



SIGNAL



de NINC

September 2007 Volume 16 Number 9

This Month's Meeting

This month's meeting program will be a presentation by Bob W1XP on 600 Meters The New Ham Band.

We have renewed our reservation at the Pepperell Community Center for the coming meeting year. The next regular meeting will be September 20th at the Pepperell Community Center.

The October meeting is our annual QSL card sort. It will be the first test of the six sorting boxes we built. We have invited PART and MARA to participate. Bring a friend. NVARC will provide pizza and soft drinks after the sort.

Last Month's Meeting

There was no August meeting.

Repeater Upgrades

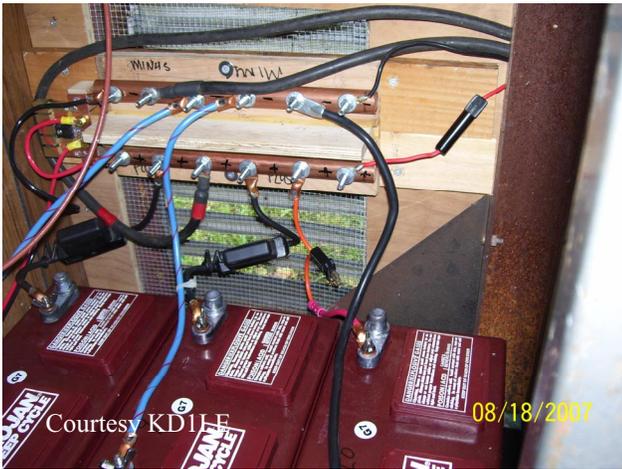
We have been working on upgrades to several of the N1MNX repeaters. The first improvement needed was the replacement of the simple ground plane antenna used for the two meter repeater and located on the top of the tower. Another improvement we have been working on was extending the time the repeaters will stay on line in a power outage. The six meter and 440 repeaters were supplied power from a bank of three batteries. They have relatively low idle currents and have been modified to run down to very low battery voltages. The 440 machine goes into low power mode when power fails shutting off the amplifier. We had made a presentation to the North Middlesex Area Emergency Planning Committee about backup communications we provide for RACES and ARES as well as various public service activities like the Groton Road Race. With continuing discussions Larry KB1ESR was able to get funding for a new antenna for the two meter repeater. He

also got funding to add three deep cycle batteries to the three that supported the six meter and 440 repeaters. A new buss bar system was built to connect the new batteries. With the six meter and 440 repeaters isolated to their own set of batteries they will not go off the air at the same time. The addition of the three batteries doubles the storage capacity and will bring us to our goal of three days of operating without power.



Above Ralph KD1SM, Leo K1LK, and Bob W1XP assembling the antenna. Ralph did the climbing and spent more than four hours on the tower in two stints.

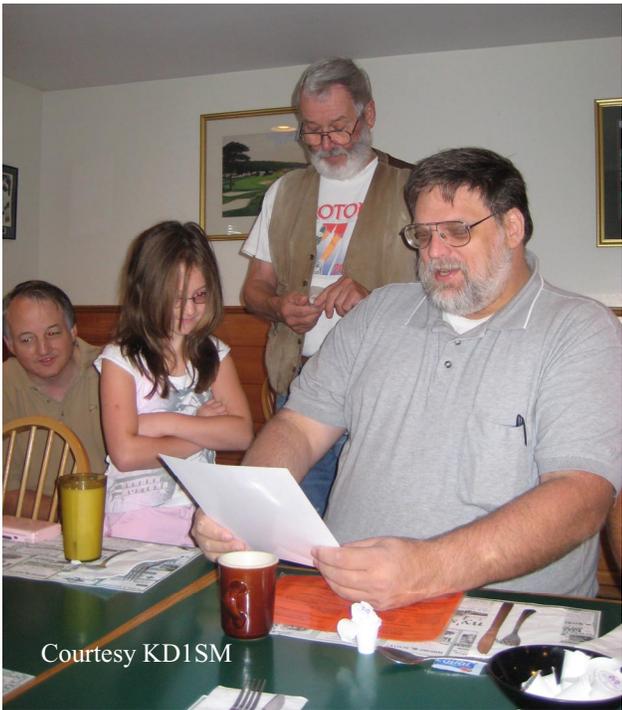
The next weekend Bob W1XP and Stan KD1LE continued the work. The new buss bar was mounted and connected to the charging supply.



