RADIOACTIVITIES

NEWSLETTER OF THE ARGONNE AMATEUR RADIO CLUB

Volume XLVII, Number 8 — August 2006

Club Meeting

Nothing received.

The Treasurer's Report

by Jack Albert, WA9FVP

Members: East 18; Associate 38; Newsletter 6; Retired 12
Balances: Checking $3515.36; Cash $0.00; ANL fund $30.00
Distributed as: Club $2,767.56; Repeater $563.80; Newsline $55.00
For the period Jun 27, 2006 thru Jul 26, 2006:
Income: Dues $3.00; Club $2.53; Rptr $2.53; Newsline $0.00; ANL $0.00
Expenses: Club $0.00; Rptr $0.00; Newsline $0.00

REMINDERS

CLUB BREAKFAST: Always the 2nd Saturday of each month, 8:30 AM at:

Old◆Country Buffet◆

59th Street and LaGrange Road in LaGrange

CLUB NETS: Thru our Club Repeater 145.19.
SKYWARN NET: Mondays in season at 7 PM with Deni, W9DS.
THE CLUB'S 9PM NET: every Monday with Jack WA9FVP.
THE NIGHT PATROL: every night at 10:30 PM with Paul, W9FNM.
THE BREAKFAST CLUB: every morning at 8 AM.
THE NOONTIME NET: every weekday at noon.

Mil's Corner for July

Nothing received.

WE NEED A NEW TREASURER!

On October 31, 2006 I will retire from Argonne and resign as club treasurer. If you are a full or retired member and you have a head for finance and can volunteer your time as acting treasurer, contact me or any of the board members. We will appreciate your help.

July Board Meeting Minutes

by Jack Albert, WA9FVP

Only 3 members attended, therefore no votes were cast. Most of the time was spent discussing the repeater controller. "What features do we need? How much can we spend? Is there a telephone interface with DTMF control?" I said "For now we can get by with just a simple telephone line interface box. It has a ring detect, on/off hook control and DTMF control for $50.00" It can interface to the VXR5000 through the 25 pin D connector and allow us to meet the FCC requirements for repeater control.

Your Vertical Needs More Gain

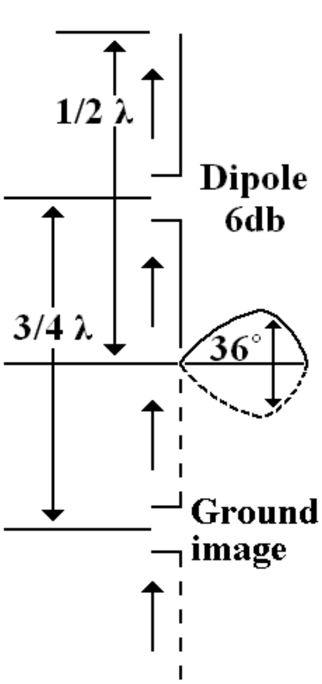
by Deni, W9DS

The jest of this article is adding up ¼ wave units until we reach our skies the limit. In an article by H.W. Kasper, K2GAL, CQ Magazine 1960 starts with a ¼ wave vertical on perfect ground will yield 3db over a dipole lying limply on the ground. That horizontal dipole at ⅝ wave above the ground radiates with a better set of rules. Vertical and horizontal polarizations are different from each other. Either one has more gain than the other, but they do their thing, but differently. A ½ λ vertical has 6db over a horizontal ½ λ dipole. If both are at the same height ⅝ wave high then both should have the same gain? The vertical dipole reaches ⅜ λ height its maximum radiation resistance is 72 ohms close to its free space value, but not gain, that happens when our ½ λ vertical attains its center to center spacing between it and when its ground image is around ¾ λ, maximum gain occurs, 6db gain over a reference dipole 36º radiation angle. Is this another vertical dipole or a horizontal dipole at its maximum highest gain at ⅝ λ?

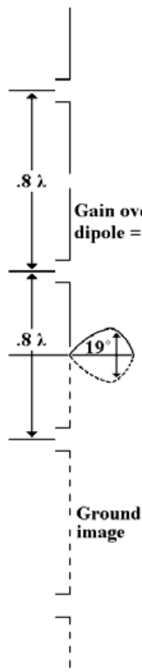
The only thing I can imagine is that both are at their maximum gain visa vee their polarization radiation angle because vertical polarization will reach its maximum low angle before the horizontal dipole reaches its maximum lowest angle height and gain. At ½ wave height the horizontal dipole has a radiation angle of 36 degrees.

