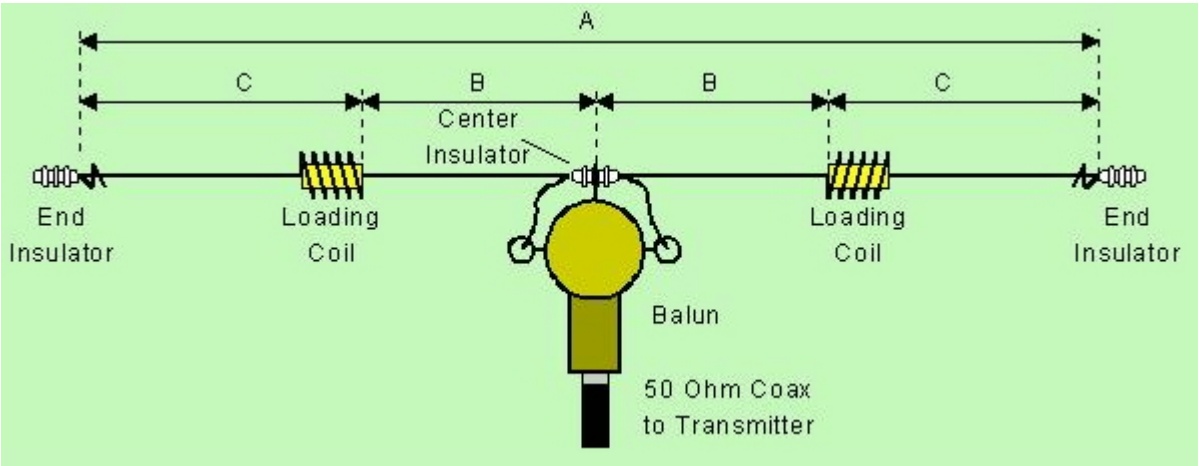
80 m center-loaded short dipole

In dire need of a a halfway decent antenna for the 80 mtr band, I decided to try a simple center-loaded dipole (i.e., loading coils located half way between the center insulator and the end-insulator). The longest that I can fit on my terrace, albeit with a dog leg between the dipole halves, is 2 x 10 m (2x 33 ft), i.e., about ¼ wavelength. I had already stocked up on zip cord (14 AWG houshold hookup wire), still had half of a polyethylene plastic kitchen cutting board (for insulators), 32 mm PVC pipe (coil cores), and 0.8 mm enameled copper wire (#20 AWG is 0.812). So I have all the necessary ingredients. As always, I use a choke balun in series with the coax.

Articles:

- "Loading of short antennas" by Doug/WB6BCN
- "How Does an Inductor or Loading Coil Work?" by Tom, W8JI
- "The Fabulous Dipole - Ham Radio's Most Versatile Antenna" by Steve Finch, AIØW, June 2006
- "Signal/noise-ratio performance of loaded wire antennas", P.A. Ramsdale, Proc. IEE, Vol. 124, No. 10, October 1977, pp. 840-844

I determined the required coil value via the K7MEM on-line calculator. Note that the calculator is for a straight line, flat top antenna, sufficiently placed in "free space".



7 February 2010: this is a quiet Sunday afternoon, so I decided to build a short, center-loaded dipole for the 80 mtr band. Took about 1½ hours to make the insulators, wind the coils and put the whole thing together for initial testing.

Frequency -	3.58 MHz
Available Space (A) -	65' 7-3/8" (20.000 M)
Dimension B -	16' 4-7/8" (5.000 M)
Dimension C -	16' 4-7/8" (5.000 M)
Required Inductance -	42.098 uH

Based on an on-line calculator for helical coils, the required 42 µH coil should take about 50 turns of 0.8 mm CuL on a 32 mm core (0.15 mm inter-winding space, which is what my coils tend to have).

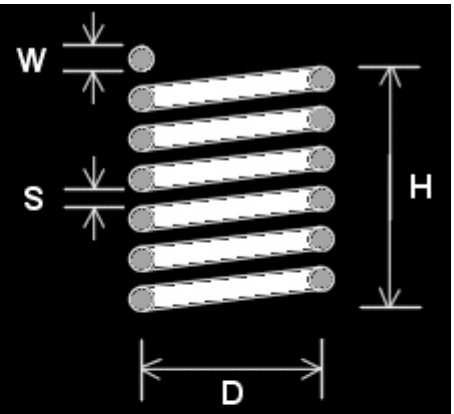
Helical Coil:

Units: ○ Inches ◉ Millimeters

Diameter(**D**):	32.4	mm
Number of turns(**N**):	50	
Wire Diameter (**W**):	0.8	mm
Turn spacing(**S**):	0.15	mm

