

G3EJS 2-Tuner

Having recently bought an FT-817, and immediately missing the internal tuner my IC-703 has, I started looking for an answer.

There are tuners around, but everything I saw was just about as big as the 817 itself. Seemed a bit pointless then to have a very small rig, and have to double its volume to be able to use it on a different antennas.

I have my portable antenna for the 703, which is pretty close to having a low SWR on most bands, so my first thought was to build something to match that. But what about using my dipole at home, or throwing a wire over a tree?

It seems the biggest occupier of space in a tuner is the capacitor, Use an L network and you only have to have one. Then I thought that making the inductor more finely adjustable would mean that less variation in capacitance would be needed to obtain a match.

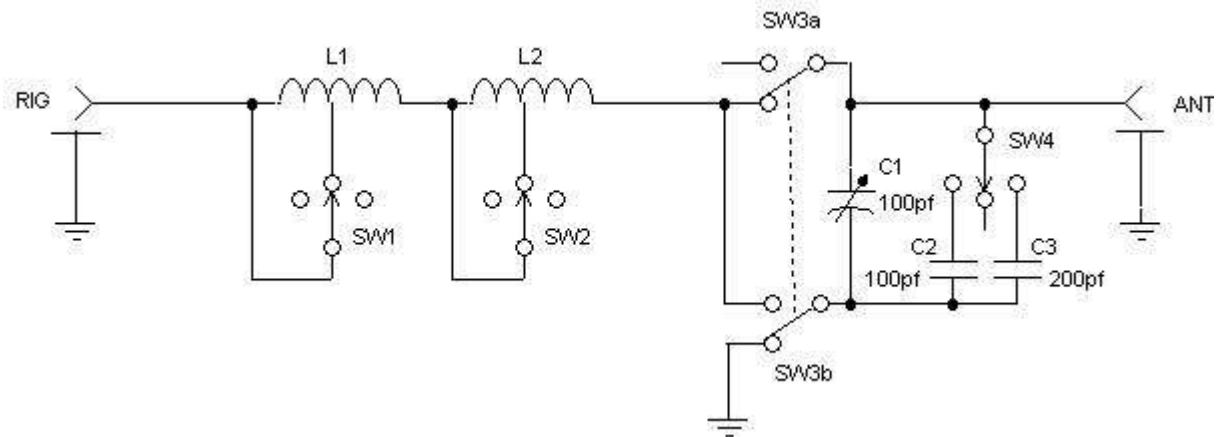
I considered having two banks of switches, one for the capacitor and one for the inductor, eight of each would give a huge range, but discarded that idea (for now) as not being intuitive to use.

I had an old die-cast box about 1 X 2 ½ X 4 ½ and decided that it would fit into that.

In order to be able to adjust the inductance reasonably closely to what was required, I used two switched inductors.

The capacitor had to be small, I had the choice of two, one of 140pf and one of 100pf, I chose the latter, as neither the rotor or stator were grounded. I can switch either a 100pf or a 200 pf fixed capacitor across the variable capacitor giving an effective range of about 10 – 300pf.

I didn't want either part of the capacitor grounded as I wanted to be able to switch the capacitor in series with the inductor to add flexibility. I use the tuner as a series tuned circuit most of the time, and only occasionally as an L network.



