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# THE TNC-PI – A REVIEW BY NICK BOWN 2E0CGW

The TNC-Pi is a KISS TNC board which is designed to connect to the GPIO port of a Raspberry Pi computer and costs \$40. In plain English, this means it's a very cheap radio modem and allows licensed amateurs to enjoy data modes such as packet radio and APRS for less than £100; quite an achievement considering the cheapest TNC and computer can cost over £800!

So what's the catch? Well, the TNC comes as a kit, so you must assemble it yourself, and you must build your own radio interface cable yourself. However, if you're remotely handy with a soldering iron and have some basic tools, you'll have no problems.

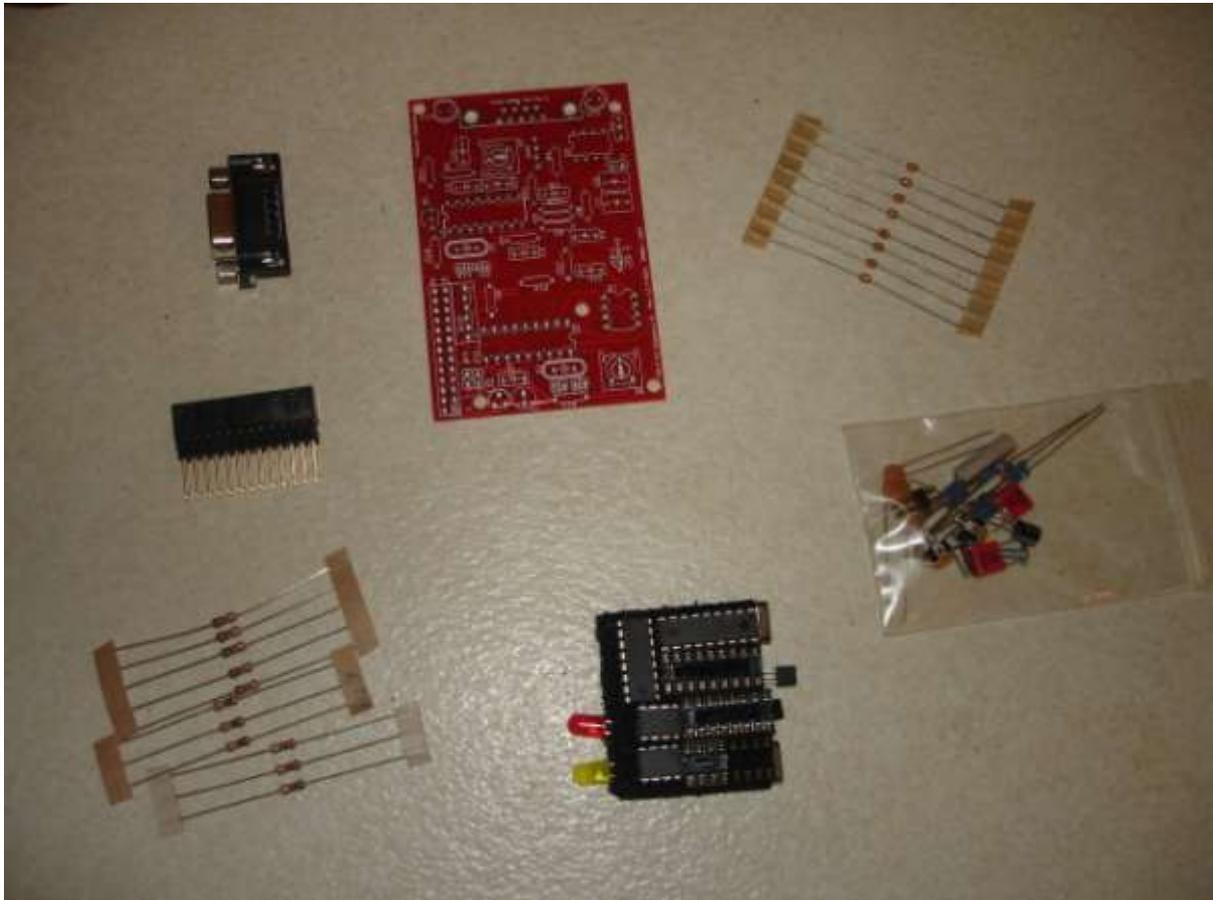
## REQUIRED TOOLS

The kit is a moderate to advanced project and will require the following tools:



a soldering iron, solder, pliers and a pair of side cutters. In addition, a heat shunt, magnifying glass and multi-meter will make your life much easier.