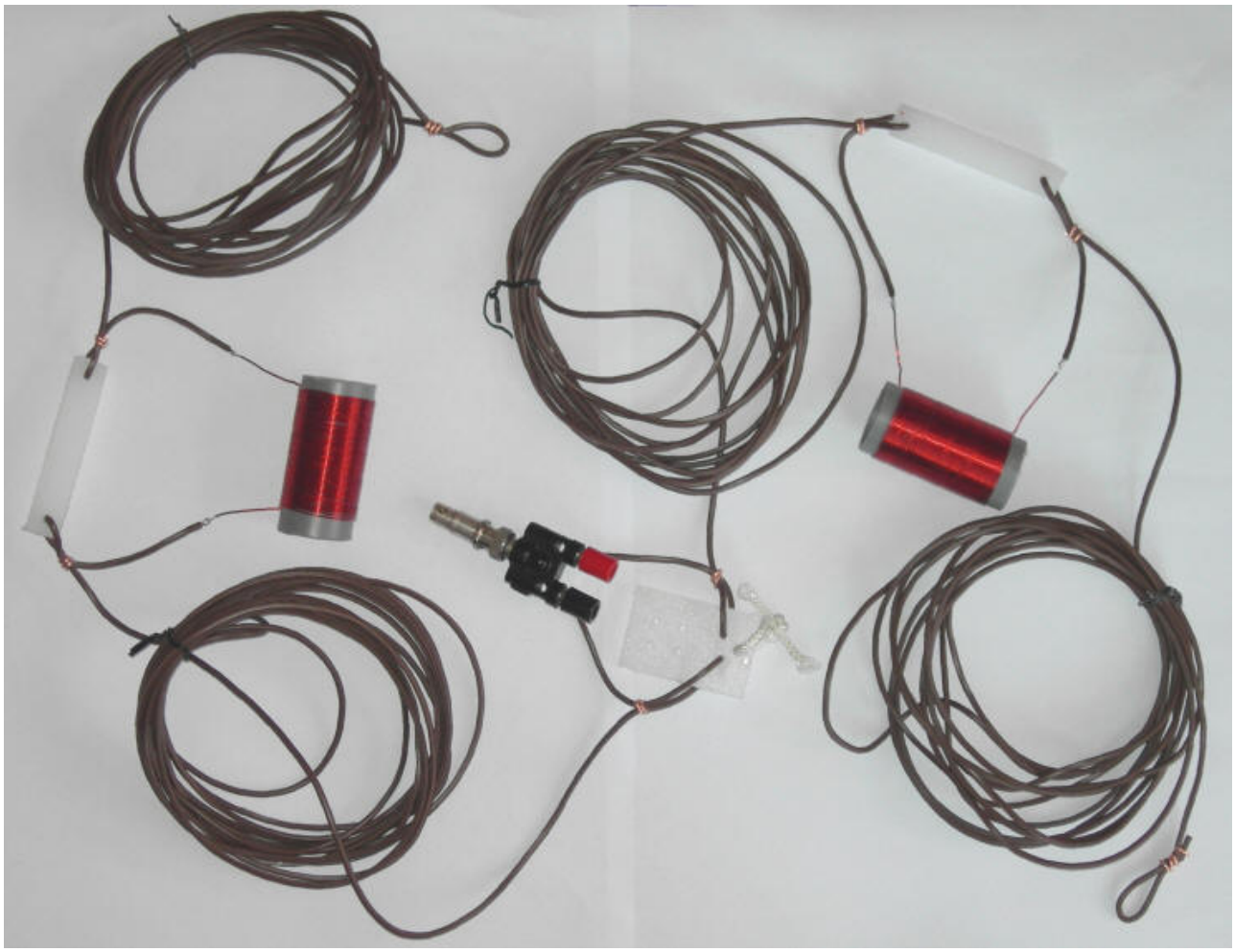
*Move (TAB) to next field to update result

Height(**H**):*	47.5	mm
Length of wire:	5.089	metre
Inductance(**L**):*	41.608	uH
(Self Capacitance:	1.513	pF)

