

Universal Code Practice Oscillator (uCPO) with built in Morse tutor

These instructions can be used with the Module only Kit OR the full kit.

uCPO Specifications

3 Mode Processor Controlled Morse Oscillator/Tutor

Mode 1:- Straight Key Practice Oscillator

Variable Tone : 400-1000Hz (via internal trim pot)

AutoSense Key type

Mode 2:- Iambic/bug/Sideswipe Mode

AutoSense Key type

Variable Tone : 400-1000Hz (via internal trim Pot)

Adjustable Speed 10-35wpm

User selectable Iambic A or Iambic B + dot memory

Mode 3:- Morse Tutor Mode

Built in 6 Mode Morse tutor

1) Random Letters

2) Random Numbers

3) Random Prosigns

4) Mixed Mode

5) International Callsigns (*Advanced mode)

6) Contest Mode (*Advanced Mode)

7) Adjustable WPM rate (10 to 30+wpm)

8) Adjustable Gap (Farnsworth Mode 0-3sec approx)

***Advanced modes**

The two advanced modes have been designed to add a bit of realism and interest to your practice sessions, the speed of each 'over' will automatically change by upto +/- 10%. So some will be faster than your set speed and some slower, just like the real world. To make things even more realistic the user can select VariTone mode too. In this mode the pitch as well as the speed will change.

- **Zoom /Decoder Output feature**

Since the world has changed a lot in the past year. Many of us are now not meeting up in clubs for practice sessions and so organisations such as CWops and the CW Academy are using Zoom or Skype for remote training. The uCPO has a built in low level output socket for connecting to a PC or Mac, this output is a sinewave for a cleaner sound. This output can also let you run decoding software on the computer to test your own sending or to show what the tutor is sending so you can check your own receiving. The uCPO also has a headphone output for personal practice too.

The uCPO is built around a clever little processor chip and offers a lot of features. With all these features being controlled by just a single knob and a straight/paddle key the initial setup can seem a little complicated the first time you try it but for many the default settings will be fine,

Default settings

Automatic Key selection

Side Tone Pitch approx 700Hz

Tutor Speed:-17 WPM

Vari-Tone for advanced Tutor modes ON

Iambic B Mode active

How to setup the uCPO options

This is now the new version 3 of the uCPO with more features than before.

The instructions below sound complicated but once you have run through them a couple of times you will find you can make the changes in just a few seconds with ease.

- 1) Turn OFF the uCPO.
- 2) Press the key down or if a paddle squeeze both paddles and HOLD.
- 3) Turn on the uCPO, (Still holding the key!)
After a short delay you will hear the letter 'A' in Morse, adjust the speed control to set the tutor WPM rate. I suggest setting the control at the 12o'Clock position which will be about 17 wpm character speed. Once you're happy with the speed release the key.
- 4) If you just wanted to change the tutor WPM rate do nothing else. Turn off the unit and then back on to use the new set speed (which will be saved for all your sessions until you change it again)

If you are doing the initial setup or want to change other features carry on and do NOT turn off the unit as above.

- 5) As soon as you release the key in step 4 hold it again, after a second or two you will hear 'VT' in Morse. This is now going to allow you to set the Vari-Tone feature ON or OFF. If you want the Vari-Tone (VT) on continue to hold the key. After a second or two you will hear a high pitch tone (2000Hz), this tells you that VT is on. If you wanted this option off then when you hear the 'VT' Morse signal release the key and a second later you will hear a low pitch tone (1000Hz).
- 6) As soon as you hear the low or high pitch tone start hold the key again. You will now hear 'KM' for keyer mode. This mode allows you to set Iambic A or Iambic B

with Dot memory. If you continue to hold the key after the KM signal you will hear another high pitch tone, this means you are in Iambic B mode, if you release the key as soon as you hear KM you will hear a low pitch tone. This means you have selected Iambic A mode.

- 7) All settings will be saved in the chip until you repeat this process again at some point in the future.
- 8) Turn off the unit and now you're ready to practice.

How to use the uCPO

The uCPO is easy to use despite having many different modes and uses.

Straight Key Practice oscillator Mode.

Make sure you have wired your key to a 3.5mm MONO plug. Turn off the uCPO and plug the key into the front panel. Turn on the uCPO, that's it! Adjust the volume to suit. The uCPO automatically senses the straight key since it uses a MONO plug unlike the paddle key.

Paddle/Bug/Sideswiper Practice Oscillator Mode.

