Adventure Tuner Instructions

Revison History

8-August-2014	First issued
18-August-2014	Parts list updated. Variable capacitor mounting instructions revised.
20-August-2014	Added test with all inductors in circuit. Other minor changes to the test section.

Adventure Tuner Packing List

It's a good idea to check that you have all the parts before you get started:

Item	Number	Comments
Front panel	1	
ABS box with lid	1	130 x 68 x 44. Self tapping screws in box (4 off black)
Feet for box	4	self adhesive
4mm binding post (red)	2	
4mm binding post (black or green)	2	
Solder tags for binding posts	4	
BNC bulkhead socket	2	
variable capacitor with mounting kit	1	2 x M2.5 (6mm) 1 x M2.5 (10mm) 1 x plastic extension
knob for variable capacitor	1	
slide switch DPDT	6	
Mounting screws for slide switches	12	M2 x 6mm
Nylon screw	3	M4 x 16mm
Nylon washer	3	M4
Nylon nut	3	M4
Hyper bright LED	2	20,000 mcd
Toroid T50-6	2	YELLOW
Toroid T50-6	3	RED
Toroid T50-10	3	BLACK
Wire tinned copper	55	cm for general wiring
Wire enamelled	350	cm for winding toroids
Resistor 330 Ohm	2	orange, orange, brown
Instruction leaflet	1	web link to download full instructions

If anything is missing, just get in touch for help.

Adventure Tuner Instructions

The Adventure Tuner kit is easy to make and you will end up with a very useful antenna tuner. The Adventure Tuner is based on the popular L network tuner. To increase the flexibility of this tuner circuit, the Adventure Tuner is bi-directional. This means that you can use the L network in two ways and will double the matching range of the tuner. For high impedance loads, the transmitter is connected to the socket on the left and for low impedance loads, to the socket on the right.

The inductance is selected by switches and gives a range of 0 to 6.3 uH in 0.1 uH steps. That's enough for matching most antennas from 7 - 30 MHz and for some antennas on 3.5 MHz too.

The Adventure Tuner also includes a tuning indicator. This gives an indication of the RF current flowing from your radio. It is helpful when you don't have a VSWR meter.

Step by step instructions together with lots of photographs will make it easy to build your tuner. It will take around three hours work. I advise that you spread it over two or three sessions. This will lessen the chance of you making mistakes. As with any construction project, as soon as you feel tired, stop. If you don't mistakes will follow!

Spotted a mistake or need help?

Please let me know!

Email Richard@sotabeams.co.uk, telephone +44 (0) 7976 688359

Session 1: mounting the hardware (estimated 30 minutes)

The first thing you will need to decide is whether you want to paint-fill the engraving on the front panel. This makes the writing stand out although it's easy to read without doing the paint-filling. The panel is supplied with a paper mask attached. To paint fill the engraving, put a sheet of paper over the paper mask and rub the flat part of your thumbnail over the engraved areas. This will ensure that the paper mask is stuck down properly. Using and acrylic paint, fill the engraving by spreading the paint with a soft plastic spatula. Once you are happy that the engraving is properly filled, leave the panel to dry for 24 hours.

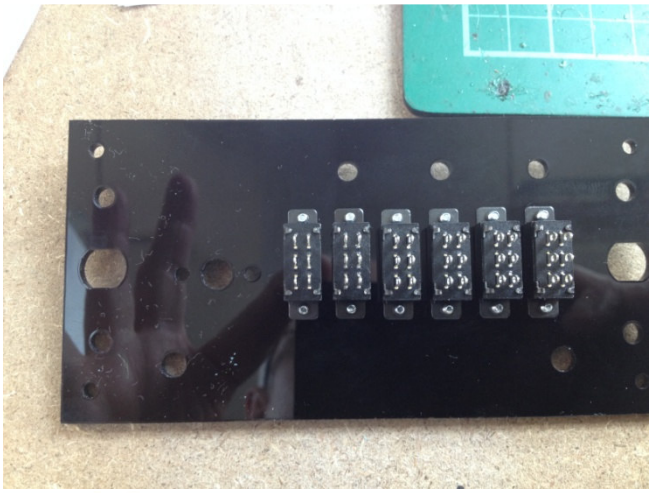
When the paint fill is dry, peel off the paper mask. Use tweezers to get the smaller bits off – CARE: don't scratch the panel. Remove the plastic masking from the rear of the panel. Finally clean the panel with a soft cotton cloth wetted in rubbing alcohol. This will give a great result if you take care.

If you don't want to paint fill your panel, just remove the masks on both sides and clean the panel with a soft cotton cloth wetted in rubbing alcohol.