Placing a second vertical above the first one fed in phase with two equal transmission lines adds 3db gain. The best part is that the gain is 3db more totaling 9db and the radiation angle is at 19 degrees. That's one wavelength high from ground. The RF current runs in one direction, up. However, if the resistance of one dipole is not equalized, the dipole with the lower value will receive more power and gain overall will drop.

These vertical heights are best used an UHF and VHF perhaps ten meters and 6 meters are possible. Perhaps a second vertical aerial identical to the first spaced ¼ λ apart adds 4db gain and broadens the pattern and radiates into two directions at 11db gain.



Radiation Pattern for
a Vertical Dipole



Pattern for 2 Stacked
Vertical Dipoles
(Half Shown)]

Mobile Low Frequencies Loop

by Deni, W9DS

QST carried an article by Robert Webster, W4IMN, June 1954. It was assumed that the loop might be a better aerial at low frequencies, namely 80 meters. The loop consists of a rear whip 8 feet or so long mounted at the rear of the car and another whip on the cowl, the two bent over joined, connected by a wire. The base of one whip is grounded directly. The base of the other whip is grounded through the coupling and tuning circuit, and the vehicles body completes the loop.

The current is almost equal throughout the aerials length. The radiation resistance is separate from the feeding and tuning element location. It can be fed at either end. The loop can be tuned by simply a series variable capacitor within reach of the drivers position.

The load whip, on the other hand, is equal to a capacitance of a few pf in series with the radiation resistance at 75 meters. Power can only be fed via inductance to cancel the high series capacitance reactance. The coil resistance will be many times the radiation resistance at 75 meters. Thus, a small amount of exciter output is useful radiated power.

Now, the loop is an inductance and to cancel this reactance in series with the radiation resistance of the aerial, to tune to resonance, a variable condenser, and not a coil, is used since the losses in an air capacitor is very slight compared to a lump inductance. It seems the loop would be better than a loaded whip. The power that reaches the loop depends on the resistance by the tuning and coupling system vis-à-vis the radiation resistance of the loop.

If radiation resistance is one ohm and the resistance introduced in feeding power to the loop is one ohm, half the exciter power will reach the loop and half will be heating the feed circuit. But, if the radiation resistance is 100 ohms and feeding resistance is 100 ohms, half of the exciter power will reach the loop.

The loop reminds me of my Uncle’s 160 to ten meter master mobile aerial on his black fifty’s Ford; a fat little coil just above the right rear bumper and the coil being tunable from the front seat with Eimac rig. The whip part of the aerial made a big bow tying the tip to the rain gutter. I thought he was a detective cop seeing the car for the first time. Anyway, now math comes not my best topic. The formula for radiation resistance is: R = 31,200 times ((N * A / λ squared) squared) ohms, where N is the number of turns in the loop (one in this case), A is the area enclosed by the loop in square meters, and λ is the wavelength in meters at the operating frequency.

For a 20 foot circumference loop, the radiation resistance at 4mHz is about 0.01 ohms. On the other hand, an 8 foot whip at 75 meters has been in a range of 0.4 to almost 1 ohm depending on the bottom or center loading. For the same radiated power, the current in our loop must be from 6 to 10 times the current in the whip aerial. Therefore, power is proportional to the square of the current.

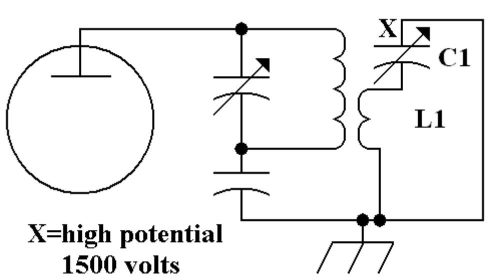
Every effort to keep the loss resistance of the loop conductor and feed circuit resistance to a minimum in terms of fractions of an ohm. The car body sections all should be bonded to assure a low resistance path.

Feed method: The loop of ¼ inch copper tubing with a 20 foot circumference has an inductive reactance of about 200 ohms which is cancelled by tuning it out with a capacitance of about 200pf yields minimum loss tuning. Load coils are not needed. The loop current flows into the pick-up link and leads, so the link should have a minimum of turns and built a large diameter conductor to lessen skin resistance. Current loss through the link can be reduced by using a capacitive divider circuit to get the low antenna resistance to a higher value. C1 and C2 values: XC2 = square root of RRA and XC1 = XA – XC2 where R is the desired load across the link, RA is the loop resistance, and XA is the loop inductive reactance in ohms.

