Building a Super Station - 30th Anniversary

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David Robbins

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30th Anniversary!

30 years of construction, reconstruction, and maintenance at K1TTT with tips for both big and small contest stations.

By David Robbins K1TTT (ex N3ADQ, KY1H)

30th Anniversary Edition

30th Anniversary Introduction

Thirty years??? Has it really been that long? This is a relatively minor update from the 25th Anniversary edition, 5 more years of ice and repairs, some station upgrades, and other stuff. Just read it.

25th Anniversary Introduction

Twenty Five years, one quarter of a century, not a long time by geologic clocks, but it sure seems like a lifetime… or almost half a lifetime anyway. Since I took the time to write the first edition of this book the station has continued to evolve. New antennas, new amplifiers, improved networking and software, and lots of repairs and maintenance. Much of the work is now being chronicled in an almost daily maintenance blog on my web site. I expect I will continue that as it seems an interesting way to not only let my operators and other interested parties know what is going on, but helps me keep notes of what I have been doing. Before 2008 I had kind of kept some pictures and notes of big changes, but when I started using a freeware Wiki system in 2008 it got down to daily details. The final result of the 2008 blog is included in this update. You can watch the 2009, and hopefully future ones evolve on the web site.

1st Edition Introduction

I started in contesting in 1984 after moving to Peru Massachusetts. "Peru? Where is that?" is the normal question. Well, its about 12 miles east of Pittsfield where I got a job with GE Defense Systems after getting out of the Navy. In other words, it's about as far from anywhere as you can get in southern New England these days.

I didn't have a plan to build a multi-multi station from the start. In fact when I moved to this location I didn't even know how a multi-multi station was set up or operated. When I moved up here my only experiences with Amateur Radio were from apartments, mobile operating, and a Field Day or two. Not long after moving here I met K1RQ who had a multi-multi station just 2 miles up the road. He gave me my first introduction to contesting and how to build, and (sorry Dana) in some cases how NOT to build, a station.

I put up my first tower that year, a third or fourth hand aluminum crank up with an A3. The first 'real' tower, 150' of Rohn 45g went up the next summer. It wasn't long after that when I realized I was not a 48 hour iron pants operator and decided to start doing multi-ops from here and just kept on adding steel and aluminum.

Some of what I am writing in this book are things that I would do if I were to do it again. Some are things I would never do again. Much of what is in this book are things I have learned from many different contest mentors over 20 some years of building this station. Some are things I have learned the hard way, things that had to be un-done or re-done because they took me off the path. In any case, I hope they give you some ideas to improve or build your own contest station, large or small. And maybe this will help some of you avoid some of the mistakes that I made over the years.

The first part of the book is a brief history of the evolution of the station. It contains commentary on how and why the station is the way it is today. After that I start considering different factors of designing and building a station. I start with some notes about finding a location, overall design, and then on to towers, antennas, and inside stuff. Then I get into some notes on tools, how to do the work, maintenance, and end up with a section of technical notes.

In case I don't mention it later I would like to thank all those who helped me over the years building and operating this station. Special thanks for K1RQ for getting me properly introduced to contesting and the Yankee Clipper Contest Club (YCCC). The YCCC and its members have also been a huge help in too many ways to list.

Many of the pictures and other material are available on my web site at http://www.k1ttt.net. You can also find out more information there about current and upcoming contest operations, watch the live web cams, and access more technical information links from other contributors.

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Evolution

In the beginning… Long, long ago, but not that far away…
No, it wasn't a great event that built this station. It was many years of slow growth and evolution. It started as a wire thrown out the window in January of 1984 and after many years it grew into the station I have today. It has taken help from more people to build than I can remember, and has been host to even more operators for contests and other things.
I have had visitors from around the world, and more people probably know where Peru, Mass. is because of my operations than anything else… Of course there isn't really much else in Peru that anyone would want to know about outside of the town. The town doesn't even show on lots of maps.
I hadn't tried to even estimate the total number of contacts that have been made from here until I started on this book. I created a database that has all the contest logs I could find from my operations, which is probably a good percentage of the contacts and come up with about a half million contacts. I hate to think how many QSL cards are sitting in the crawlspace waiting to be sorted, it's up to 10 file boxes now I think.

The First Year

Anyway, back to the beginning…
I bought this house, no I didn't build it for this purpose, when I took a job with General Electric Defense Systems Division in Pittsfield in 1984. Finding it was not easy, well, finding was, getting to it was another problem. In December 1983 GE paid for me to come up for a 1 week house hunting trip. I arrived late in the afternoon Monday at the real estate agent's office so we couldn't really do anything that day. I had talked to the agent on the phone and told her I was looking for a place away from town with 5 or more acres and 'good views'. She had a few places lined up to visit and gave me a copy of there Multiple Listing Service book. The MLS book this was the pre-internet way of sharing listings between agents in an area, basically it was a thick book with 6 or so listings per page that included a bad black and white picture and a small summary of the listing. That evening I found my way to a store in Pittsfield that had USGS Topographic maps, remember those? Actual paper maps, the kind that you can't zoom or search except by eye. I took all that paper back to my hotel room for the night and started studying them. In the MLS book I found another half dozen or so listings that looked interesting, including this one… 30 acres, 4 bedrooms, about 30% cheaper than most of the others, must be something wrong with it.
Tuesday morning we started off to see her finds, and I gave her the ones I had found in the MLS book. After visiting a house that seemed to be in the middle of a busy state highway, another one at the bottom of a gorge next to a river that literally had a stream flowing through the basement's rubble stone walls, and a beautiful renovated, but tiny, house perched on the side of a hill with a large fenced field that would have been great for horses, we went back to the office to check on the other listings. A couple of the ones I had found in the book were already sold or otherwise not available, but this one was still available, though they hadn't found out why it was so cheap yet… but they set up an appointment to see it Wednesday afternoon. Wednesday morning was spent driving back and forth through the county looking at other places and slowly working our way into the hills. When we got done with her listings we were not far north of this place, found it on a map and started toward it via the shortest path… bad mistake. She didn't know the roads and soon we were in a ditch on a road that was solid ice. This should have been my first clue of what was wrong. Not only that, but her company radio couldn't reach the office. Fortunately I had my 2m ht and brought up a repeater to call for a tow.
Thursday morning we tried from the other end of the road and finally made it to the house. Still icy, obviously not sanded recently, no one living there, but the listing agent showed up with the key and let us in. Obviously it hadn't been lived in for a while, the crawlspace was wet, there were lots of mice, signs of water leaking around the fireplace upstairs, and a HUGE wall of mostly fogged insulated glass

upstairs looking out on a large deck and pond, and the yard was tiny. But it had acres of Scotch pine that could be sold as Christmas trees, and it was cheap! Why?? The family that had built it had moved to Albany and had just been using it as a weekend and vacation place and to bring the kid's scout troops for outings… which explained the 13 beds, including 4 sets of bunk beds. I made some notes, marked it on the topographic map, and we moved on to see a couple more, including one right around the corner. Friday morning I spent on my own going back to a few of the better prospects and looking around the area a bit. I ended at this place, walked around a bit more, and decided this was number 1 on my list. I went back to the agent's office and told her I wanted to put an offer on the place, I would pay their asking price, but wanted the fogged windows replaced and a couple other things first. Then I packed up and went back to my Dad's place in Pennsylvania where I had been basing my job search after getting out of the Navy in Charleston SC.

A couple days later the agent calls back with a counter proposal, they didn't want to fix the windows, but they would throw in most of the furniture, appliances, Cub Cadet tractor with a full set of farm attachments, and a 1957 Jeep with snow plow. All they wanted to take out were the TV, dining room table, and a big living room table that was a huge slab of maple that was probably cut there. I told her to take it and to find a bank and attorney that could do the closing as soon as possible in January… Impossible she says, most banks around town were just branches of banks out of Boston and took months to approve mortgages. A few calls later and I found a loan officer who must have been hungry enough to really want to approve a loan… a horrible rate, but nothing was cheap on the mortgage front at that time.

January 1st I am driving from my Mother's place near Wilkes-Barre Pa where I was leaving my cat until I got into the house. Stupid South Carolina car dealer, I don't think I had ever used the windshield washer in that truck until I got on I-84 in the middle of an ice storm. Of course it was full of water and froze in the tubes. Any way, I made it to Pittsfield, started work at GE the 2nd of January. And the 12th of January closed on the house. Then the fun began!

Now, what do I do with 13 beds, a house full of furniture, cabinets full of dishes, pots, pans, closets full of blankets, and mice?? First, make room for my stuff… one of the downstairs bedrooms looks like the best prospect, so take apart 2 sets of bunk beds and stash them in another room, put in one table I had with me and set up the computers and radio. Computers?? Yes, a Radio Shack Color Computer, a Radio Shack Model 100, and a homebrew Z80 that was my senior project in college. The Radio Shack Color Computer had 2 5" floppy drives and was set up to run as a dialup bulletin board, "The Plastic Brain BBS". This had originally been run in Charleston SC and was restarted here as the first free BBS in the Pittsfield MA calling area.

Figure 1 Radio Shack Color Computer and Tandy Model 100

As for the radio, an FT-301 with an MFJ 100w tuner and a wire though the window and tied to a tree.

Figure 2 Initial Radios

Wait? Is that a CB in the box? Yeah, I had been traveling so much for the 5 years I was in the Navy that I still kept a CB in the truck for keeping up on road conditions and stuff on the interstates. Oh, and hidden behind a secret panel in that box are a couple of dip switches that took that radio up onto 10m if needed… not that I would ever do that of course.

Figure 3 First taste of Peru snow

Next, start evicting the dozens of squatters from the closets, move the cat, and get my furniture delivered... whew, that was a busy couple of months, all while settling in to a new job.

Figure 4 Not a plow to be seen

Oh, and then it snowed… And of course after the first snow storm the road isn't plowed. Call the town garage and tell them there is someone actually living on Baumann Rd… repeat this process a couple times until they get the idea that I'm staying.
Somewhere along the line I met up with K1RQ. He just happened to live about 2 miles up the road and had several towers, including a 150' one, that you could not see from anywhere unless you knew exactly where to look.

Figure 5 K1RQ's 150' tower

He invited me to come over for a contest, not that I had any idea what that was, but it sounded interesting. Anyway, I went over and watched these guys filling log sheet after log sheet (remember those??) working stations all over the world, and I was hooked. I don't even remember which contest that might have been, ARRL DX in 1984? Or maybe some other spring contest. In any case, that summer I found a used crank up tower and A3 beam.
Ah, but the first tower… I remember it well. An aluminum crank up tower, one section nested in the bottom section and a bolt on piece on top of that where the rotor mounted and stuck up about 8' more.

Where to put it? Well, right next to the house of course. No other clear place around for it, not even enough next to the house for it.

Figure 6 Aerial photo by a neighbor in a plane

In the aerial photo that is my house near the top center. And the pond down and to the right is mine. But none of the nice clear field to the right of that is mine, that all belongs to the neighbors. I have all the heavy wooded stuff and the Christmas tree farm areas around the pond. So, there not much room to put up any kind of tower, even right around the house.

What about a foundation? Well, dig a hole, throw in a few bags of ready mix, that should do it. Line it up so it will stand right next to the deck on the back of the house then I can tie it to the deck to keep it up… can't climb a crank up?? What do you mean you can't climb a crank up to put the antenna on? Hmm, that makes things a bit harder. Ok, it will tilt over, I'll put the antenna on and then stand it up. Oops, now there is a big branch in the way from this huge maple tree. Move everything out of the way and cut off the branch. Then another branch, then another… now it should stand up. Ok put everything together with it laying over, no problem. Start to tilt it up. Snap, Crackle, and Pop! Hmm, guess that top section wasn't as strong as it looked. Find someone who could weld aluminum, take the broken pieces in and have them welded… shorten the top section extension. Put it all back together and this time support the top a bit better… finally its vertical…. Hmm, has to be cranked up to clear the roof, ok, I can handle that… but on the plus side I can reach the antenna from a ladder on the deck or from the roof when its cranked down.

Figure 7 The first tower!

Ok, that takes care of the high bands… now, what about the low bands?
Well, putting things in trees up here is hard, most of the big ones are broken at the top from ice, and getting coax to them would be hard anyway. So put a tripod on the roof and make two nested dipoles so I can switch directions. What? Dipoles that low aren't directional on the low bands?? So what, I can fix that. So I run 4 pieces of coax up and connect one piece to each of the 4 legs… then in the shack I can pick any two of the legs and have 4 V beams, or 2 dipoles, or who knows what else. No, they didn't work very well.

