Ham 114 – HF Antenna Observations and Musings

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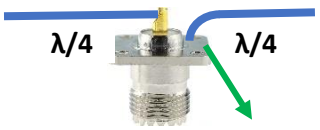

1. The musings are not for faint of heart. These are references and to compare, not to build.
   a. These model variations are for 6-m (λ=227") with transmission connection at 12'.
   b. Antenna systems have a radiator, return (radial or counterpoise), and transmission line.
   c. Elevation, length, and return dramatically impact impedance, gain, and angle.
   d. Lightning, noise, and safety need the return grounded for DC & low frequency.
   e. The high frequency return connects to the same point. These paths are parallel.
2. The electrical circuit for an antenna is just an inductor (L) and capacitor (C).
   a. Geometry, distance (length), and cross-sectional area determines if an antenna is more inductor or capacitor.
   b. Resistance (opposition to current) of wire creates loss and heat, while radiated resistance creates output power.
3. The field strength from an antenna depends on distances relative to the wavelength of the frequency.
   a. *Reactive* near field <0.16λ, *near* field <1λ, *transition* zone >1λ <2λ, *far* field >2λ.
   b. Field strength decreases linearly with distance. Field density decreases by square, and energy decreases by cube.
4. Tuning an antenna is more art than science.
   a. For HF with reflected waves, horizontal and vertical polarization means little.
   b. The orientation of a dipole-return matters little as long as it is parallel to ground.
   c. Bending and redirecting the radiator to fit the site can be compensated.
   d. Bending the radial raises Z, SWR, gain, & angle≈
5. Radials are the return. Droop 45 degrees to increase impedance.
   a. Wavelength of λ/4 is a starting length, not destination. λ /12 appears optimum for trade-offs.
   b. Decreasing length of radials requires increasing length of radiator to resonate.
   c. 1/4 radial ≈ .25 radiator, 1/8 radial ≈ .28 radiator, 1/12 radial ≈ .31 radiator, 1/20 radial ≈ .35 radiator.
   d. For antenna return height less than 2λ above earth, then it is in ground effect (not far field).
   e. For low return height, the ground wire must be a resonant length such as 1λ. Loosely separate the excess.
6. Meander lines antennas for Wi-Fi and cell are a flat-line on the circuit board to avoid windings. Works on 6-m too.
   a. The meander is very much like a close coupled coil. It increases j from negative to positive.
   b. Use small conductor size compared to wavelength. AWG 14 keeps in band while 1/2" tubing is terrible.
7. Verticals have two-lobes: about 11 degrees with 1.5 dB and 40 degrees with 3 dB.
8. Life is good. Enjoy!

MHz	λ-m	λ/4-ft
50-54	6	4.5
28.0 - 29.7	10	8.3
21 - 21.45	15	11.15
14.0 - 14.35	20	16.7
7.0 - 7.3	40	33.0
3.5 - 4.0	80	63.8
1.8 - 2.0	160	

#	*type*	*polar*	*grnd*	*reson*	*radiat*	*offset*	*rad#*	*long*	*λ*	*Unun*	*AddZ*	*SWR*	*|Z|*	*R+jX*	*dB*	*deg*	*lobe2*
1	dipole	horiz	n		54		1	54	1/4			1.3	80.8	54.1-j60	7.7	22	
2	droop	horiz	y		56		4	18	1/12			2.05	114	69.8-j90.5	1.6	26	wide
3	invL	Efhw	y		63 h	48 v	1	11.4	.05	56:1		1.2	1330	1327-j100	4.7	22	
4	dipole	vert			54		1	54	1/4			1.2	68.5	48.7-j48.2	2.7	12	45
5	L-ret	vert			56		1	56.75	1/4			1.4	43.2	31.6-j29.4	5.5	21	11
6	L-rout	vert			56.75		1	56	1/4			1.8	49.5	23.7-j43.6	2.3	11	37
6	droop	vert			53		4	56.75	1/4			1.05	52	46.4-j23.4	1.7	11	
7	"	vert			65		4	28.38	1/8			1.05	53	42.6-j31.7	2.0	11	
8	"	vert			72		4	18	1/12			1.2	67.5	50.1-j45.2	2.1	11	
9	"	vert			80		4	11.35	1/20			1.8	104.6	68.1-j79.4	2.2	11	
10	lobes	vert	y		53		4	56.75	1/4			1.05	49.1	45.0-j21.3	3.2	40	
11	"	vert	y		53		4	56.75	1/4			1.05	49.1	45.0-j21.3	1.5	11	
12	match	vert	y		56		4	18	1/12			2.4	106.9	79.9-j71.1	2.9	40	
13	"	vert	y		56		4	18	1/12	2:1		1.2	106.9	79.9-j71.1	2.9	40	
14	load	vert	y		54+1		4	18	1/12			2.8	103.7	91.1-j93.8	2.2	40	
15	"	vert	y		37+1		4	18	1/12		j200	2.1	113.8	78.6-j82	2.0	41	
16	res	vert	y	1λ	64		4	18	1/12			1.4	84.4	52.7-j66.0	2.4	12	
17	mean	vert	y	y		37x10	4	18	1/12			1.3	81.7	52.3+j62.8	1.5	14	