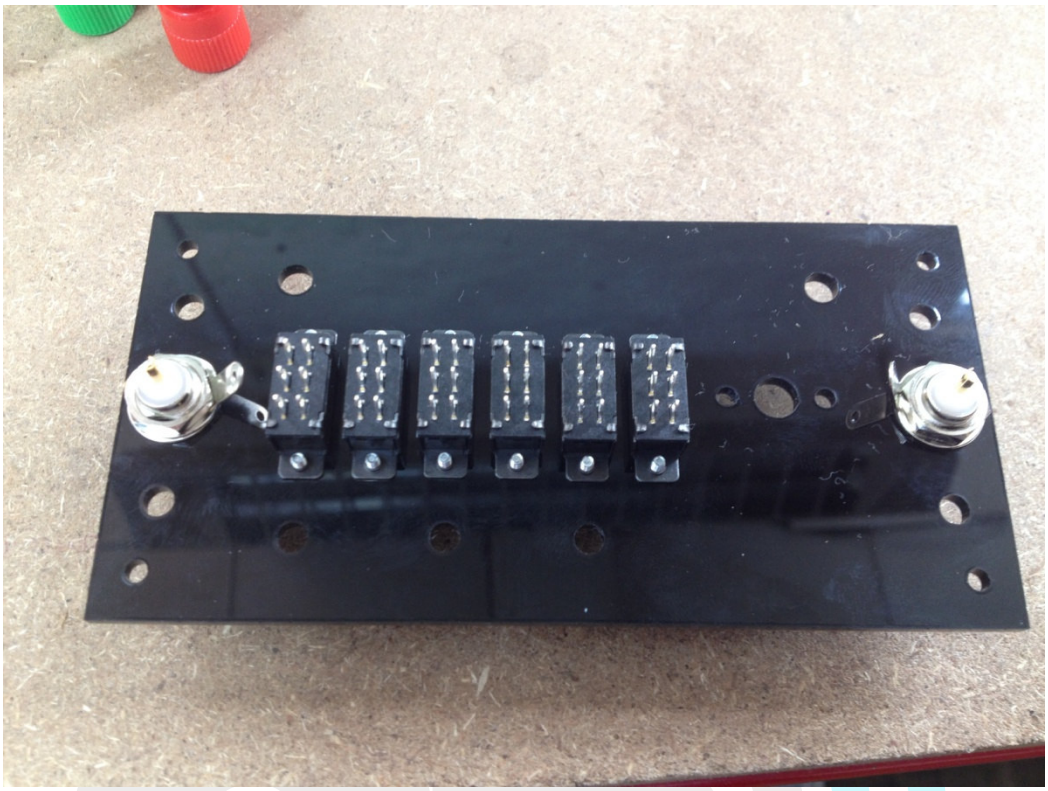
Mounting the front panel components

For all the assembly work, find a light place to work with plenty of room. A tea tray is useful to work on as the raised sides stop small parts rolling away.

❒ Mount the six slide switches. Each switch is fastened using two M2 screws. There are 12 x M2 screws in the bag with the white nylon nuts and bolts.



❒ Mount the two BNC sockets. The serrated washer goes on first, then the solder tag and finally the nut. Do not over tighten the nut as you could crack the front panel.



❒ Mount the four 4mm binding posts (two red, two black[1]). They mount with the larger washer first, then the small washer, one nut, the solder tag and the other nut. The red ones mount in the holes above the BNC connectors when viewed from the front.

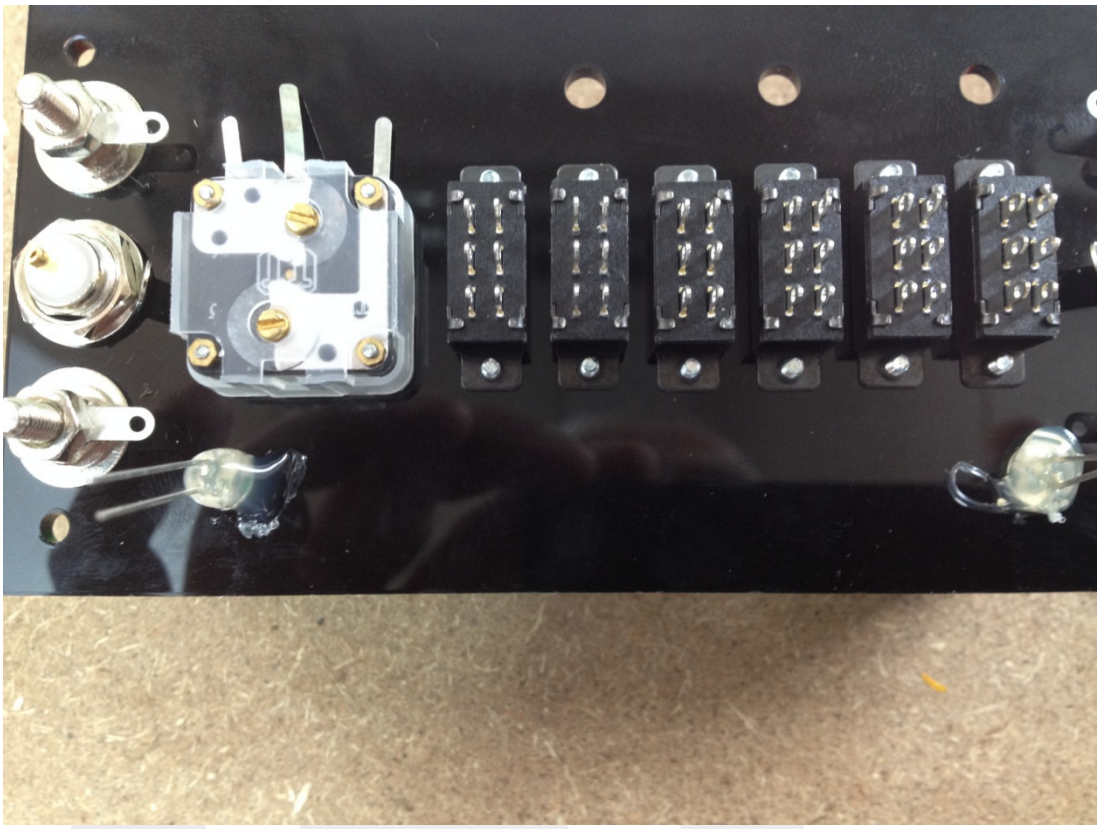
[1] Note that your kit may have blue or green binding posts instead of black ones.

