RADIOACTIVITIES

NEWSLETTER OF THE ARGONNE AMATEUR RADIO CLUB

W9ANL

Volume XLVII, Number 12 **December 2006**

Club Meeting

Unless otherwise noted, AARC general meetings are the second Tuesday of the month at the Argonne cafeteria at a table on the north end of the room. Any club member is welcome. To arrange for a gate pass contact Bruce Epperson at epperson@aps.anl.gov phone 630-252-3495 or Chuck Doose at doose@aps.anl.gov phone 630-252-6037.

The Treasurer's Report

Members: East 20; Associate 39; Newsletter 6; Retired 12
Balances: Checking $3,530.01; Cash $0.00; ANL fund $30.00
Distributed as: Club $2,773.14; Repeater $564.87; Newsline $55.00
For the period Oct 1, 2006 thru Oct 30, 2006:
Income: Dues $0.00; Club $1.82; Rptr $0.36; 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 December

10	W9DS	Dennis	Burr Ridge, IL
13	K9MUF	Don	Lisle, IL
26	KB9FUR	Robert	Addison, IL
27	W9ZEW	Rudolf	Cicero, IL
29	N9AFK	Doug	Plainfield, IL

How About 12 Meter Broadside Array

by Deni, W9DS

The aerial ties to a couple of 35 foot poles spaced about 80 feet apart. Two full wavelengths 40 feet 4 inches. Wire loops are fed in phase with the bottom feed the radiation is horizontal. The impedance of a single loop is 115 ohms at 24.9 MHz. When the two feed lines are one wavelength including the coax, 0.66 velocity factor, the impedance at the center of the aerial loop one and loop two is about 580 ohms. Half wave spacing is used between the 2 loops. Nylon ropes should be used for the guy ropes between these loops. Lowest height above ground is 20 feet, but lower is fine too for short skip though. As height increases DX performance is enhanced. Radiation is best roadside to the array.

The system can be scaled for other HF bands by formula 1005 / frequency MHz to get the aerial length of each loop. A delta loop could easily be made to work if you approve of that kind of configuration. Oh, the two one wave transmission lines are joined at a tee coax connector all 50 ohm cable one line runs to the rig. Spacing between loops is 20 feet. You will need ten insulators 1 wavelength is 26 feet 5 inches for the coax. Use RG8U if you must.

How about a two element circular quad for the house inside. Must do RF safety check now according to regulations because this is a gain aerial and can cause burns, cists, boils, headaches, cancer, and lumbago. Thus, we must tread safely putting safety of family and friends first and keep our power within the guideline limits. So, here we go!

The circular quad elements are number 8 copper house wire. Length of 1 wave at 144 MHz 80 inches circumference spacing 16 inches. We are using ½ inch PVC pipe and tees 3 are called for. Drill holes in element spacers of tee with pipe 16 inches long run wire through drilled holes. Distance between upper and lower braces is 25 inches center to center. The reflector has a shorted stub 6 ½ inches long 1 inch spaced stub runs upward not downward. A choke balun is used 13 inches of RG174U formed into 2 ½ turn coil. The reflector stub is adjusted for maximum front to back ratio. Without and matching device the SWR is 1.3 to 1.

This aerial is small and powerful, needs no metal support, easily placed around the home roof or attic,

easy to rotate, and to find the best location get a local ham to send you a steady carrier in the direction of interest is needed so you can move about the house or attic to get the best single. Stay out of trouble. Watch your RF power.

Thunder Lightning

by Deni, W9DS

Atmospheric physics dates back to 1746 and Ben Franklin and his kite experiments and studied electricity in our atmosphere. We now know what lightning is but don't know where or when it will strike next. The electrical effects in our atmosphere have a constant electrical field 100 to 140 volts per meter aimed downward. This field isn't easily detected, but we know the effects of our atmosphere. Observing blizzards, fogs, dust storms, volcanic eruptions, water falling, and nuclear explosions all make visible atmosphere electricity in lightning. The earth's electrical field varies in strength in a regular cyclic way with a 24 hour period. Here is how it looks:

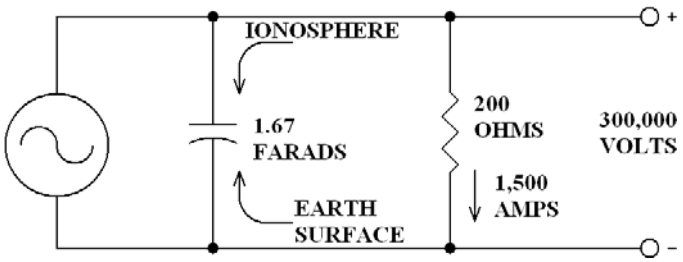

Fig 1
Circuit of Earth Atmosphere

In 1950, 2 workers, Gish and Wait, were able to measure the current flowing from the tops of thunderstorms. It turned out to be 1 ampere flowing upwards. The results of 200 years of research are an equivalent circuit of our atmosphere electricity circulation in Fig 1.

