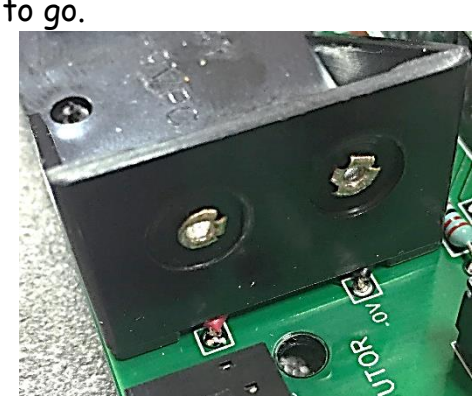


The battery holder is next, cut the leads from the holder to about 20mm, strip the ends of the wires by 3 mm and twist/ tin the ends, solder the wires in place

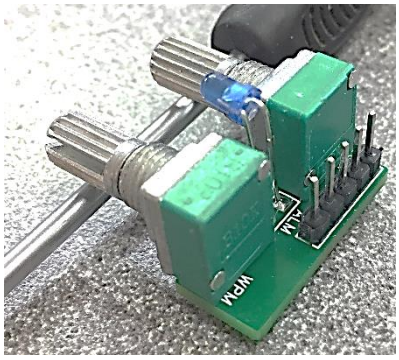
Follow the layout silk screen shows where each wire needs to go.



Then position the holder so the wires are under it and secure in place from the BOTTOM of the board with the three small black self-tappers provided.



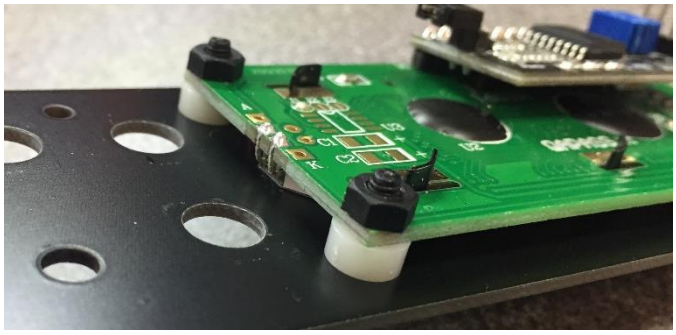
Now we need to build up the small control PCB board.



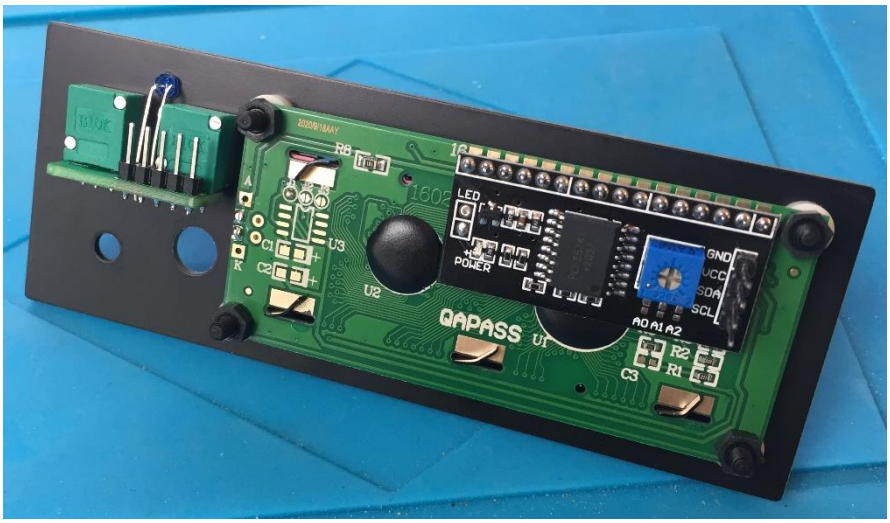
Fix the two 10K control potentiometers on the board, then the blue LED, the led should be fitted so it is a high as possible, just make sure the pins go through the board and no more. The LED as two leads, one longer than the other, the long pin goes into the ROUND pads hole.
Now fit the 5 pin header. You will be supplied with a new angled degree Header which gives more room for the cables. (Not shown in this picture)

Next move onto the front panel. These are the parts you will need for this stage

Fit the LCD module as shown below. Make sure that you put the small white spacers between the panel and the LCD display or the display will not sit correctly.