An additional current shunt was mounted and connected in the charging circuit so that the battery charging current could be easily checked.

Working on the antenna and battery upgrades were Bob W1XP, Ralph KD1SM, Leo K1LK, Larry KB1ESR and Stan KD1LE.

Breakfast at Tiny's



(L-R) Les N1SV, Sara, Larry KB1ESR and Dale AB1GA our Field Day co-coordinators. The full

gamut of business and technical is possible at Saturday breakfast at Tiny's. Above Dale reads the certificate awarded to Sara for braving the chaos and making a GOTA contact this year. She also received a Field Day pin.

Evolution Of A 4 Square

Les Peters, N1SV



The four square array is a popular antenna invented in the 80s by Fred Collins, W1FC and Dana Atchley W1CF (SK). A classic four square array consists of four vertical antennas spaced $\frac{1}{4}$ wavelength apart forming the corners of a square. A hybrid coupler mounted at the center of the array provides the required phasing in order to achieve a gain of approximately 5 dB over a single vertical, a front to back ratio (F/B) of 20 dB or greater, and a 3 dB beam width of approximately 90 degrees.

In the summer of 2000 I decided to construct my first 80m four square array. Looking back now I really had no idea what I was getting myself into. Not content with the performance of the original array its undergone a number of changes over the years in order to get to its present day configuration. I thought it might be interesting to take a look at how this project began and how it's evolved over the past seven years.

In the beginning

My first 80m antenna was a dipole strung between two pine trees about fifty feet above the ground. It wasn't a fancy antenna but it was effective in working my first 125 DXCC entities on 80m SSB. As my 80m DXCC total rose it became more difficult to hear and work new and more distant countries. I began to realize that I had reached a plateau and needed a better antenna system.

Selecting a new antenna design

In researching 80m antenna designs, I soon realized that it was unrealistic to think that I could elevate a horizontal antenna high enough to achieve the low angle of take off that I desired. So I began looking at vertically polarized antennas. With verticals being omni-directional I decided I would have to combine two or more of them to achieve the directivity I desired. So the size of this project quickly grew!

To make or to buy

The decision whether "To make or to buy" is a classic one. And in my case I decided my goal was not another homebrew project but rather upgrading an antenna system in a reasonable amount of time.

After researching various antenna systems that would fit my property, and my wallet, I decided on a four square array using shortened commercial verticals and a hybrid coupler to properly feed power to the antennas with the correct phase relationships.

Birth of a Four Square

Not having any experience with four square arrays was a little intimidating at first. Sort of like jumping into the deep end of a pool when your just learning to swim. While there was a lot of practical information available on setting up four squares using full size verticals there was little if any practical information available for someone trying to do the same using shortened verticals?

During the summer of 2000 I began construct the array in the woods in back of my house. With the array requiring almost an acre of land the first task was where to put it. After careful measurements the array was staked out with 10 feet to spare to the property lines of each adjacent neighbor. The area was then cleared and masts installed for mounting the verticals.

After assembling all four verticals in the backyard the first one was installed and its radials installed. I had decided to install four tuned elevated radials per ver-

tical instead of a much greater number of ground mounted ones for simplicity. Each pair of radials was installed about seven feet above ground and adjusted using an antenna analyzer as if they were a low dipole. After the two pairs of verticals were tuned and then attached to the vertical, the vertical was then adjusted for resonance. When this was completed the antenna was temporarily detuned so that it would not affect the tuning of any of the other verticals. This process was repeated for each remaining vertical.