We live on the ground plate of an immense electrical capacitor. The ionosphere is the other plate. We are living, moving, and dying inside a capacitor of 1.67 farads. The voltage across our capacitor is 300,000 volts with a charge of 500,000 coulombs stored up.

Our capacitor is leaking continuous current of 1,500 amperes from ionosphere to earth's surface. The atmosphere is made conductive via cosmic radiation and by earth's natural radiation acts like a 200 ohm resistor the current leakage is around 8 microamps per square mile of surface.

The atmosphere gets charged up by thunderstorms at a rate of 1 ampere per thunderstorm. 1,500 amperes discharge 500,000 coulombs in 33 seconds (1 coulomb = 1 ampere per second).

The result indicates that somewhere in the world there must be 1,500 thunderstorms in progress at any time. Meteorological estimates are about 1,800 thunderstorms in progress. There are daily variations in the earth's electric field because there are more storms at one time of the day. The peak time occurs at the time for afternoon storm activity over Africa and the Amazon Valley. What makes storms?

Air temperature and saturated moisture at 100% humidity. Moisture condenses into fog air cools 3 degrees per 1,000 feet, which is called wet adiabatic cooling. The slow erthan dry adiabatic cooling on a huge mass production scale makes thunderstorms. A storm occurs if enough hot humid air available gets heated starts convection. Like warm muggy air slides up a mountain range and lift starts the convection process. Storms arise from cold fronts and really bad ones by over running cold fronts cause storm formation. These violent fronts may turn into a tornado which are very electrical atmospheric events causing violent continuous discharges. These are caused by ice particles and water droplets of water joining, breaking, and splattering each other, which generates electric charges. Positive charges carry upward into the cloud while negative ones are not.

The storm carries 1,000 coulombs of positive charge mixed with negative charge of 1,000 coulombs throughout its interior. This averages electrical neutral. In the surface under the cloud we have a bound charge is positive held by the cloud negative charge and as the cloud moves up to 40 mph the bound charge races along under it.

These charges rise to a breaking point and flashes of lightning are seen in the cloud or between clouds, but the interesting ones are those that hit the ground. These flashes occur the field gets very intense and may develop leaping from ground to sky. Ionized channels are complete a flash strike. Then more strikes as the cloud moves currents up to 1,000 amperes. Strike currents are thousands to hundreds of those and of amperes. It all collapses when the current drops to 50 amperes.

You have heard about "ball lightning". Bright reddish or bluish ball sizes golf ball to basketball. All lightning is bad news you can hear it on lower frequencies like 80 and 160 meters.

Hams have reported high voltages on aerials during blizzards and dust storms. Passing thunderstorm type clouds can create strong earth charges and coronas without lightning. Strong winds may blow enough

material around to induce high voltage and currents in a large aerial array. Ground both ends of a beverage aerial potentials can burn up good sized terminating resistors. Also, a heavy electric sky can harm transistors. Unplug all of your gear. Play it safe. Ground everything.

Coil Loaded Aerials

by Deni, W9DS

Would you like to roll your own short beam? W9KYZ of Milwaukee, WI wrote an article using copper tape from Minnesota Mining Company April 1977 QST. He made the choice of helical winding a form end to end and using end loading capacity hats. The radiation resistance will be higher than a base loaded whip. The end hats make for more constant current distribution yielding impedance 4 times more than a base loaded whip.

You must wind ½ wave number 14 gauge copper wire for a ¼ wave element. W8KYZ knew losses would be high, reducing conductor resistance; therefore the surface area must be increased. He had a roll of ½ inch wide copper tape and he measured its skin resistance turned in a loss per unit length of 12% less 14 wire.

He wound a dipole with the tape for 100MHz field strength measurements gotten by using local FM station as a signal source. 18 inch long ¾ PVC tubing was wound 35 spaced turnes using ½ inch copper tape. It grid dipped at 104MHz. 2 5 ½ inch diameter 6 spoke capacitance hats hooked up at each end frequency dropped to 85MHz. A c-match (a variable capacitor is shunted across the feed point adjusted for resonance. A 100pf variable across feed point 50 ohm coax attached and the dipole is balanced aerial a ¼ wave sleeve bazooka was used.

RF power through a SWR meter to resonate found turns removed one after another until 1 to 1 match occurred. The dipole has 32 turns of copper tape center fed, 10pf shunting feed point and overall element length of 21 inches, which is 37 % of a full size dipole. Feed point 20 ohms impedance skin depth 0.24 ohm efficiency 20 / (20 + 0.24) = 98% which is the same for a full size dipole. Band width 6% of operating frequency between 2:1 SWR points. The capacity hats reduced the Q to obtain the wide bandwidth translated to 20 meters bandwidth would be 500KHz.

Rolling your own. 1) Make element length no shorter than necessary for your bandwidth and efficiency. 2) Use large capacity hats this reduces conductor helical length. 3) The larger the diameter form the fewer the turns the width of conductor can be increased lowering losses. 4) Capacity hats reduce losses. 5) Use split driven elements and feed with balun coax transformer to keep current off coax braid. 6) Grid dipper is necessary for finding resonance with a fixed length. Good luck.