Turn off the uCPO. Plug your key in, turn on the uCPO. Tap away. Now the speed control will be active and you can set the speed from about 10 to 35wpm, the 12o'Clock position is approx. 20 wpm.

Morse Tutor Mode.

If using a paddle key squeeze both paddles when turning on the oscillator or if using a straight key just hold it down on power up. Once turned on release the key within a second or you will enter setup mode. The tutor will now start sending 5 figure letter groups, if you now hold the key down or hold the left hand paddle it will switch to random numbers, next press it will switch to Prosigns, then next mode which is all of the above mixed. One more press and you get a more interesting mode, Callsigns, this mode sends random international callsigns but each callsign will be sent at a slightly different speed and pitch (if VT is turned on) , just to make things a little more realistic. The next mode is typical Contest mode, a callsign followed by the standard '5NN' and then a 3 or 4 digit serial number, sometimes this serial number will use Cut numbers (instead of '0' it sends 'T' and instead of '9' it send 'N'), again with random speed and pitch like the callsign mode.

When changing modes the tutor will first send a Morse letter at a higher pitch tone that identifies the new mode ('L' =letters, 'N'= Numbers, 'P' = Prosigns, 'M'= Mixed, 'C'= Callsign, and 'CT' = Contest)

A worthwhile tip. There is no point trying to learn the code with a slow character speed, you will only need to relearn the sound of each letter again when you get on air.

It's an easy mistake to learn the code with character speeds that are so slow you learn by counting the dots and dashes. This is a **mistake**. From day one learn the sound of each letter, **DO NOT** count the elements of each letter. Yes it will seem harder at first but it's not a race and the rewards are much higher. So I recommend you use a character speed of around 17 wpm which is a realistic speed used by many operators in the real world. (start at the speed you want to get to and just increase the gap to start with) I will not be cruel and expect you to start learning Morse at such speeds so the speed control in this mode will allow you to set a gap of your choice upto 3 seconds between characters, this will make the task of learning much easier without you falling into the counting trap! In the setup guide I have explained how to set the Character speed to a suitable value.

Another new feature is the AUX output connection. This is a fixed low level **sinewave** output that can be connected to a computer for practice over the internet via Zoom etc. Another use of this output is to use it to test your sending, connected to a PC running software like CWGet , FLdigi or many others that will decode Morse. This way you can see if what you're sending makes sense, decoders typical struggle with hand sent Morse so if you can get yours decoded you know it's good!

The version 3 also gives a convenient headphone output connection point too.

The tutor functions and other features make this practice oscillator unique and exceptional value.

There is an on-board trimmer pot for pitch adjustment. With the exception of the sockets all the other controls are board mounted and the volume control (incorporates the power switch) can be mounted on the left or right of the board to suit your application as placement of this control (and the Key input connections) is duplicated on both sides of the board. The uCPO will drive a standard 8 ohm (or higher impedance) speaker.

The power to the uCPO needs to be between 6 and 12 volts so a standard 9v battery is ideal (or 4 AA batteries for a long long battery life).

The SPEED control will only be active in Paddle mode or to set the Gap in tutor modes.

When you want to change between the different modes of the tutor you need to press and HOLD the key until you hear the mode Letter from the tutor. One little thing to be aware of is when in either Callsign or Contest mode and you chance to the next mode the tutor will Announce the new mode Letter but may have a few letters from the last mode in its buffer that will be played before the new mode starts.

It sounds more complicated than it is, after a couple of goes you will find it very easy to change these options. You can control all of this with just a straight key after all!

I hope you enjoy the uCPO.

Best 73 Paul MOB MN

Important Fully Boxed Kit Instructions

If you are building the uCPO full kit version in the supplied case you **MUST** follow the instructions as regards the fitting of the user adjustable controls and LED, failure to follow them will result in a poor fit to the case. Read all these instructions before starting work.

Building the uCPO



The uCPO is built on a fairly small and busy looking PCB.

If you're new to building kits please don't be put off by the fact that it looks like there are many soldering points on this board, many are duplicated to give different options

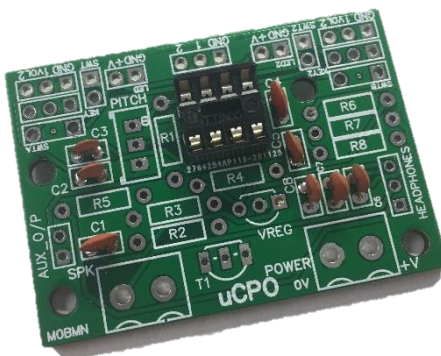
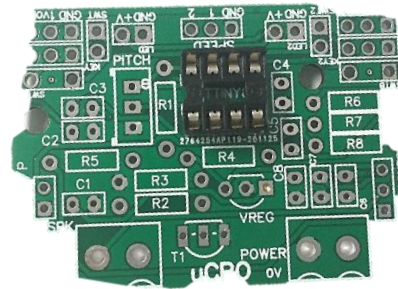
Let's check we have all the parts first:-

Parts list.