With all the verticals properly setup the hybrid coupler was installed along with the four 75 ohm RG-6 phasing lines that would connect the hybrid coupler to each vertical. In addition 200 feet of RG-213 coax and control lines were run between the hybrid coupler and my shack. The second coax run was connected between the dump port on the hybrid coupler and a dummy load and power meter in my shack. Being able to monitor the dump port power in the shack allowed me to smonitor any energy that was reflected back from the array due to a mismatch.

Tuning the array was accomplished by monitoring the dump power from the hybrid coupler with 100w of drive applied and making small adjustments to the length of each vertical. This was repeated for all four directions (NE, SE, SW, and NW). This was a very tedious and time consuming process due to the interaction between the antennas. At times when I thought I had all the antennas in the current direction looking good, I would switch to another one only to find I had screwed another one up. Once I had properly balanced the array and achieved minimum dump power at 3.8 MHz for all four directions, I repeated the process with 1000w of drive power to make my final adjustments.

The array was completed in the fall of 2000. The first contacts made were with Europeans and the performance was eye opening. Signals from state-side stations received off the back or sides of the array were down 10 to 20 dB making it much easier to hear the DX stations in the highly congested DX window. While the many reports from Europeans confirmed that the array was working toward Europe, reports from Australia and Africa weren't so stellar. They indicated that there was little if any front to back in those directions. It was obvious that further adjustments were required before this array could reach its full potential.

More elevated radials?

During the summer of 2001 I increased the number of elevated radials from four to eight in the hopes of

reducing my angle of take off and gaining a better front to back ratio in other directions Europe. While the results using the increased number of radials showed an improved front to back ratio on longer paths like Australia or Africa. I still was unable to see the 20 dB or better I typically saw with the Europeans.

Still more elevated radials?

So if eight elevated radials work good then sixteen must work better right? So in the summer of 2002, I again doubled the number of elevated radials under each vertical to sixteen. At this point the radials in the back woods looked like a series of spider webs. The upgraded radial network showed an improved front to back on longer paths but how much was unclear. Was I starting to reach the point of diminishing returns? I found it difficult to find distant stations in certain directions that were strong enough that when I turned the array away from them that they were still far enough above the noise level to accurately measure F/B. Two stations that were very helpful were Don VK3DZM (SK) who regularly was on the short path at our sunrise and Robin VK6LK who was regularly on long path at our sunset.

Ground radials VS elevated radials

I wasn't fully satisfied with the elevated radial system and a little concerned with maintenance of all those wires. So in 2003 I decided to replace the elevated system with a system of 64 ground radials under each vertical. This was a fairly significant task that required nearly 3 miles of wire. I found adjusting the array using the new ground radial system much easier and I was able to achieve a minimum dump power of less than 1% for all directions as compared to 2.5 to 3% with the elevated radial system.

On air performance confirmed that the ground radials provided a lower take off angle in all directions as well as a minimum 20 dB front to back ratio. On several occasions I saw a 30 dB front to back ratio (~6 S-units difference). As expected my 75m DXCC total began to accelerate as I was now able to finally work stations in the Indian Ocean and Southeast Asia.



What about all that DX down on CW

During the winter of 2005 finding new countries to work was becoming difficult. It seemed that all the new countries I needed were only showing up down in the CW DX window from 3.500 to ~3.525 MHz. When I tried to use my four square array down there I ended up dumping more than 80% of my transmitter power into the dummy load connected to the hybrid couplers dump port. On receive the array exhibited little if no front to back ratio. It became obvious that I needed to modify the array if I expected to work station in the CW DX window.