Tuning and Tuning

by Deni, W9DS

Aerial resistance is purely resistive when current and voltage are exactly in phase. This is called the resonant frequency. Off of this frequency we must retune with coil and capacitor as we QSY from this frequency resonance. This happens by feeding the center of our wire and drive a voltage across the gap, so when current phase leads voltage the impedance is capacitive and frequency is below resonance. If current lags behind voltage, impedance is inductive reactive and above resonant frequency.

Capacitive reactance increases as our aerial shrinks and when it gets longer inductive reactance joins the impedance. Our aerial resistance starts climbing when length exceeds 135 degrees or about ⅜ wave length and maximum 180 degrees at ½ wave length. At this point our impedance is 73 ohms in free space. For wire aerials, 65 to 55 ohms is the case usually. ½ wave dipole over a garage metal roof can change inherent impedance to rise to 300 ohms. If you plan on measuring impedance or the aerial resistance it's always at a current loop.

Remote quad tuning, the driven element is tuned on frequency if close to ground resonance will be too high when installed at a higher plane thus lower resonance by 150 cycles.

The reflector is usually the same size so lower frequency is needed by inductive reactance which usually a hinging stub with shorting bar ¼ λ long or a ⅜ λ stub and a phasing capacitor placed across the bottom of the stub. Yet one more possibility is just the addition of a coil and shorting clip placed at the right turn for the best maximum forward gain or front to back ratio. The latter being 1db of lost forward gain.

So, when the driven element is resonant and reflector stub is adjusted for lowest SWR, this equals the point of best front to back ratio. As old hands know, the actual adjustment is quite critical for maximum performance. Using the ¼ wave stub with shorting bar plus or minus ¼ inch in position makes it a directional quad or a bidirectional stacked dipole. Using the 150pf variable receiving type across the reflector stub terminals with a single variable capacitor for a null on the signal. If none noted, cut away 2 inches of stub and try again. You want the stub to null in the mid range of the capacitor.

If the driven element is matched minimum SWR will occur at reflector optimum setting of the capacitor. We switch now over to yagi aerials and gamma matches. One comes to mind a coaxial cable matching capacitor. The feed point impedance is low so we raise it with a variable feed line. Now that doesn't sound right, but we substitute a length of coax which has capacitance of 20pf to 30pf per foot depending on the type used. It can be trimmed to proper value needed. It is water proof. The values of capacity depend on the band of use so the coax line values are RG8U – 29.5pf per foot, RT11U – 20.5pf per foot, RG58U – 28.5pf per foot, & RG59U – 21.5pf per foot.

How much capacity do we need on our 3 or 4 element yagi?

I have 30 meters at around 150pf, 20 meters 100pf, 17 meters 85pf, 15 meters 75pf, 12 meters 60pf, 10 meters 50pf, 6 meters 30pf, and 2 meters 10pf. Now we find the lengths needed. At ten meters we need 20 inches of RG8U for a gamma capacitor. Measure back this distance from the end of cable and remove 3 or 4 inches of only the vinyl cover. The exposed shield braid should be cut in the middle of the area from cover removed. Make sure not to cut the dielectric between the shield and the inner copper wire. These two lengths should be unbraided and then twisted, watching not to stick your finger, to form two pigtail leads.

Shield lead from the transmitter end of the coax is connected to the center of the driven element in a normal manner. Shield lead from the short section used as our gamma capacitor is connected to the end of the gamma rod. No connection is made to the center coax conductor; it's our coaxial capacitor.

The gamma rod shorting bar is adjusted for lowest SWR at our ten meter resonant frequency. Now the free open end of our coax capacitor is trimmed about an inch and the shorting bar gamma rod is adjusted again in our out. This procedure is continued alternating adjusting the shorting bar and trimming the coax until you are satisfied. When this happens, the free end of what's left of your hacking away all of that good coax away the area of were the coax jacket was remove must now be sealed with a good grade of plastic tape and sealer to keep out moisture. Solder the leads and seal those as well.

As for that length of coax hanging loose can be coiled and the open end also sealed from moisture. Now, wasn't that easy.

Grid dipping a quad requires a steady carrier signal on 3 bands to adjust the reflector stubs for optimum front to back ratio. Well, this doesn't work very well so what's next. Borrow an impedance bridge to measure impedance this didn't work well.

At the end of the feed line a 5 turn pick up coil was connected. Grid dipper was calibrated in the receiver only 20 meter driven element was in the band. So all driven elements were adjusted at 14.1, 21.1, and 28.5. With that done reflector resonance was next. A ten turn 1 cm diameter wide spaced silverware coil was placed in the 3 reflectors stubs are replaced. 20 meter reflector 350 KHz below driven frequency ok, then 550 KHz on 15 meter was adjusted, and 10 meters last 500 KHz lower than the driven element this way it was easier than fooling around for hours. Where did I bet those 3 silverware coils? Well copper is better and more available these days. Be sure to scrape the copper get it to shine so it will solder easily. I found out this is the only way to get a solid contact. 73's.

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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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Please send club and editorial correspondence to the club address, or to travisdj@bigfoot.com Please include “AARC” in the subject.