The resulting circuit

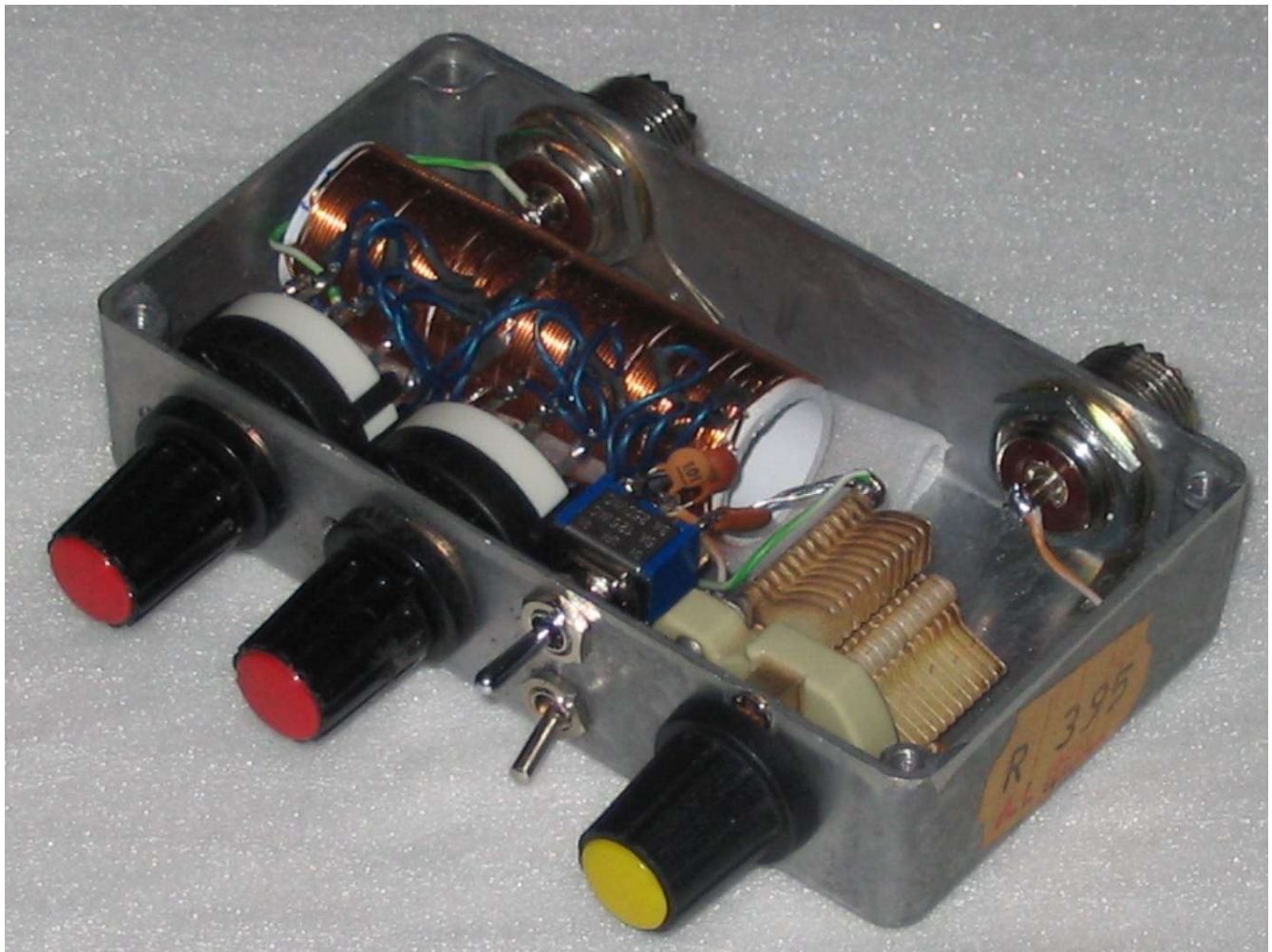
L1 and L2 are wound as one long coil of 96 turns of 24 SWG (0.56mm) wire on 3/4 " electrical conduit, divided in half by a centre tap where the common pole of SW2 connects.