During the summer of 2006 I installed a loading coil and relay at the feed point of each antenna. When the relay was energized it would insert the loading coil in series at the antenna feed point making it resonant at ~3.510 MHz. I also designed a new phasing network with a relay box and two new phasing lines for each antenna. The idea here was to construct a new 75-ohm phasing line which when connected to the relay box in a normally closed configuration represented a $\frac{1}{4}$ wavelength path at 3.8 MHz. When the relay was energized, a another 75-ohm phasing line approximately 1 meter long would be connected in line making the combination a $\frac{1}{4}$ wavelength at !3.510 MHz.

With the modifications in place, the array was now operational from 3.500 – 3.550 MHz as well as in the SSB DX window. The array appeared to have the same F/B down at 3.5 MHz as it did at 3.8 MHz. Having the capability to now use the array in the CW DX window has allowed me to work nearly 30 new

countries including my first 80m contacts to India and Mongolia. So with my 80m DXCC total now approaching 250, what's next?

Final thoughts

The evolution of my 80m four square array over the past seven years has been a real learning experience for me. Long term on air comparisons with other stateside stations running an identical array of full size verticals has shown that my signal is typically lightly lower to the same path due to my use of shortened verticals. However on receive my array hears just as well as those using full size verticals and as they say you can't work them if you can't hear them!

While this array was an expensive investment for me, there were more cost effective ways I could have approached it and achieved the same outcome. The commercial verticals purchased from Force12 worked well, but homemade verticals would have worked just as well and would have been considerably cheaper. If I were to build another four square array, I would not use elevated radials. Installing and maintaining an array like this takes a considerable amount of time and effort but produces big results. For those wanting to take on a project like this I suggest doing a lot of research. Talk to people who have successfully tried this before and take a look at several different installations to get ideas on how to create your own.

Townsend 275th Parade

Gary K1YTS is monitoring planning for the Townsend 275th Anniversary Parade which will take place September 23rd at 2 PM. Exact requirements have not been determined but he will be looking for Volunteers. The parade will consist of 4 main divisions and over 100 units. The parade route is 1.6 mi long and will be about 1.5 hours in duration. Hams are needed for organization and safety functions. Contact K1YTS@ARRL.org or phone 978 815 4992 for information or to volunteer. Also visit <http://www.townsend275.org> or www.townsend275.org or tune to 91.7 FM radio in the center of Townsend.

Former Member Update

For those who remember Ken K1KEY who became a ham, NVARC member and moved to Florida all in just a few years KB1ESR has an update. He has upgraded to General. This past July his daughter

Kelsey passed her Technician exam is now is K1KLC. Congratulations to Kelsey.

Board Meeting

This month's board meeting discussion topics.

We have created an NVARC brochure aimed at the general public which is different than the regular brochure which is more targeted toward people already licensed. We got approval to use a picture from our ARRIS contact and from the ARRL for the use of some text we used. Ralph has printed some copies. They should be good to use at events we support to explain a little about Amateur Radio. The pictures are not captioned and can be used as talking points.

Regular Club Brochures have been updated and we have a supply on hand. We regularly attract members by people seeing the brochure or meeting us at breakfast. If you know of a location that would be suitable to leave a few see Stan or Ralph. Some ideas are local businesses that have public bulletin boards, restaurants, electronics stores, libraries, community centers, senior centers, and meeting places.

Gary presented on the status and changes in the Townsend 275th Anniversary Parade plan.

We are working on meeting presentations for the fall. The October meeting will be our QSL card sort and we have scheduled cards from the W1QSL Bureau. We have invited PART and MARA to the meeting. Pizza and drink budget approved.

We also thought that having some short presentations in pocket would be good to add to another presentation that might be slightly short. We are always looking for member input to find suitable speakers or subjects.

Settled cookout expenses.

In attendance Ralph KD1SM, Bob W1XP, Joel W1JMM, Stan KD1LE, John KK1X, Gary K1YTS and Les N1SV.

Adopt A Highway

Our next road cleanup will be Saturday day September 22nd since many will be tied up the week after at the Townsend 275th parade.

