A Shortened Antenna for 40 metres and 80 metres Portable Operating

Here in the UK the Worked All Britain award scheme [i] is primarily conducted by nets on 40 or 80 metres. The introduction of their new Trig-points award [ii] has generated interest in portable antennas for these bands. A 40m dipole is an easy antenna to manage on a hilltop but an 80 m dipole is very much harder to manage. If you are using a portable telescopic pole as a mast and running your dipole as an inverted Vee, the ends tend to sag very close to the ground and more wire is not good.

Over a few beers in a local pub, I suggested to a friend that a shorter dual band antenna might be worth trying. One way of shortening an antenna is to use inductive loading (i.e. a coil in series with each dipole leg). If multiband performance is required, the coils can be turned into traps.
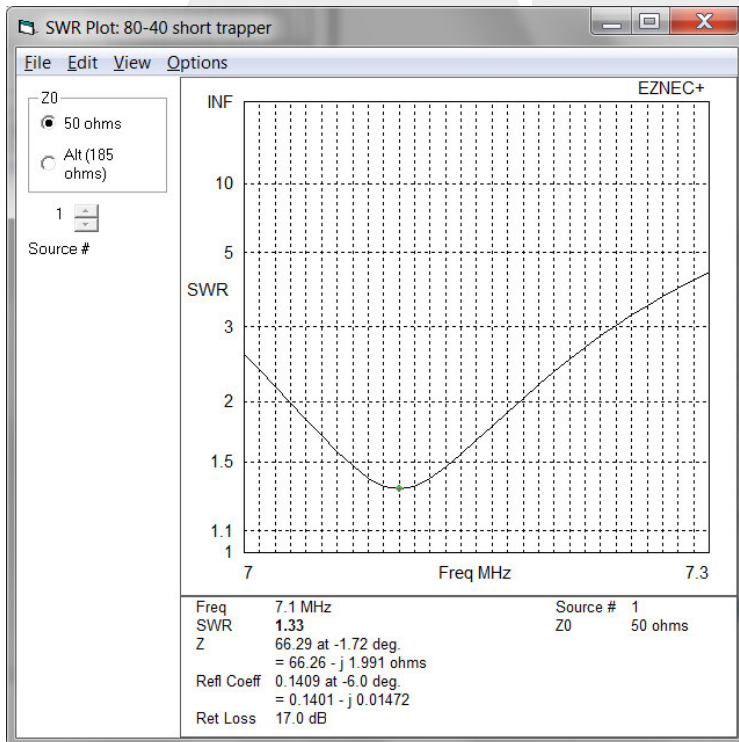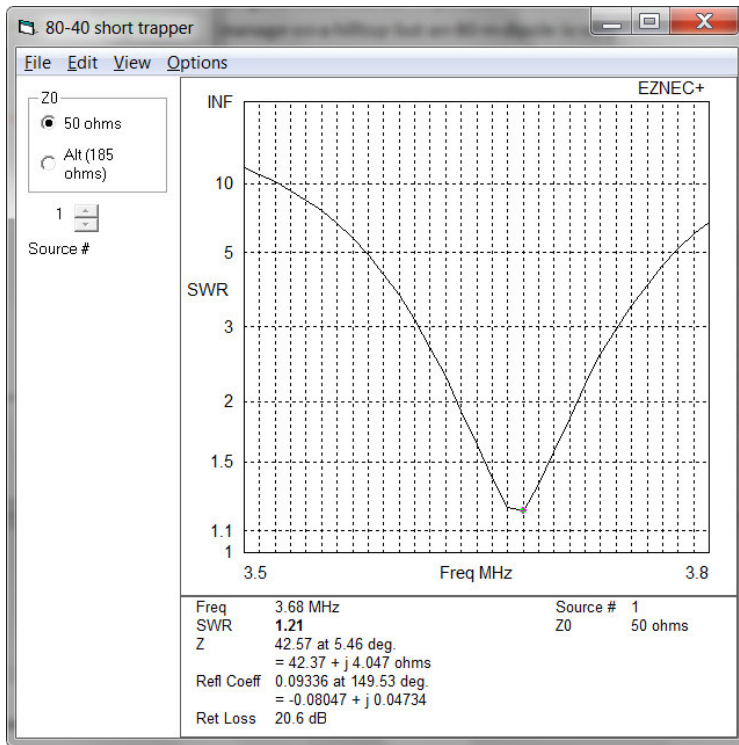
To get the shortest antenna, the inductance of the coils needs to be fairly high thus a small value capacitor is needed to make a resonant trap. So our special trap has a high L to C ratio. With co-axial traps you cannot alter the L-C ratio so "lumped constant" traps are needed. These are traps with a discrete L and C.
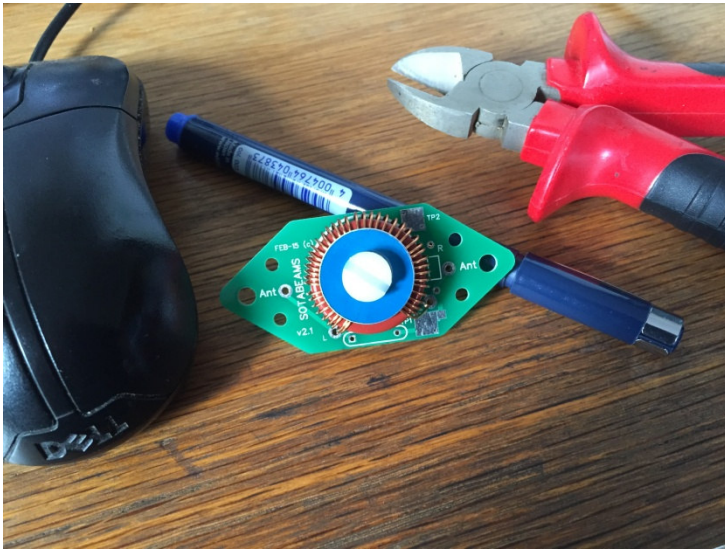
I had some T94-2 toroid cores at the factory so I did a few calculations. A bit of head-scratching and I designed the traps. Each one consists of a T94-2 coil with 43 turns of 0.6 mm diameter (23 swg) enamelled copper wire. This is the maximum number of turns that can be wound on without the ends windings of the inductor being too close together. These inductors are about 15.2uH so to resonant them on 40m as traps they will need 33pF in parallel. I would recommend using a mica capacitor