- 1 x uCPO PCB
- C1, C4, C5 0.1uF Disk (marked 104)
- C2, C3, C6, C7, C8 0.01uF Disk (marked 103)
- R1,R3, R4 3K9 $\frac{1}{4}$ Watt Resistor
- R2 10 Ohm $\frac{1}{4}$ Watt Resistor
- R5 1K8 $\frac{1}{4}$ Watt Resistor
- R6, R7, R8 22K $\frac{1}{4}$ Watt Resistor
- Speed Pot 10K Potentiometer
- Volume/Swt 10K Potentiometer c/w Switch
- Pitch Control 10K Trimmer
- U1 78L05 5V Regulator
- T1 Audio Amplifier Transistor 2N2222 (or any general purpose NPN)
- LED Red 3mm "Power On" LED
- IC Socket 8 Pin DIP
- IC1 Attiny85 Programmed with uCPO Code
- 2 x Blocks 2 way Blue PCB Terminal Block
- 3 x 3.5mm Stereo Key Socket
- PP3 Battery Clip
- 8 Ohm Loudspeaker
- Connection Cable
- 2 Knobs for controls
- Pre-Drilled Base plate & Box c/w speaker & mounting hardware (**only with full kit**)
- 4 x Case base screws (**only with full kit**)
- 1 x Stick on Label (**only with full kit**)

Let's make a start!

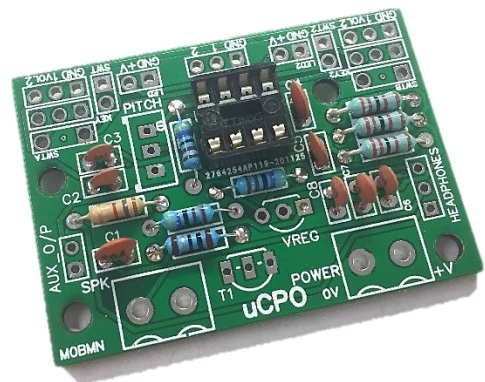
- 1) Fit the IC Socket in the middle of the board, you will note the socket as a dimple on one of the shorter sides, arrange the socket so that dimple is matched by the silk screen printing on the board.
- 2) Fit C1, C4, & C5 these are 0.1uF disk capacitors. They will have '104' printed on one side. They can be fitted either way round.



- 3) Fit C2, C3, C6, C7, C8 these are 0.01uF disk capacitors. They will have '103' printed on one side. They can be fitted either way round.

- 4) Fit R1 which is a 4k7 resistor. Now there are two different marking schemes used and it depends on the batch of resistors R1 comes from. Some will be 5 band markings and some may be 4 band markings. For this resistor the first 2 bands will tell you if you have the right one, look for first band Yellow and the second band Violet. All the resistors can be fitted either way round.

- 5) Fit R2 which is a 10 ohm resistor. The first two bands will be Brown and Black.
- 6) Now fit R3 and R4, these are 4K7 resistors. These are the same as R1 above.
- 7) Fit R5 which is a 1K8 resistor.
- 8) Finally fit the last resistors R6, R7, R8 which are all 22K $\frac{1}{4}$ watt resistors.

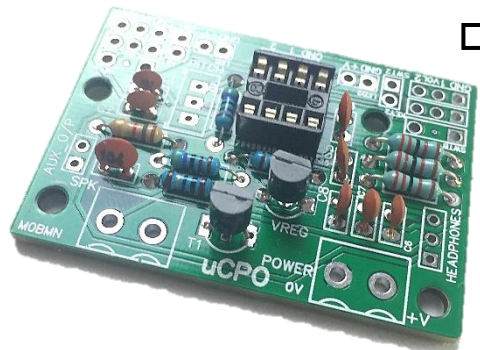


- 9) Now stop and take a break, take this chance to double check that you have fitted the correct parts in the right places. Also check your soldering for dry or poorly soldered joints.