The last cleanup was Sunday August 19th. We had a good turn out especially considering it is a big vaca-

tion month and at least three of our regular participants were out of town. We picked up 10 bags of trash.

Thanks to the following participants for helping out at the cleanup; (L-R) Bob W1XP, Stan KD1LE, Callie K1ZAK, Nancy KB1KEF, Gary K1YTS, Bob AB1CV, Earl WR1Y.

ARRL Letter

2007 ARRL Teachers Institutes Reach 45 Schools

Forty-eight teachers representing 45 schools from around the country attended the 2007 ARRL Teachers Institutes, held this summer in Rocklin, California, Spokane, Washington and at ARRL Headquarters in Newington. Each class of 12, ranging from pre-school teachers to college professors, got the opportunity to explore and experience firsthand wireless technology basics, how to teach basic electronics concepts integral to microcontrollers and robots, as well as how to bring space technology into the classroom. The four day course culminated with building and programming a robot.

Education and Technology Program Coordinator and Director of the ARRL Teachers Institute Mark Spencer, WA8SME, said, "We had a good range of students this year. We had a higher percentage of hams than we have seen in the past. These were slightly older teachers, ranging in all levels of experience. We even had a student teacher at one of the sessions, something I am really excited about."

Spencer said his four "instructional pillars" -- Science of radio, Space in the classroom, Microcontrollers and Robotics -- are "ever-present" during the Teachers Institute. "Each day is packed with lectures, hands-on activities and demonstrations, building, programming and a robotics competition. The first two days include instruction on how to teach wireless technology. Day three covers microcontrollers and the finale is how to teach basic robotics. The class materials are a mix of basic theory coupled with teaching strategies these instructors can use immediately when they return to the classroom."

A new feature in this year's Teachers Institute is Soldering 101. Spencer said including this basic skill was "extremely useful. We had both experienced hams and people new to technology. A lot of the experienced hams hadn't soldered in a while, so it was like a refresher course for them. The new people enjoyed learning a new skill."

Spencer said some people might have already known how to solder, but had never considered soldering in the classroom. "They came up to me, happy that they had learned the teaching skills that would enable them to bring soldering in the classroom. They said, 'I knew how to solder before I came here, but I never thought I could teach it to my students. Thank you for giving me the skills and showing me the way so I can teach this to my students in a way they can understand.'"

Another new feature this year was satellite contacts. Spencer chose AO-27 due to the timing of its pass. Spencer divided the class into two groups and took them outside for the pass. "The satellite comes over the horizon, and the participants announce their call sign and grid square and maybe exchange some short pleasantries. Once that's done, they go on to the next contact," Spencer said.

By using satellites, Spencer said, he shows the Teachers Institute participants that they can actually contact an orbiting satellite using inexpensive equipment. "The lessons involving satellites are valuable and focused. By using satellites, these teachers can go back to their classrooms and teach more than just the satellite. This lesson teaches the students how to get ready, how to prepare; this is something they can and will carry with them all their lives. Without advance preparation, it's really hard to make the satellite contact."

Of the 48 teachers at this year's Teachers Institutes, about 20 percent come from "Big Project" schools, Spencer said. "About another 25 percent of the non-Big Project schools go on to apply for grants and get involved in the Big Project. These schools then go on to apply for an Amateur Radio on the International Space Station (ARISS) program, but the Teachers Institutes show them that there is much more to it than just an ARISS contact."

While the emphasis of the course is not Amateur Radio and teachers need not be hams to attend the all-expenses-paid sessions, some do go ahead and take the Technician license exam. Seven have received their Technician license and two have upgraded to General this year alone. "About 80 percent of the non-ham teachers have gone on to get their Amateur Radio license. They get really 'jazzed up' about ham radio while they are here. Since the genesis of the Teachers Institute, each participant that has taken their Amateur Radio license exam has passed on their first attempt," Spencer said.

