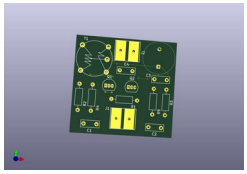
# Active Receive Loop Antenna assembly. Page 1

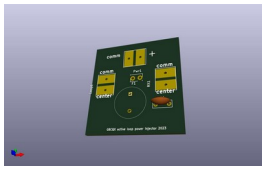
## 1 Components check

You will need a soldering iron, solder, multimeter with volts and ohms or continuity settings, small wire-cutters and long nosed pliers. Check all the following are present:

☐ One bare PCB each for Amplifier and

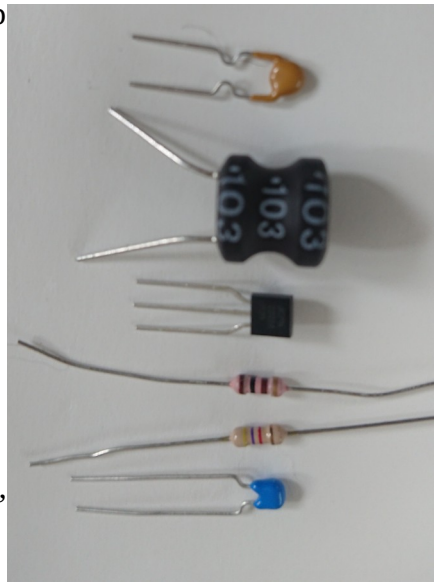
☐ Power Injector





All components will be mounted on the silk screen printed side of the board with leads pushed through the through-holes and soldered on the other side.

6 component types/values as per photo (right) from top down




☐ One 100mA little-fuse marked “r010”, 1 off for Power Injector.

☐ 10mH choke marked “103”, 2 off, one for Amplifier, one for Power Injector.

☐ PD2222A transistor, 2 off for Amplifier.

☐ 100ohm resistor (brown black brown colour code bands), 1 off for amplifier

☐ 4700 ohm resistors (yellow purple red colour bands), 4 off for Amplifier

☐ 1µF ceramic disc capacitor 5 off, 1 for Power Injector, 4 for Amplifier

Also

☐ Fair-rite FT-23-75 ferrite core 6mm diameter and 300mm length of 0.4mm enamelled wire for the transformer in the amplifier.

☐ 2 way screw terminals 5 off , 3 for Power Injector, 2 for Amplifier.

☐ BNC sockets 3 off, 1 for Amplifier, 2 for Power Injector.

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□ 2 off plastic boxes, 1 for Amplifier, 1 for Power Injector.

□ 3.3m length of aerial wire and 1.5m each of red and black hookup wire.

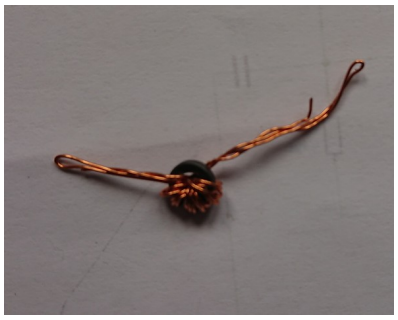
You will need to source a 3m length of 15mm diameter PEX plastic barrier pipe and a 15mm push fit or compression fit T piece, some double sided sticky pads or tape and transparent silicone sealant, available in many DIY centres.

If you are not familiar with soldering there is a lot of help and guidance available on the Internet, for example the link to the YouTube video covers the necessary ground https://www.youtube.com/watch?v=Pjsoq-ZejRM .

Once a component has been soldered onto the board, do not press down on the component or it might cause the plated hole to track joint to break. When inserting boards into the box take care to press down on the board only.

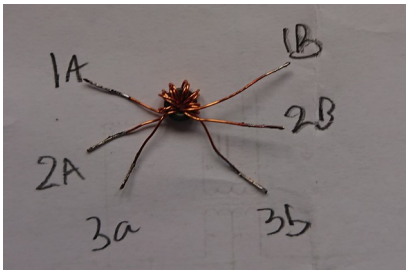
## 2 Make the transformer

This transformer is the critical component of the whole unit and its balance is critical. To make sure all windings and their mutual couplings are the same we make it as a trifilar winding. Take the 0.4mm diameter enamelled copper wire and fold it into 3 parallel equal length strands then starting with a 10mm lead twist this up into a 3 core twisted wire which should be ~100mm long. Wind this tightly onto the ferrite core till you have filled it with at least 6 turns.