Up to now the parts you have fitted are tolerant of heat and should have given you chance to practice your soldering. Now we are moving onto the 'active' parts such as the next two, which are a voltage regulator chip and a transistor. Take care not to 'cook' these parts by overheating them while soldering, they will be

happy with the iron being applied for a few seconds on each leg so don't panic about this just take care with the soldering and you will be fine.

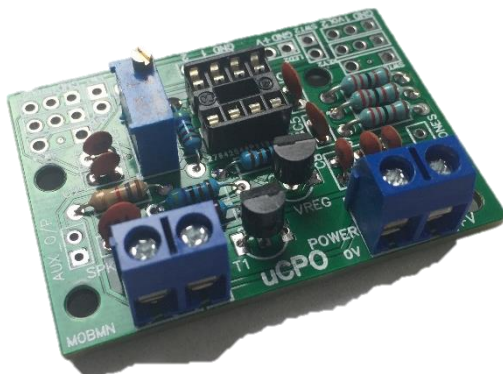
10) Find T1 and U1, they look the same. Each one has 3 legs and a black plastic body. They may look the same but are very different and the right part must be fitted in the right place. Use a magnifying glass if you must but read the identifier printed on the flat face of each part. Now find the part labelled 78L05, this is U1. The screen printing on the PCB shows how to align this, make sure you fit it the right way round, you do not need to push the part right down on the board I would recommend pushing it down so about 5 or 6mm of leg is above the board. Once fitted this way solder the three legs and trim as normal.



11) You only have one similar device left now but check that it's labelled 2N2222. Again align it as per the silk screen printing and push down to 5 or 6 mm above the board. Solder and trim.

12) Fit the blue Pitch trimmer, you will see a small brass screw on the top. Look at the PCB silk screen and you will see it shows where the screw head should be. Fit this part and push it right down onto the board it should sit flush on the board when correctly fitted.

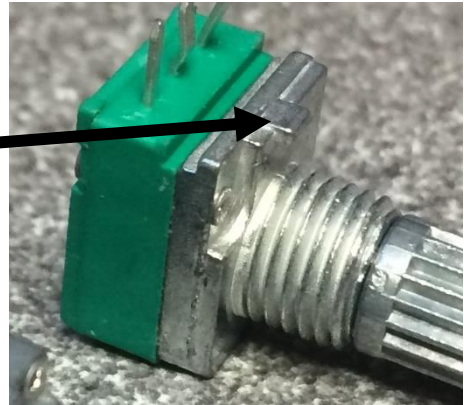
13) Fit the two 2 way blocks, these should be straight forward to fit.



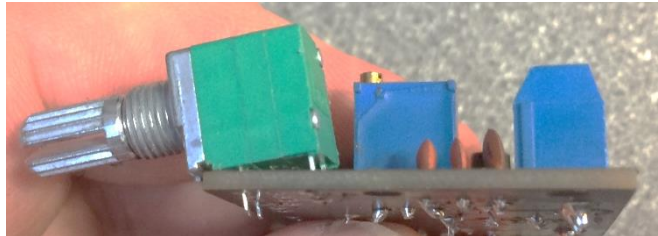
Time to take a break again and carefully check all the work you have done so far, check that all the joints are good and that you have not made any solder bridges between pins, if you have one use a magnifying glass to inspect each joint one by one. The most common reason kits don't work is poor soldering and short circuits. Make sure yours look good.

14) Now we need to fit the volume and speed controls, **THIS STEP IS CRITICAL AND MUST BE FOLLOWED**. You can't really mix these up as the volume control also has the on/off switch built in. Before you start soldering, look at the body of the two controls, if you're lucky I have already broken off the little locator tag just under the shafts.

If not use cutters/pliers and snap off this tag, it comes off easily as it's only diecast aluminium. Do this to both controls. **Take care with this step or the board will not sit correctly in the case.**

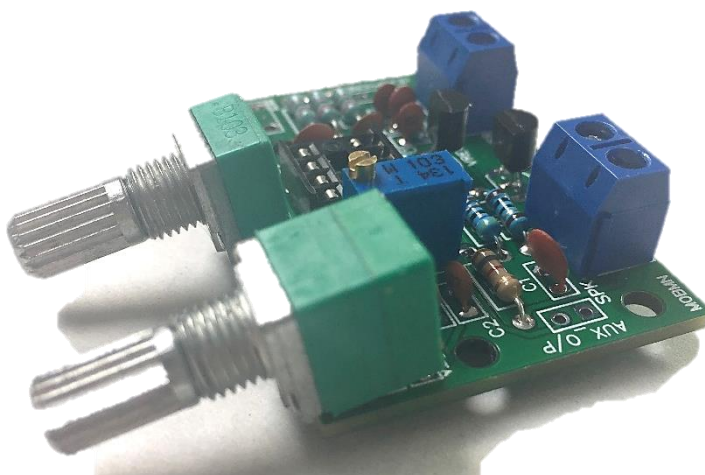


Put the volume control on to the board, it must be on the side near to the pitch control as in this picture if you're fitting it into the box with the full kit.