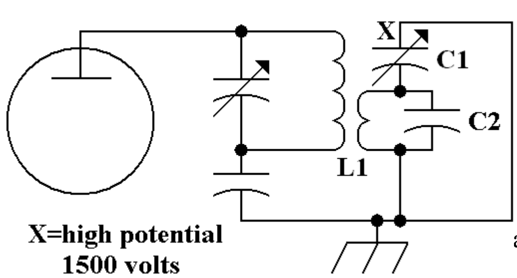
We choose to feed the loop at 100 ohm level with the link looking into 100 ohms XC2 = square root (100 times (0.1 + 0.16)) = square root (17) = about 4.1 ohms. XC1 = 200 –4.1 = 195.9 ohms. C1 = 203pf, C2 = 0.01ufd.

The impedance is increased in the circuit, which includes the link L1 from 0.17 ohms in circuit Fig 1 to 100 ohms, using circuit Fig 2. For the same power output level, therefore, the current through the link will now be only 0.04 times the current in the link of Fig 1, and the power lost about 0.0016 of the power lost in the link of Fig 1. Efficiency to be gained by transformation depends upon actual Q of the link compared to the Q of other circuit elements. Consider the feed through connecting loop to C1 and the plate spacing of C1. If 10 watts is fed to a total loop resistance of 0.17 ohms, a current of about 7.7 amperes will flow in the aerial circuit. This current through the 200 ohm reactance of C1 will cause a 1500 volt drop, and so at point X in Fig 1 or Fig 1 will be at 1500 volts to ground (the drop across C1 less only the drop across L1, which is small). Select a low loss feed through insulator.

It is realized that other factors haven’t been considered. Principally is the relative amount of ground loss. This is difficult to estimate, but it might be reasonable to suppose the average losses might be less for our loop. Factor 2 is the radiation patterns that influence the gains of the aerials.



Feeding the loop with direct inductive-link coupling



Capacitive divider transforming circuit for reducing current through the coupling link.

Small Beams and Gain

by Deni, W9DS

In an article by G6X, Leslie Moxon, aerial inventor writes in March Ham Radio 1979 about the question how to get maximum gain from small aerials. He writes: “Some of the most outstanding signals observed during my 50 years as a licensed amateur have originated from stations using driven arrays with only two elements!” Small size spacing down to ten feet brings the problem of over coupling; no one is making beams as small as possible. In order for this to be done, elements must be capacitor end loaded and using little inductance as possible. Tuning elements and couple them tightly together with high efficiency and narrow bandwidth. Make the tuning of each element separately using a feed line in the radio shack. We want the beam path to be reversible, 180 degrees using open wire feed lines as simpler cheap methods of rotation. It turns out that gains in excess of 6db are only found with half wave length boom length or more. Can we go down ten square feet down in size and realize 4.5db gain.

Gain results by concentrating radiation in one direction by 2 completely different methods of beams of beam formation, additive and subtractive. That makes sense. The subtracted method provides radiation patterns like the W8JK array, the gain is dependent on size provides high proficient so most power is radiated, but in practice what limits subtractive gain is the need for bandwidth, which limits size which limits the subtractive beam to 6db. So much for subtractive ways now how about addition effectiveness? Addition causes wider spacing and more bandwidth which means bigger is better. Now we can tweak addition for in phase fields favoring our wanted direction, but the elements must get closer together which causes phase shift and a 4db gain drop; that’s not good. Alas, another friend, Q, because a tiny beam can receive as much energy as a big beam. Hurray! But, a loss in radiation resistance with tighter coupling of the small aerial space. Now, a point of view. Only when an element is large do you get extra gain and directivity. Stacking, the higher gain of each aerial the further apart they have to be to get stacking gain.

The maximum gain for a 3 element beam on a ¼ wavelength boom is 7.5db, but radiation resistance is 4 ohms and the maximum gain normally found is under 6db. For a single 12 foot loop at 14mHz radiation resistance 750 ohms and 20 ohms for a 6 foot loop.