Figure 8 Low band nested dipoles/V beams

By November I was ready and entered SS SSB as N3ADQ/1 as single op low power. And got a certificate for Low Power Phone WMA section! Ok, now I was really hooked!

Growing

Ah, spring (1985). A time when birds are chirping, grass is growing, flowers are blooming, and a ham's thoughts turn to tower construction. And up here that means one thing, chainsaw. Peru is nice, all the neighbors are friendly and eager to help out, and especially eager to give away garage filling stuff. A neighbor gave me a chainsaw, and it was a beauty! About a 20 year old McCullough model 73 with what must have been a 36" bar and huge chain… but I was young and strong and didn't know any better, besides I had some big trees to take out! Unfortunately the saw was easy to start so I used it.

Figure 9 Before

And I cut trees, and I bucked logs, and I trimmed, and stacked, and cut more trees. And cut more trees. Shhhhh, don't tell the environmentalists.

Figure 10 After

I ordered a tower through K1RQ who was the local Rohn dealer, 150' of Rohn 45. Dana gave me a catalog that had the base and anchor specs and explained how to do it… but would I listen?? Well, I did to some of it I guess. If you read the Rohn book a 150' of Rohn 45 gets guyed at 4 levels, mostly with 3/16" EHS and the top with ¼" EHS… until you read the fine print in the footnotes where it says 'except in Peru, Ma'. The Peru specs call for 5 levels of guys and all ¼" EHS all around. Then I looked at the foundation requirements and guy spacing and started surveying the clearing I had made… And cut more trees.
Then I looked at the stumps, and rocks, and mud holes, and called a local contractor who had a D8. About 4 hours of D8 time and I had two big piles of stumps and a nice flattened area that a concrete truck could drive in to each of the anchor points and base.

Figure 11 After bulldozing and growing some grass

A couple more hours of backhoe work by the same contractor and there were 4 nice holes. A couple hours after that the holes were half full of water. Welcome to the Peru aquifer, it lives about 4' down, just under a 3' thick layer of hardpan just waiting to get out. Nothing a little bailing wouldn't handle… yeah, right.
Anyway, I built forms and bent rebar.

Figure 12 Anchor hole

And I surveyed and measured and lined things up and did it all again. After all, the Rohn specs call for something like 1 degree tolerances and all that stuff… yeah, right.

Figure 13 Base hole with gravel and short base section

Figure 14 Using one straight section to plumb the base section

The short base section just didn't want to stay in place, and with only a little bit of it above the level of the form it was hard to secure. So, put on the first section above that and guy it. That extra section gave it some weight and plenty of leverage to keep it in place and properly aligned.
After I thought I had everything lined up I called the concrete company… deliver to Peru? For a what? 500' away from the road?? Yeah, right. But they did it, the driver was good, he drove right on in to the center and filled the form on up, he didn't like my form so made the mix a bit stiffer than usual, the form still bulged but didn't break. Then up to the first anchor point and assured me that a foot of water wouldn't hurt the concrete pour and would help it cure better, besides I don't think he wanted to wait for me to bail it out. Now, on to the second anchor point. Again only about a foot of water, no problem. Then on to the last one… I was walking along side watching the wheels starting to sink and he was hanging out the cab window, but he didn't stop… all he said was that whatever he had left was going in the last hole… and he filled it up, literally. Guess they had a bit extra in the truck since I had given them the exact number of yards I needed… yeah, right. In any case what was left came almost to the top of the hole, well so much for covering with compacted fill and all that stuff from the Rohn book. Twenty some years and its still there so it can't be all bad. Actually the mud wasn't any problem for the truck, you see, the bulldozer had basically scraped it down to the hardpan when removing the stumps then pulled back a foot or so of dirt… so a foot down was a great hard packed road, all the concrete truck did was churn up some surface muck on the way back out.

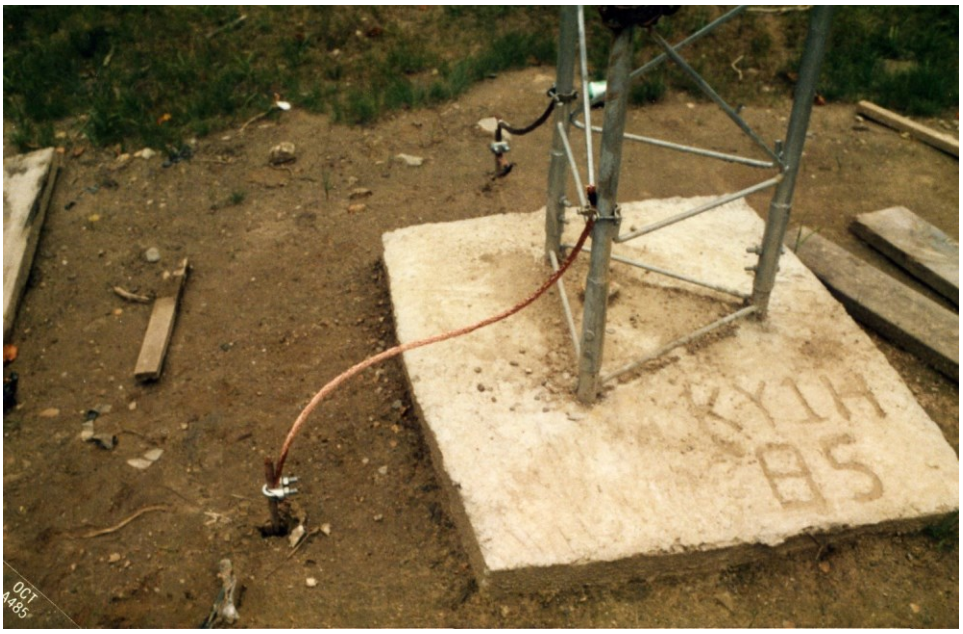


Figure 15 Got to have ground rods and your call carved in base.

Ok, give the concrete a month or so to cure, remove the forms, backfill and compact… yeah, right. Two days later I am trying to take out the forms, well at least the ones that weren't covered in concrete, which left just the base forms. Besides the third anchor point that was totally full we had overfilled the other two because all we could do is to probe by feel through the muddy water to be sure there was enough to fill the form, then add a bit extra. So those just got backfilled… by hand. My form wasn't quite strong enough for the base so it had bulged a bit, so the braces I had wedged in the hole were well pinned but most of them came out with a bit of persuasion…but the plywood wasn't going to move. So just break it off a foot or so down from the top and backfill. After checking at least everything had stayed in alignment, I guess all the extra rebar I used for temporary braces and guying had done its job.

Now to get ready to build a tower. I had been warned about Rohn tower legs and how they didn't like to fit together sometimes so I took the precaution of laying out the sections in order and pre-fitting the legs. I also attached the guy brackets at the appropriate spots.

I was a bit disappointed in the guy wire, it came in 3 coils instead of on a roll. Have you ever tried to unroll a 1000' coil of EHS? There is only one way to do it, VERY CAREFULLY! But wait a second, how to cut 15 different lengths of guy wire out of those 3 rolls so we didn't have to splice any of them? A couple hours of trig, allow a bit extra just in case, and yes, it was possible, cut the first couple from one roll, then more from each of them, and by the time you get to the top there should be 3 pieces left that are just the right lengths. Yeah, right.

Anyway, the first 3 sections stack up just fine, and I get on the first set of guy wires on. Then Dana checks my work and shows me how to properly tighten the guy wires by twanging them with your hand and checking the pitch of the note, just about high-c I think. And there sits a 20' ¼" wall steel mast, 100 pounds of cold hard steel! He warns me that I would not want to put that in the tower from the top, so it goes into the bottom to wait for the tower to grow around it. Three sections by hand weren't too bad, but going above that was definitely going to be a pain, so now its time for a Tower Party!

The First Tower Party

Ah, the Tower Party. Fire up the grill, a few burgers, some dogs, chips, chill a keg... Oops, violation of Rule #1! No alcohol until the sun is over the yardarm, AND the tower is topped off. Besides, its summer and that means afternoon thundershowers or hot sun. So start early, get done early, more time for beer!

Anyway, even though I was obviously too busy to take pictures I had K1RQ helping supervise and KB1W on the tower I think, maybe with WB1EYL? Well, however it was done we got it up and guyed that day.
K1RQ made a few suggestions for dealing with ice. One of them was to put a cable clamp about half way up each guy wire. The idea of these is to break up the ice before it slides down to the anchor point. Nice idea, and it does work amazingly well… but what a pain when working with inverted V's and other ropes or wires around the guy wires. They are always hanging up on the clamps causing extra work. When I had the guys replaced I left off the clamps and never did it on other towers. Another suggestion was to put a clamp on the top of the dead ends to prevent them from pealing off if ice does get to them. I have done this, or put a clamp above the grips on all my towers. It does work, I don't know that it is really needed though, I have been running an experiment for a couple years with some grips not actually holding anything put just above the bottom and they haven't pealed off yet.

Antennas come next. And a rotor. And lots of coax. 3 runs of 9914 going 350' from the top of the tower back to the shack. Add a couple of Heathkit remote antenna switches to select the antennas. Those old Heathkit switches were nice as no control cable is needed.
Antennas were a Cushcraft 40-2cd, a Telrex 20m327, and a pair of 2m porcupines, vertically polarized of course for kerchunking repeaters up and down the East Coast.

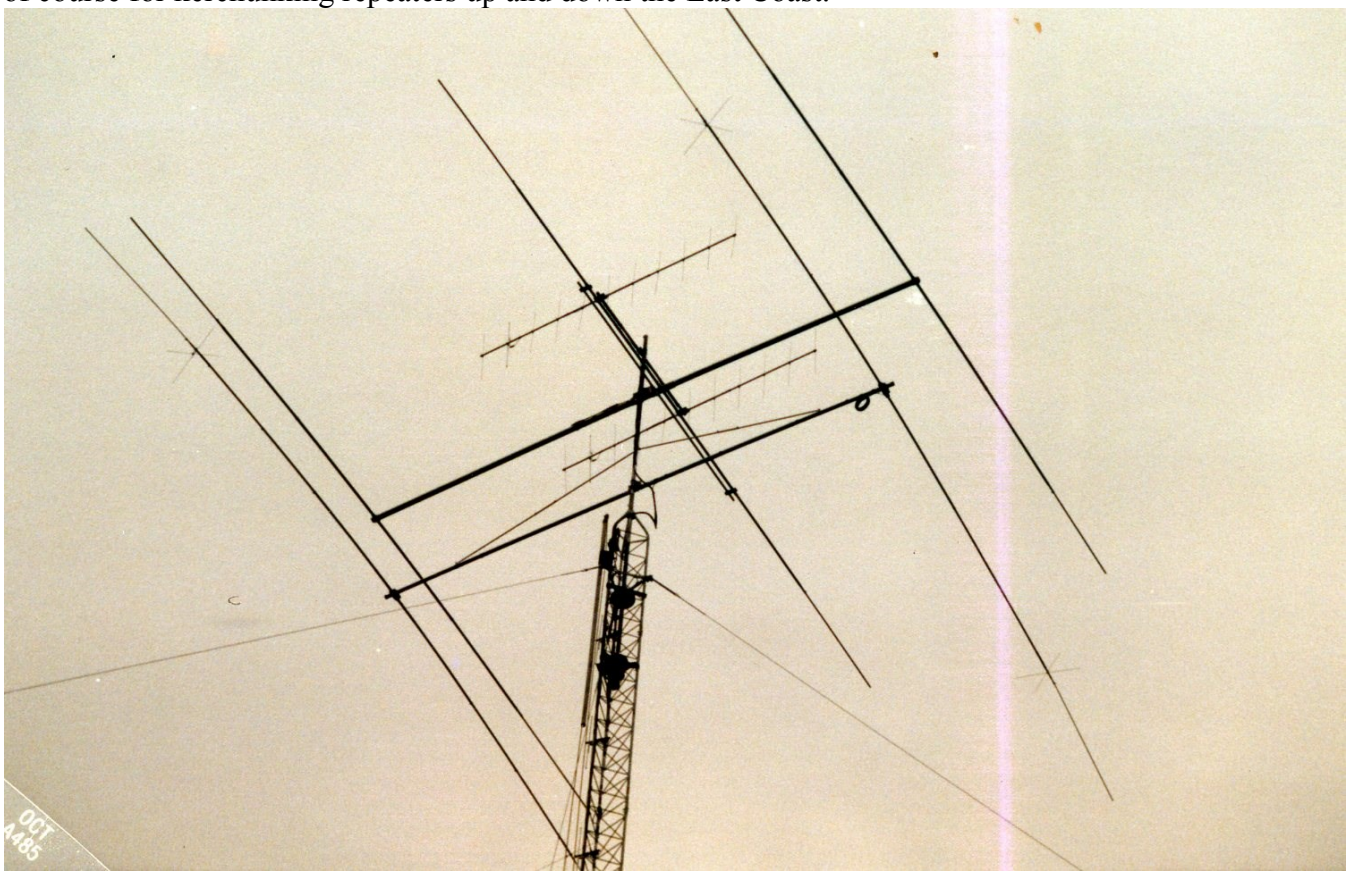


Figure 16 Ah, antennas.