- ❒ The variable capacitor is mounted using the hardware in its bag. Mount the variable capacitor with its connections towards the top of the panel. The two short M2.5 screws hold the capacitor to the panel. Tighten these screws evenly. Check that you can turn the capacitor shaft with your fingers. It should be tight but smooth.

  The small tubular spacer screws onto the end of the brass shaft of the capacitor to act as an extension. It's attached with the longer (10mm) M2.5 screw. It's a good idea to use a small amount of ***epoxy glue*** to hold the extension screw and spacer firmly in place. This will stop the spacer spinning on the screw and stop the assembly from unscrewing. Make sure no glue is visible as this will stop you putting on the knob later. Allow the glue to set completely before mounting the knob on the shaft of the variable capacitor.


3.2uH
1.6uH
SB
2
4
1
5
Tuner

❒ Push the two LEDs through the front panel. Glue them in place on the back of the panel with a spot of hot melt glue or epoxy glue.



This completes session 1.

Session 2: the toroids (estimated 45 minutes)

In this session you will wind the toroids. There are eight to wind. It's not hard but must be done carefully. Firstly, Google "winding toroids" for lots of good advice on the web.

There are three different toroid cores used in the kit and they are painted different colours so that you can identify them.

T50-10 BLACK

T50-6 YELLOW

T50-2 RED

The toroids will be wound with enamelled copper wire. This is a brown/bronzed or red colour. First print out the sheet below. This will be used to "store" your completed toroids.

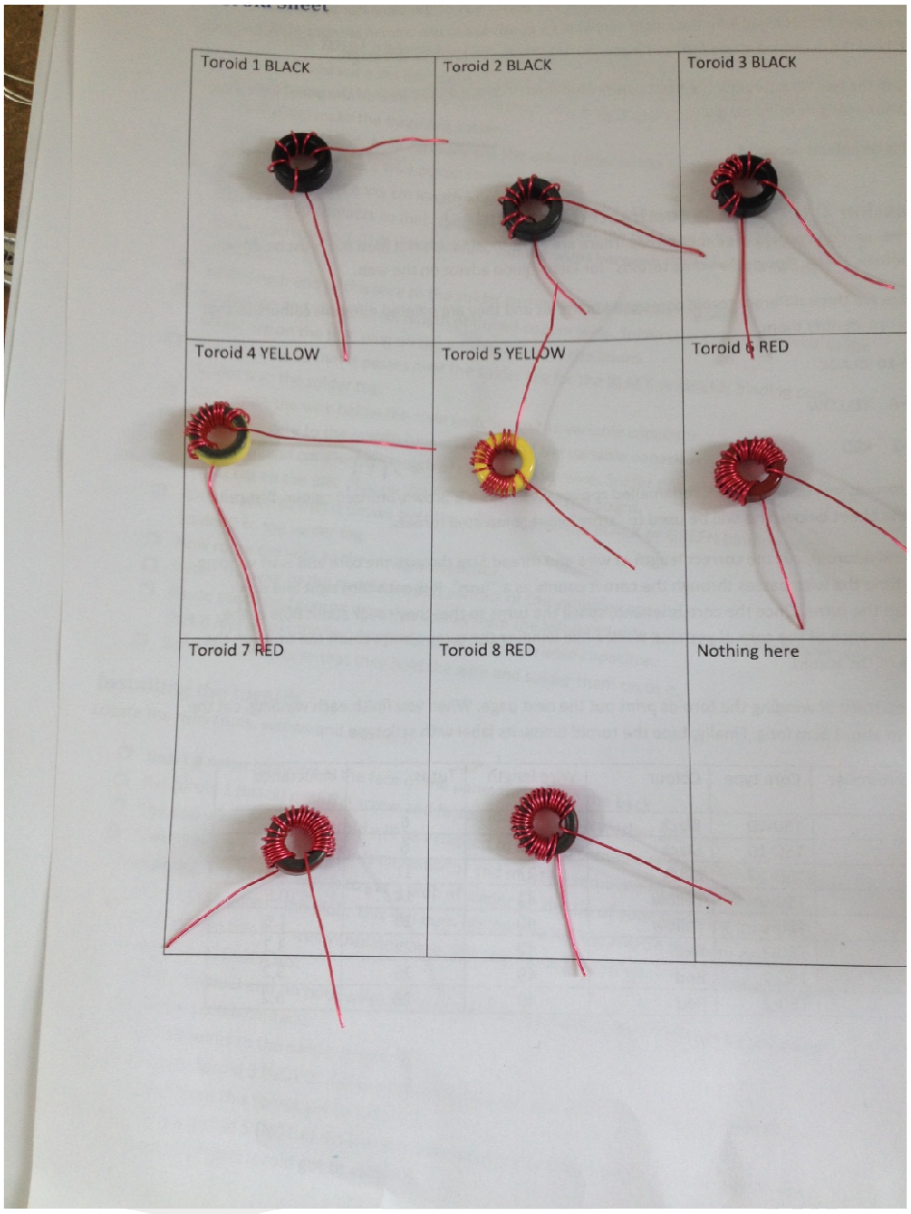
To wind a toroid, cut the correct length of wire and thread 3cm through the core and start winding. Each time the wire passes through the core it counts as a "turn". Pull each turn tight and don't overlap the turns. Once the core is wound, space the turns so that they cover about 80% of the circumference of the core. If you lose track while winding the turns always count the turns on the inside of the toroid.