## THE KIT



The kit comprises of (clockwise from the top) a PCB, bead capacitors, a bag of miscellaneous components (capacitors, trimmers, etc.), semiconductors, resistors, Raspberry Pi GPIO header and a DB9 connector (which acts as the radio interface).

The PCB is quite well designed but the solder pads are very small which can make soldering the components tricky, the mounting hole doesn't properly line up with the one on the Raspberry Pi and the integrated circuits (ICs) are orientated in different directions, rather than pointing upwards which is the convention in most PCB designs. These are minor points however and, hopefully, they will be addressed in a future release of the kit, plus the small surface area of the pads reduces RF interference on the board.

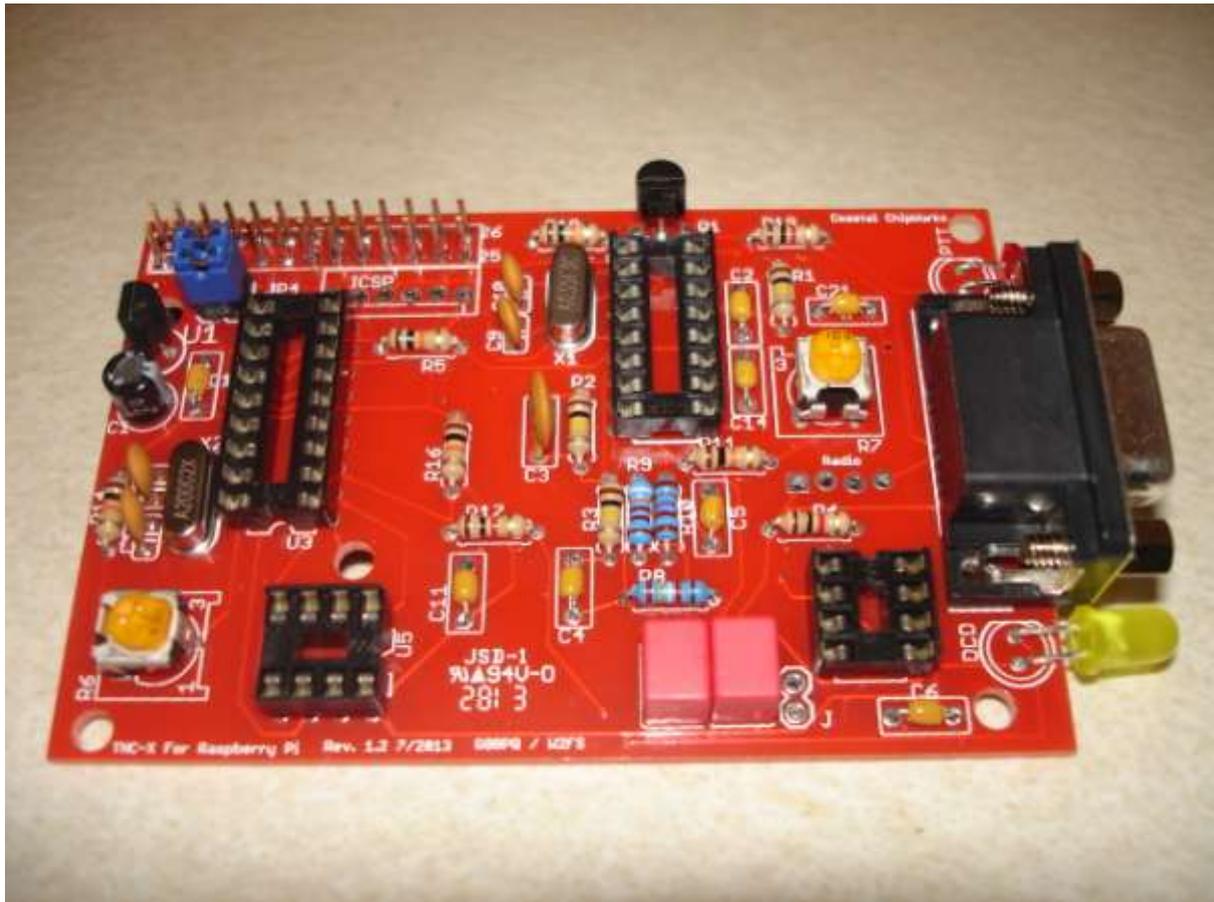
The first step of assembly is to install the "flat" components, the resistors and bead capacitors:



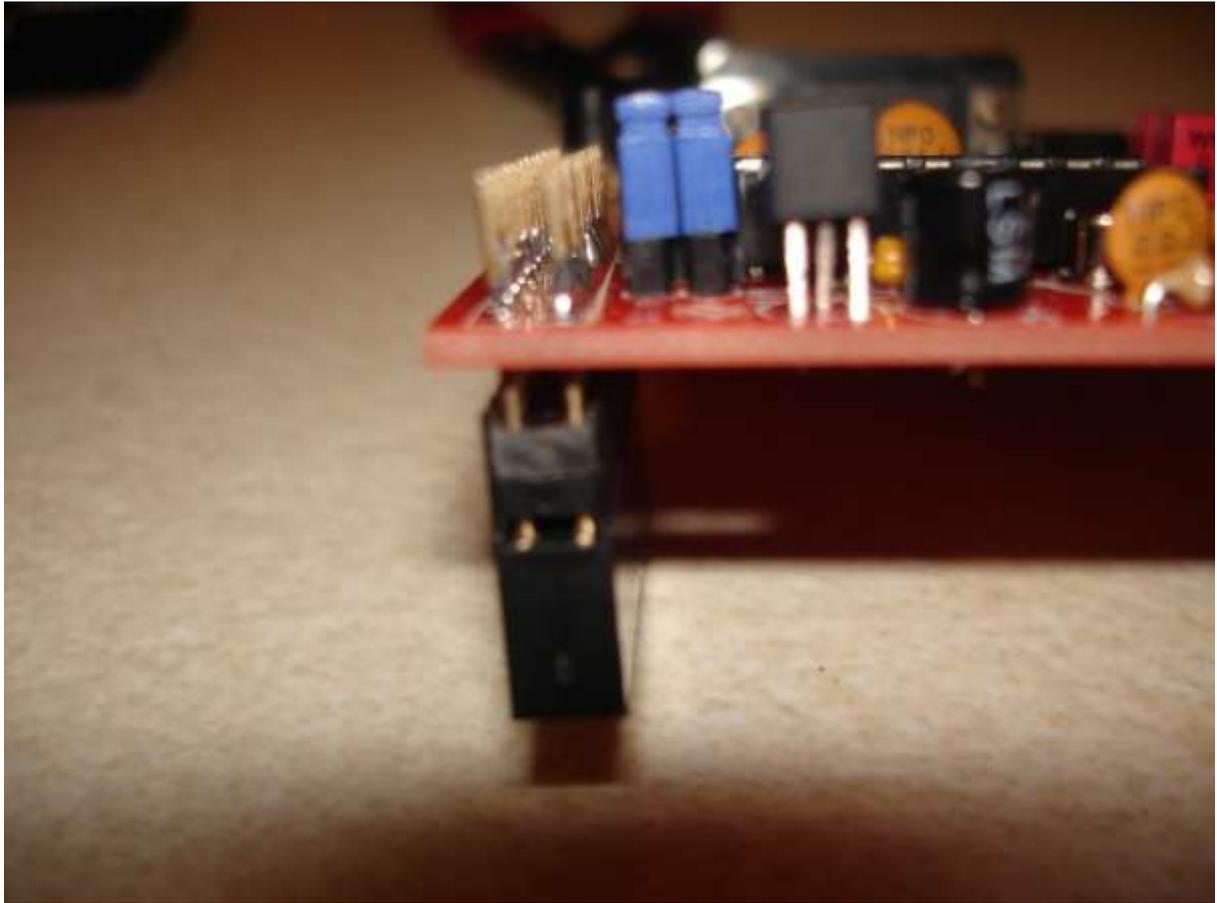
As you can see above, some of the resistors supplied are the blue bodied style which makes the colour bands hard to read. If you have good eyesight then you should be fine but using a multi-meter to check their values is a wire precaution.