Then add two inverted V's for 80m and two for 160m from the top of the tower. And oh yeah, Beverages… just strung tree to tree with electric fence wire and hook insulators.
The rotor I built out of a small prop pitch motor, a variable transformer that weighed about 50 pounds, an old Telrex rotor indicator, and a couple of 60hz synchros.

Figure 17 Bottom view of prop pitch rotor with synchro motor on right

Thanks to W1WF for machining a brass bushing for me to adapt the mast to the shaft of the prop pitch motor. This was a no welding setup, the bushing fit into the end cup of the motor and was secured with 4 bolts rounded off the fit in the access holes at the bottom of the shaft. Then it was drilled through for two ¼" stainless steel bolts to go through the mast at the top of the bushing. The brass turned out to be too soft and after the holes enlarged too much I had it duplicated in stainless at a local machine shop. The indicator used a pulley that was the same diameter as the motor output shaft attached to one of the synchros. A waxed string wrapped around the pulley, motor shaft and back to the pulley where it was tightened with a small spring. It worked well but the string needed to be replaced periodically. The whole thing was covered with an aluminum flashing cover and there was an aluminum flashing cone above it to keep ice out of the works.

And now for some operating!

Now for the first contests in the Fall of 1985! CQWW Phone single op. Used FT-301 and a borrowed SB-200. Spent lots of time operating, some more time up the tower fixing the rotor, but ended up with 672 QSOs for not quite ½ million points. WOW!
SS Phone next, 20 hours and 786 QSOs and 73 sections (no YU/NWT of course). This time with an Alpha 76, my first real amp!
And the first Multi Op… CQWW CW. Ops were KB1W, KB1KE, K1RQ and me (KY1H at that time). Over a million points with 1138 QSOs. Rotor didn't break, but it was stuck on the Pacific until Saturday morning when the ice melted. Oh yeah, K1RQ loaned me a 4 element W2PV design Yagi to help out on 15m… all of 88 QSOs worth of it. That was better than 10m where we only got one contact anyway. And yes, Peru does get ice and snow. And stock 40-2cd's don't like ice.

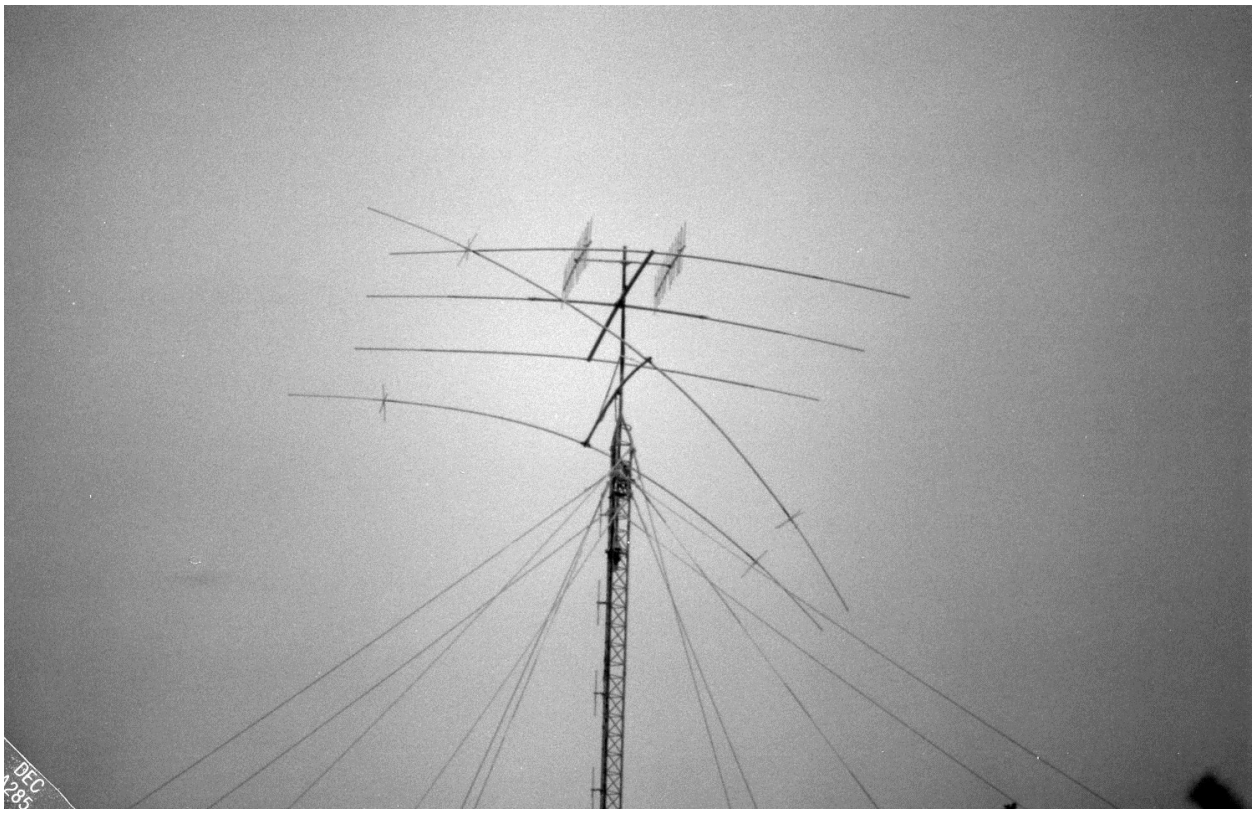


Figure 18 First ice storm results.

This was my first experience with winter tower work, but definitely not my last. After a while you get real good at handling nuts and washers with gloves. I didn't take the antenna down to fix this, I just straightened it out up the tower as best I could and hoped to get through to spring.

February of 1986 was a big time in Peru. Maybe a bit too much party and not enough operating.

Figure 19 Can't let it go to waste!

Figure 20 Well, you need something after the beer ball runs out.

But we did have fun! We also entered the first contest where a packet spotting network was used, the 1986 ARRL DX CW contest. Operator list for that entry was: KY1H, KB1W, K1RQ, WB1EYL, KS1N, KB1KE, WB2VLM+XYL, KJ1K, WA1ZAM, SP1KE/KAT, PACKET NET, BEER BALL.

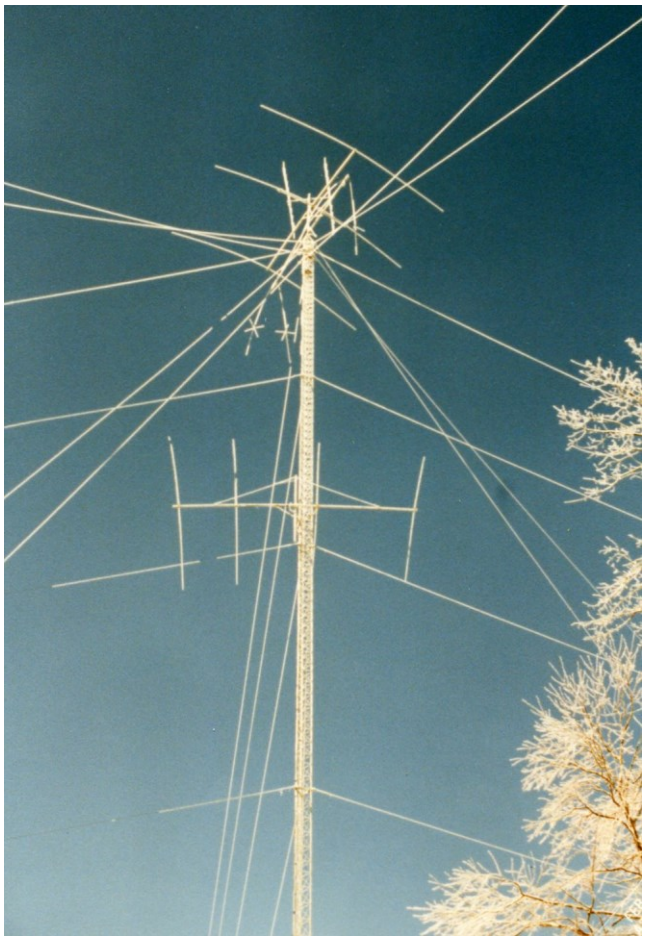


Figure 21 Next big ice storm, bye, bye 40-2cd.

Oh, and did I mention that Peru had ice problems?
And that 40-2cd's didn't like ice?
But this is what insurance was meant for. Fortunately I had excellent coverage under my homeowner's policy that covered the antenna replacement and then some. The whole story is later on in how to deal with insurance adjusters.

Figure 22 Yes, it was a bit of ice.

Figure 23 You didn't want to be under the tower when these were falling off!

Around this time the YCCC started a packet spotting network. The first try was all of 5 stations K2TR-KY1H-KM1C-K1EA-N1AU. The 'spots' were just unproto broadcasts set to digipeat through the backbone stations. There was of course no fixed format, no sh/dx command, and only your one screen worth of data at a time. Interesting enough to get us to work on more development and for AK1A to write the first PacketCluster software, and me to write the first spot sucker software for future contests.

Spring Cleaning 1986

What to do with a broke 40-2cd? Well, besides put it back together anyway. Well, lets see, two elements broken in the middle makes 4 quarter wave pieces. Four quarter wave elements, some radials, some phasing lines, and a switching network make a 4-square! Though not a very good one.

Figure 24 Half of 40-2cd element as a vertical

Field Day 1986 was another big time in Peru. 22 operators, a couple towers, fishing, and food… what else do you need? Oh yeah, a bit of operating!

Figure 25 KB1W operating FD

Figure 26 WB1EYL (NJ1F) Putting up field day antennas

Figure 27 K1RQ and KB1W-Jr fishing during FD

Figure 28 FD Dining room and kitchen

Notice that down under the deck on the right side is the first appearance of the old white fridge. This was to become a fixture in the station and is still going strong 20 years later.

Figure 29 NT2X and KB1W-Jr at packet station

I think this was the first year for a packet station bonus for field day. I think this was N2EPV's van with my Model 100 as a packet terminal.

Figure 30 W1DWA operating

Back to the broke 40-2cd… Since I didn't know how to properly reinforce it yet and the sunspots were supposed to be increasing I decided to replace it with some different antennas. So the top of the 150' tower got a Telrex mini Christmas tree. This consisted of their 3 element 20m, 15m, and 10m antennas.

Figure 31 Building the Christmas Tree

KB1W was up the tower for this one and didn't like those 2m 'porcupines' up there so the stuck them down the tower out of the way. This was a mast jacking operation. Since the top antenna was going to be too high to reach the mast was lowered down, and the antennas installed as the mast was jacked up.

Figure 32 Big ground crew

and I got my first stack on 20m, 3 over 3!

Figure 33 The Christmas tree plus a low 20m on side arm.

The 2m porcupine became a fixed link in the growing packet spotting network. And eventually the 40-2cd got rebuilt and side mounted for the fall of 1986.

Oh yes, did I mention that Peru gets a bit of ice? And some snow?

Figure 34 More ice, but this time everything lived through it.

Figure 35 Nice little plow piles, unless your driveway is behind one of them.

And Growing

Ah yes, spring again… and once again a ham's thoughts turn to towers! And of course that means?? You got it, more chain sawing!

Actually the Spring of 1987 didn't mean much chain sawing. The only tower addition was a 50' tower left over from field day that got a 4 element 15m Yagi fixed at Europe.

But the summer of 1987 was the dawning of the real 4-square construction. I built a full size 80m vertical from chain link top rail and tested it tied up to the deck.