To keep track of winding the toroids print out the next page. When you finish each winding, cut the leads to about 3cm long. Finally, tape the toroid below its label with sellotape.

Toroid Number	Core type	Colour	Wire length (cm)	Turns	Inductance (uH)
1	T50-10	Black	19	6	0.1
2	T50-10	Black	22	8	0.2
3	T50-10	Black	27	11	0.4
4	T50-6	Yellow	31	14	0.8
5	T50-6	Yellow	40	20	1.6
6	T50-2	Red	49	26	3.2
7	T50-2	Red	49	26	3.2
8	T50-2	Red	49	26	3.2

Toroid Sheet

Toroid 1 BLACK	Toroid 2 BLACK	Toroid 3 BLACK
Toroid 4 YELLOW	Toroid 5 YELLOW	Toroid 6 RED
Toroid 7 RED	Toroid 8 RED	Nothing here


Toroid 1 BLACK
Toroid 2 BLACK
Toroid 3 BLACK
Toroid 4 YELLOW
Toroid 5 YELLOW
Toroid 6 RED
Toroid 7 RED
Toroid 8 RED
Nothing here

Session 3: the final assembly (estimated 2 hours)

- ❒ Straighten and cut a 7 cm length of tinned copper wire. Thread this through the lower row of switch contacts so that there is 1 cm over on the right and 1 cm over on the left. Long-nosed pliers make the threading easier.
- ❒ Solder each contact. Now carefully clip the wires between the switches so that each individual switch has a wire across its contacts.