Each half of the coil is tapped as follows from the connection points of SW1 and SW2 common poles:-

32t – 24t – 16t – 12t – 8t – 4t – 2t – 1t

The ten positions of SW1 and SW2 are therefore connected to the following coil points:-

<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>	<i>7</i>	<i>8</i>	<i>9</i>	<i>10</i>
Not connected, i.e. full coil	32t	24t	16t	12t	8t	4t	2t	1t	end i.e. coil bypassed

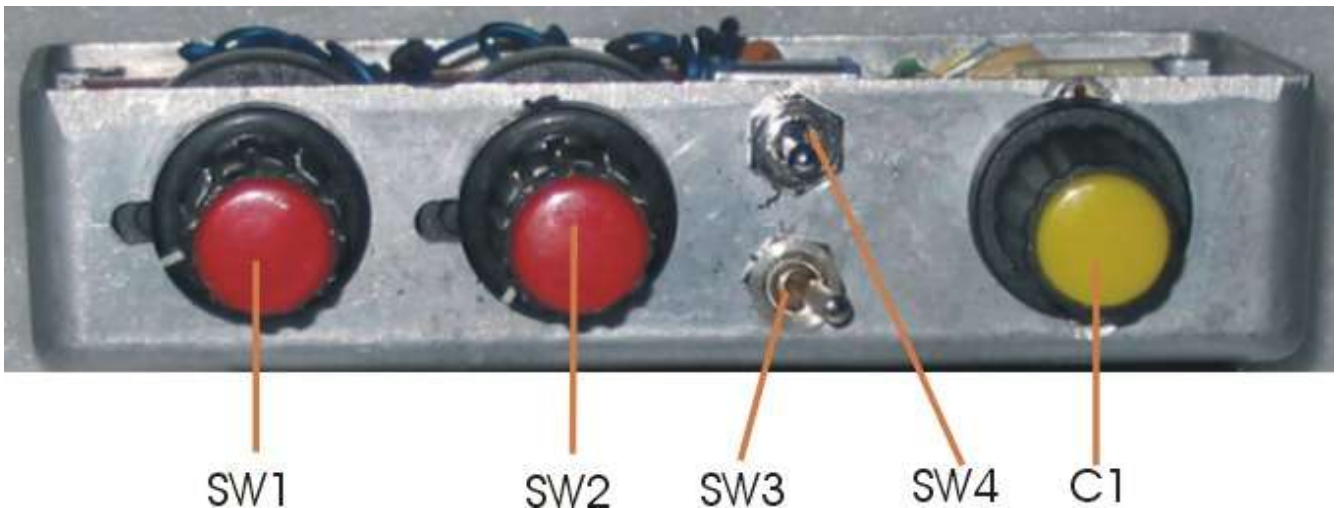


As you can see, the fit is fairly tight, in fact all the controls are touching each other, so there is no room for error when measuring before drilling.

Under the coil you can see the packing material I use to insulate and secure the coil to prevent it moving around, another piece fits between the lid and coil, positioning it securely.



The and view show clearly how the components are above the level of the bottom of the box, filling the space of the raised lid. The switches have a total of less than 1/32" total clearance between the top and bottom of the case.



Operation is quite simple.

Set SW4 to the centre position, to isolate the fixed capacitors, set SW3 to the right (in my tuner) to configure as an L match.

Set SW1, SW2 and C1 to the centre positions, adjust SW1 and SW2 for maximum receive noise (try to keep them as close as possible to the same position on each, i.e. Not one at maximum and the other at minimum) and then peak with C1. You should get a definite peak, noise dropping off on each side.

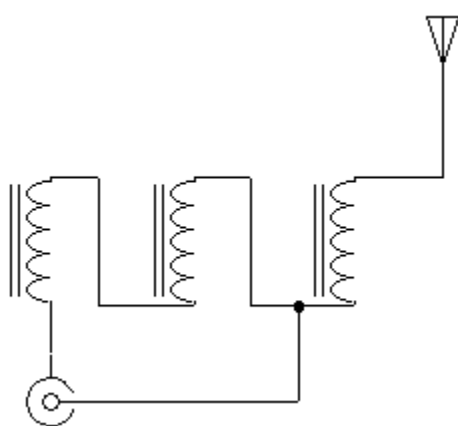
Then check the SWR on low power, and fine tune (it's usually within limits after the receive tuning). On the 817, switch the meter to PO and peak, **BEING VERY CAREFUL TO MAKE ONLY VERY SMALL ADJUSTMENTS WHILST PEAKING POWER.**

If you then set the meter back to SWR, it may show 2 segments on the SWR meter, it seems that the minimum SWR reading does not always correspond to the maximum power out.