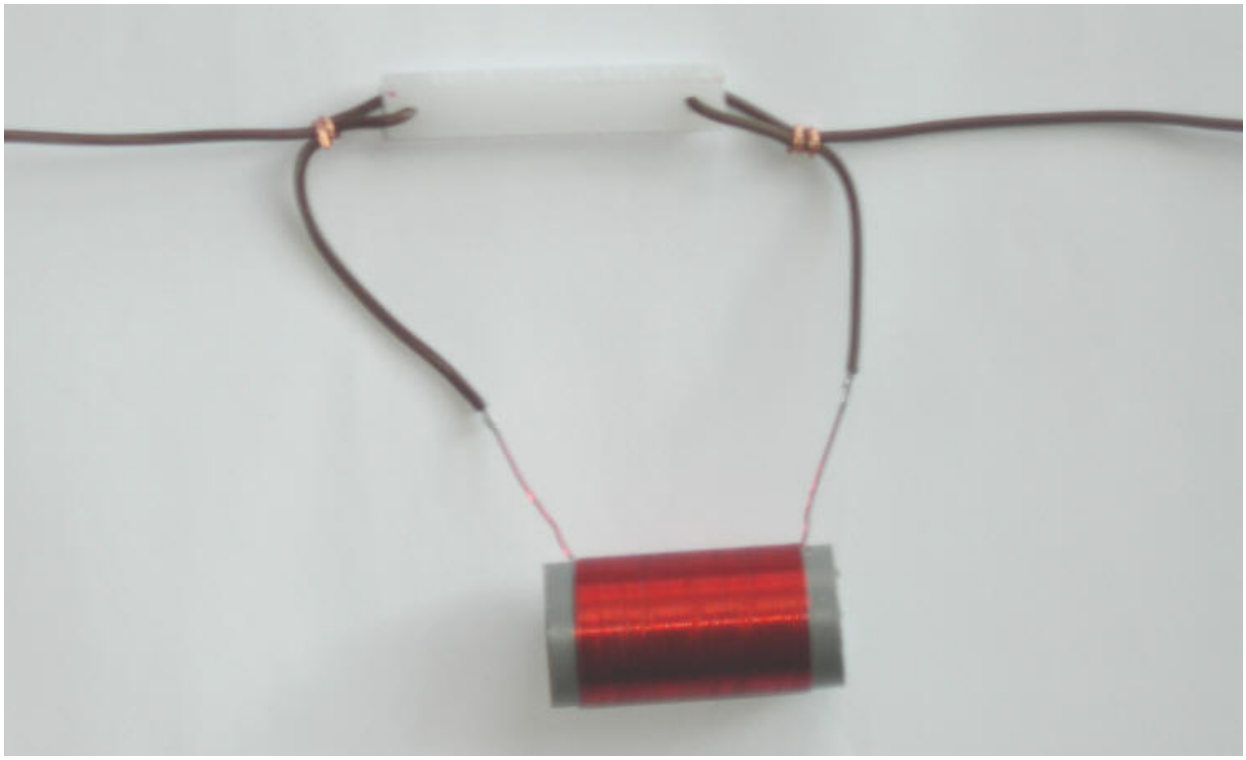


$$L = \frac{N^2 \times R^2}{9R + 10H}$$

$$\left(R = \frac{D}{2} \right)$$

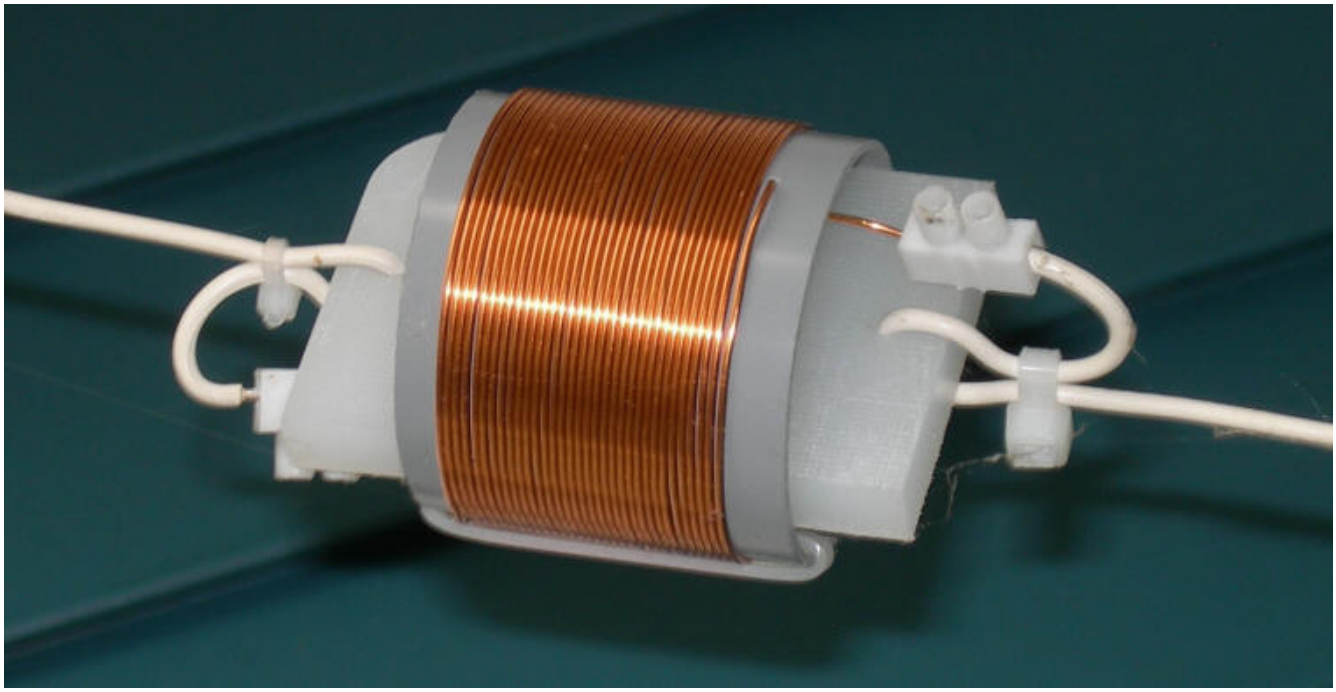


The complete dipole, with experimental coils



Insulator with experimental coil (56 turns on 32 mm core)

I suspend my loading coils from a narrow strip of poly kitchen cutting board material. My dear friend Rolf, DF7XH, uses a strip that is as wide as the inner diameter of the PVC coil core, and slides the coil over it.