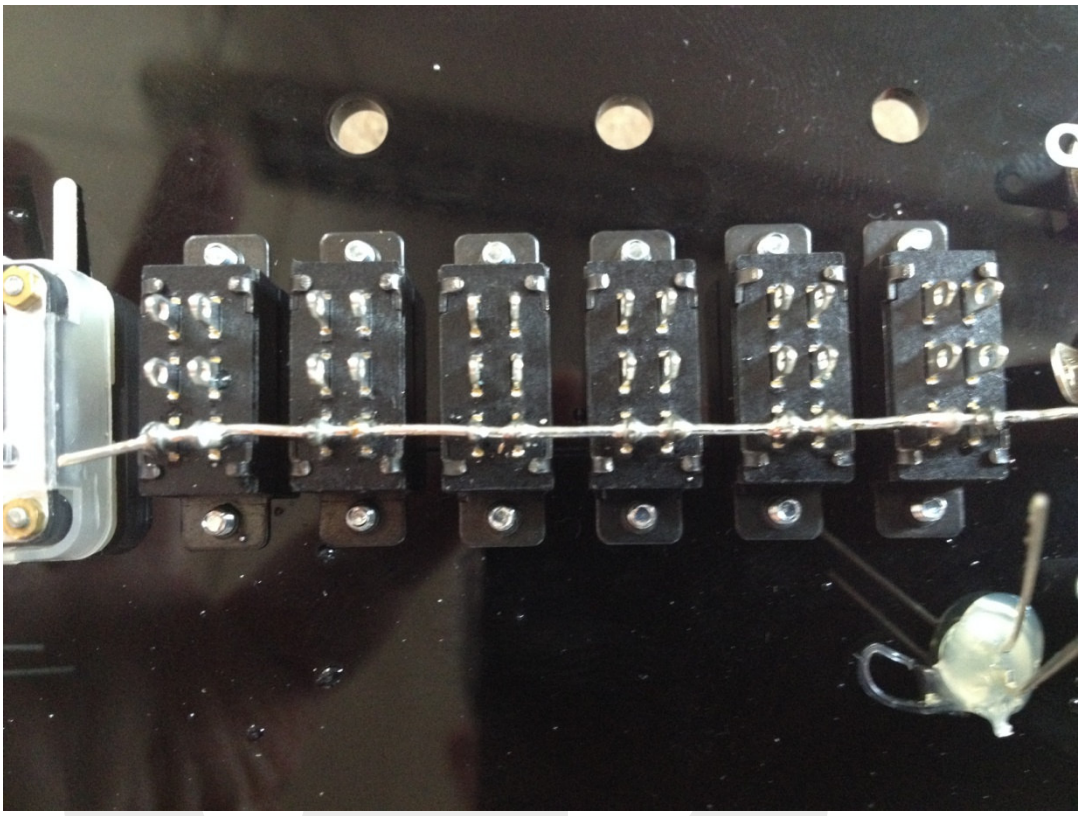
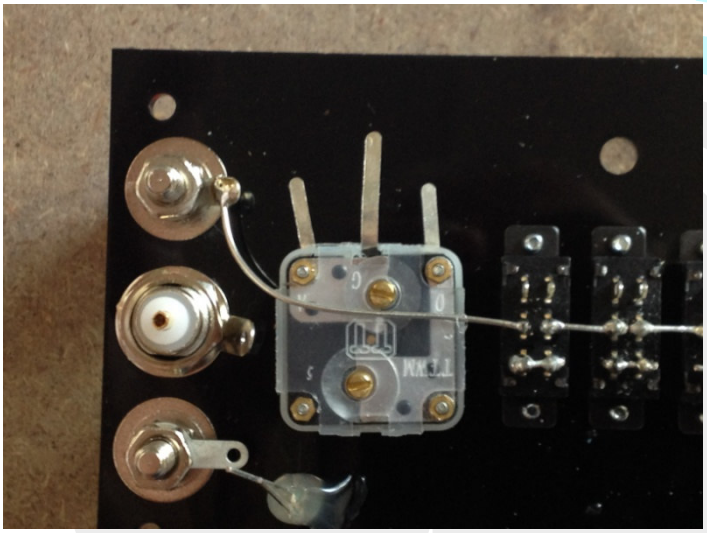


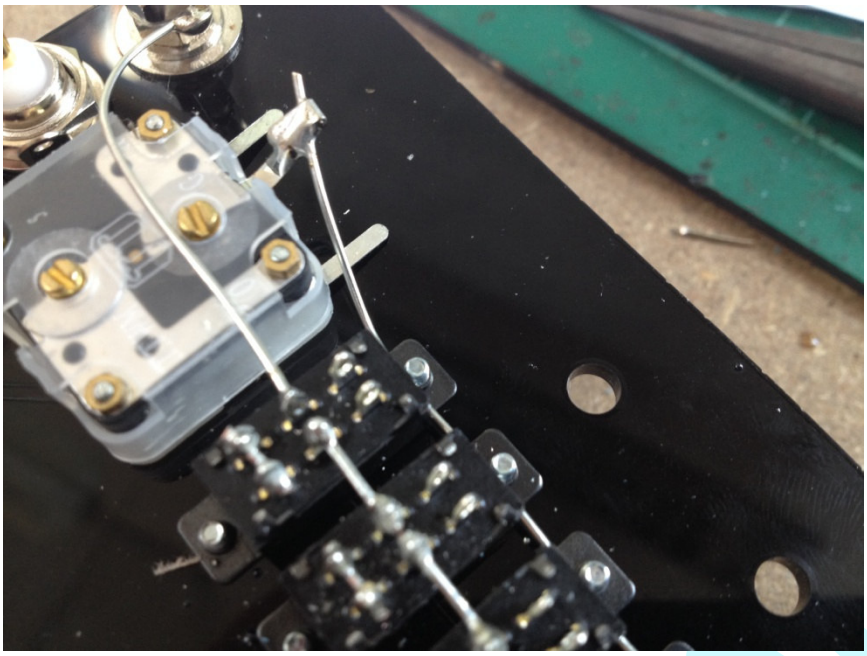
Photo shows wire before clipping

- ❒ Straighten and cut a 14 cm length of tinned copper wire. Thread this through the middle row of switch contacts so that there is 3 cm over on the right and about 5.5 cm over on the left. Solder each contact. This time carefully clip the wires between the individual switch contacts.
- ❒ Solder each end of this wire to the solder corresponding RED binding post.



- ❒ Straighten and cut a 11.5 cm length of tinned copper wire. Solder one end of this wire to the solder tag on the Green/black/blue binding post on the left-hand side of the board.
- ❒ Run the wire so that it passes over the solder tag for the corresponding BNC plug. Solder it to the solder tag.

- ❒ Now route the wire above the slide switches to the variable capacitor.
- ❒ Solder the wire to the middle (upper) contact of the variable capacitor.



