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

Fully Boxed Kit Instructions

Thanks for buying the uCPO full kit version. Since we are building this to fit 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.

'Oh No !' I hear you cry, not another Morse practice oscillator. Well this one is a little different.

I get asked more often than you would think for a dual mode code practice oscillator to work with both a straight key and also work with a paddle key. Some people tell me with this you can start learning the code with a straight key and then use it again later to practice sending with a paddle. Well this simple circuit does just that. (and a lot more). The Oscillator will automatically sense what key is inserted when it powers up and work as a standard practice oscillator if a straight key was inserted or a simple keyer oscillator if it finds a paddle key. The Keyer function is very simple and has no Dit or Dah memories or true Iambic mode but is great for simple paddle practice. If you want Iambic options and memories then look at the OSK-1 keyer kit.

Now I also said that it did a lot more too. We in fact there is a Morse tutor built in too.

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. The oscillator will now start sending 5 figure letter groups, if you hold the key down or hold the left hand paddle it will switch to random numbers, next press it will switch to mixed letters. 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, just to make things a little more realistic. 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 and 'M'= Mixed, 'C'= Callsign)

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 and take more time at first but it's not a race and the rewards are much higher. So I recommend you use a character speed of around 14 wpm which is a realistic speed used by many operators in the real world. I will not be cruel and expect you to start learning Morse at 14 wpm so the speed control will allow you to set a gap of your choice up to 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 will explain how to set the Character speed to a suitable value.

These tutor features make this practice oscillator unique and exceptional value. If you want a full blown Morse tutor with a LCD readout then look at the FMT Tutor Kit.

The uCPO is based around an 8 pin microcontroller, the ATTINY85. There is an on-board trimmer pot for pitch adjustment. With the exception of the Key socket 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 speaker.

The power to the uCPO needs to be between 7 and 15 volts so a standard 9v battery is ideal.

The circuit is shown below.

How it works...

The code on the chip will on start-up read the value of the pitch control trimmer and set the tone of the oscillator. Then it will check the key input, since it will work with a dual paddle key it as two inputs, one for the dot and one for the dash. If neither of these inputs is activated at power up the software will switch to paddle Mode, if

however one input (the Dash) is closed then the software starts in straight key mode. For this reason use a mono plug on your straight key and of course you must use a stereo plug on a dual paddle key anyway.
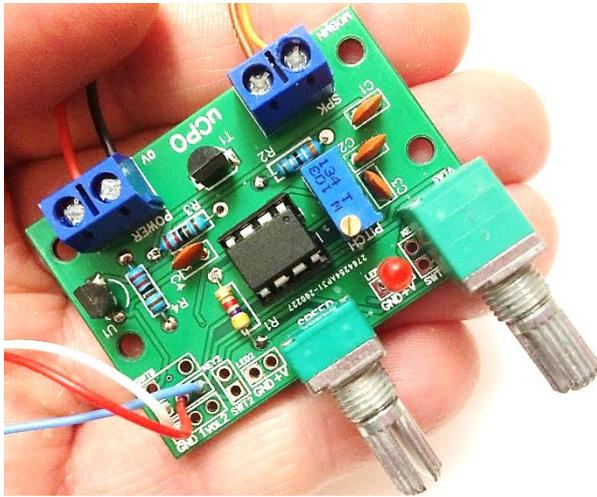
The SPEED control will only be active in Dual Paddle mode.

The 'Keyer' does not have any memories or other features. If you want that buy a keyer but is useful as a simple method to get some paddle key practice.

I hope you enjoy building the UCPO.

Best 73 Paul M0BMN

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

Lets check we have all the parts first;- Tick off each part as you check it.

Parts list.

1 x uCPO PCB ☐   ☐
C1, C4   0.1uF Disk (marked 104) ☐
C2, C3   0.01uF Disk (marked 103) ☐
R1   4K7 ¼ Watt Resistor ☐
R2   10 Ohm ¼ Watt Resistor ☐
R3,R4   2K2 ¼ Watt Resistor ☐
Speed Pot   5-100K Potentiometer (any value between 4K7 and 100K may be supplied) ☐
Volume/Swt   10K Potentiometer c/w Switch ☐
Pitch Control 10K Multiturn Trimmer ☐   (Any value between 4K7 and 100K could be supplied)
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 Block   2 way Blue PCB Terminal Block ☐
1 x   3.5mm Stereo Key Socket ☐
PP3 Battery Clip

Phoenix Kits

www.phoenixkitsonline.co.uk

8 Ohm Loudspeaker ☐
Connection Cable ☐
2 Knobs for controls ☐
Pre-Drilled Base plate ☐
4 x 10mm speaker screws ☐
4 x Base panel Screws ☐
4 x Penny Washers ☐
4 x M3 Nuts ☐
1 x Thin Foam Tape ☐
1 x Thick White Tape ☐
1 x Thick Grey Tape ☐
1 x Stick on Label ☐

Lets make a start!