READ ALL THE INSTRUCTIONS BELOW IF FITTING INTO THE CASE SUPPLIED IN THE FULL KIT, if you're building just the module you need to fit the volume and speed controls flush on the board as you would expect.

The **IMPORTANT** thing is that the control **MUST NOT** be fitted flush to the board. The case has a slight slope to the front panel, if the controls are fitted flush to the board the PCB will not sit flat in the box. Look at the picture above and you will see that the back pins are higher than the front. Push the control onto the board then push the control so that the back pins are **just** sticking out of the back of the PCB, they should just be protruding, solder tack the middle pin on the front row of terminals to hold the control in place and then double check the back pins are just protruding and solder them in place. The most



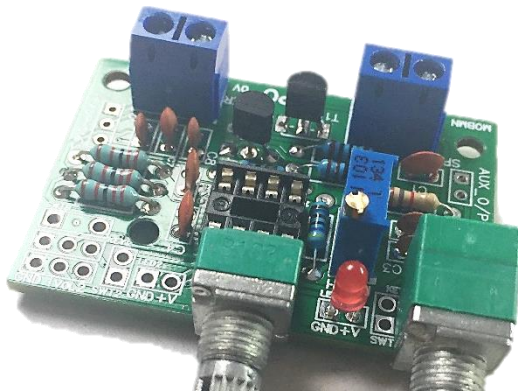
common fault with this kit is forgetting to solder the other pins of this control. Once you're happy that the control is fitted as the photo then make sure all five pins are soldered in place.

Now fit the second control and angle it the same as the

first. This is easier as it's just one row of pins. Make sure you solder all of them this time when happy.

Now fit the Power on led, the led as two legs, one long ,one short(er). The position to fit the LED is between the two controls. You will see the two holes that it fits in, one hole is square one round. The long leg of the LED **MUST** go into the round hole. Push the LED in and leave it with about 5mm of leg above the board.

If fitting the module in your own case you can fit the LED to the board or wire remote

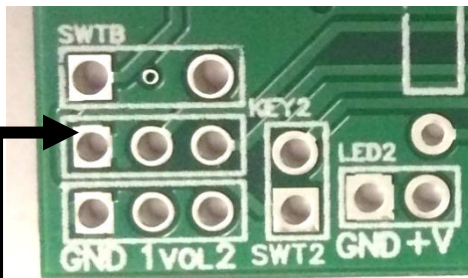


Check the fit of the board in the case, to do this bend the LED right over .

Now drop the board into the case, push it forward and make sure the LED is placed in the 3mm hole between the control holes. Carefull push the board forward, you will feel resistance to this as the LED legs will fold backwards as the board moves forward.