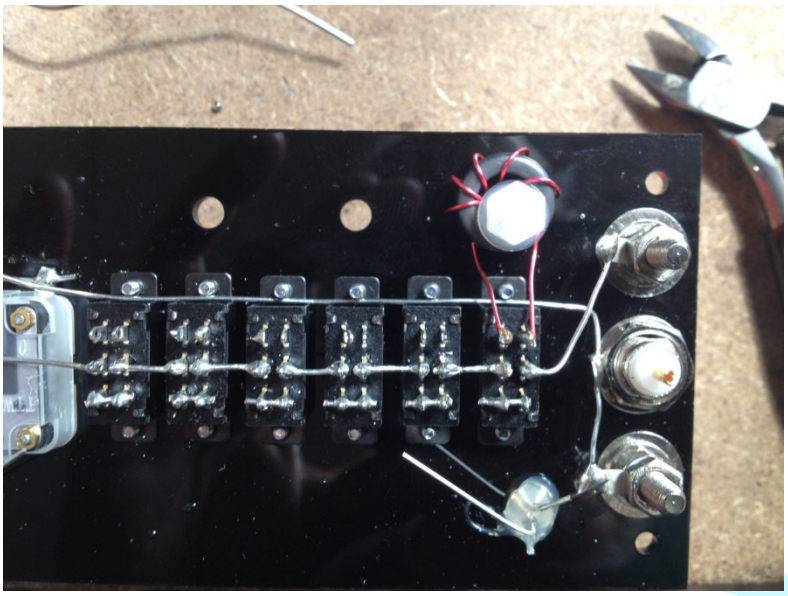
- ❒ Straighten and cut a 5 cm length of tinned copper wire. Solder one end of this wire to the solder tag on the black/green/blue binding post on the left-hand side of the panel.
- ❒ Run the wire so that it passes over the solder tag for the corresponding BNC connector. Solder it to the solder tag.
- ❒ Now route the wire to the variable capacitor.
- ❒ Solder the wire to the middle (upper) contact of the variable capacitor.

- ❒ Straighten and cut a 4 cm length of tinned copper wire. Solder one end to the solder tag on the left hand red binding post. Run the wire so that it passes over the lower solder tags of the variable capacitors.
- ❒ Bend the two tags on the capacitor around the wire and solder.

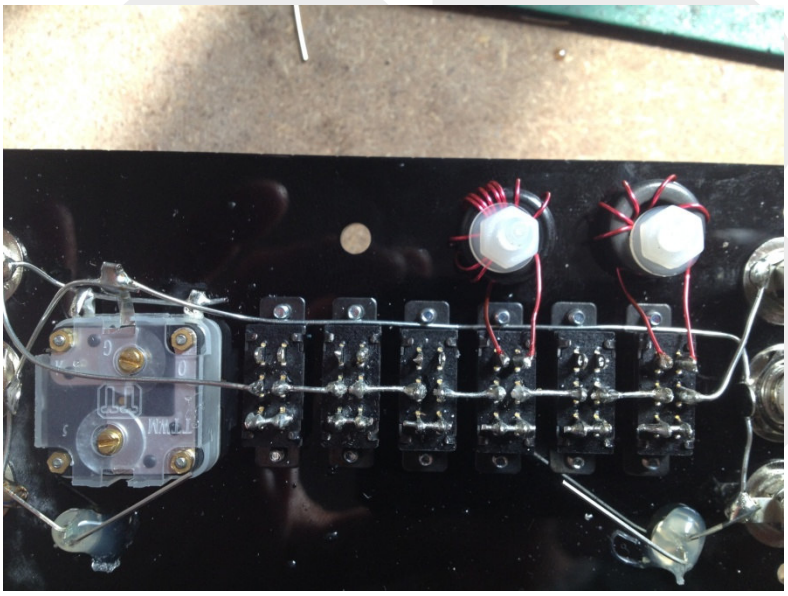
- ❒ Solder one of the legs of each LED to the solder tag on the nearest black/red/green binding post. It does not matter which led of the LED you use.

Installing the toroids

- ❒ Locate the 3 x nylon nuts, 3 x nylon screws and 3 x nylon washers.
- ❒ Insert a nylon screw from the face of the panel through to the back through the right hand hole above the line of switches (viewed from the component side of the panel).
- ❒ Put toroid 1 (black) over the screw and fasten loosely with a nylon washer and nut.
- ❒ The two wires from this toroid will be attached to the top contacts of the switch immediately below it. This is the right-most switch.
- ❒ The wires are enamelled. This is an insulator and must be removed to allow the wire to be soldered. The easiest way is to get a blob of solder on the tip of your soldering iron and heat the ns of the wire in the blob. This will burn off the enamelling and tin the wire ready fir soldering. Do this in a well ventilated area. We use a small fan to blow the fumes away from us here at SOTABEAMS.
- ❒ Strip the enamel and tin both wires from toroid 1 at the point where they can be wrapped round the switch contacts.
- ❒ Solder the wires to the top pair of switch contacts.