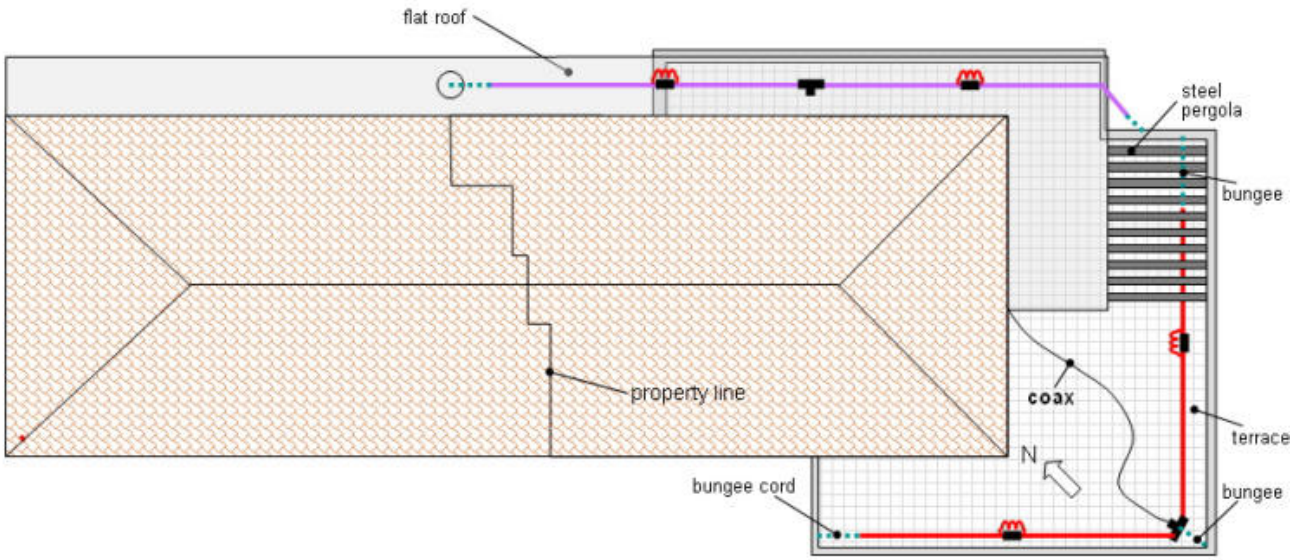


Dipole loading coil made by Rolf, DF7XH

Center-insulator with temporary BNC adapter

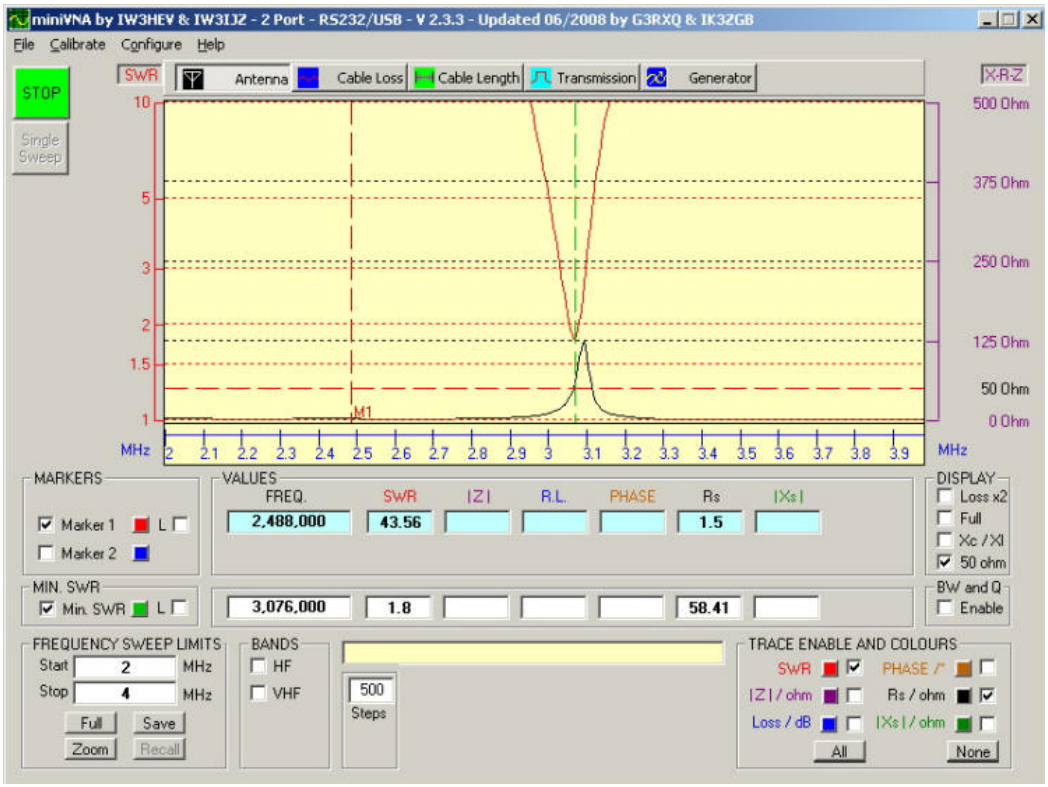
The antenna is installed horizontally. I tried two configurations, both only 1-1½ m (3-5 feet) above the terrace floor. Not great, but no choice. The L-configuration (90 degree dog leg) is shown in red in the diagram below. The end-insulators and the center-insulator are tied off with bungee cords. One leg runs parallel to the steel railing of my terrace. The other leg will run close to a steel-reinforced concrete walls + floor, and partially underneath a steel pergola. So there is capacitive loading in all directions. The second configuration (purple in the diagram) is almost straight, but runs underneath a concrete flat roof.

The antenna tunes beautifully, but ..... I'm seem to be getting much signal in our out! To a great extent, this is caused by the fact that the antenna is only installed about 1+ meters above the terrace. This antenna height is *very* low, compared to the 80 mtrs wavelength. So most of the transmitted energy will go straight up. Not a fault of the antenna! It *does* receive all harmonics of the 50 Hz AC power, hi!



Installations on my terrace

I hooked my miniVNA antenna analyzer up and obtained the plot below.