Tick off each part as you fit them.

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 and C4, these are 0.1uF disk capacitors. They will have '104' printed on one side. They can be fitted either way round. ☐

3) Fit C2 and C3, these are 0.01uF disk capacitors, They will have '103' printed on one side. They can be fitted either way round. These capacitors are a little smaller than C1 and C4. ☐

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 2K2 resistors. The first two bands will be Red and Red. ☐

7) 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.

8) 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. ☐

9) 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. ☐

10) 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. ☐

11) 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 maginifing 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. ☐

12) Now we need to fit the voulume and speed controls, THIS STEP IS CRITICAL AND MUST BE FOLLOWED. You cant really mix these up as the volume control also as the on/off switch built in. Before you started soldering, look at the body of the two controls, if your lucky I have already broken off the little locator tag just under the shafts.

If not use cutters/pliers and snap of this tag, I comes off easy as its only diecast aluminium. Do this to both controls. Now we need to fit these two controls. Take care with this step or the board will not sit correctly in the case.
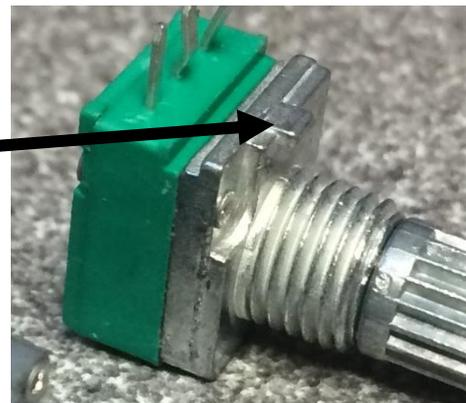
Put the volume control on to the board, it must be on the side near to the pitch control as in this picture.
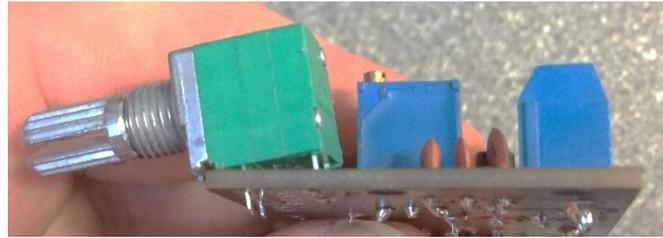
The IMPORTANT thing is that the control MUST NOT be fitted flush to the board. The case as a slight slope to the front panel, if the controls are fitted flush to the board the PCB will not sit flat in the box. Look at the picture above and you will see that the back pins are higher than the front. Push 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 its just one row of pins. Make sure you solder all of them this time when happy.
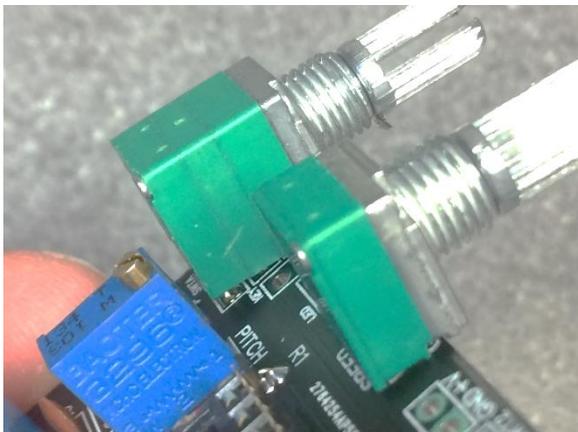

Now fit the Power on led, the led as two legs, one long ,one short(er). The postion to fit the LED is between the two controls. You will see the two holes that it fits in, one hole is square one round. The long leg of the LED

MUST go into the round hole. Push the LED in and leave it about 10mm higher than the board.

If you wish check the fit of the board in the case, to do this bend the LED right over .