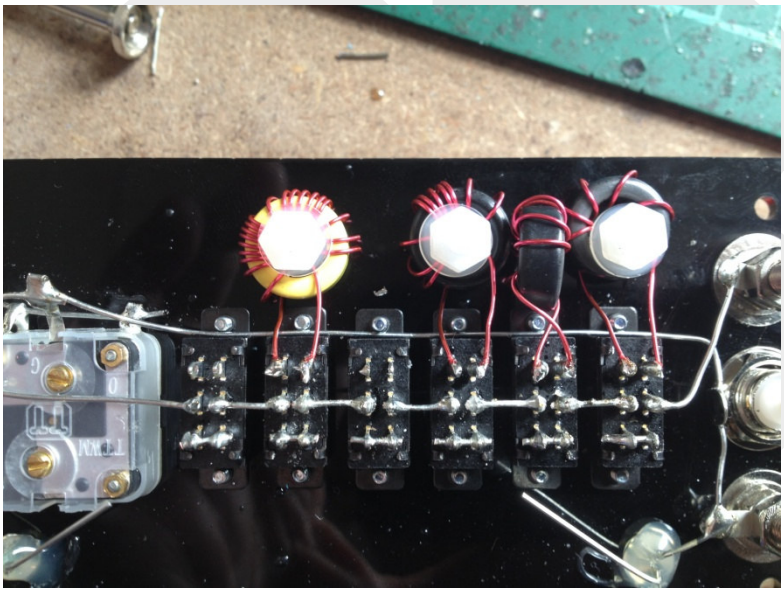


❒ Next locate toroid 3. Follow the same process as above using the next hole along (left of the first toroid). The leads from this toroid got to the switch immediately below the toroid (see photo).



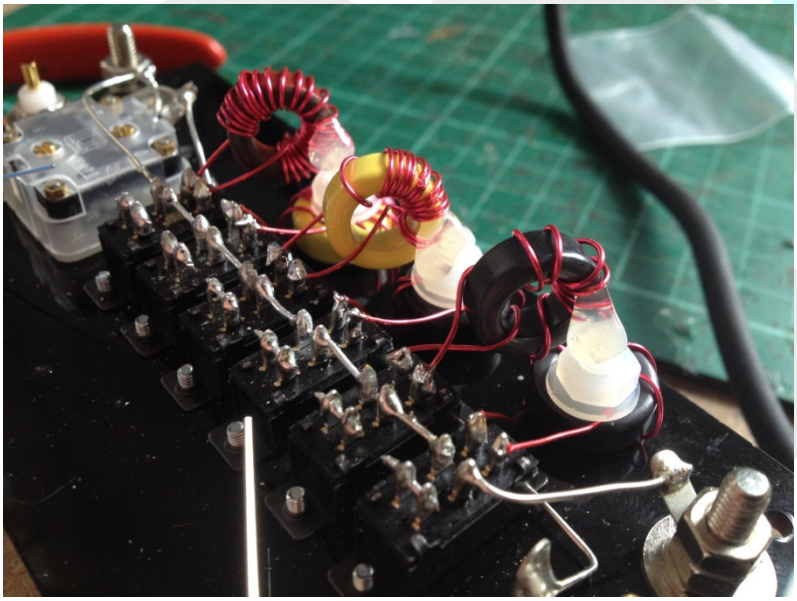
❒ Next locate toroid 5. Follow the same process as above using the next hole along. The leads from this toroid got to the switch immediately below the toroid (see photo).

- ❒ Tighten up the nuts holding these three toroids in place.
- ❒ Locate toroid 2. Tin the leads of this toroid. Solder it to between the ones that toroids 1 and 3 are soldered to. Mount it at loosely at right angles to and between, toroids 1 and 3.



- ❒ Locate toroid 4. Tin the leads of this toroid. Solder it to switch between toroids 3 and 5. Mount it at right angles to and between toroids 3 and 5.

- ❒ Locate toroid 6. Tin the leads of this toroid. Solder it to left-most switch. Mount it at right angles to, and next to, toroid 5.
- ❒ Toroids 2, 4 and 6 should be attached to the tops of the nylon screws with hot-melt glue or a small blob of epoxy resin.



  - This completes the variable inductance part of your Adventure Tuner.

Current monitors

Toroids 7 and 8 are used to help tuning up your Adventure Tuner. They are used as part of RF current monitor circuits at both of the BNC antenna sockets.

- ❒ Tin the wires on the remaining toroids (7 and 8).
- ❒ Measure and cut a 4 cm length of tinned copper wire. Solder one end to the solder tag on the left RED binding post. Thread it through toroid 7 and solder the end to the centre of the BNC socket on the left hand side.
- ❒ Cut the unsoldered lead of the left LED down to about 1.5cm length. Solder one end of a 330 Ohm resistor (orange, orange, brown) as shown in the photograph.

- ❒ Solder one end of the toroid winding to the resistor. Solder the other end to the solder tag on the black/blue/green binding post.

  - That completes the first current monitor.

The second current monitor is similar.