Sweep from 2 to 4 MHz with my miniVNA antenna analyzer - initial coil

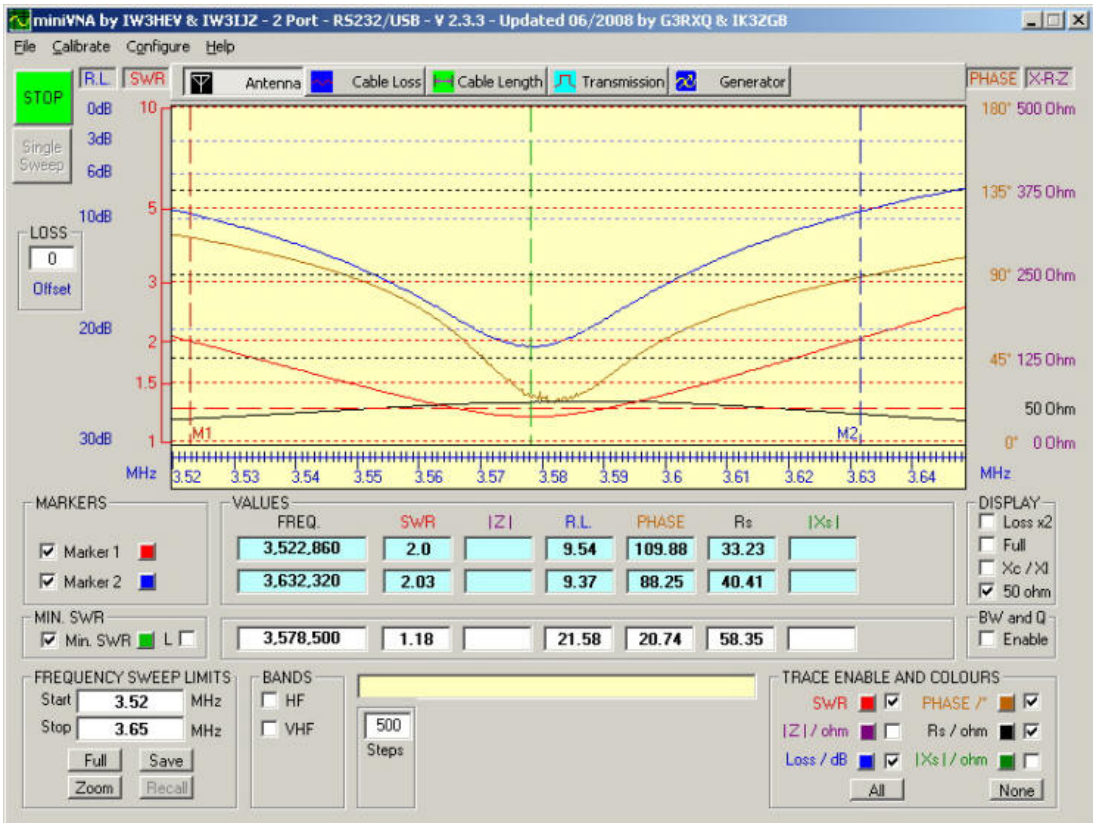
The resonance frequency is too low, so obviously the coil has too many windings. This is OK! So I removed windings in two steps to arrive exactly at my target frequency: 3578 kHz. Sometimes you get lucky (rare when dealing with antennas)! The bandwidth between the SWR=2 points is 110 kHz.

The plot below shows the SWR and Rs curves for the final coils. Note that the resonance frequency drops to 3252 kHz (!) when the choke balun (located at the end of the coax, not at the antenna) is removed. Per the on-line calculator for helical coils, these coils now have about 77 µH inductance...

Windings	Resonance freq.	SWR	Rs
56	3076	1.79	58
49	3425	1.18	56
44	3578	1.17	58

Tuning data (40 ft coax + current choke)

Inserting a small bar (8x25x75 mm, ⅓ x1x3") of polyethylene (the kitchen cutting board material I use for insulators) increased the coil inductance by a mere 0.12 %. I may slide the coils over the insulators, rather than dangle them from those.



