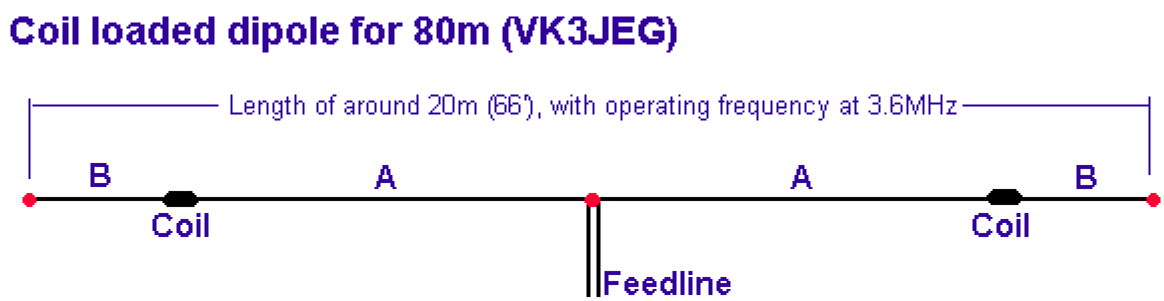
Coil loading of an 80m Dipole for restricted space...

By Chris Arthur VK3CAE

Here's a method that may allow you to fit that 80m dipole into your suburban backyard

Most suburban amateurs have quite a few constraints to deal with nowadays, one of the major ones is a lack of space. If you grab the ARRL Antenna handbook off the self, you will find a small section on "Antennas for restricted space", a description is given for the probable coil loading of dipoles. About 20 years ago I decided to take this description further and with the aid of a computer, some ugly basic programming and a friend, several experimental versions of coil loaded dipole went on test. The result was a dipole for 80 Metres that has a length around half that of a conventional dipole with a transmission loss of less than 3dB (<1/2 an S point).



Of course the aim here was to effectively reduce the size of the antenna without to greater reduction in radiation efficiency, sounds easy, well not quite. To achieve maximum efficiency with a coil loaded dipole you need to place the coils as far out on each side as possible, there are a couple of reasons for this. The first and most important is to obtain as much of the dipoles current distribution on the wire between the coils, not only does this increase the radiation efficiency it decreases the amount of current in the coils. The closer the coils are to the dipoles centre the greater the current within the coils. However as you move the coils out further on the wires the required inductive reactance increases and a much greater number of turns is required for resonance, eventually you reach the point where so many turns are required that Q losses cause matching problems.

The original program used to calculate the required inductance for various length combinations of A & B was written in Basic and I still have the file. There is also a module to work out the number of turns required for a given coil former diameter. They were converted to Basic from the formulas given in the ARRL Antenna Handbook. Rather than go through all of the calculations, I'll just skip to the tests and results (see diagram above). If you want to conduct some experiments of your own I can send you the basic code, I have also seen similar basic code (loadpole.bas & coils.bas) on the Web at various FTP sites.

The Practical stuff

The following experiment was carried out at a height of between 9 and 10m (30' - 33') over sandy bay side soil.
On completing several tests we found that the optimum coil placement distance (A) for a half sized dipole was between 0.65 to 0.70 of one half of our doublet (A+B). In order to obtain resonance at around 3.58-3.60MHz the required Inductance at AB was calculated at 65uH. I used 1.2mm enamelled wire for all of my test coils with the antenna wire being 1.6mm Hard Drawn Copper. At this point I should make a note that the antenna wire in use is not all that critical as most of the l/d ratio effect can be tuned out at the ends of our wire, keep as close to my figures as possible and yes, insulated wire is fine. The coils which gave me the best results were wound on 32mm PVC, to get the required inductance of 65uH you need 80 turns of 1.2mm enamelled wire. With this many turns we have a lower Q than would be considered desirable but I found (as suspected) that the trade-off of a increase in usable bandwidth (~10kHz) at 80mts is more of an advantage. The 2:1 bandwidth of this type of antenna is around 60 kHz, with a 3:1 bandwidth of 80 kHz (or more) it is quite useful for novice operation.

Construction Details for a half sized dipole for 80m:

Figures apply to the VK novice band (design @ 3.58 MHz)

A grid dip oscillator was used to find the initial resonant point, this should be on the low side (~3.55MHz) with the dimensions given. By decreasing the length you will be able to tune to your desired frequency, the antenna works just as well in Inverted Vee configuration but the required length for resonance may be a little shorter due to the effect of ground proximity increasing capacitive reactance. As with most antennas mounted at lower heights, varying ground conditions (wet or dry soil) will change radiation resistance this will be noted by a moderate change in SWR and resonant frequency. I must also mention that I didn't use a proper Ferrite Balun on this antenna, however the RG-58 feeder had around 8 to 10 turns (20-25cm dia) near the feed-point, thus forming a make shift current Balun.

Total Length of dipole = 19.8m (includes 15cm for each coil former)
Length of A = 6.40m (21') of 1.6mm HD Cu wire (or sim)
Length of B = 3.35m (11') of 1.6mm HD Cu wire (or sim)

Coil Construction:

80 turns of 1.2mm enamelled copper wire on a 32mm PVC former 15cm long

Drill a couple of holes to hold the wire and start winding about 25mm in from one end

A hint is to use tape to hold the turns in place as you go...

It should also be noted that due to the high number of turns on each coil a trap effect takes place. The inner A sections also work as a half wave dipole, for me that was a bonus as I gained a SWL antenna for the 25 - 27m bands (11 - 12MHz). You could experiment with different lengths for A and B to gain dual band operation or even tri-band operation on the 3rd Harmonic but that's up to you... Those who want to model this antenna will find that most programs generally predict a narrower usable bandwidth than the figures I found in practice!