Spencer said the Teachers Institute curricula are constantly being tweaked. "Right now, we are at a maturing stage, doing the grunt work and sustaining

the program. Next year we are looking at adding Amateur Radio Television and making an umbrella activity board that ties all four of the instructional pillars together. I am already looking at expanding the program for next year."

He has many long range plans in mind for the Teachers Institute. "In the next 10 years, I would love to see a Teachers Institute in each of the 15 ARRL Divisions. These instructors would work in conjunction with their state's science museum and run the Institute regionally through the museum. What a great way to bring science to kids," Spencer said.

ARRL/TAPR Conference Comes to Connecticut Next Month

Mark your calendars for September 28-30 for the 26th Annual ARRL and TAPR Digital Communications Conference in Hartford, Connecticut <<http://www.tapr.org/dcc.html>>. This conference is an international forum for radio amateurs to meet, publish their work and present new ideas and techniques. Presenters and attendees will have the opportunity to exchange ideas and learn about recent hardware and software advances, theories, experimental results, and practical applications.

Topics include, but are not limited to: Software Defined Radio (SDR); digital voice; digital satellite communications; Global Position System (GPS); precision timing; Automatic Position Reporting System (APRS); short messaging (a mode of APRS); Digital Signal Processing (DSP); HF digital modes; Internet interoperability with Amateur Radio networks; spread spectrum; IEEE 802.11 and other Part 15 license-exempt systems adaptable for Amateur Radio; using TCP/IP networking over Amateur Radio; mesh and peer-to-peer wireless networking; emergency and Homeland Defense backup digital communications; using Linux in amateur radio; updates on AX.25, and other wireless networking protocols.

The three-day conference will include introductory and technical sessions on Friday and Saturday, a Friday evening social and a Saturday evening banquet. The ever-popular Sunday Seminar focuses on one topic and provides an in-depth four-hour presentation by an expert in the field. The Sunday Seminar speaker has yet to be announced.

According to TAPR Vice President Steve Bible, N7HPR, "the ARRL and TAPR Digital Communications Conference is for all levels of technical experience, not just for the expert. Not only is the conference technically stimulating, it is a weekend of fun for all who have more than a casual interest in any

aspect of amateur digital electronics and communications. Introductory sessions are scheduled throughout the conference to introduce new technical topics for beginners and experts alike. For those amateurs who are more technically inclined, this is a must attend conference. Now more than ever, Amateur Radio needs this great meeting of the minds to demonstrate a continued need for our current frequency allocations by pushing forward and documenting our achievements. The ARRL and TAPR Digital Communications Conference is the best way to record our accomplishments and challenge each other to do more."

Each year at the Digital Communications Conference, a separate and lockable room is provided for people to bring and show off their latest projects. Tables and power will be provided. Bring your equipment and display for all to see, learn and ask questions about, as well as a small sign and flyer naming and describing your project.

Registration is open until September 1; after that date, late registrations will be accepted. The cost of the two-day Digital Communications Conference is \$70; to attend only the Friday or Saturday session is \$40. Lunch is available on Friday and Saturday for \$15. The Sunday Seminar is priced separately at \$25. The Saturday evening banquet is \$35 and includes dinner, guest speaker, an awards ceremony and a prize drawing. Students under 17 are priced at 50 percent of the registration fees. Conference registration includes conference proceedings, sessions and meetings.

Conference presentations, meetings, and seminars will be held at the Doubletree Hotel Bradley International Airport in Windsor Locks, Connecticut <<http://www.doubletree.com/en/dt/hotels/index.jhtml?ctyhocn=BDLETTDT>>. A block of rooms at a special rate of \$79.00 has been reserved, and it is highly recommended that you book your room prior to arriving. This special rate is good until August 30, or until the block of rooms is all sold out. To book your room, call the hotel directly at (860)627-5171 and mention group code DCC when making reservations.