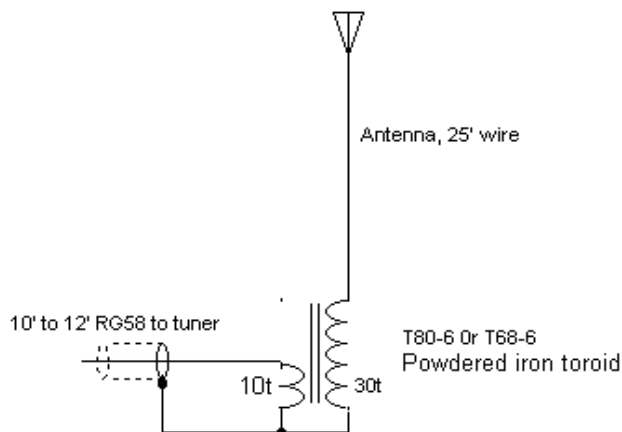
The tuner worked better than all expectations on the dipole in the house, and for tuning my portable antenna.

To connect it to a random wire, I tried a toroidal transformer with a primary of 10 turns connected to a short length of coax and a 30 turn secondary to the antenna.

I tried an ordinary 4:1 balun, and finally I tried the reputed circuit for the 'magnetic long wire balun'. This was interesting, as it seemed to increase the range of wire lengths I could tune, and could tune a 33' length of wire from 160m to 6m.



So called "Magnetic Longwire Balun"

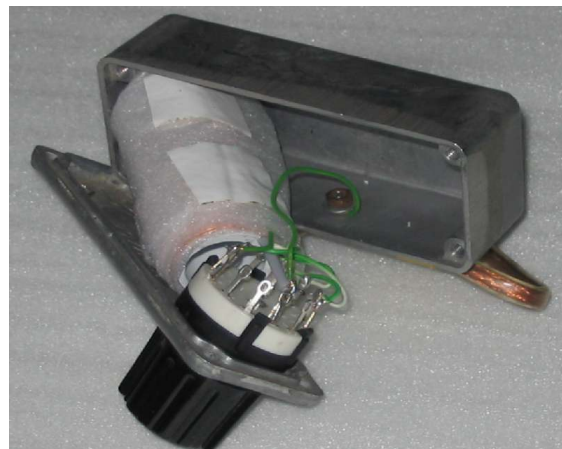


This has turned out to be my favourite

I found that about 10' of coax between the "balun" and the rig reduced the need for a counterpoise, but this is also influenced by DC power cables (or not if on internal batteries).



Tunable Counterpoise.

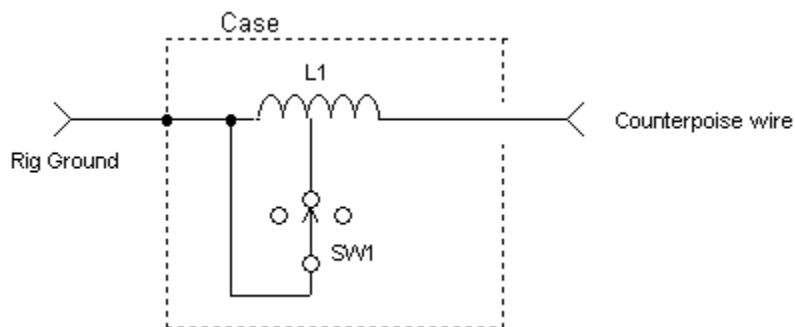


A counterpoise is most needed when running of internal batteries and using a “walkabout” antenna.

As soon as you add anything to the ground of the rig, DC power cord or coax, it seems to become less of a necessity.

Again I wanted something small, and I did not want to trail a tail if pedestrian portable.