The next components to be installed are the IC holders and crystals. Make sure the notches on the IC holders match the printing on the board and ensure the crystals are installed in the right place. The manual isn't too clear on where the crystals should go (if you're not used to working with them) but, as you can see above, the 3.57 MHz crystal which goes in position X1 is marked with 035 and the 20 MHz crystal in position X2 is marked 200. These can be difficult to see so using the magnifying glass will make life easier.

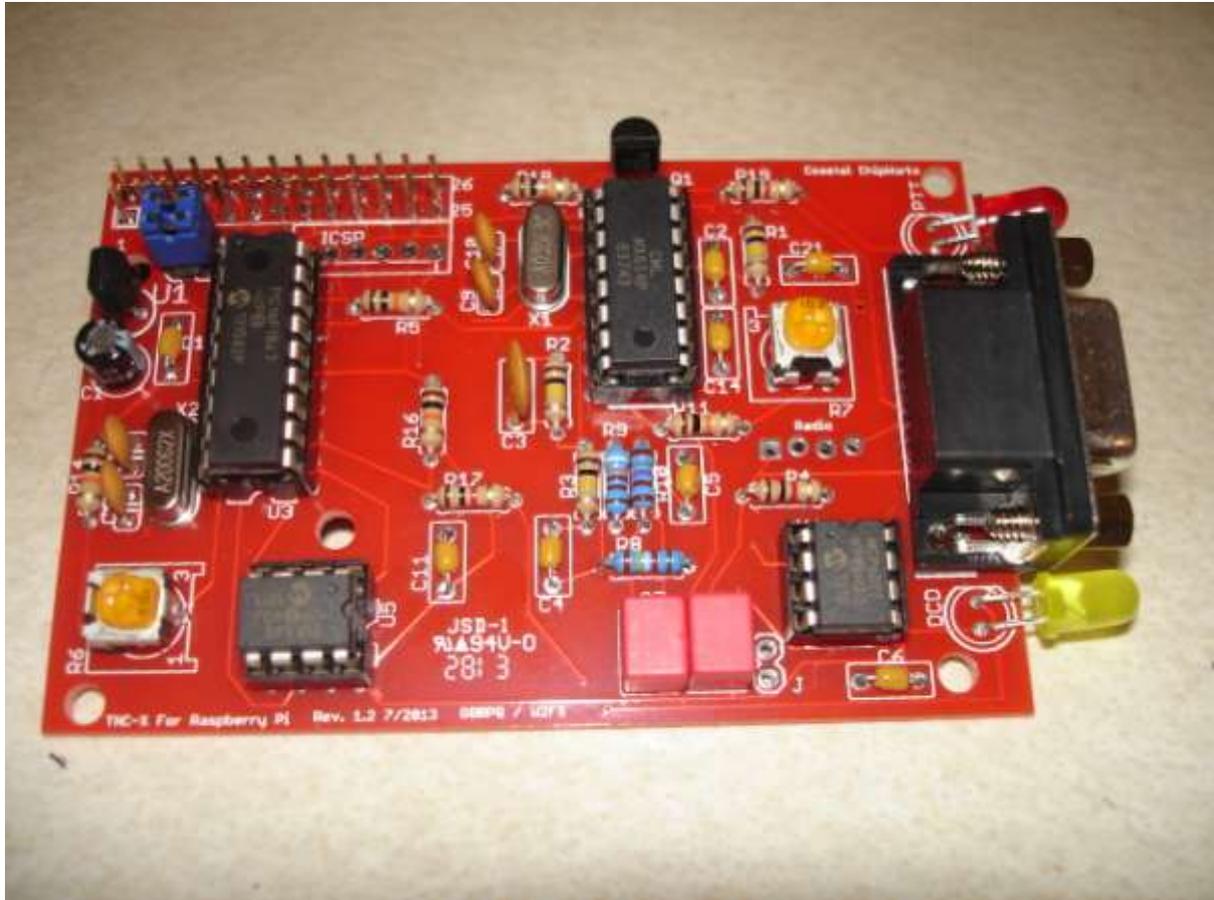


The last components to be installed on the boards are the remaining capacitors, the D9 connector, LEDs, trimmers, header pins, transistor, regulator and GPIO header. Installing these components is pretty straightforward (remember to use your pliers or head shunt to protect the transistor and regulator!) but the GPIO is quite challenging. A gap needs to be left between the header socket and PCB, the header needs to be installed straight and the pins need to be kept as clear of solder as possible which is quite a tall order. When I built my board, I installed the header socket on my Raspberry Pi and soldered pins 1 and 26 before removing it and soldering the rest of the pins. This worked quite well but I didn't manage to get the socket perfectly straight:



This isn't a major issue as the kit comes with a stand-off but does make using the board a little harder as you have to ensure that the underside of the D9 connector doesn't short out on the Pi's USB socket (although this is less likely if you have a model A Pi).