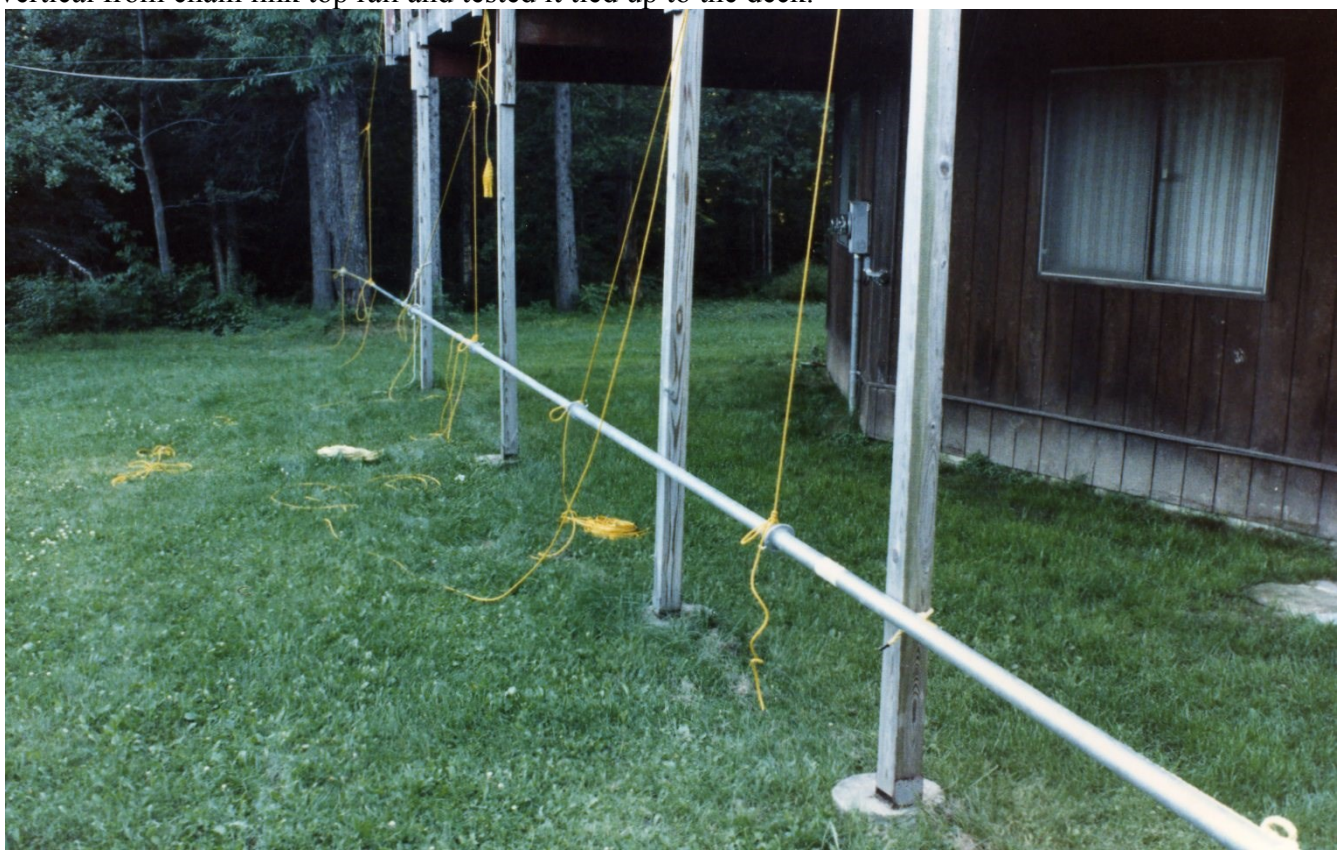


Figure 36 80m vertical of chain link fence top rail

Unfortunately that pipe proved too weak and after some redesign it was put up as base loaded 48' tall verticals. The first phasing network for this used Wilkinson power dividers and coax phasing lines. This phasing network did the job, but was relatively inefficient. See my description later on about the different ways I have built and controlled 4-squares.

For a while the 80m and 40m 4-squares shared the same feed point and radial system. This was definitely a mistake. While they each seemed to work I don't think either one of them was really working as well as it could, even with the Wilkinson dummy loads eating up the power.

The feed systems for each one were in their own custom made galvanized enclosures. Its amazing how well these enclosures worked, they never had water in them and only occasionally were houses for mice or wasps.

Figure 37 80m 4-square and 40m 4-square feed points and one set of verticals

The 80m base insulators were simple fiberglass tubes with a bolt through for holding the vertical up and feeding it.

Figure 38 base of 80m vertical feed point

A big effort this year was doing a bit of reorganizing in the shack. Some new tables were constructed and the shack was transformed from this.

Figure 39 TS-830, Alpha 76, and lots of pieces!

To a bit more organized operating area for the 1987-88 contests.

Figure 40 KR1R trying to figure out what to do with packet on dumb terminal.

Figure 41 NS1M, SP1KE, KB1W hard at work.

Figure 42 NT2X with world's first packet spot sucker on right.

Figure 43 Coffee, Tea, but not me!

One thing about hosting contest operators… they either drink a lot of coffee, or soda, or beer. The coffee pot arrangement has changed a few times but has always been just outside the shack. I have never been a coffee drinker so someone else always has to make the coffee. I think I still have that coffee maker, along with 4 or 5 more that various operators have donated to the cause over the years. I think that hot water maker on the right came with the house along with most of the cheap cups hanging on the peg board.

Figure 44 The other side of the story.

This was another short lived fixture. Too much beer leads to too many trips to the bathroom and too little operating. This fridge still is in use in 2005, believe it or not, but now it's filled with soda and coffee creamer.

And Growing Some More

Ah yes, spring(1988) again… awww, the heck with it, fire up the chainsaw again. This was the project from Hell for the tower that should never have been. This was obviously conceived before I had 'The Vision' or any kind of a real plan. First, it was too short. 90' of Rohn 25 is only good at the top of the sunspot cycle for the low stacks on 10m and 15m… at least when you compare it to the possibility of stacks on 120' or 150' or higher towers. In a larger station, such as what I evolved to later, this type of short tower gets used for second station on a band spotting antennas, VHF stuff, and miscellaneous uses. For that it was in the wrong spot, it was either too close or too far away, but the spot where it went should have been reserved for a BIG tower for other bands. In any case, this is the story…

Well, this time the chainsaw didn't want to fire up. The old second hand McCullough had given its all on the first 150' tower, clearing stuff around the house, and cutting firewood. And the area that had to be cleared was mostly those little Scotch Pine Christmas Trees that were in nice neat rows. These trees were probably about 15-20 years old at this point, planted in nice straight 4' wide rows they had never been trimmed or thinned. Now they were 15-20' tall, half dead, and tangled up with lots of little Maple, Cherry, and Crab Apples. Ok, bright idea, buy an electric chain saw… Extension cords not long enough? Ok, use the generator, it needed a workout anyway. So the start of the project was full of putting the generator on the cart behind the yard tractor, driving it to the end of a row, starting the generator, and then crawling on hands and knees down a row of these stupid little trees and cutting them off as close to the ground as possible. After half a row or so I would be covered with pine needles, the saw would be full of dirt and pine needles and other crud, and all the trees would still be standing there. The next step would be to bring in the old Jeep, wrap a line around the trees and try to pull them out of the tangle with the next row. Once they were free they got dragged down to one of several big brush piles and plowed up as high as I could go. 17 years later and those piles are just about rotted down.

Then back to clean out the saw, refuel the generator, and do another part of a row. Over, and over, and over again. LOTS of ugly little pine trees. A couple years ago I decided it would be nice to thin out the last of this area between the house and pond so I could see the pond again from the house. I started cutting again, but after about half a row of the now 30-40' tall tangled up trees I gave up and called a pro. Two guys with a huge chipper not only cut down all the junk but chipped it up and gave me tons of mulch in one week. Sometimes it's worth hiring out the ugly jobs!

The next step was the foundations. Well, this was just an itty bitty tower so the base and anchors weren't all that big. Somehow I got talked into doing them myself. So I think it cost a case of beer to get a neighbor to come up with his backhoe to dig the holes. Then I got a load of sand, gravel, and a bunch of bags of Portland cement. The same neighbor with the backhoe loaned me his electric mixer and I was off! A couple shovels of this, a couple of that, a bit of water, then tip and pour. Boy, that didn't make much concrete did it?? Ok, this time double the mix… oops, guess that was a bit too much, so help the poor electric motor out a bit. Back to the original mix size… over and over and over again. Finally the bases were done, now the easy part. Just throw up 90' of tower and stick some antennas on it. Well, the tower was easy enough. And antennas were no problem. Buy boy, it's a long way back to the shack, what to use for feed line? When I did the 150' tower I bought 9913 for the 2 runs I initially did out to the tower. Of course for that everything was remotely switched so it wasn't much good for Multi-Multi use. Now on this tower I wanted to be able to use the antennas for the different bands so I couldn't do remote switching, which made for lots more runs of feed line. Well, it turns out that about this same time the cable company in Pittsfield was wiring up a new section of town. One of the installation crews went out in the morning to run some new cable, pulled off a couple hundred feet and went to stick a connector on it… The connector didn't fit. Ok, it's the wrong size cable, chop it off and go back to get the right size. Turns out they had been shipped one roll of 5/8" where the rest of the city was done with ¾". Fortunately the chief engineer was a Ham who knew that I needed some feed line… the almost full roll that they couldn't use showed up in my driveway one day! Now I had enough feed line to really wire stuff up right!

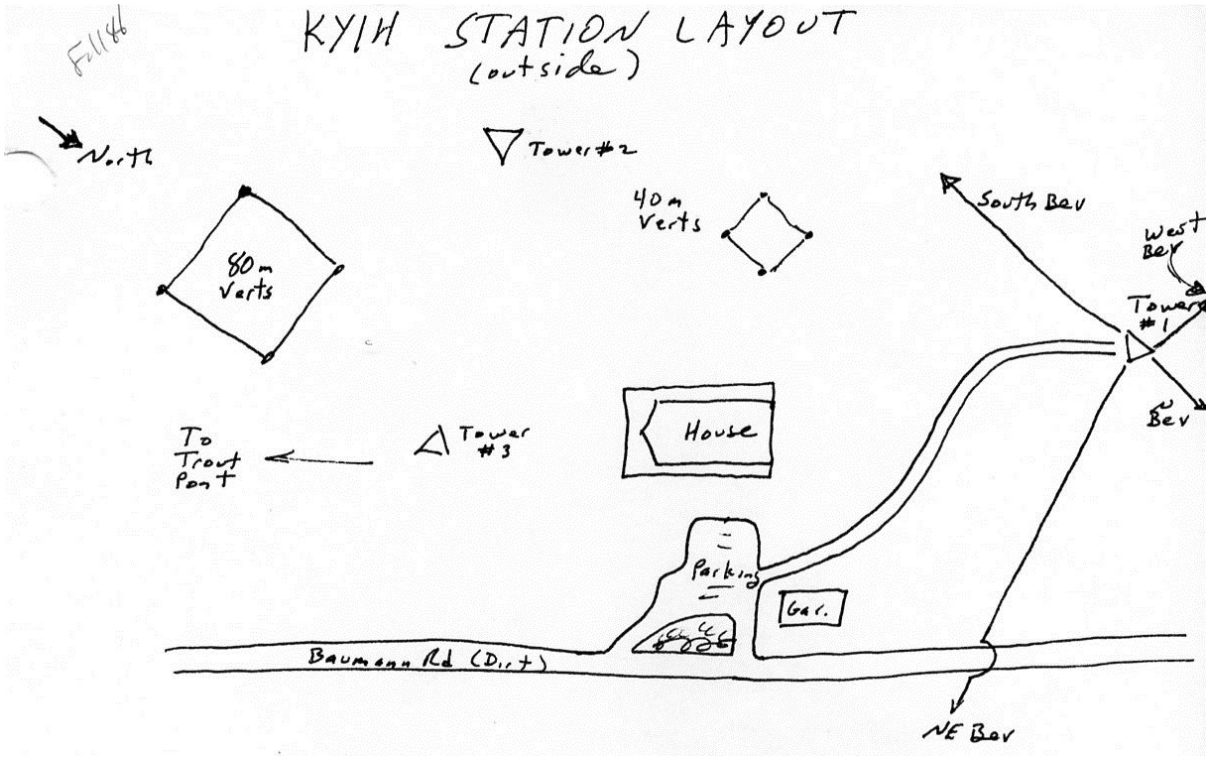


Figure 45 Fall of 86 drawing of layout

At this point there were 2 'permanent' towers and still the left over field day tower. Tower 1 on the right was the original 150' tower. Tower 2 is the new 90' tower. And tower 3 is the 'temporary' Field Day tower. By this time I had figured out that the 80m and 40m verticals shouldn't share the same area and moved the 40m ones. Also you can see that the NE Beverage went across the road. The land on the other side of the road was owned, or leased, I never did figure that out for sure, by a Ham from Long Island who only came up occasionally. He was the only one who ever complained about TVI up here. He was trying to get some New York City TV station with a super deep fringe antenna and preamp. This is not easy up here, we are on a long ridge that runs North-South, so NYC is right down over the back of the ridge the whole way, very poor for VHF/UHF unless you get up a hundred feet or so. In any case the rapidly growing packet network included a 220MHz link from me to Montauk Point on Long Island, which needed a beam and 100w amp to work properly… and which just happened to beam right over his TV antenna, and of course blew away the preamp. But he did let me run the Beverage into his property so I turned the amp off when he was in town.