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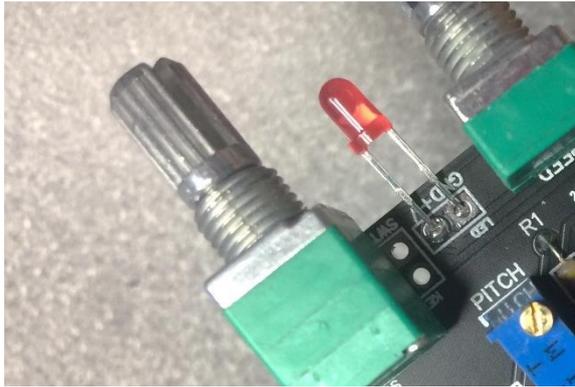
Now drop the board into the case, push it forward and make sure the LED is placed in the 3mm hole between the control holes. Carefull push the board forward, you will feel resistance to this as the LED legs will fold backwards as the board moves forward.
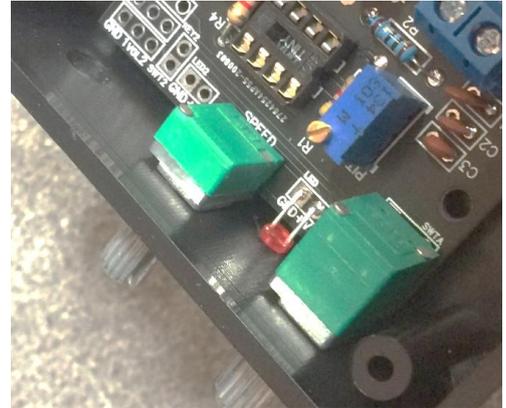

Check the board fitting, at this stage you should not have any problems, the LED legs will fold back, just make sure that they do not short on each other. Now remove the board, we have to wire the key socket.
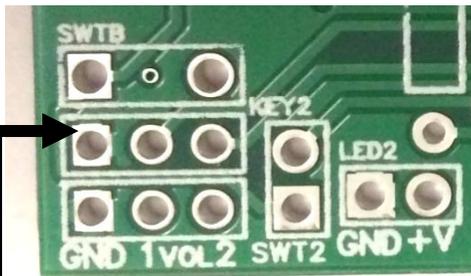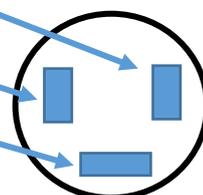

Now we have to wire the key socket to the board. I have supplied a few short lengths of wire that can be used for this.

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.
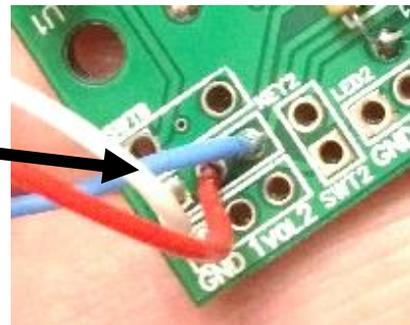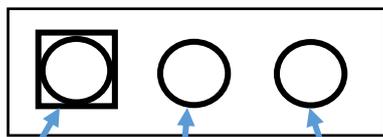
Common or Ground

Paddle 'DIT'

Paddle 'DAH'

Rear View of the Key Socket

The wires to the socket do not need to be long, just about 30mm will do it nicely. When wired re-fit the board into the box for the finial time. Use the washer and nuts provide with the two controls to secure the module.

Now we are ready to start work on the base of the uCPO.

In the past I have suggested drilling holes for the speaker into the bottom panel of the box. You can do that if you wish (use the base plate as a template) but I have had a new base plate made with all the holes pre-drilled for you and this makes sure that the speaker doesn't catch on either the battery or the blue terminal blocks on the PCB.

Find the base plate, the four 10mm screws, four penny washers and four M3 nuts.