- ❒ Measure and cut a 4 cm length of tinned copper wire. Solder one end to the solder tag on the right RED binding post. Thread it through toroid 8 and solder the end to the centre of the BNC socket on the right hand side.
- ❒ Cut the unsoldered lead of the left LED down to about 1.5cm length. Solder one end of a 330 Ohm resistor (orange, orange, brown) as shown in the photograph.
- ❒ Solder one end of the toroid winding to the resistor. Solder the other end to the other lead of the LED.
  - That completes the second current monitor

Final assembly

Take a few minutes to look closely at your soldered joints. Try to compare the circuit diagram (at the end of this document) to what you have constructed. If any connections look too close to others, gently move them apart.

Insert the Adventure Tuner into its box. Screw the front panel down at each corner with the four black self-tapping screws. Don't over-tighten them as you may crack the front panel.

Stick the four self-adhesive feet to the bottom of your new Adventure Tuner.

Your tuner is now good to go.

Testing and using the Adventure Tuner

Using an Ohm meter measure the resistance between the two right-hand binding posts – it should be an open circuit (resistance greater than 1,000,000 Ohms).

Do the same check between the two left-hand binding posts.

With all the switches down (no inductance in circuit) measure the resistance between the two red binding posts. The resistance should be around 1 Ohm.

With all the switches up (all inductance in circuit) measure the resistance between the two red binding posts. The resistance should be between 1 and 50 Ohm.

If the resistance test above do not give the correct result, check your connections. You may need to reheat some solder joints to get a good connection.

The first configuration to try is always the same – it assumes that the impedance of your antenna is greater than 50 Ohms. This is almost always a good assumption. Testing will be done using your transmitter. During the tuning process the transmitter will "see" loads that may show a very high VSWR, so ensure that the transmitter is suitable robust. Very few modern transceivers will have any problems.

Attach your radio to the left-hand BNC socket. Attach the antenna and counterpoise/earth to the right-hand binding posts or, if it is co-ax fed, to the right-hand BNC socket.

Set all the inductance switches to OUT (down) and set the variable capacitor to about half way.

Set your transmitter to a power output of 2 - 5 Watts. Select a mode that will give a carrier (AM/FM/CW etc). Transmit.

Look as the right-hand LED and adjust the inductance and capacitance so that it is as bright as possible. Some practice is needed to use the switches and knob effectively.

If the LED does not light it may be that the antenna impedance is less than 50 Ohms. To match low impedances, attach the transmitter to the right-hand BNC socket and attach the antenna to the either the left-hand binding posts or, if it is co-ax fed, to the left-hand BNC socket.

Repeat the tuning process but look at the right-hand LED.

A note on the current sensing system

It's maximising the current flowing into your antenna that will give you the best signal. Maximum current may not coincide with the best VSWR. The reason for this is that the output impedance of a transmitter is rarely actually 50 Ohms: this is a little known fact but it's true.

If you run 20 Watts and the LED seems too bright you could reduce the number of turns on toroid 7 and 8 or increase the value of the 330 Ohm resistors to (say) 680 Ohms.

Useful additional information

Not sure what cm means? Cm stands for centimetre. This is a measure of length used in most parts of the World. The following table gives conversions.

Centimeters To Inches Conversion Table

Cm	Inch	Cm	Inch	Cm	Inch	Cm	Inch
1	0.393700787	26	10.23622046	51	20.07874014	76	29.92125981
2	0.787401574	27	10.62992125	52	20.47244092	77	30.3149606
3	1.181102361	28	11.02362204	53	20.86614171	78	30.70866139
4	1.574803148	29	11.41732282	54	21.2598425	79	31.10236217
5	1.968503935	30	11.81102361	55	21.65354329	80	31.49606296
6	2.362204722	31	12.2047244	56	22.04724407	81	31.88976375
7	2.755905509	32	12.59842518	57	22.44094486	82	32.28346453
8	3.149606296	33	12.99212597	58	22.83464565	83	32.67716532
9	3.543307083	34	13.38582676	59	23.22834643	84	33.07086611
10	3.93700787	35	13.77952755	60	23.62204722	85	33.4645669
11	4.330708657	36	14.17322833	61	24.01574801	86	33.85826768
12	4.724409444	37	14.56692912	62	24.40944879	87	34.25196847
13	5.118110231	38	14.96062991	63	24.80314958	88	34.64566926
14	5.511811018	39	15.35433069	64	25.19685037	89	35.03937004
15	5.905511805	40	15.74803148	65	25.59055116	90	35.43307083
16	6.299212592	41	16.14173227	66	25.98425194	100	39.3700787
17	6.692913379	42	16.53543305	67	26.37795273	125	49.21259838
18	7.086614166	43	16.92913384	68	26.77165352	150	59.05511805
19	7.480314953	44	17.32283463	69	27.1653543	175	68.89763773
20	7.87401574	45	17.71653542	70	27.55905509	200	78.7401574
21	8.267716527	46	18.1102362	71	27.95275588	250	98.42519675
22	8.661417314	47	18.50393699	72	28.34645666	300	118.1102361
23	9.055118101	48	18.89763778	73	28.74015745	500	196.8503935
24	9.448818888	49	19.29133856	74	29.13385824	750	295.2755903
25	9.842519675	50	19.68503935	75	29.52755903	1000	393.700787

Circuit diagram