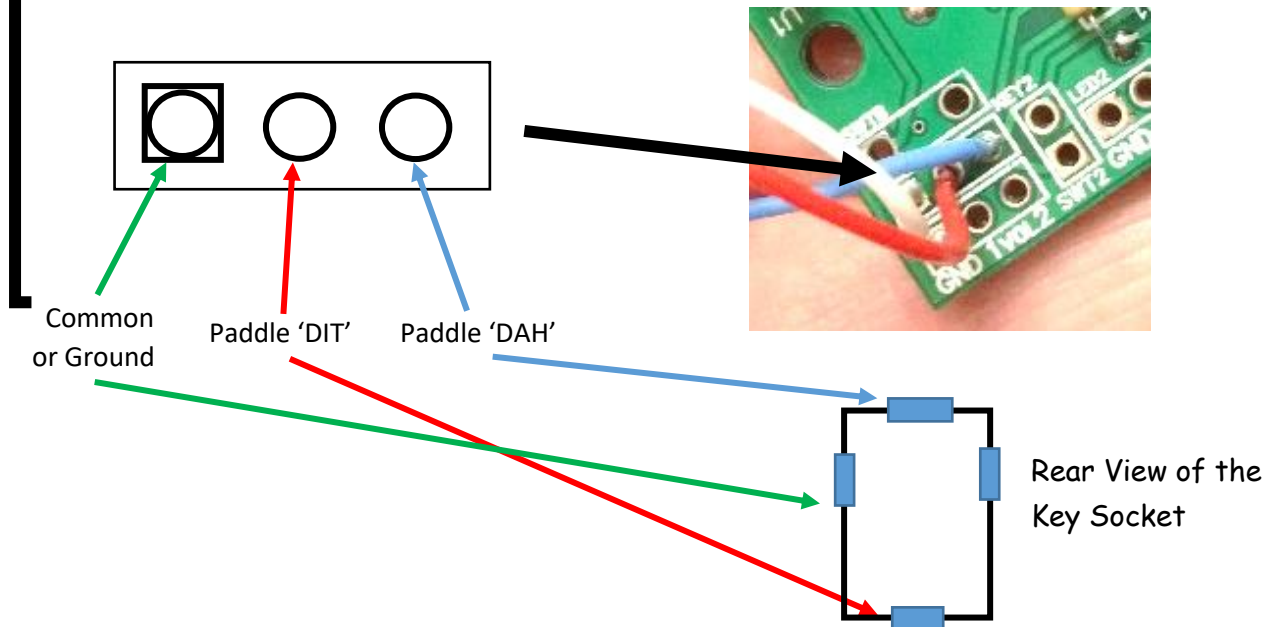


Check the board fitting, at this stage you should not have any problems, the LED legs will fold back, just make sure that they do not short on each other. Now remove the board, we have to wire the sockets.



Now we have to wire the key socket to the board. I have supplied a few short lengths of wire that can be used for this.

On the left of the speed control there is a second position for the volume control (if you are fitting the uCPO in your own case you can fit the volume either side.) The middle row of 3 holes is the connection point for the key, the square pad is the GND or common pin for the key and the other two are the left and right paddle connection points.



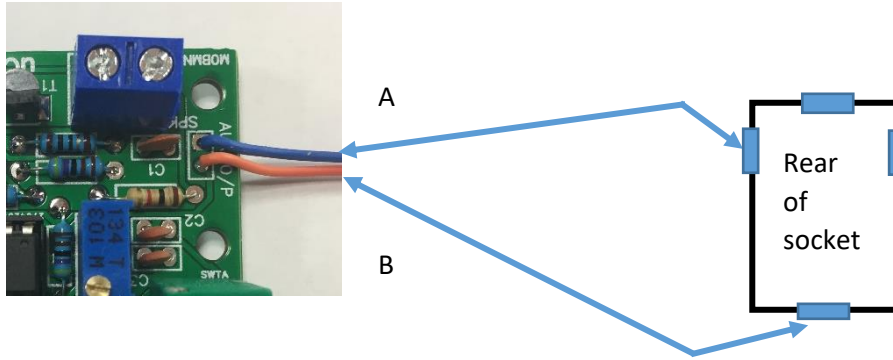
The wires to this socket do not need to be long, just about 60mm will do it nicely.

If your building the full kit then you need to fit the headphone and aux sockets, if you are building the module only kit then it's up to you if you want to fit them. If you do not fit the headphone socket you will need to install a link on the PCB (Details further below)

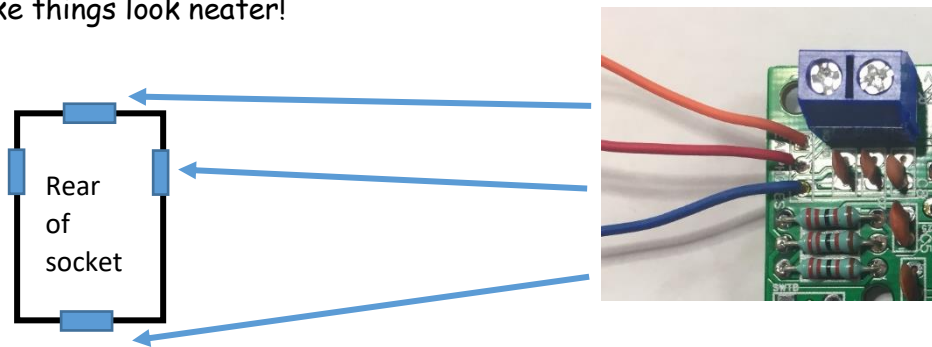
Now we can wire the AUX output and headphone socket

The AUX output is two wires that connect to one of the 3.5mm sockets, the wiring is as shown here. These wires should be about 140mm long.

