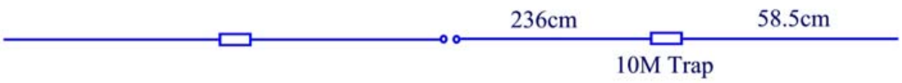
TRAP DIPOLES **Ron Hayman VK4BRH**

My motivation in building trap dipole antennas stemmed from a desire to have a light, portable antenna that worked on several HF bands and did not need a tuner. Searching through an old ARRL handbook, I read an article on building traps using small iron powder toroids, and decided to try them out. The theory was simple. Build a pair of traps to resonate on the frequency you want to trap, attach them to the ends of an already resonant dipole antenna, then add extra lengths of wire to get a second (lower frequency) band to resonate. In practice it is slightly trickier, particularly if you want more than two bands. This is because loading effects of the traps tend to shorten the antenna. Some trial and error is required to get the wire lengths correct.

I used the formula $\lambda/4$ (cm) = 7495/f (MHz) as a starting point.



10 / 15 metre trap dipole

Now to the practical considerations. Since I wanted a lightweight, portable antenna, I would need small traps. The ARRL handbook suggested Amidon T50-6 toroids, which are powdered iron and 0.5 inch diameter, and silver mica capacitors for temperature stability. 1mm enamel coated copper wire was wound around a toroid to form an inductor, and a capacitor was added to create a parallel tuned circuit. This was then measured and adjusted using a dip meter and frequency counter, then mounted inside a length of electrical conduit. Wooden dowel plugs with small stainless bolts through them were used to seal the ends.

Coil and Capacitor Values for Traps

The equations used for the calculations were the standard ones for capacitive reactance (Xc) and inductive reactance (X_L). These are as follows:

$X_c = 1 / 2\pi f C$ transposing this we get **$C = 1 / 2\pi f X_c$** (μF if freq. is in MHz)

$X_L = 2\pi f L$ transposing this we get **$L = X_L / 2\pi f$** (μH if freq. is in MHz)

A suggested "rule of thumb" is to use 200 ohms as the reactance values at each of the trap resonant frequencies required. Remember, at resonance, $X_L = X_c$. The following table shows the capacitance and inductance needed for a range of frequencies, and the approximate number of turns of wire on the toroids.

Band Metres	Frequency MHz	Capacitance (C) pF	Inductance (L) µH	Turns on T50-6 Toroid
10	28.800	27.6 (27) #	1.12	17 (15) *
15	21.200	37.5 (39) #	1.50	19 (17) *
20	14.200	56.4 (56) #	2.24	24
40	7.200	110	4.42	33

Available capacitors in the series shown in brackets
* In practice, the turns were less (shown in brackets), probably due to stray capacitance.

The number of turns was calculated from the formula T = 100 x SQRT (L / A_L). The A_L value for T50-6 toroids is 40, while for T68-6 toroids is 47 (if you want to make bigger traps). The largest diameter wire possible should be used to help reduce losses.

For 20 and 40 metre traps, you will have trouble fitting the turns on the small diameter toroid if you use 1mm wire. The solution is to go to smaller diameter wire. A useful little program is the mini ring core calculator, available for download at
http://www.dl5swb.de/html/mini_ring_core_calculator.htm.

In practice, the turns should only be wound on about 75% of the toroid, because there will be some distributed capacitance between the turns. The "gap" will also be useful later when the dip meter is used to measure the resonant frequency. Capacitor leads and coil ends should be kept as short as possible to reduce stray capacitance. I found that, with a bit of manipulation, I could usually fit the capacitor inside the toroid. After checking and adjusting the resonant frequency, I used hot glue to keep everything in place.

Toroidal coils have an inherent self-shielding characteristic, which can make it hard to get adequate coupling with the dip meter. Generally, a dip was detectable when pointing the dip meter coil at the "gap" in the toroid windings. Once you determine the frequency where the meter dips, you can then get a more precise value by putting the dip meter coil near the input lead of a frequency counter. If your dip meter includes a modulator function, you could also use a standard HF receiver to check the frequency – just put the dip meter coil near the RF input of the receiver, tune the receiver and watch the S meter for maximum signal strength.

Once you determine the resonant frequency of your trap, you will most likely want to adjust it to be at the centre of the band you will use it on. For example, a 10M trap would most likely be adjusted to be resonant around 28.5MHz. The turns on the toroid can be moved further apart to raise the resonant frequency, or pushed closer together to lower the resonant frequency. Before using hot glue to keep everything from moving and altering the resonant frequency, add any hardware such as ring terminals, and even the bolts through the dowel end plugs. With such small capacitances involved (< 100 pF), these may effect the final frequency.

When I first started experimenting with trap dipoles, I had good results, so I just kept adding traps for more bands. I managed to get one working satisfactorily on 10, 12, 15, 17, 20 and 40 metres, with SWR values below 2 on all bands. But I have to admit it took a lot of adjustments and about a whole day of cutting and trimming wires. My preferred configuration now is 10, 15, 20 and 40 metres, which still took some effort, but was easier.

The T50-6 powdered iron toroids are available from Mini-Kits (www.minikits.com.au). Incidentally, in this designation, T = powdered iron toroid, 50 is the diameter (0.5 inch), and 6 is the material type.   A ferrite toroid would be designated FT.

The electrical conduit was 20mm OD , 16mm ID, and each trap was 50mm long.

Camping at Mt. Tamborine on Saturday, August 16th., ready for the RD Contest. The 10 – 40 metre trap dipole is in an inverted V configuration at the top of the yellow mast.

10 – 40 metre trap dipole
with
mini 1:1 balun