The last step in the construction is to install the ICs into their sockets:



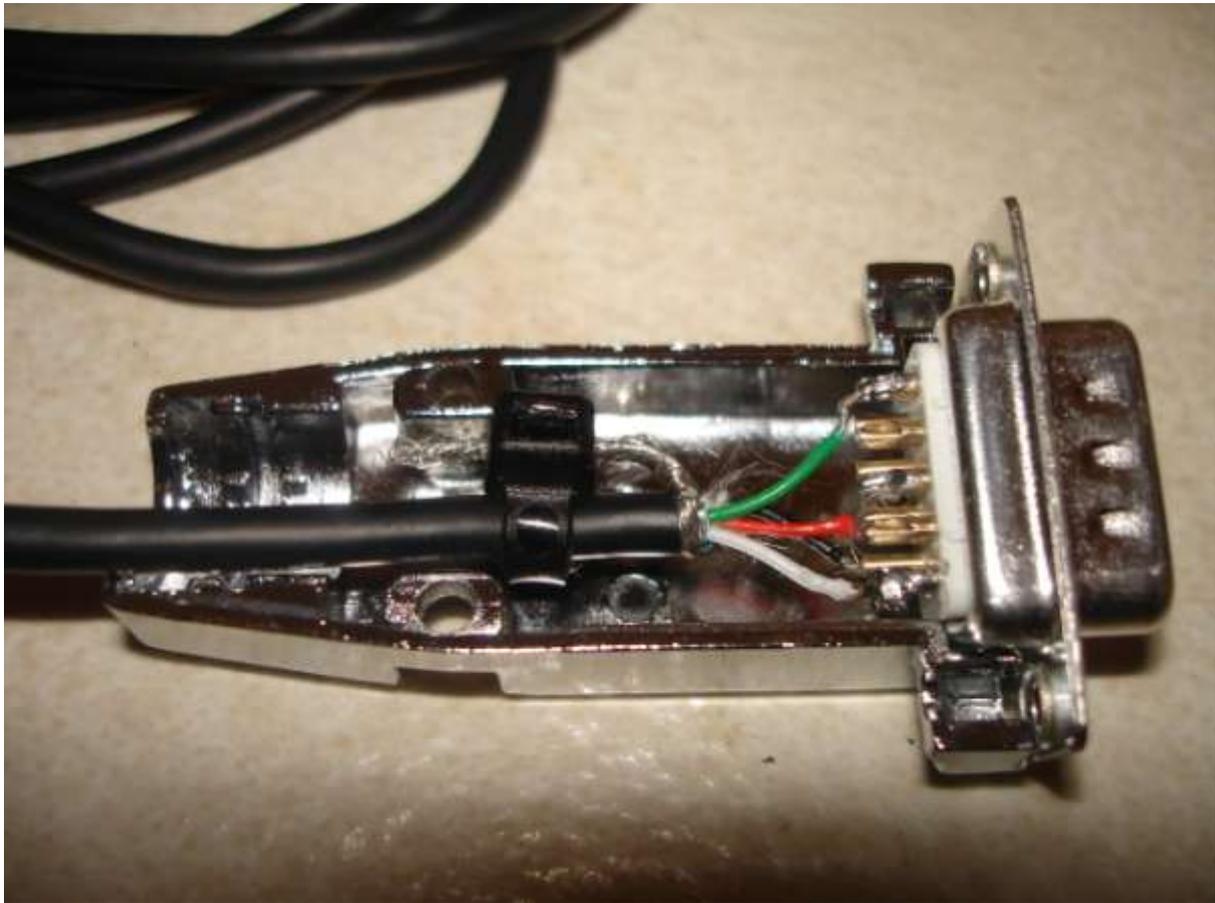
Again, be careful that you insert the ICs the right way round. The convention in electronics is to have the ICs pointing upwards but U3, on the left of the board points downwards so make sure you have it in the right way round (unlike I have in this picture!).