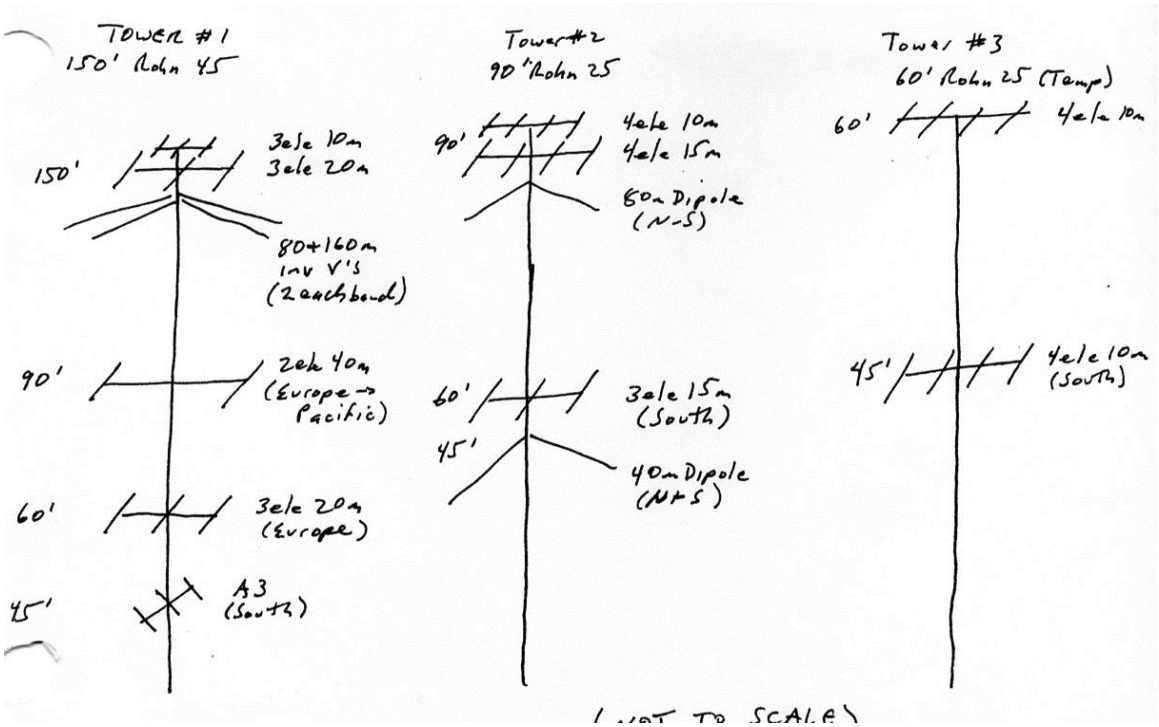


Figure 46 The antennas on each of the towers.

This was a year for bad decisions I guess. A second separate station was set up in a room on the opposite side of the house.

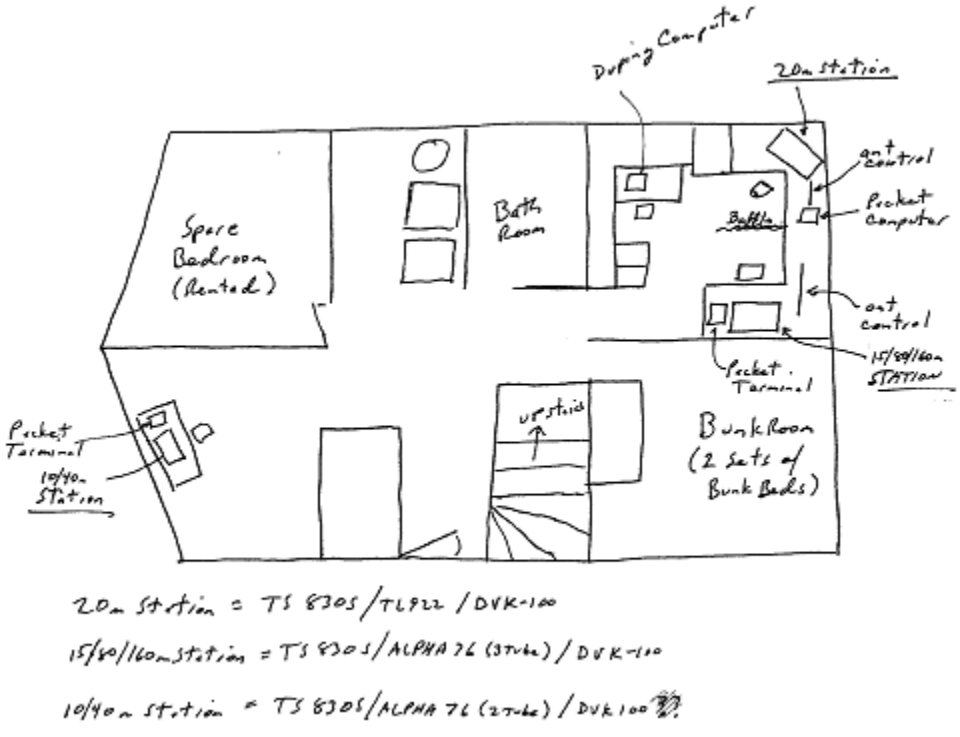


Figure 47 Interior layout

This caused lots of problems with coordinating passing multipliers and other stuff. Plus it spread the noise out so both bedrooms were noisy due to the operating right next to them. Eventually the bunk room on the back of the house was taken over for the multi-multi setup and the front room was converted to a bunk room.

1988 was a big year for computers coming into contesting. While we were still logging on paper we did have a computer for duping, not in real time though.

Figure 48 Off line duping computer

By now the spot sucker/cluster node was running full time on my Radio Shack model 4p computer.

Figure 49 SP1KE on top of spotting radio on top of cluster spot sucker.

Figure 50 Packet spotting network in New England

The packet spotting network had grown to cover much of New England and eastern New York. And the equipment was getting better organized!

Figure 51 Maybe time to clean up a bit

Note the large backup batteries under the table, several radios and amps, all being run by the Radio Shack model 4p. Also visible in this picture are several great artifacts, including an original NelTech DVK on top of the TL-922. A Heathkit antenna switch control box to the right of the amp, and probably every tool I owned on the table or floor. I don't know what I might have been using it for but on the floor just left of the ball peen hammer is the original brass bushing for the prop pitch rotor. A few tools might have been left out of that picture, but can be seen in this one.

Figure 52 The other operating position wasn't much better.

This one shows a second DVK, stubs made out of RG-58 or 59 that later melted down during a contest, and a master control panel with home made 12 position switch, a couple more Heathkit switches, a pre-amp, and attenuator. On the right is a good example of a dumb terminal used for packet.
Around this time the collection of cables coming in through the little holes under the window started to be a bit hard to control.

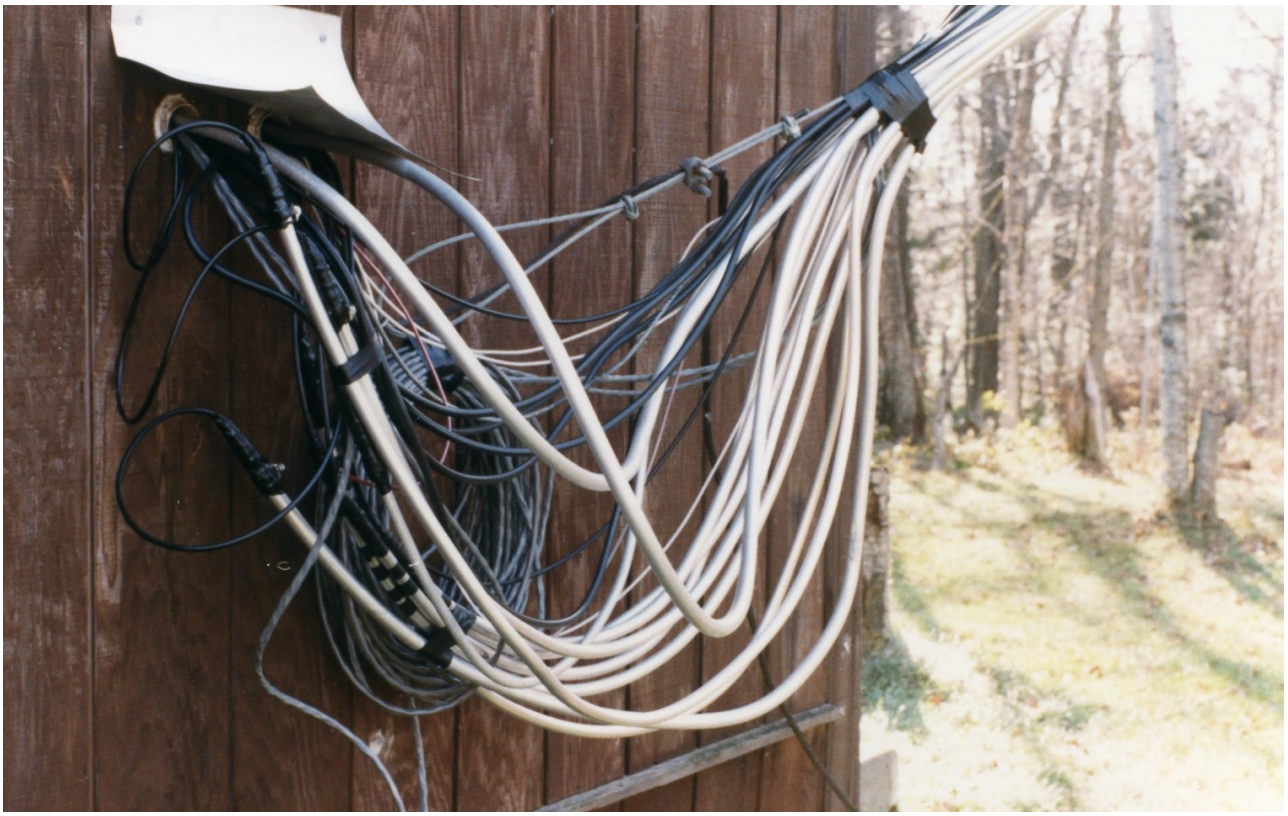


Figure 53 Two wall feed through holes pretty well packed.

Figure 54 What came inside

And the operating area was getting a bit crowded.

Figure 55 NB1Y? in high tech shack!

The summer of 1989 was the first incarnation of the 40m raised 4-square array in the area between the house and pond. The 80m 4-square was also moved to the swampy area North of the 150' tower.

Figure 56 New 40m raised verticals

The verticals themselves are Rohn pushup pipe towers with one section removed and the top one re-pinned lower in the next section to tune them for 40m. The supports that are still going strong in 2005 are pressure treated 2x4's spaced with more 2x4 pieces. The pipe tower is supported on two ½" bolts insulated with fiberglass tubes and spaced on the sides with little squares of Plexiglas. Remove one of the two bolts and the towers can be laid down for tuning or maintenance.

Also this year was the first use of a TIC Ring Rotor. I got one of the 1032 models and put it on the 150' tower at 90' to turn a 40-2cd. This replaced a rope and sidearm 'rotor' that required running outside at about 2am in the snow to turn it from Europe to Japan. I'm kind of sorry I don't have some pictures of that one, it was a cute design for getting a rotate able antenna without a rotor. The idea was pretty simple, just put a pipe in a Rohn sidearm and mount the antenna on it. Now the antenna is free to rotate. Put 2 pulleys on the tower level with the antenna and run ropes from the boom through the pulleys and down to ground level. With this you can get about 150 degrees of rotation. Of course if you use it on 40m you can expect to have to run outside about 2am in the snow or rain to turn it from Europe to Japan.