I then modelled the antenna: I started with a 40 m dipole. Having adjusted that for resonance I added the traps. Traps sometimes increase the resonant frequency of an antenna that they are added to (I can't figure out why). They did in this case so I added a little extra length to the 40m dipole. In the end it came out at 10.3 metres each leg. Finally, I added the 80m extension sections. 5.7 metres each side gave a resonant frequency in the centre of 80m.

I did SWR plots for both bands:

See below.

80-40 short trapper — EZNEC+

Z0: ● 50 ohms ○ Alt (185 ohms)

Source # 1

Freq	3.68 MHz	Source #	1
SWR	**1.21**	Z0	50 ohms
Z	42.57 at 5.46 deg.		
	= 42.37 + j 4.047 ohms		
Refl Coeff	0.09336 at 149.53 deg.		
	= -0.08047 + j 0.04734		
Ret Loss	20.6 dB		

SWR Plot: 80-40 short trapper — EZNEC+

Z0: ● 50 ohms ○ Alt (185 ohms)

Source # 1

Freq	7.1 MHz	Source #	1
SWR	**1.33**	Z0	50 ohms
Z	66.29 at -1.72 deg.		
	= 66.26 - j 1.991 ohms		
Refl Coeff	0.1409 at -6.0 deg.		
	= 0.1401 - j 0.01472		
Ret Loss	17.0 dB		

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Prototype 7 MHz trap using a SOTABEAMS trap PCB

So what is the benefit of this shortened antenna? Well a full sized 80m antenna will be around 40m long and cover just one band. My design is 8 metres (26 feet) shorter at 32 metres long and covers 2 bands.

Some other thoughts

I did wonder if self-resonant traps could be made for 40 metres. I have managed to make self-resonant traps for 2m and with some experimenting with winding thin wire on a toroid, it might be possible on 40m. Self resonant traps would tend to have a higher L/C ratio which will make the antenna even shorter. They can be a bit unstable for portable use though.

Another possibility would be to add additional loading in either the 40 or 80m sections of the antenna.

i http://wab.intermip.net/default.php

ii http://wab.intermip.net/Trig%20Points%20Award.php