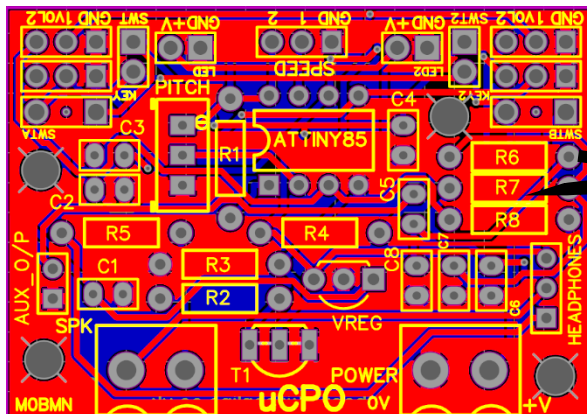
Wire as shown below. (colours of wire provided may be different from shown)



Next wire the headphone socket, again leads about 140 mm long. Twist the wires together to make things look neater!



Important:- If you are not fitting the headphone socket you need to fit a link on the PCB or you will get no audio on the speaker connection block.

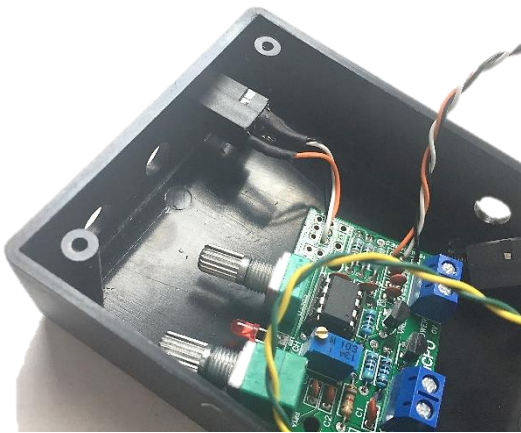


Fit the link between these two pins if you are NOT using the headphone socket.

Now fit the control chip, it's a small microcontroller type chip called a ATTINY85. An amazing little high performance chip that can do a lot for its size. The chip if you look carefully, has a small dot near one pin. This dot tells you which is pin 1. The Pin 1 end of the chip should be nearest to the blue trimmer.

Now fit the PCB into the case and attach the sockets into the holes made for them.

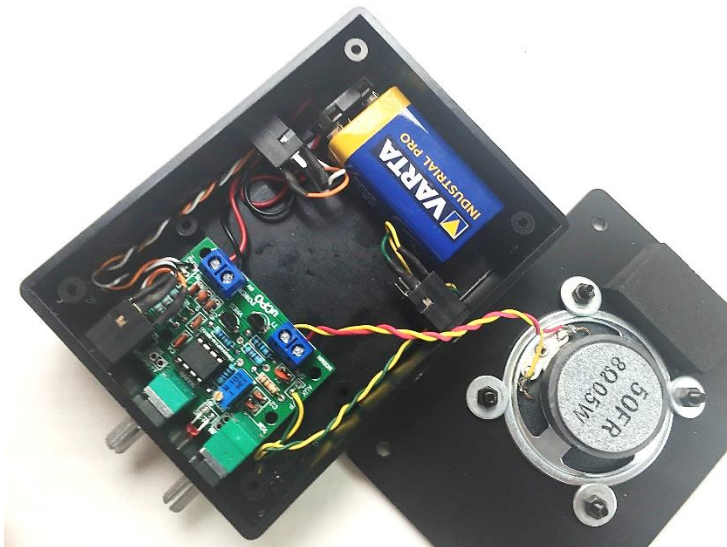
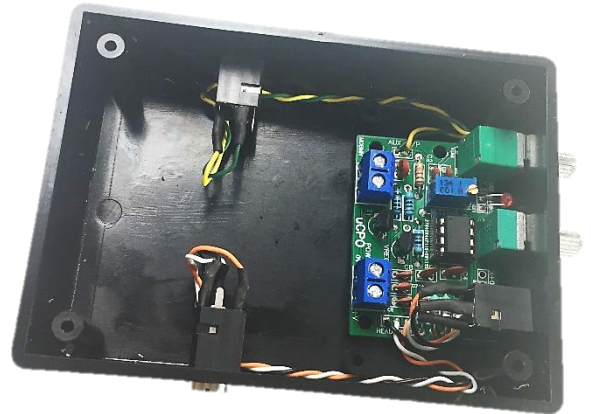
Fit the Key jack first BEFORE the PCB.