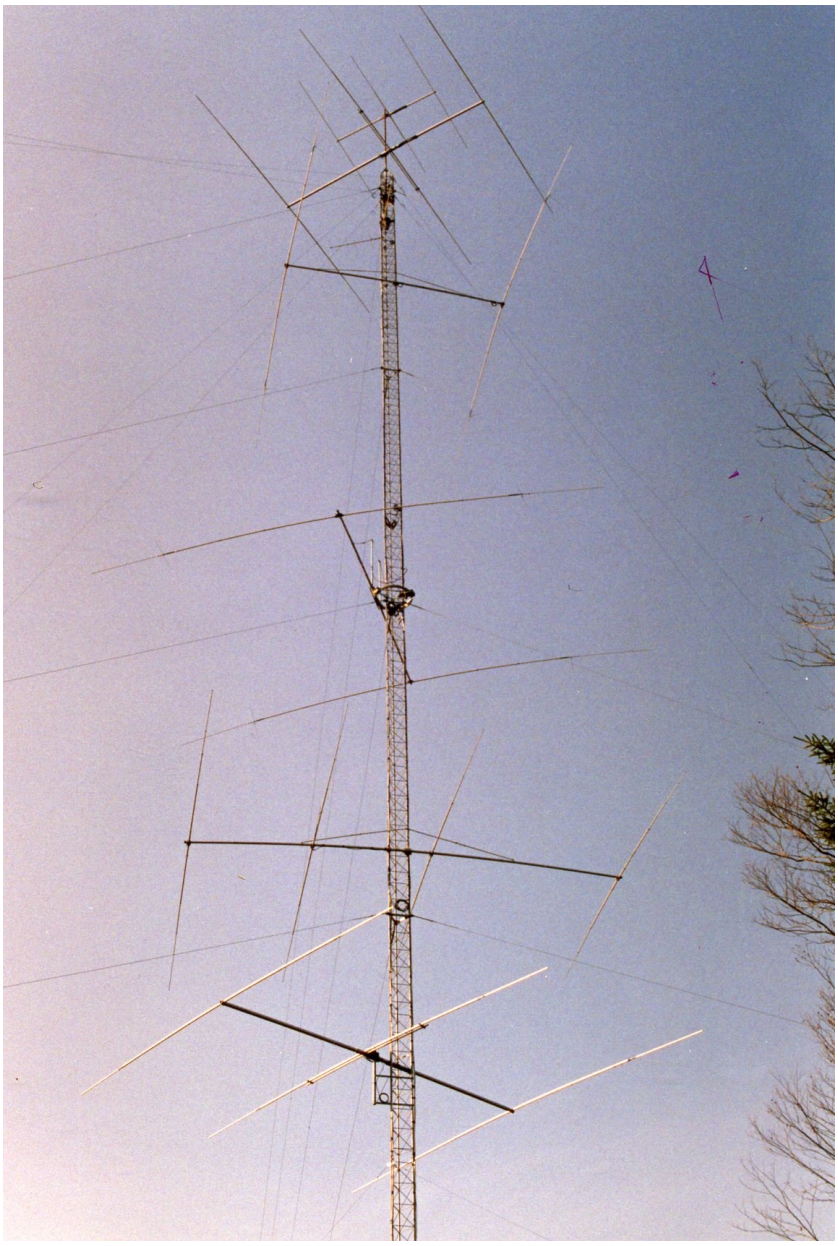


Figure 57 150' tower getting a bit crowded again.

This ring rotor would eventually get moved down to 60' for the bottom of the 20m stack.

Figure 58 Weight test of new operating table.

This summer was the time to re-organize the station again. KA1RE volunteered to build some custom operating tables that are also still going strong in 2005. The first of the tables is being tested with most of the equipment I owned at the time. These tables provided two solid levels for radios and monitors on the bottom and amps and tuners on the top. The front section can be removed by two wing nuts to provide easy access to the equipment. In at least some of the 6 tables we drilled large cable holes in the back sections for cables, but for the most part they are now kept a few inches from the wall and cables just hang down the back.

Figure 59 New Beverage hub

Some other changes included the conversion of the 4 old single wire Beverages to 2 wire designs and construction of a 6 to 3 relay matrix by NJ1F so that 40m, 80m, and 160m could each select any of the 6 independently.

I also moved all the feed lines to a new hole in the wall that was up above the tables and was later hidden behind a drop ceiling.

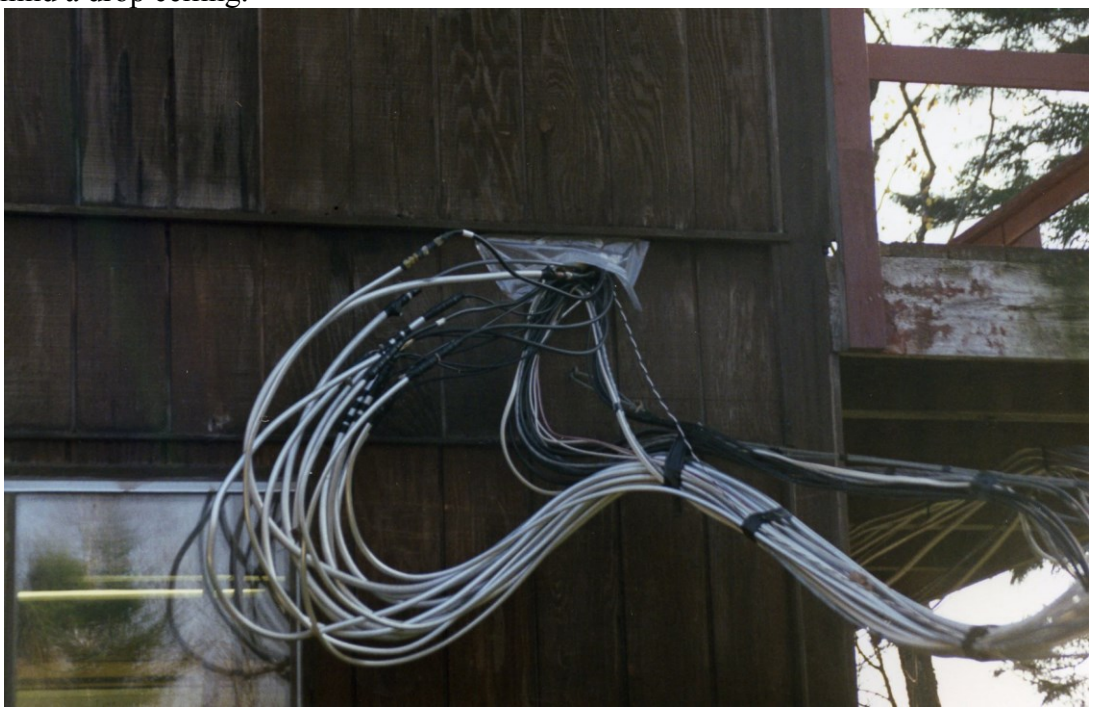


Figure 60 New wall access hole

The final arrangement was like this, which is still the basic setup used into 2005.

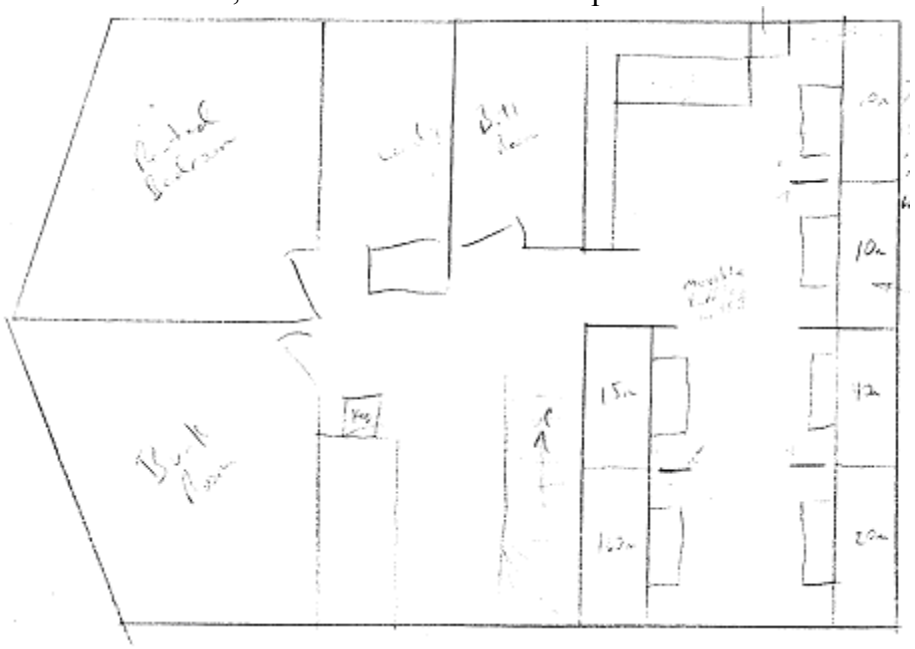


Figure 61 Downstairs rearranged for M/M

This summer was when I wrote my modification of CT 6, the MM Logger (not to be confused with the N1MM Logger). This logger used one 386dx 24 MHz computer with 18 com ports. It ran 7 dumb terminals and 6 MM-3 keyers via serial ports for CW sending. I have always been careful with software and computer hardware for contesting. There are just too many things that can go wrong with RF around computers. When writing this software I learned an important lesson, you need good testers. I found my best tester real quick for this one, I had KB1W try it out and it only took him 2 or 3 keystrokes to break it. Now that is a good software tester!

Just to make sure we didn't lose anything I went with a belt and suspenders system for logging. The log was simultaneously written to a CT type binary file, a plain text file, and to a printer. And of course every hour it was backed up to floppy. I never did need the backup files or paper, but they were interesting to use for extracting data after the contest at times.
Some classic pictures from CQWW in 1989:

Figure 62 NB1Y on 20m CW

Oh, seems to be a broke SB-220. I had my hands in a couple of them over the years, guess this one wasn't fixed in time for the contest though.

Figure 63 N2KW on 15m CW

That must be a spare SB-220. I think everyone that came brought one along just in case. One of them even took up semi-permanent residency under the tables for about 10 years I think before it was finally claimed.

Figure 64 Me at control center.

A rare picture of me watching the computers, the left one is the logging computer, the right one is the PacketCluster.

Figure 65 NQ2D on 10m CW

Notice the pile of spare tubes on the top shelf.

Figure 66 AA2Z on 10m SSB with the ARRL's IC-781 test radio

Figure 67 KA1RE on 40m SSB

Note the Henry amp and spare tubes for the TS-830's and amps on the top shelf. These were essential spare parts for keeping those old amps and radios running.

Figure 68 WB1EYL (or was it NJ1F by then) on 75m SSB,

Figure 69 NS1M on 160m SSB

Note the aluminum foil shielded pre-amp on top of the TS-830.

Figure 70 An even rarer picture of me operating on 20m SSB

That year we got up to second place in the USA on CW. It must have been the bowls of peanuts that helped us along.
There were many operations under several calls during the next couple years.
One tough thing with 6 stations trying to operate in the same room on SSB is noise. An important thing is to use the computer voice keying as much as possible, this makes a big difference. I also built some baffles to go between stations.

Figure 71 A sound damping partition between 20m and 40m.

The baffles were just two drop ceiling tiles in a 2x4 frame, I normally only had them in place for ssb contests. After a while I concluded that these were more of a pain than a help and got rid of them.
An exciting one that stands out is the 1992 ARRL 10m contest. NJ1T operated that one Single Op CW and got 4th place in the US/Canada… though that wasn't the most memorable part. The story starts early

Friday when it started snowing. Doug needed a ride up for the weekend and I was going to pick him up on the way home after work. Well, in mid morning they started closing down roads because the snow was so heavy. I called Doug and told him I was leaving at noon and would get him then. The roads were already horrible and the snow was coming down so heavy it was hard to see. Coming up RT-143 about 3 miles from the house I was wondering if we would make it. Fortunately turning into East Windsor Road was a town plow being driven by the police chief. We followed him up East Windsor Road the 3 miles to Baumann Rd where he stopped and got out. I got out and talked with him, he said they had given up on Baumann Rd already because of the large drift across the end of it from the open field there. He did try to break through it but couldn't, and ended up just making me a parking spot slightly off the road. Doug and I grabbed a couple bags of groceries and set off up the road in knee deep snow and deeper drifts. After plodding through 1000' of that stuff we got to the house… no keys! And of course for some reason all the doors and windows were properly locked! I leave Doug to wait and head back to the car, it was already disappearing under a drift, but I got the keys and made my third trek along the road for the day. Operating was uneventful.