Sweep from 3.52 to 3.65 MHz - final coils

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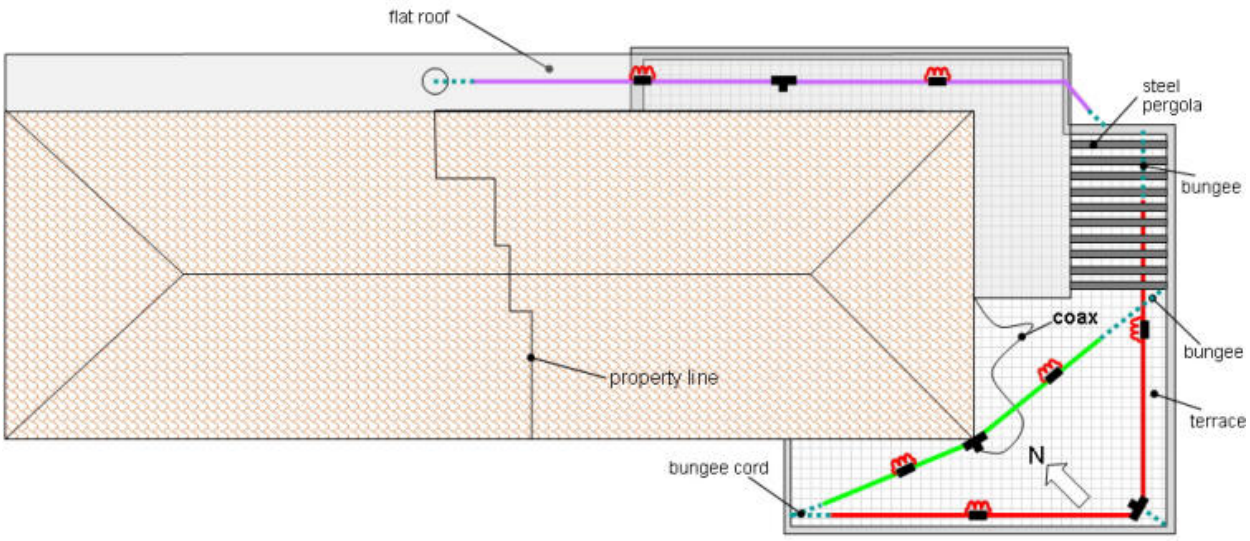
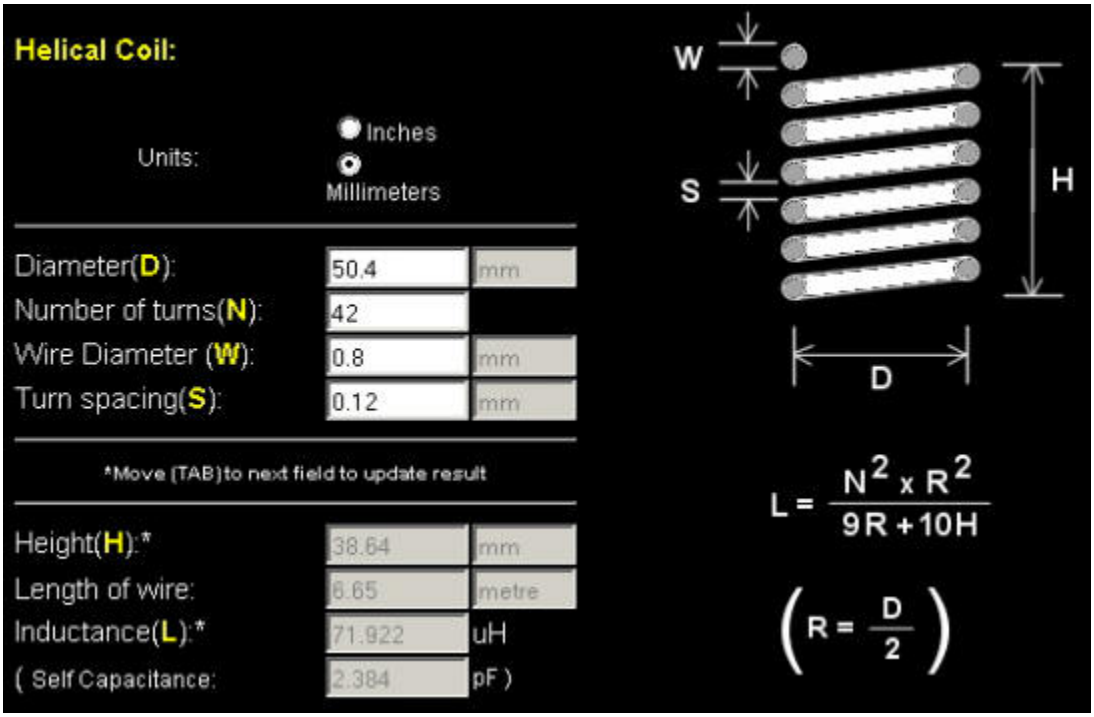
27 February 2010: clearly, the installation of the 2x10 mtr dipole turned out to be terrible. Not to be blamed on the antenna itself, nor on its creator! My Cobra dipole (2x6.3 mtr, ≈2x 20 ft) is also installed on my terrace, and is not "deaf". It actually performs quite well on 40 and up. It is also installed horizontally, but at an angle with respect to the walls. Maybe that will do the trick. So, why not try a 2x6.5 mtr center-loaded dipole and put it where the Cobra is? See green antenna in the diagram below.



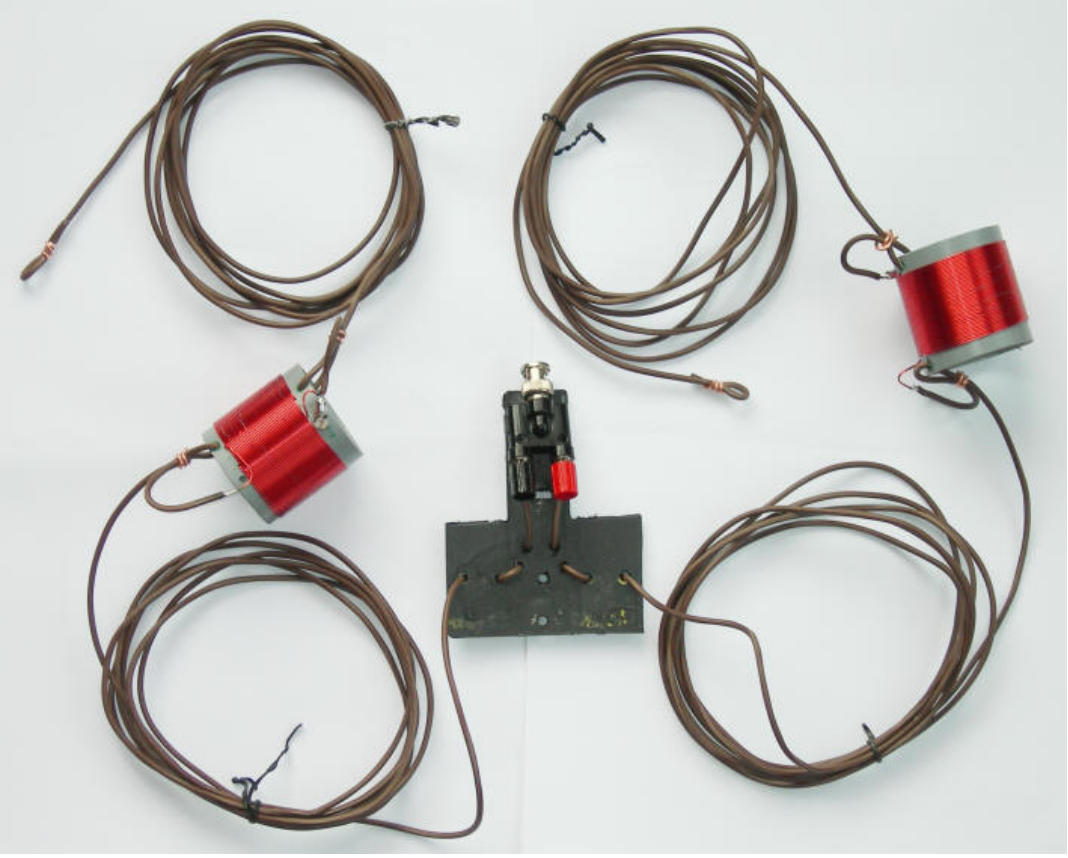
Per the K7MEM on-line calculator I will need loading coils of about 72 µH.