Mount the speaker as shown below.
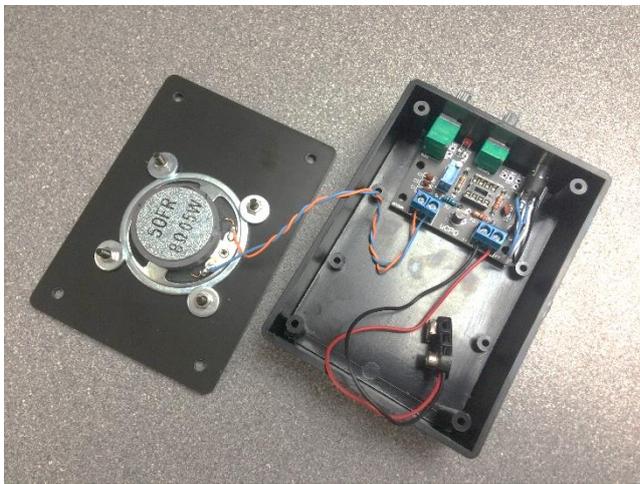
Solder two 4 to 5 inch wires to the speaker, give the wires a light twist to keep them together and strip and connect the free ends to the two way blue block marked SPK (just behind the pitch trimer).

Now fit the battery clip wires into the other two way block, Red is +V and Black is 0V. (yes I know you knew that!)

Now all we have to do is to put it all together.

The Battery will sit at the bottom of the box but would be a loose fit if we just put it there now.

I have supplied some foam pads that act to trap the battery in place and stop any rattles.
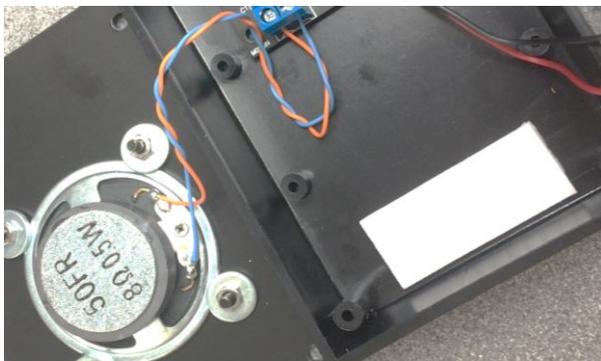
Peel the backing off ONE SIDE of the thin foam tape I have provided and stick that as shown. That will be under the battery.

Next connect the battery and drop it in place in the box.

Now use the thick White tape pad to trap the battery in the bottom of the box as shown here.

Then fix the grey pad to the bottom panel just under the speaker, note, do NOT put the grey pad right to the edge of the bottom panel it should have about 3-5mm clearance from the edge.

If happy with everything carefully fit the chip into the socket, make sure the chip is fitted the correct way round. If you look carefully on the chip you will see a small dot near to one pin, that is pin 1. This needs to be near the pitch control trimmer.

Now put the battery into the case and drop the bottom panel onto the case, use the four round head self-tappers provided in the kit to secure it, the four sliver countersunk self-tappers that came with the case are not used.

Now fit the four stick on feet to the bottom and you're virtually done, All that is left is to fit the top sticker (if you wish it's up to you !). If you do fit the top sticker then take time and carefully smooth the sticker down as you apply it, this can be tricky. I have provide two stickers so if you make a mess of one you at least have a spare.

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)

Hopefully you have no problems.

Now plug a key into the socket,

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.

IMPORTANT, THE FOLLOWING SETUP MUST BE FOLLOWED!

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)

If using a paddle key hold both paddles and turn on the unit, if using a straight key hold it down while turning on the unit. **DO NOT RELEASE THE KEY.**

After a couple of seconds you will hear a series of dits and Dahs at the current wpm rate, use the speed control to adjust this speed to a suitable value, 14 WPM is roughly when the speed control is just over half way. When you're happy with the speed **THEN RELEASE THE KEY.** The tutor will now save the new speed in its memory and you're done. You can turn off the oscillator and now it's ready for use.

How to use the tutor modes

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

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 Mixed mode and a finial one will give you the Callsign 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.

The uCPO should provide many years of service and I hope that you find it a worthwhile project to build. Enjoy learning Morse and consider joining the best Morse Club in the world! FISTS. Take a look at the FISTS website www.fists.co.uk

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 • •	/ ▬ • • ▬ •
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L • ▬ • •	2 • • ▬ ▬ ▬
M ▬ ▬	3 • • • ▬ ▬
N ▬ •	4 • • • • ▬
O ▬ ▬ ▬	5 • • • • •
P • ▬ ▬ •	6 ▬ • • • •
Q ▬ ▬ • ▬	7 ▬ ▬ • • •
R • ▬ •	8 ▬ ▬ ▬ • •
S • • •	9 ▬ ▬ ▬ ▬ •
T ▬	0 ▬ ▬ ▬ ▬ ▬
U • • ▬	