Treasurers Report

We had no income in August. Expenses were \$16.40 for newsletter postage and \$30 for the July cookout leaving a net expense of \$46.40 for the month.

Current balances:

General fund	\$4,305.28
--------------	------------

Community fund \$2,136.83

As of 13 August we have 60 members who are current with their dues and 4 renewal outstanding. Please check the member roster that is circulated at the monthly meeting if you do not remember your renewal date. Your membership date also appears on your newsletter mailing label.

If you have not been receiving the monthly notices when the Signal is posted in the Web then we do not have your current email address. These notices are usually sent the weekend after the Board meeting.

If you are not yet an ARRL member please consider joining and showing your support for the programs developed by our national organization. If you let me send in your membership then the Club pays for the stamp and receives a portion of your ARRL dues.

Ralph KD1SM

PSLIST

Sept
16 Boston MA Jimmy Fund Walk
Steve W3EVE 508.922.9688 w3eve@arrl.net

29 Bristol NH NH Marathon Cliff N1RCQ
n1rcq@amsat.org or Dave KA1VJU
ka1vju@cnharc.org

Oct
6 Hollis NH Applefest Half Marathon Jim WD4JZO
wd4jzo@arrl.net

Oct 19-20 Cambridge MA Head of the Charles
Regatta1Jeff K1EMS RWJeffA@comcast.net

NVARC Club Net

The club net meets on the 442.900 repeater. Subjects discussed recently; Field Day wrap up, Cookout planning and post party comments, Winchendon triathlon from participants, repeater projects such as battery and antenna replacements.

Recent participants include Dave N1MNX, Bob W1XP, Bob AB1CV, Joel W1JMM, Larry KB1ESR, Skip K1NKR, Gary K1YTS, Ralph KD1SM, Stan KD1LE, Les N1SV, Richard W1LTN, Ken K1JKR, Den KD2S.

The net is a good place to bring information for the club and questions or discussions. The net meets at

8:00 PM Monday evenings on the 442.900 N1MNX repeater.

Flea Markets

September
15 Forestdale RI
15 St Croix Valley ARC Alexander ME
16 Western CT Hamfest Newtown CT
16 MIT
16 Western CT Hamfest Newtown CT

October
6 Mt Tom Amateur Radio and Electronics Feeding Hills Ma
7 CT State Convention Wallingford CT
12-13 NEAR-Fest (Deerfield) Deerfield NH
21 MIT

November
3 IRS Flea Market

2008
August
22-24 NE Division Convention Boxboro

Advertisements



DICK WILBORG W1ZC
JOHN ROSE WW1Z

BELTRONICS, INC.

AMATEUR RADIO SERVICE DIVISION

www.beltronics.net

hamrepairs@beltronics.net

603-465-2422
800-323-5876

FAX 603-465-3320

P.O. BOX 330
19 PROCTOR HILL RD.
HOLLIS, NH 03049

Tell them you saw it in the Signal. Advertisers should contact the NVARC Treasurer for information.

Contest, DXpeditions and Special Events

The information for a DXpedition can be quite detailed and may include bands, dates, number of stations, and times of day they plan to work certain continents so I can not list it all here. But if a country or prefix is of interest you can get more information at www.425dxn.org.

Contests 2007

September

30-October 1 RSGB 21/28 MHZ Contest
30-October 1 FISTS Coast to Coast Contest
October

7-8 California QSO Party
7-8 Oceania DX Contest
7 PSK Rumble

Oct 14 ARRL EME Contest
Oct 15 North American RTTY Sprint
Oct 16 School Club Roundup
21-23 USI W/VE Islands QSO Party
21-24 QRP ARC! Fall QSO Party
28-29 CQ WWDX SSB
28-29 10-10 International CW/Digital Contest