It should look like this:

next trim the leads to about 10-15mm, separate them out and then tin. The best way is to use a sharp blade, file or emery paper to gently scrape off about 3mm of enamelled coating being careful not to nick the copper wire then thinly tin with solder and a hot soldering iron keeping the heat on which will burn off any enamelling that got left behind. Be particularly careful here to ensure all insulation is removed so we don't get any dry joints. We need to lay it out with the three windings identified. Use a multimeter on ohms or continuity test to find one winding (one wire connects through to the other) and set its wires at the top, repeat with the next in the middle and check that what is left is the third. It should be laid out like this:




We will use the bottom winding as the secondary and the middle and top as the primary center tapped. To create the tap take lead 1B and twist it together with lead 2A. Place that middle top then switch wires 1 and 3 both sides from top to bottom and

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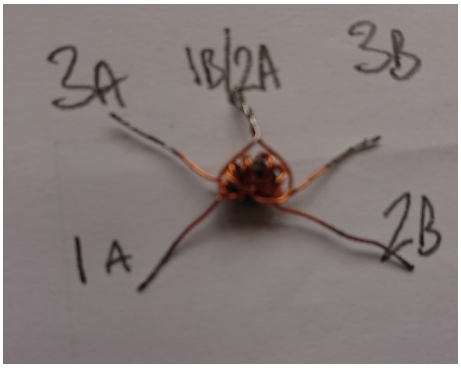
vice-versa to get this layout which when rotated 90 degrees clockwise fits on the board as shown below




## 3 Assembling the Amplifier

*Figure 1: PCB component positions*

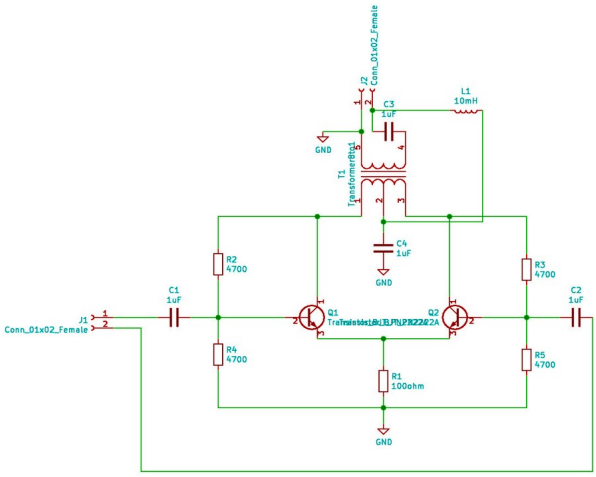
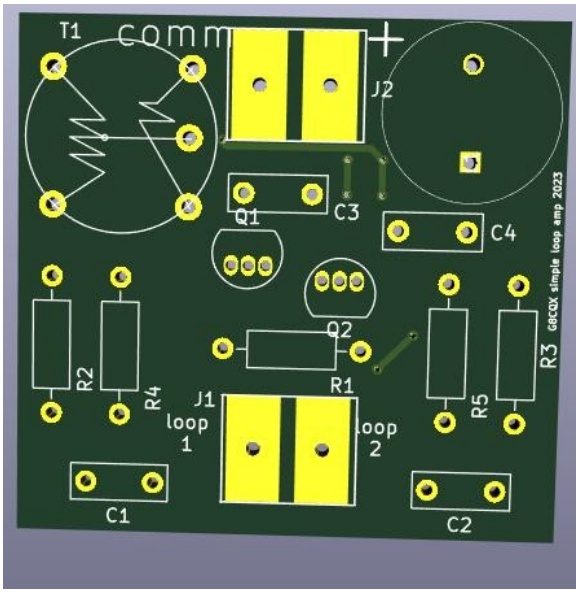



*Figure 2: The circuit schematic*




Insert a 10mH choke into position with leads through the holes at top right of the board as shown above so it is sitting on the white circle top right. Bend the leads away from each other by 45 degrees (this will hold the component in place) then solder. Trim off the wires at the joint with wire-cutters.

□ Insert the transformer wires for T1 taking care to connect it as shown on the silk screen print on the board, that is turned a right angle clockwise compared to the photo above. Each end of the centre tapped winding (1A, 2B) is on the left as shown and its twisted 2 wire centre tap is middle right, and the 2 turn secondary terminations (3A,3B) are top and bottom on the right. Poke each wire through and bend to 45 degrees again to hold in place before soldering. Trim off any excess wire at the joint. Take extra care to ensure that the soldered joints are sound and without any enamelling in the way of good wetted joints.