## THE INTERFACE CABLE

To connect your TNC-Pi board to your radio, you will need to build an interface cable. Interfaces vary from radio to radio so you will need to find out which connector it uses and which pins provide transmit audio, receive audio and push to talk as well as where the ground is.

I planned to use my TNC-Pi with my Wouxun KG-UVD1P so this section of this document will focus on making an interface cable for that style of radio. However, I believe the connector layout is the same for the Baofeng radios and the theory will be the same for all radios.

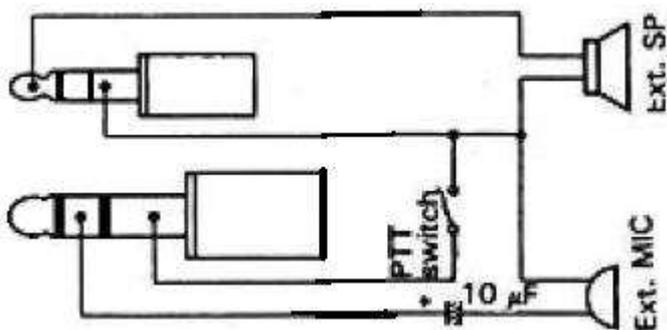
The first thing to do is gather the connectors you need and some good quality cable. I would recommend you use metal, shielded connectors and shielded cable. The first job is to solder the D9 interface:



Note how I have twisted the cable's shield so that it touches the body of the connector and used a cable tie to stop the cable being pulled out of the connector. Most connectors have a cable clamp and that would be the ideal place to earth the shielding. In the picture above you can see wisps of cable reinforcement and, although this isn't conductive, it's worth trimming as much away as possible to keep things neat.



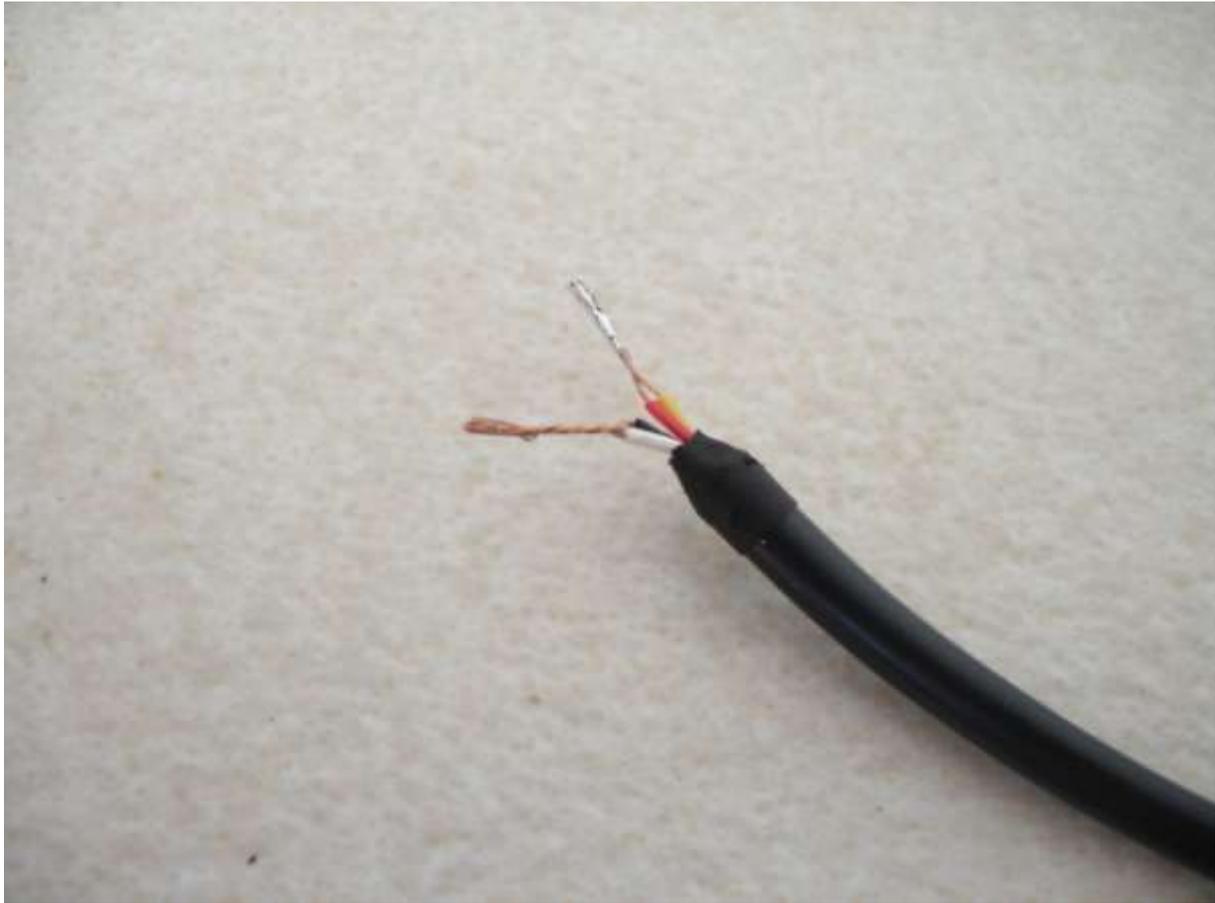
The Wouxun uses a special connector with 3.5mm and 2.5mm stereo plugs in a single package and I wasn't able to find one of these anywhere. Although buying a data cable or mic and cannibalising it for the connector and cable was an option, it was a rather expensive way of doing things so I opted to make a Y shaped cable with separate plugs. As you can see above, stereo plugs are usually wired with the tip and ring (the first two connectors you can see from the left of the plug in the picture above) connected to the inner wires of a cable and the sleeve connected to the cable's shield. Unfortunately the Wouxun design engineers seem to have completely ignored that convention and have chosen the following layout:



This causes a bit of a headache as you have to make sure the shielding is good at the other end and make sure it can't short on the other. The way I got around this problem was to wrap the shielding out of the way:



and then cover it with some heat-shrink sleeve:



Note that I am using four core wire as I didn't have any two core shielded cable to hand. It doesn't make any difference but it does mean I have to twist two cores together at both ends before soldering them to the single core of the length of cable connected to the D9 connector.



This looks quite a mess but what I have done here is connect the cores from the cables connected to the stereo plugs (on the right) to the cores of the cable connected to the D9 plug (on the left). After soldering each core, each joint has been covered with heat-shrink sleeve and the yellow tape provides some extra mechanical strength. As I have been unable to connect the shield of the cables on the right to the stereo connectors (as the sleeve is used by the radio), and as connecting the shield to the D9 wire is vital, I have pulled the shielding together as much as I can.



and a piece of tinfoil ensures that the shielding is maintained along the length of the cable.



Finally, some tape, heat-shrink sleeve or potting compound secures the tinfoil and improves the cable's mechanical strength (I used tape for speed).

Regardless of the radio you have and the type of cable you have built, performing a full continuity test will save you a lot of headaches. Shorts between the cores and the cores and the shield will cause, at best, loss of signal or may stop the TNC from properly controlling the radio. To run a continuity test, set your multi-meter to continuity mode, if it has one, or its lowest resistance range otherwise, and test between the pin on the D9 and the corresponding pin on the radio plug. Next, test between each pin on the D9 pin and the other D9 pins to make sure there are no shorts between the cores and, finally, test each pin in the D9 and the shield. If you get any incorrect readings on your meter then you know you'll have to fix the issue before using your cable.

## CONFIGURING THE RASPBERRY PI SOFTWARE

The TNC-Pi manual comes with a very clear and comprehensive guide to setting up the software required to run your TNC-Pi and how to run Xastir, a popular APRS client. If you have some basic Linux skills you'll have no trouble following the instructions.

## SUMMARY

The TNC-Pi is a nice little kit and provides a great way of getting into data modes or, as its possible to stack multiple boards on a single Pi, running a cheap digipeater. There are a couple of niggles with the PCB layout; namely the position of some of the components, the fact that the mounting hole doesn't line up with the one on the Raspberry-Pi and that the bottom of the D9 connector can short out on the USB connector on the model B Pis. However, these issues are pretty minor and will, hopefully, be resolved in a future revision of the board.

On the whole, the kit is a great project for anyone who enjoys building their own equipment and wants to either dabble with data modes or set up something more ambitious and is a worthy addition to any shack.