Figure 72 NJ1T on 10m

But come Sunday the town still hadn't been up the road. I skied down the road and put a flag on top of the car. I think it was Monday sometime when a LARGE front end loaded dug out the road, I think they were a state road crew that had come in to help dig out because the town plows couldn't handle that much snow at once. Even the dog didn't like it…

Figure 73 Before plowing

Figure 74 After Plowing

Did I say that Peru got some big snows?
The Spring of 1993 was one of the big WZ1R WPX operations.

Figure 75 N1IBN (AA1AS)(W1IX), KB2R, WZ1R(N1RR), N1MM

Dig those crazy shorts on WZ1R, with KB2R in the back on 20m and AA1AS in front on 40m.

Figure 76 NU1P and K1MBO

Also NU1P(now SK) on 80m, and K1MBO on what must be a dead 10m.

Figure 77 Outgoing bureau shipment.

With the use of computer logging I was also preemptively QSLing. This tended to generate large shipments to the outgoing bureau. This was probably 3 or 4 contests worth of cards. After a couple years of doing this the rates for the outgoing bureau started going up, as did the cost of cards, so I gave up on this. It also tended to produce large return shipments from the incoming bureau from DX stations responding to all those cards. Now I only reply to direct cards with SASE's and do all contest QSL's to the LOTW.

And Still Growing

It was either early in 1993 or late in 1992 that N1CQ decided to downsize a bit. I went there and helped take down 2 Rohn 25 towers and cleaned out some of his aluminum stash.

Figure 78 Aluminum stockpile, most from N1CQ downsizing

Figure 79 A Rohn 25 Tower ready to go somewhere

From all the stuff and some other acquisitions I was able to get enough tower for two 120' towers, four 15m Yagis, and some other miscellaneous things. Yeah, you got it, more chain sawing. Of course I was getting good at it by now since I was also heating the house, including hot water, with just wood.

Figure 80 One way to dispose of excess trees!

This wood fired furnace was an interesting find. Made by a company called Taylor it was basically a big hot water tank with a firebox stuck into it. The big black thing above was the door which had a thermostatically controlled fan mounted on it. When the tank temperature dropped it would turn on the fan and get the fire roaring, then shut off. When it shut off a little swing damper closed and let the fire smolder until it was needed again. In the back there was a tankless hot water heat exchanger that made

domestic hot water for the house, and 2 big copper loop heat exchanges for making hot water to heat the house. Inside the house I had 2 zones, one upstairs and one down. In each zone I had a forced hot air system that used commercial refrigerator type heat exchangers to turn the hot water into hot air and blow it through ducts to the various rooms. Downstairs this just replaced the old propane burner that was there, upstairs I had to add ducts since that was only heated by electric wall and baseboard units.
The furnace was so good that it only had to be stoked 2 or 3 times a day depending on the outside temperature and how much hot water was used. It could take logs up to about 30" long and as heavy as I could pick up. But it was a real pain to clean. About once a week you had to take off an access cover in the back and scrape the tubes out. And it generated lots of ash that had to be carted away. But it did keep me from buying propane for about 13 years and used up lots of the trees that were cut down.

Figure 81 Base ready for concrete

The summer of 1993 saw the first of the 120' towers go up. This was a very dry summer and one of the only times I have had holes dug for a tower that didn't get wet. This one had just the opposite problem, when the backhoe dug the hole the soil was so dry it kept crumbling into the hole. To keep them from just collapsing the holes were about twice as big as needed in the end.

Figure 82 NJ1F, KJ4KB (K1KB)(now SK), WA1ZAM, AK4L(W1VE) relaxing

Big operating crews mean you need some extra room for off duty operators. Fortunately I had plenty of extra room. A computer up in the dining room on the logging network makes it easy to monitor progress and hold all the big discussions about operating plans away from the operating room to help keep the noise down.
Did I mention that Peru occasionally got some snow?

Figure 83 Peru from 150'

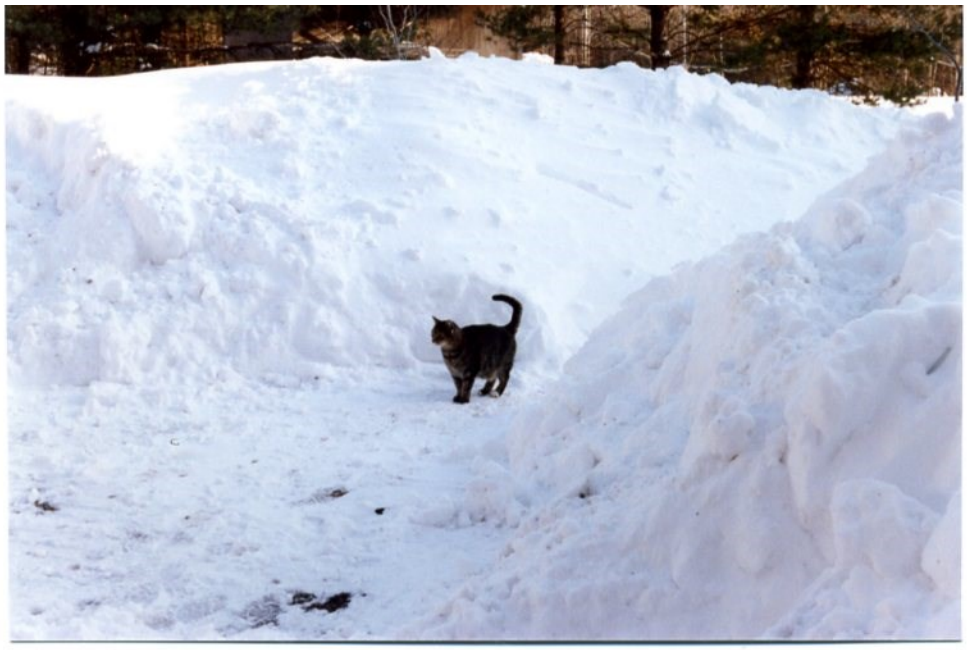


Figure 84 A little bit of snow and Spike, the Valdosta Ga. alley cat.

Oh, and about un-modified 40-2cd's… they don't like ice and wind. By this time I had about enough of fixing these things, fortunately some modifications were published that beefed them up enough to live through Peru winters. Another needed modification is to replace the sheet metal screws (why do manufacturers like to use these??) that attached the coils to the aluminum with stainless bolts. Without this mod you either end up with a rotating dipole (when one of the reflector traps opens) or intermittent high SWR, or arcing noises all over the bands.

Figure 85 Slightly skewed 40-2cd

Ring Rotors make nice platforms to stand on… but they are a bit of a pain to climb around.

Figure 86 TIC 1032 ring on 150' tower

Why do they call this 'wireless' anyway??

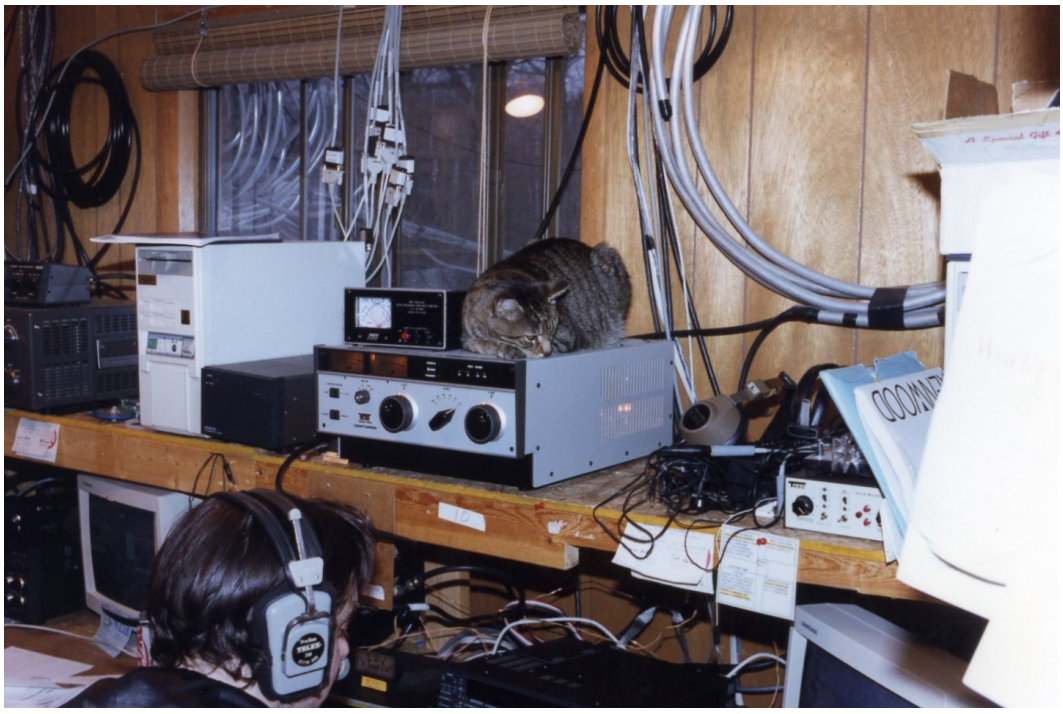


Figure 87 Wireless?

Note the hard line stub hanging on the wall on the right, the coax stub on the left, and the serial cables going from the network hub machine to all the other logging machines in front of the window. Since each logging computer generated it's own cw now using one of the W1WEF keying interfaces with CT there was no need for the other 6 serial ports for the MM-3 keyers. Since I didn't need 2 of the 8 port DigiBoards I gave one of them to K1EA so he could add support for that for networking. The other DigiBoard from the old logging system went into the 80m computer to run the serial network for the other computers and packet.

Figure 88 TB5 on temporary tower, 120' 40m tower

For a while I had a TB-5 Telrex tribander. This was a disappointing antenna performance wise, and I also blame it for creating lots of cross band interference. When it came off the tower lots of noise on 20m, 15m, and 10m went away. It's possible it had a bad trap or other connection problem and since it was resonant on those bands it just created more junk.

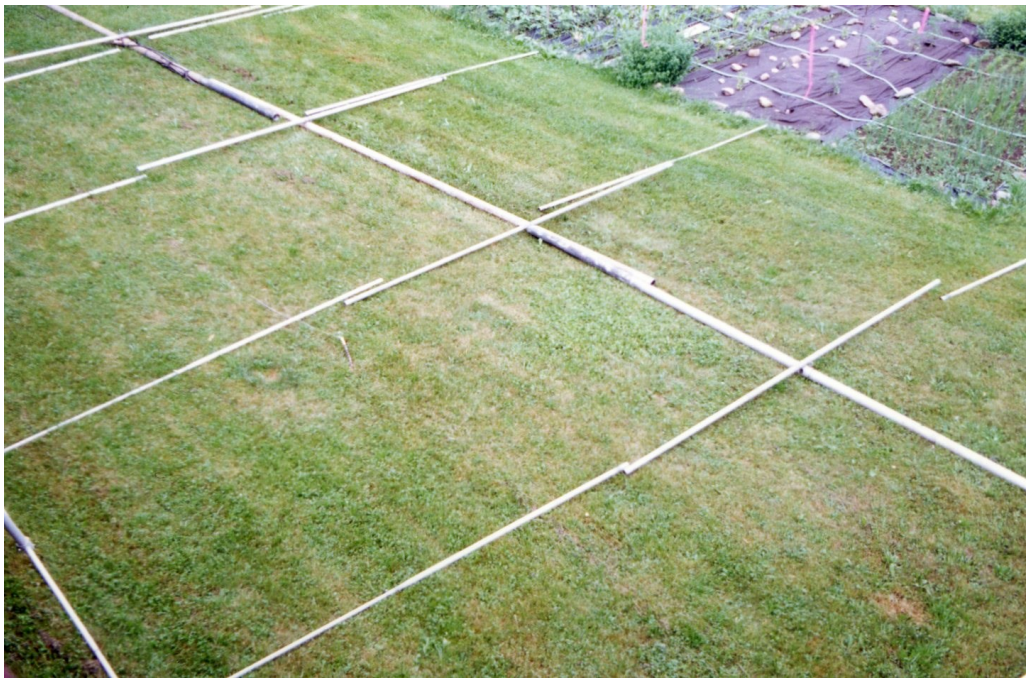


Figure 89 Laying out the parts for the 20m monster.