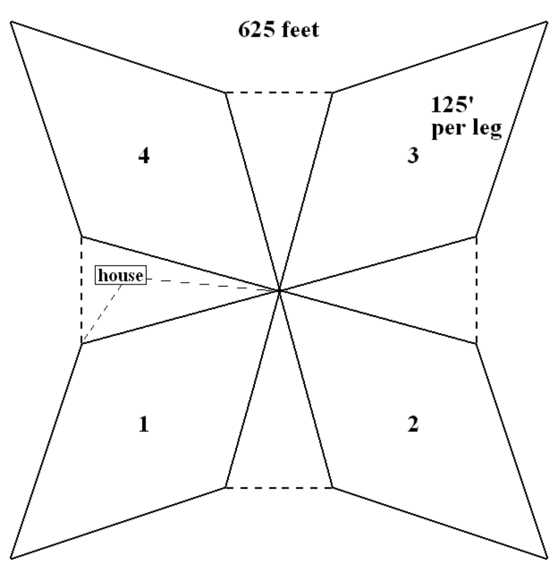
I found a drawing of a EWE that I made from QST January 1996 a 4 direction U 90 degree spacing each 50 foot wire from center post is terminated 1.2k resistor to ground stakes (4 of those too) 50 foot wire supports are 4 x 4 pressure treated wood 12 feet long, 2 feet in the ground 5 poles needed use 2 bags of concrete, 4 foot ground rods, feed point 400 ohms. 60 + 60 = 120 so this should work ok on 80 and 40 meters its 4 inverted "L"s so what's new about that? Each "L" is fed separately switched into 4 direcions.

Your Lot 625 Feet Square?

by Deni, W9DS

It can hold a five in one rhombic area. And article by Jack Scott, ZL3GG, QST Oct 1974. 4 small rhombics emanate from a 75 foot pole in the center of the array with each their won feed line coming from the radio shack. The 80 meter rhombic is the outer rhombic the other four are 10, 15, 20, and 40 meters. The tilt angle points of the four smaller rhombics are tied up with polyethylene line, saving the cost of eight poles.

Wires sag at the tilt points he claims good results on all rhombics. Each rhombic is ended in 800 ohms with combined 50 ohm 1 watt resistors to get 800 ohms. 4 feed lines are 165 feet of 600 ohm line, but the 80 meter is fed with 450 ohm line. The smaller poles are 25 feet high each. The tilt angle is 67.5˚ each. Inside the radio shack switching makes fast steering. Each leg of four making one small rhombic. Legs are 275 feet each.



Vertical Reflections

by Deni, W9DS

Do you feel you are not getting the best out of your vertical? It may be ground reflections. The quarter wave is the most popular but the ⅝ λ is much better. C.J. Michaels, W7XC, wrote an article for us in July 1987 QST describing how much attenuation we run across in our operating. Our signal gives out two paths; one directly from the vertical and the other by earth reflection. These waves change in amplitude and phase, which will change by 180 degrees, and it will subtract from the direct wave. At zero angle it will be equal in amplitude but 180 degrees out of phase with the direct wave and completely cancel any radiation or reception at that angle. The Brewster angle is named for the Scotts physicist Sir Dave Brewster. This angle has to do with earth under your vertical.

The pseudo-Brewster angle (PBA) is that angle which the reflected wave is 90 degrees out of phase with the direct wave. Below this angle the reflective wave is 90 to 180 degrees out of phase so some degree of cancellation takes place. Ground around the vertical determines the PBA. The first factor conductivity is simply soil ability to conduct electricity. It acts inverse of resistance. Next, the dielectric constant, K, which deals with earth capacitive effect. The higher the quality of these to numbers better for our signal. The third factor is frequency of operation. Sadly, vertical polarized radiation will be 6db down from perfect earth pattern. Angles below PBA, the reflective wave subtracts from the direct wave and radiation falls off rapidly. Now, above the PBA, signals add to the direct wave.

Horizontal aerials polarized reflection the attenuation increases with poor earth. The image aerial is located exactly as far below the surface as the real aerial is above the surface and develops a null at zero angle of radiation because out of phase reflection cancels the direct wave. A vertical may not be a best aerial for frequencies above 40 meters.

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Officers

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MEMBERSHIP is open to all who are interested in amateur radio. This club is sponsored by Argonne National Laboratory. Employees of ANL or DOE-Chicago are eligible for full membership. Auxiliary membership is available to non-employees.

W9ANL/R is an open repeater, coordinated on 145.19 MHz (-600 input). The AARC repeater has been in operation on this frequency pair continuously since February 5, 1982.

CLUB NETS: 2 meter fm 1) Regular, every Monday evening at 9:00 and 2) the Night Patrol every night at 10:30, both on W9ANL/R. The Peanut Whistle Net (PWN) every Sunday at 1:30 p.m., and many evenings at 8:30 p.m. on 1932 kHz (cw/am/ssb), QRP.

RADIOACTIVITIES is published monthly by the Argonne Amateur Radio Club as a nonprofit newsletter intended only for the use of its membership. Material appearing here does not represent the official position of Argonne National Laboratory or the U. S. Department of Energy. Please give credit to the author and to Radioactivities or the Argonne Amateur Radio Club, when using original material published here. Deadline for submissions normally is the 20th of the preceding month.

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