The answer is quite simple, it's simply a $\frac{1}{4}$ wave wire on 10m, with a switched loading coil for other bands.



I have a 68 turn coil, wound with 24SWG wire on $\frac{3}{4}$ ” electrical conduit with taps at the following points:-

48t - 32t - 24t - 16t - 12t - 8t - 4t - 2t - 1t

The first switch position is open putting the whole 68 turns in series with the wire, and the last position goes to the end of the coil bypassing it.

The start of the coil and the common pole of the switch are connected to the case, and a braided earth strap connects the case to the rigs ground, or the ground on the tuner or antenna, depending on how you want to use it.

The counterpoise wire is around 9' long, I used 42 X .2 mm speaker wire, good amount of copper and flexible.



All that's left to do now is to build them with some decent front panels and some black crackle paint!

Winding the Coils

This is the procedure I used in both the Tuner and the counterpoise, and previously in my 703 antenna, where these photos are taken from.

The length of the coil is roughly the number of turn times the diameter of the wire, and I allowed about a 1/4" extra on the ends.

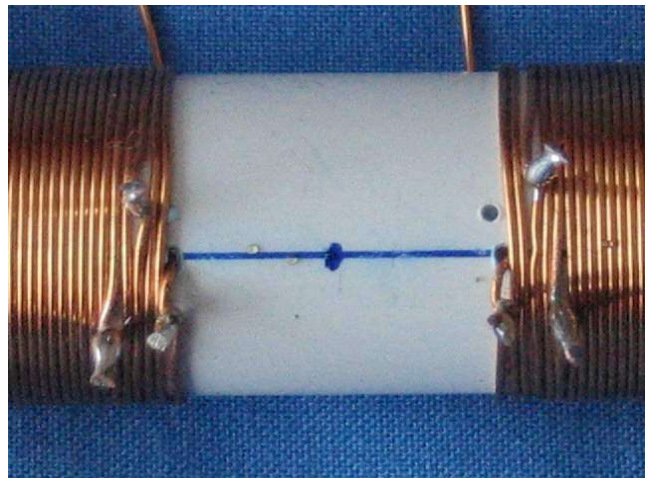
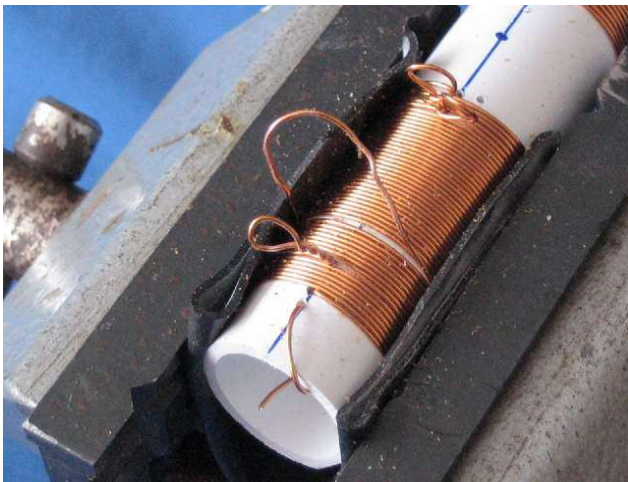
Drill a hole at the starting point of the coil, and one where the coil should end.

Wind the turns on, making loose loops where the taps will be.

Once the winding is complete, you need to hold the coil while you neaten up the taps.

I used a piece of old bicycle tube, it stops the wire slipping and prevents damage.

One at a time, open up the taps, carefully scrape of the enamel, trying to only scrape it off the



wire that will form the tap and not the wire that will lie flat on the former. Then twist it together, making sure the wire is taught on the former.

If two taps are close together, offset them from the centre line by about 1/8"

The taps can then be soldered and trimmed back to about 1/8" long.

When you solder on the wires that go to the switch, slip on about 1/4" of heat shrink tubing, which neatens it up and insulates it nicely.