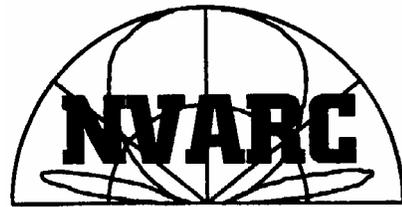
November

ARRL November Sweepstakes CW
17-19 November Sweepstakes Phone
30-Dec 2 ARRL 160 Meter Contest

DXpeditions

Call	Location	Until
TU2/F5LDY	Ivory Coast	31 August 07
9V1CW	Singapore	2008
8Q7IM	Maldives	Nov 2007

See www.425dxn.org for more listings



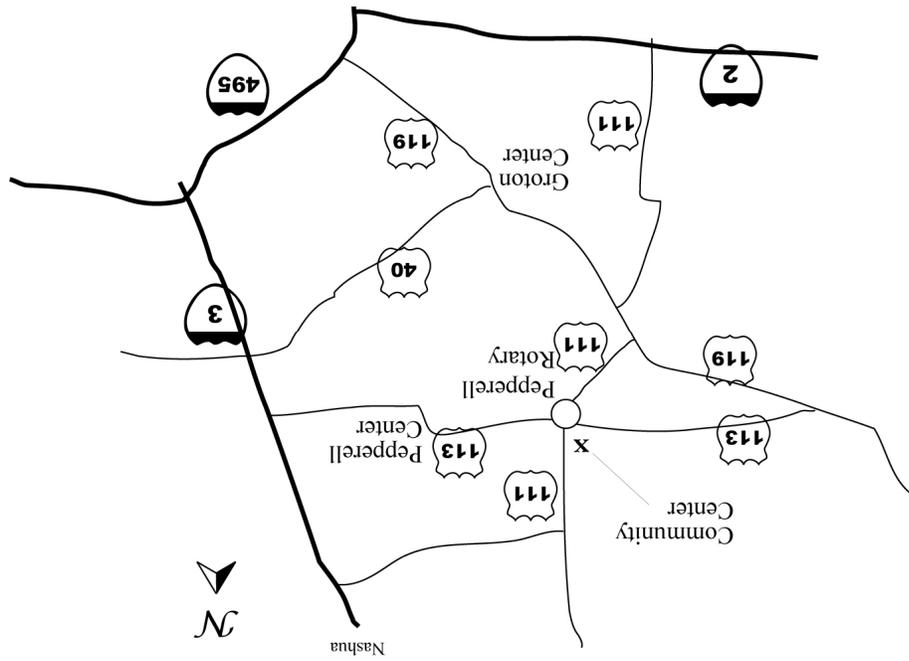
Nashoba Valley Amateur Radio Club

PO Box # 900
Pepperell Mass 01463-0900

<http://www.n1nc.org/>

President: Stan Pozerski KD1LE
Vice President: Peter Nordberg N1ZRG
Secretary: John Griswold KK1X
Treasurer: Ralph Swick KD1SM
Board Members:
Les Peters: N1SV 2005-2008
Joel Magid W1JMM 2006-2009
Bob Reif: W1XP 2007-2010

Editor: Stan Pozerski KD1LE
Emergency Coordinator: Den Connors KD2S
Photographer: Ralph Swick KD1SM
PIO: Dave Peabody N1MNX
Librarian: Peter Nordberg N1ZRG
Property Master: John Griswold KK1X
N1NC Trustee: Bruce Blain K1BG
Meetings are held on the 3rd Thursday of the month
7:30 p.m. - Pepperell Community Ctr.
Talk-in 146.490 simplex
442.900 + 100Hz Repeater
147.345 + 100 Hz Repeater
53.890 - 100Hz Repeater
This newsletter is published monthly. Submissions,
corrections and inquiries should be directed to the
newsletter editor. Articles and graphics in most IBM-
PC formats are OK.
Copyright 2007 NVARC



Nashoba Valley Amateur Radio Club

PO Box 900

Pepperell, MA 01463-0900