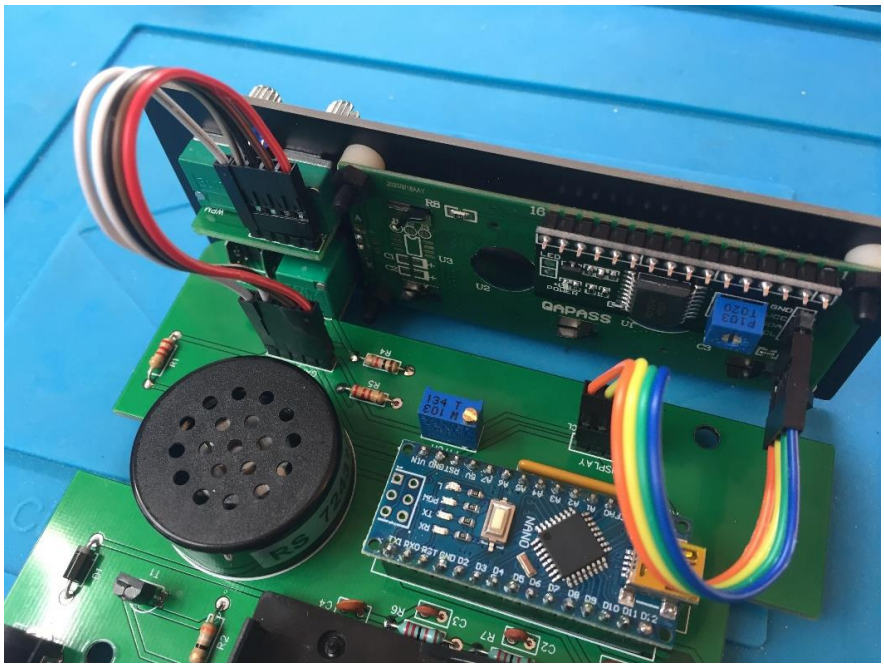


Now attach the small PCB to the front panel. Bend the LED so that it can just protrude through the small hole between the GAP and WPM controls.



Note the pins on the display module in this picture. They are sticking out straight. Your module will have pins bent over by 90 degrees. You will need to straighten these pins. Use a pair of pliers and **carefully** bend the pins back to the upright position. Make sure they are nice and straight and all the same distance apart.

Now fit the front panel loosely to the main PCB, don't tighten this up at this time.
If all looks good it's time to fix the speaker. We have left it till now because the speaker attracts just about every bit of off cut wire it comes near, the magnet inside causes this. So before you fit it have a clean-up on your work bench!
The speaker has Positive side (look at the bottom of the speaker) this side should go nearest to the Nano Chip.



If you wish you can now test the tutor, to do so we need to fit the cables between the board and the front panel. The first is for the display, take the 4 way cable that came in the kit and plug it onto the main PCB.
The other end of the cable connects to the piggy back board on the display, it will only work one way round. Look at the picture here to show you the correct way to fit the cables.

Then you need to fit the control cables to the GAP/SPEED PCB use a 5 core cable for this.

Fit the 9v Battery and turn on the tutor, the blue LED should flash briefly and the display will light up. The text on the display may be faint (or even not there at all!) or just a row of black squares. Adjust the small trimer on the back of the display board to set the display to your liking. By Now you should also be hearing the sweet sound of Morse code. Press and release the mode switch should allow you to move from one mode to another, the volume, gap and speed controls should also be working.
If the display is not working check you put the cable the right way round. Same for the controls. If all ok turn off and remove the battery. Find the bottom part of the case and the back panel. Hold the back panel in place next to the back of the PCB and lower the lot into the cases base. Now use the 4 small black self-tappers to secure the PCB into the case. Refit the battery and fit the top case and use the two long case screws to fix the two half's together.

You have completed the Tutor, good job!

Now How to use it. Most of the controls do not need any real explanation, the only thing you may have a problem with is the practice oscillator.
In the earlier versions of the FMT Tutor the practice mode was accessed by the mod e button. In this version it's a little different. You can leave a key plugged into the tutor at all times, but to activate the practice mode you will need to turn off the tutor and depending on the key type (Paddle or Straight) you will hold down the straight key (or (press the left hand paddle) and turn on the tutor, continue holding the key until you see the sign on message. The tutor will then read the key input and switch to practice mode. There are no options in straight key practice, press the key and the unit will emit tone as you would expect, if it's a paddle key the display will show the approx. WPM rate it is set to (adjusted by the WPM control on the front panel) .
When finished using this practice mode turnoff the tutor, next time you turn it on it will just return to tutor mode unless you are holding the key at power up.

The MK4 also has a fixed low level output. This output is a sine wave so it sounds better when fed into a separate amplifier or computer (your choice) this will allow you to use software such as CW get, fldigi or many others (links on my website on the 'Links' page) to decode your own sending as the tutor does not have a built in decoder. Also this can be used over the internet for CW train via Zoom etc.

The only other options you may want to play with are the five jumpers on the main PCB. The jumpers are labelled as HYPER, ACM, Iambic A/B, H/S, and DEV. The user guide is the best source of information on these as I update the firmware that can change the function of these

The Hyper jumper will control the max speed of the tutor, not for the faint hearted! Above 40WPM max with this enabled.

The ACM jumper is for the Advanced Contest mode. In this mode the tutor will randomly adjust the speed and pitch when in contest mode to make things more realistic.

The Iambic A/B jumper selects the Iambic Mode in the practice oscillator.

Next is the H/S jumper, The AF output socket on the rear of the tutor can drive a external speaker at much higher volume levels than the built in one. That's fine but with headphones it's very loud. The Jumper here when removed reduces the max volume at the socket and is more suitable for headphones, if you intend to only use the socket for headphones its worthwhile removing this jumper (if fitted).

The finial jumper DEV (or marked REV on latest boards) is currently used to reverse the left/right paddles
If I add more features later this may be changed to a software setting. (Features can be added by changing the plug in chip at some later time)
One thing I get a number of emails about is the Blue LED, 'it doesn't come on' that's what I keep getting told. This LED will ONLY come on after 10 mins of tutor use. It will come on and remain on for only 10 seconds. After that it will go off again until another 10 minutes as past. It's an indicator that it's time to take a break not a power on LED.

I hope you enjoy building the new FMT tutor and that you fin dit helps you learn the Code. Consider joining FISTS CW Club you will get a warm welcome and encouragement/support to help you to learn the code.
73 Paul M0BMN