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□ Find the 100Ω resistor (colour code bands brown, black,brown), bend the leads to 90 degrees and insert in the position marked for R1. When through and flat on the board, bend leads outward to 45 degrees to hold the component in place and solder. Trim off at the joints.

□ Find the four 4.7kΩ resistors (colour code yellow, purple, red). Insert and solder as before in the positions for R2,R3,R4 and R5.

□ Find four 1µF disc ceramic capacitors and insert and solder as before in the positions for C1, C2, C3 and C4.

□ Find the two transistors and insert into the positions marked Q1 and Q2 making sure that the flat side of the transistor is lined up with the flat part of the white silk screen marking on the board so they are the right way round. Bend the outer wires out to 45 degrees and solder all leads then trim with wire-cutters

□ Find two two-way screw terminal posts and insert so the wire entry is facing outwards in each case. Hold flat to the board and solder in place. The board assembly is now complete.

## 4 Power injector assembly.

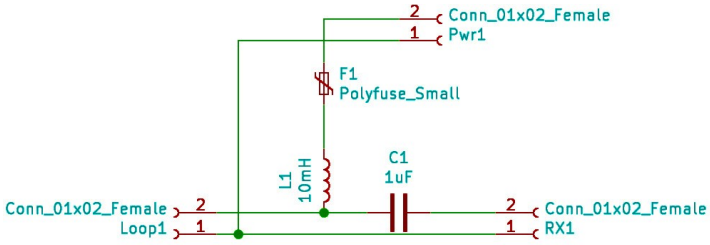
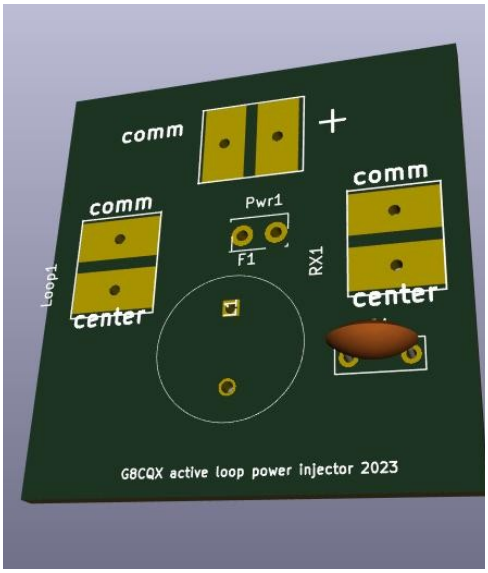



*Figure 3: Power injector circuit schematic*




□ Insert the L1 10mH choke into position with leads through the holes at the bottom of the board as shown above so it is sitting on the white circle. Bend the leads away from each other by 45 degrees (this will hold the component in place) then solder. Trim off the wires at the joint with wire-cutters.

□ Insert the 1µF disc ceramic capacitor leads through the holes at the position marked for C1, bend the leads away from each other by 45 degrees and solder. Trim off the wires at the joint with wire-cutters.

□ Insert the littlefuse leads through the holes at the position marked F1, bend the leads away by 45 degrees and solder. Trim off the wires at the joint with wire-cutters.

□ □ □ Get the three two-way screw terminal posts and insert so the wire entry is facing outwards in each case. Solder in place. The board assembly is now complete.

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## 5 Boxing the boards.

The boards will be attached with double sided sticky pads to the base of the boxes. Starting with the Loop Amplifier, drill a 10mm hole in a plastic box for the BNC at one end of the box. The hole centre should be in the middle of the width and 13mm from the top Drilling a large hole in plastic and keeping it circular is difficult so start with a small drill (say 3mm) then enlarge it in small steps with bigger ones so the end result is circular. The loop ends will enter through two 4mm holes 5mm apart in the middle of the width and 15mm from the top on the opposite side to the BNC connector. Drill the holes, fix the BNC connector (with washer, solder tag and nut on the inside having bent the tag so it sits away from the box) and solder a couple of 30mm tinned hookup wires to the BNC connector (red for center, black for outer, cut from the length of red and black wires and 4mm insulation stripped from each end and lightly tinned. ) The red wire needs to be soldered at right angles to the pin and not protruding beyond or it is difficult to slide the board down under after fixing the wires to the terminal. The other ends to be secured in the J1 screw terminals black to comm, red to +. Before we connect the loop wires to J2 to finish assembly some testing is in order so connect the BNC connector wires to J1 with the board loose in the box because a power up DC check is a good idea before sticking it down and connecting the loop. Make double sure the + marked terminal goes to the coax inner via the red wire on the BNC connector and comm (black wire) is the outer.