Frequency -	3.58 MHz
Available Space (A) -	42' 7-13/16" (13.000 M)
Dimension B -	10' 7-15/16" (3.25 M)
Dimension C -	10' 7-15/16" (3.25 M)
Required Inductance -	71.709 uH

Per the on-line calculator for helical coils, I will need about 42 windings of 0.8 mm CuL tightly wound on a 50 mm (2") diameter core.



I quickly made two coils of 40 wdgs of 0.8 mm CuL on a 50 mm PVC core (h=38mm, 66 µH calculated),and re-used the center insulator of my ZS6BWK/G5RV dipole.

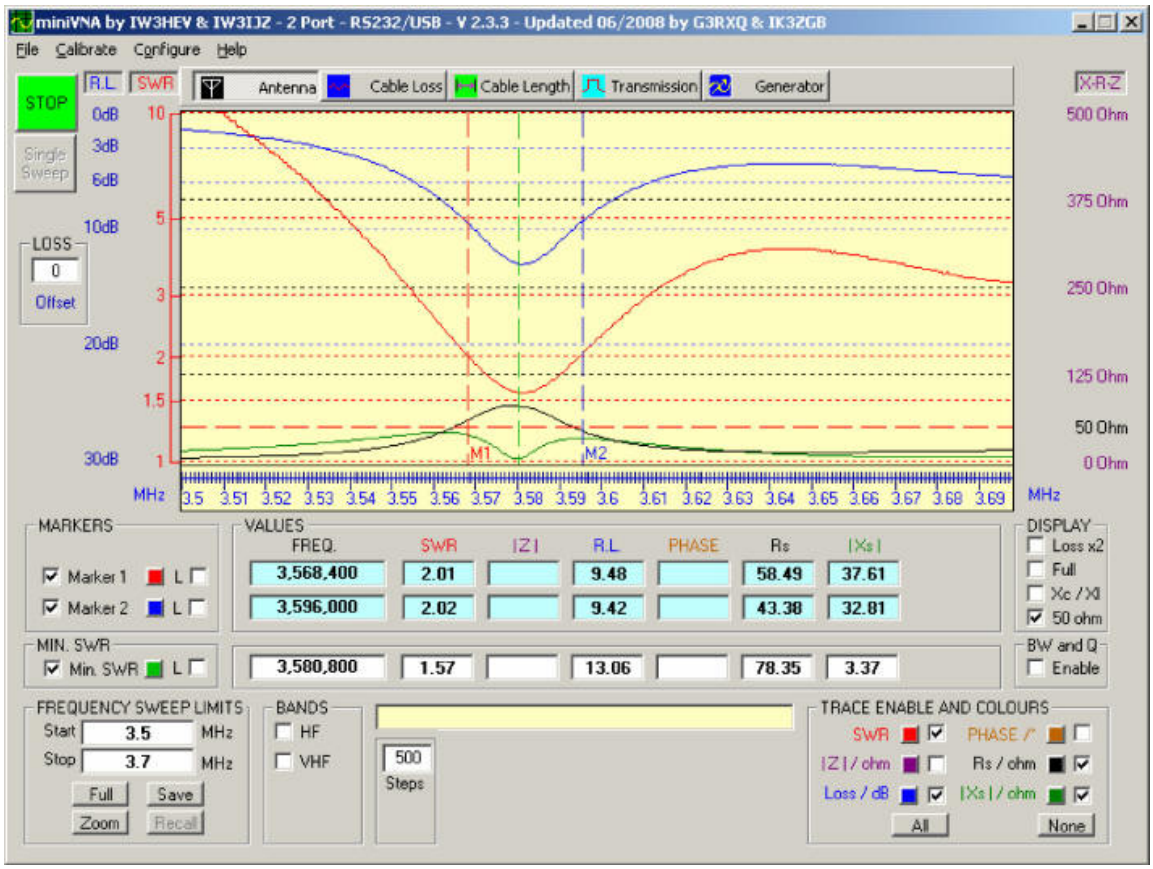


The quick-and-dirty dipole

With 2m88+2m94 per side (2x5m76 total), the antenna ended up a little shorter than intended. Don't you dare ask me why I did that, hi! The resonance frequency was about 85 kHz too high. No worries! Just replace the "outboard" wire sections with longer wire, and prune & tune down from there. The table below shows how I did that, after changing to 2m88+3m46=6m34 per side. The resonance frequency ended up at 3581 kHz, close enough to my 3579 kHz target.

