SHORTENED ANTENNA EFFICIENCY

Short antennas all suffer from the same problem – they are too short! A shortened antenna has the following bad properties that become more and more severe as the length is reduced:

1. Reduced efficiency
2. Non-resonant – REACTIVE- the reactance must be canceled with either inductive loading (a coil) or capacitive loading (a capacity hat)
3. Narrow bandwidth
4. Lower antenna impedance, needs transforming to 50 ohms

The straight line length of the antenna generally determines the maximum practical efficiency of an antenna. Shown below is an example of efficiency versus length analyzed on a modeling program using a NEC core. All models in this paper are done over real ground.

Reference antenna: 40m ¼ wave vertical with two elevated radials. All other antennas are single elevated (shorter than ¼ wavelength by folding of both the vertical element and the radial) radial verticals. The radial in all folded cases goes out 27' then folds back to appropriate length to resonate:

Vertical height	F/B (dB)	Gain dBi (elev degrees):	25 D	30 D	35 D	40 D
33' (¼ ref ant)	0.0		-.78	-1.1	-1.7	-2.5
22' (folded over)	5.78		-.76	-.68	-.77	-.98
18' (folded over)	6.84		-1.7	-1.5	-1.5	-1.5
13' (folded over)	9.35		-3.4	-3.1	-3.0	-3.1
10' (folded over)	11.94		-4.8	-4.5	-4.3	-4.2

This table represents the what the CrankIR can achieve as the antenna is shortened.

WAYS TO MAKE LOSSES EVEN HIGHER

1. Use coils to resonate the antenna, this method makes the antenna impedance decrease by up to a factor of two compared to capacitive (ie 5 ohms instead of ten ohms - bad). To achieve good effieciency large, high-Q, low loss coils, and low resistance conductors for antenna elements are required. These are rarely found in portable antennas.
2. Use high resistance conductors such as stainless steel and chromed steel for the antenna elements.
3. Use matching networks to transform the the resultant low antenna impedances (could be as low as 1 ohms as radiator approaches .1 wavelength). This adds even more losses and inconvenience, because it's one more thing to do to change bands.

CRANKIR SOLUTIONS

1. Use capacitive loading to resonate the antenna by using our patented method of folding the adjustable element back on itself resulting in higher impedances (lower currents), wider bandwidth, and much lower losses.
2. The antenna conductors are copper – very low resistance.
3. Matching the low impedances is done by feeding the antenna off-center which allows a very wide range of impedance matching at almost no loss. This is accomplished by allowing both the radials and the vertical radiator to be adjusted together and with the inherent wider bandwidth of this antenna results in very easy tuning because there are many combinations that result in a perfect match at no loss in efficiency.
4. Most portable antennas have elements that are about 8 feet on a side, resulting in a 16 foot long dipole or a vertical with a single elevated radial with both elements 8 feet long. This requires an extremely good coil (think a Q 0f 700 or more) to achieve any reasonable efficiency. The design of the CrankIR makes longer elements possible by the use of light weight, high conductivity, copper wire supported by a single lightweight fiberglass tube. Just as importantly it can be easily, and quickly tuned to a perfect match.

A GRAPHIC EXAMPLE

Let's compare a coil loaded 10 foot vertical with a coil loaded 10 foot single elevated radial and a CrankIR with a 10 foot vertical radiator. I am giving the typical portable the extra two feet because that is the lowest we want to recommend on 40m!

Antenna	Coil Q	Gain dBi @ 25 degree elevation
10' x 10' Brand X	666	-4.81
10' x 10' Brand X	100	-8.5
8' x 8' Brand X	100	-10.31
10' CrankIR	N/A	-4.84

as you can see the coil loaded 10' vertical would need an inductor with a Q of 666 to equal a CrankIR, nearly impossible on a portable antenna you put in a carry-on bag! The loaded Q of these coils is ranges from 50 - 250 at 40m so you can see they are around 4 dB down from a CrankIR, that is a significant, especially if you are running low power. As you can see with an 8' vertical you are 5.47 dB down from the CrankIR! So now put your CrankIR pole up to 16' and your gain will be – 2.0 dBi and that is 8.31 dB higher than the 8' coil loaded model.