The Power Injector box needs a BNC connector at each end so drill 10mm holes as before. It also needs a 4mm hole in the long side facing the terminal post for power (pwr1). Because it is a bit of a tight fit we need to trim the centre pin of the BNCs back a couple of mm leaving enough to solder a red hookup 30mm wire. Solder the short tinned hookup wires cut from the length of red and black wires onto each of the BNC connectors. Again make sure “comm” is connected with black wire to the outer of each coax connector and center with red wire to the inners. Twist the remaining red and black wire (put one end in a vice and use a drill to twist from the other end) to make the power lead and strip and tin the ends. Connect one end to the power terminal post being careful that the red wire connects to the + terminal and black to the common. Push the wire through the 4mm hole from outside the box. When everything ir working it is good idea to seal this with sealant to hold it in place. Connect the BNC hookup wires to the terminal posts on the board. Mark the BNC connectors RX (for the RX1 terminal) and Loop Amp for the other(e.g. with sticky labels or white paint). Now check that both outers of the BNC connectors and the black wire of the twisted power lead all have continuity to each other on a multimeter. From a power supply connect +12V nominal to the red wire, 0V to the black. Check that there is a DC voltage of 12V on the Loop Amplifier BNC center pin relative to the outer and 0V on the RX BNC inner. It will work with a 14V shack PSU or a pp3 9V battery or even with 5V from a built-in supply from an SDR like a RSP1A. If that is all correct you can fix the board in the box with a couple of sticky pads, disconnecting and reconnecting the terminals as necessary, but be sure to make sure it goes back the same, re-testing after.

Connect the BNC connector of the Power Injector which you marked “Loop Amplifier” to the Loop Amplifier BNC connector with a BNC lead. Apply power as before. NB, if there happens to be a short somewhere on this lead the “littlefuse” will cut the power and will only return to is “on” state after a short cool down delay. So if there is no power first of all look for short circuits on the

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connection. Or better before! With the Loop Amplifier BNC connector at the top, measure the voltage on the left hand side of R1 with reference to 0V (for example, the outer of the BNC). It should be around 4.6V. (5.5 with a 14V PSU) Check the voltages on the bottom of R4 and R5 are both about 0.7V higher than this. This finishes the check. (Note, if you are using an inbuilt 5V provision from the likes of an RSP1 SDR then the voltages will be about 1.45 and .7V higher than this). Stick the Loop Amplifier board down in the box and re-connect the BNC and power if necessary double checking they are re-connected the right way round.

Make the loop former by bending the 3 meter length of 15mm diameter PEX tubing into a 1m diameter circle shape and pushing each end into a 15mm PEX T joining piece. Strip and tin the ends of the 3.3m long antenna wire and feed it through the tube loop. It might be easier to do this before bending into a loop. Then push each end of the wire through the holes in the Loop Amplifier box and secure each end in a screw terminal connector.

Before screwing down the lid it is worth just doing the sealing round the very top edge of the box edge with a minimum amount of silicone sealant. Assuming the loop will be used outdoors then we need to keep moisture at bay. Before screwing down the lid a little sealant pre-placed on the screw posts will help keep moisture out there. Use a bit of silicone sealant to seal the aerial wire in their holes again to help keep moisture out. Allow the sealant to set. In in the unlikely event you need to reopen the box you need undo and remove the screws then the seal can be broken by running a thin craft knife blade along the join and lever off to break the screw post sealant. Clean it all off before re-sealing

With the loop mounted with its plane vertical and powered up via the coax lead from the power injector which is then connected to a receiver with another BNC terminated lead, noise and signals should be audible when 12V nominal power is applied. The loop can be mounted at any modest height when used this way, even with its edge on the ground and as a rule, elevated mounting will not increase signals at a clear site unless it is placed at a height over unusually conductive ground which reinforces the ground image at a certain angle. Signals will be strongest off the end of the loop and minimum at right angles, so setting it broadside to, and away from likely sources of interference can improve received signals. The loop can be used horizontally. It needs to be well off the ground then and will be omnidirectional in azimuth with a null vertically. The loop will work well from 630m through to 10m.

This completes the project.