Windings	length 2x (mtr)	Resonance freq. kHz	Δ kHz / cm (per side)	SWR	Rs	Feed-line	Choke
40	5.82	3664	-	1.69	79	coax	no
40	5.82	3668	-	1.55	78	coax	yes
40	5.82	3476	-	5.02	11	twin	yes
40	6.35	3406	-5	1.61	80	coax	yes
40	6.20	3477	+4	1.55	77	coax	yes
40	6.05	3551	+5	1.53	76	coax	yes
40	6.0	3581	+5½	1.57	78	coax	yes

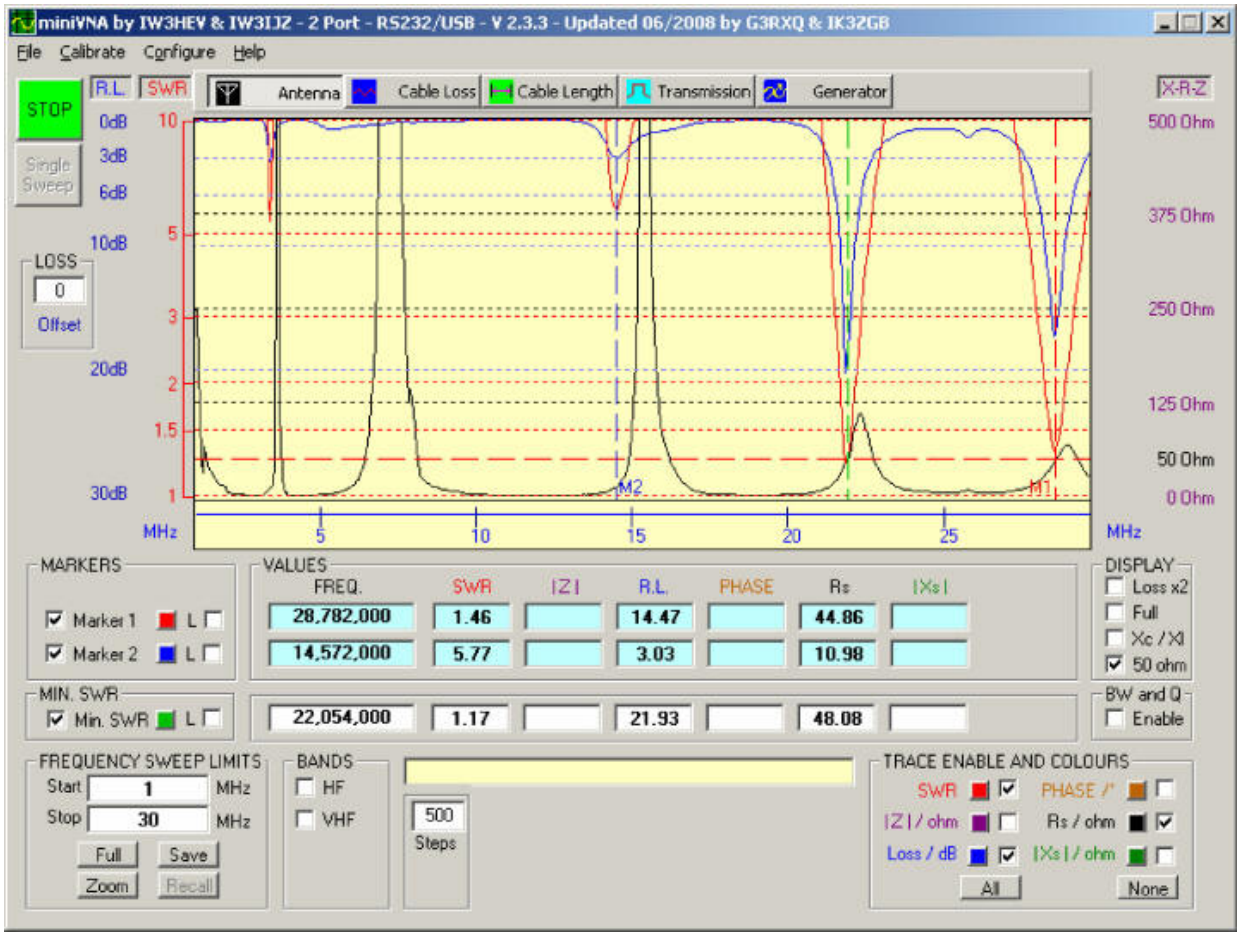
Tuning data



80m sweep of the dipole with 11m coax and choke

Tested the antenna, but found that like the 10 m version, it primarily receives all harmonics of the 50 Hz AC power. I had hoped that the slightly different installation location (45 deg angle to the walls, slightly higher) would have helped... Again, not a fault of the antenna.

As the above table shows, I also checked the antenna characteristics with 11.6 m 300 Ω twinlead as feedline. Just in case the dipole might be usable as a multi-band. The analyzer plot below shows that this does not appear to be the case, except for around 22 and 28 MHz.



HF sweep of the dipole with 300 Ω twinlead and choke at analyzer