Once you have fitted the key jack then push the PCB in place making sure the LED is seated in the small hole, use the washers and nuts provide to secure the board.

Next we need to fit the AUX and Headphone sockets.

Tuck the wires as shown.



Now connect up the battery clip and speaker as shown here, the foam block is there just to stop the battery from moving around.

Finally place the back plate on the case and secure with the screws provided.

Now you just need to push the control knobs onto the control shafts, if the

knobs seem loose you may find that the slot in the shaft of the control has been closed a little, place the tip of a flat blade screwdriver into the slot and very gently re-open the slot a slight amount, be careful we don't want to break the shaft and only a tiny amount of pressure will be needed to open it the fraction we need. Finally If not already fitted apply the top panel label and the four stick on feet.

Time to test the uCPO

Turn on the uCPO by turning the volume control, you should hear a click from the control and the LED should light up, if it doesn't light up turn off the power and double check everything including the wires in the terminal block from the battery clip. If you have a test meter check that (9V is getting to the terminal block on the board). One of the most common 'faults' is that the battery clip wires are not making contact.

Hopefully you have no problems. Now turn off the uCPO.

Now plug a key into the socket, and turn the uCPO back on.

If a dual paddle key

Set the speed control half way. Upto now you will not have heard anything, if it's a paddle key touch one side of the key and you should get Dits, the other paddle and you should hear Dahs.

If you adjust the speed control the keyer speed should change.

If a Straight Key

The straight key should be wired to a Mono plug.

The uCPO only reads the key type when it's turned on so plug the key in when the unit is turned off. With the key connected you should get tone when you press the key down.

The speed control is not used in straight key mode.

If all well great the uCPO is working!

The Morse Tutor Mode.

The first time you turn on the tutor the WPM rate as not been set, it needs to be set before the tutor is of much use. The speed is set in the on board memory and is stored and used each time you use the tutor so this can be a set once and forget setup (but you can change the speed at any time if you wish) make sure you followed the setup details at the front of the instructions.

How to use the tutor modes

To use the tutor modes is simple, if you are using a straight key just hold it down while you turn on the oscillator, **NO NOT** continue to hold it down or you will enter setup mode. If using a paddle key just squeeze the paddles while turning on and release as soon as its turned on.

The tutor will start in 'LETTERS' mode

This is a Random Letter mode and you will hear 5 character groups of random Letters, the gap between each letter will be adjustable via the speed control. Press and hold the DIT paddle (or hold down the straight key) and the mode will change to Numbers, do the same again and you will get Prosign mode and another press will give you Mixed Mode, the next press Callsign Mode. The final mode next is Contest mode

A note about learning the Code....

The goal is that you will learn the code to allow you to use it on air. With this in mind I don't want you to fall into the same trap I did many years ago. You are going to train your brain to automatically translate the sound of Morse into letters (and later words).

You need to start listening to Morse at a speed that is used in the real world. If you learn at an artificially slow speed you will have to re-learn the sound of each letter again when you want to use it on air.

Try not to think of the code as Dots and Dashes, think in terms of the sound so Dits and Dahs.

The uCPO should provide many years of service and I hope that you find it a worthwhile project to build.

73 Paul

International Morse Code

- 1 dash = 3 dots.
- The space between parts of the same letter = 1 dot.
- The space between letters = 3 dots.
- The space between words = 7 dots.

A	• —	V	• • • —
B	— • • •	W	• — —
C	— • — — •	X	— • • —
D	— • •	Y	— • — —
E	•	Z	— — • •
F	• • — •	.	• — • — — —
G	— — •	,	— — • • — — —
H	• • • •	?	• • — — • •
I	• •	/	— • • — •
J	• — — — —	@	• — — — • •
K	— • —	1	• — — — —
L	• — • •	2	• • — — —
M	— —	3	• • • — —
N	— •	4	• • • • —
O	— — —	5	• • • • •
P	• — — •	6	— • • • •
Q	— — • —	7	— — • • •
R	• — •	8	— — — • •
S	• • •	9	— — — — •
T	—	0	— — — — —
U	• • —		

Prosigns

(.)	• — • — • —
(.)	— — • • — —
(?)	• • — — • •
(/)	— • • — •
(=)	— • • • —
(AR)	• — • — •
(BK)	— • • • — • —
(CT)	— • — • —
(VA)	• • • — • —
(KN)	— • — — •