Also in 1994 I acquired 'The Monster'. This was a Telrex 20m646, their 6 element 20m monster on a 46' boom.

Figure 90 WZ1R (N1RR) decked out for climbing.

The Wiz getting ready to help put it up on the field day tower to test the redesign.

Figure 91 Getting temporary tower ready for the monster.

And here it is ready to test.

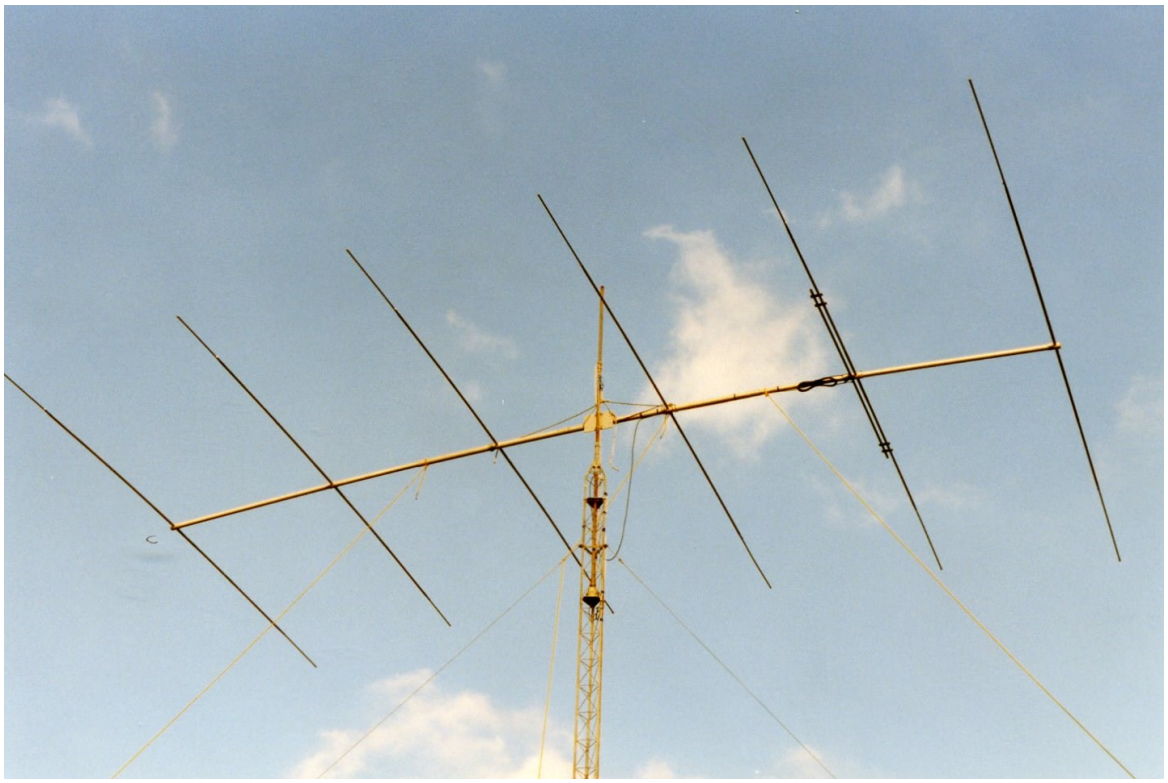


Figure 92 The monster on temporary tower for testing

You can't really tell from this picture, but I had redesigned the monster before putting it up. By running it through YO I improved the performance quite a bit. It basically ended up as a long boom 5 element with a spare director being used for wind balance.
This was the first use of a tram system here to get this thing up to 150'.

Figure 93 The monster rigged to tram to go up 150' tower.

Figure 94 Tram rigging.

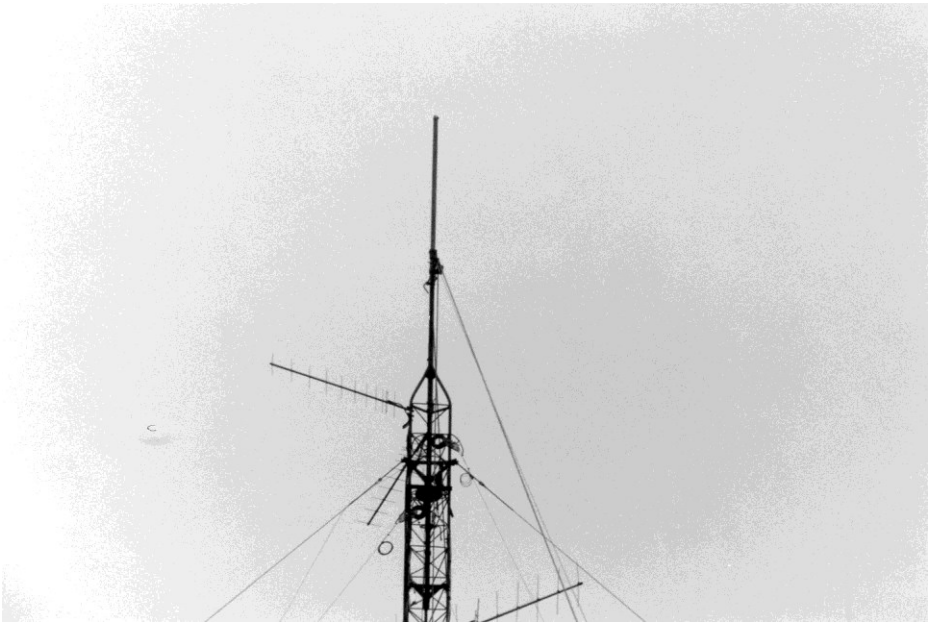


Figure 95 Top of tram before pulling out back guy.

This of course makes it much easier for the ground crew since they are just steering instead of trying to pull the antenna away from guy wires.

Figure 96 WM1K, KB1KE, AA1AS(W1IX) ground crew

Figure 97 Getting ropes out of the way.

Careful planning and control of ropes is important. Notice in the picture above the tag line on the left. There is a large loop around the boom that is tied with a Bowline knot so it can't tighten. A short piece of rope from the knot is tied over to near the boom-mast plate so the knot can be easily pulled over to the tower to untie.

It was a lot of work, but in the end it was worth it just to get this picture.

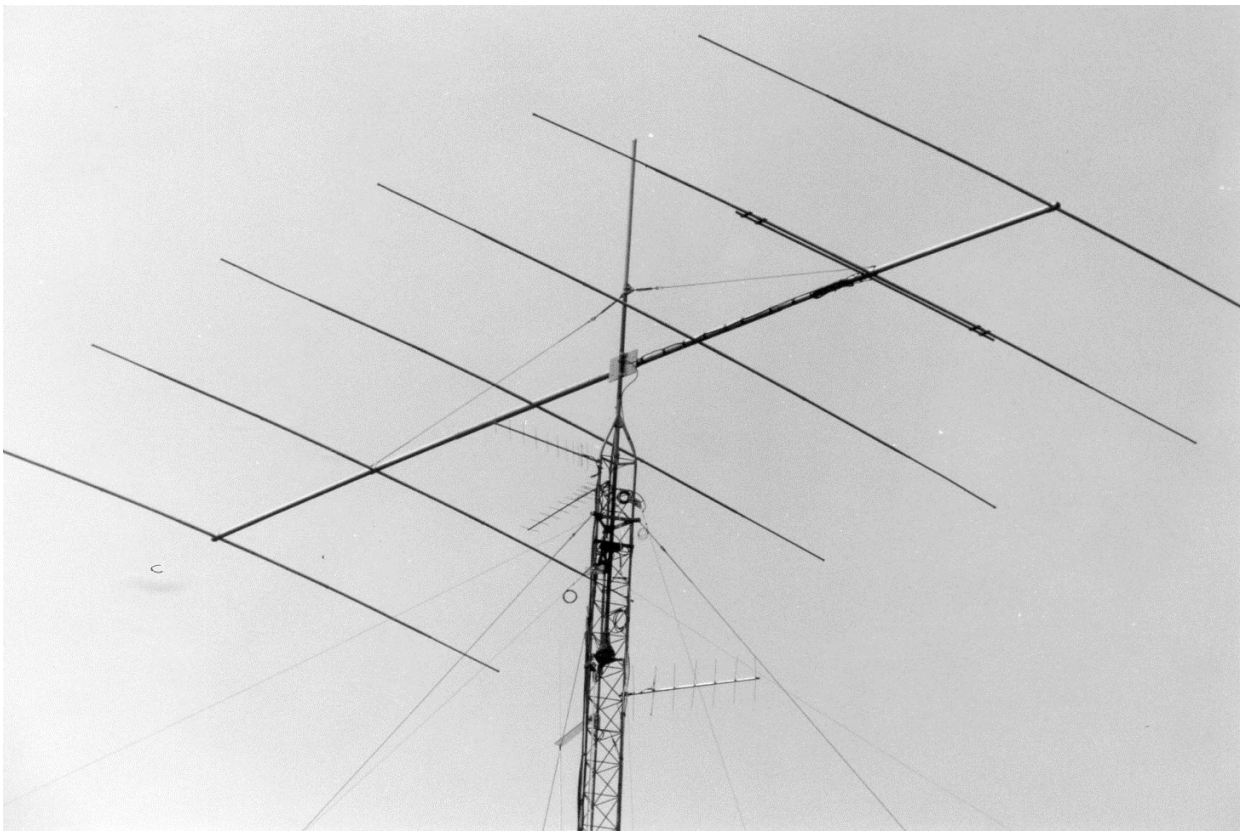


Figure 98 The monster in place!

This was stacked over 2 of the Telrex 4 element Yagis that were obtained from a cleanout of old W1AW antennas when they upgraded their system.

In retrospect the 6 element 20m and eventually the 8 element 15m that I put up were big mistakes. Not only were they rotor killers and much more work to get up and down than smaller antennas, but for contesting they didn't really help all that much. Good 4 element Yagis are in my mind the best antenna for contests, at least from here in New England. Very long Yagis with narrow patterns reduce coverage on the fringes of our main target area in Europe. Also the extra work to get them in the air, and keep them there, makes them maintenance headaches.

Besides antennas I had been accumulating radios and amplifiers over the years. While most of them worked fine there were a few exceptions. Some are well known, the TS-930 digital board, TS-940 connector pins and phase noise, the poor front ends on the original TS-850s, are a couple that come to mind. Others aren't so well known, like the 3 hole Alpha 76 band switch burning up on 10m, and some funky ALC problem when IC-765's are used in m/m setups. I went through a couple repairs on that Alpha amp before I banned it from 10m, all I can figure is that with the 3 tubes there must have been very high current at the band switch under certain conditions and it just melted off the contacts. If you were very careful you could take the switch apart and move an unused set of contacts into that position.

And then there is the joy of acquired home brew projects. I acquired a 4-1000 amp that was designed as grounded grid/screen… yes, you got that right, ground both of them and drive it from the cathode like you would a 3cx1500. While this makes the design lots simpler by not requiring bias or screen supplies, it required 200w drive to get to 1500w output. So the only band I could really use it on was 80m where NJ1F had 'temporarily' loaned me his FT-1000. This amp was a real monster, the RF deck was separate from the power supply, and the power supply was in an old arc welder cabinet.

Figure 99 4-1000 amp

The power supply was so heavy I couldn't pick it up and I think it left permanent indentations in the floor were it sat for a couple years. It also had another problem, parasitics. Twice it scrambled the plate choke before I figured it out and sent away for AG6K's modification kit. I put in the modifications that seemed to apply and hooked it back up. In the picture the operating desk with the radio is on the right. I was carefully bringing the power up and watching the meters each step when there was a loud BANG! After I came down off the ceiling and my ears stopped ringing I noticed the front of the grid meter was hanging out of the hole and the plastic cover was missing. I later found pieces of the plastic cover on the other side of the room about 20' away. The amp was turned off, unplugged and listed for sale as '4-1000 RF deck and power supply, needs work'.

At this point I was accumulating quite a collection of cables coming into the shack. I had a couple friends bring their wives over just to see how bad it could get. I guess after seeing this they didn't have as many objections to one or two pieces of coax coming into the house.

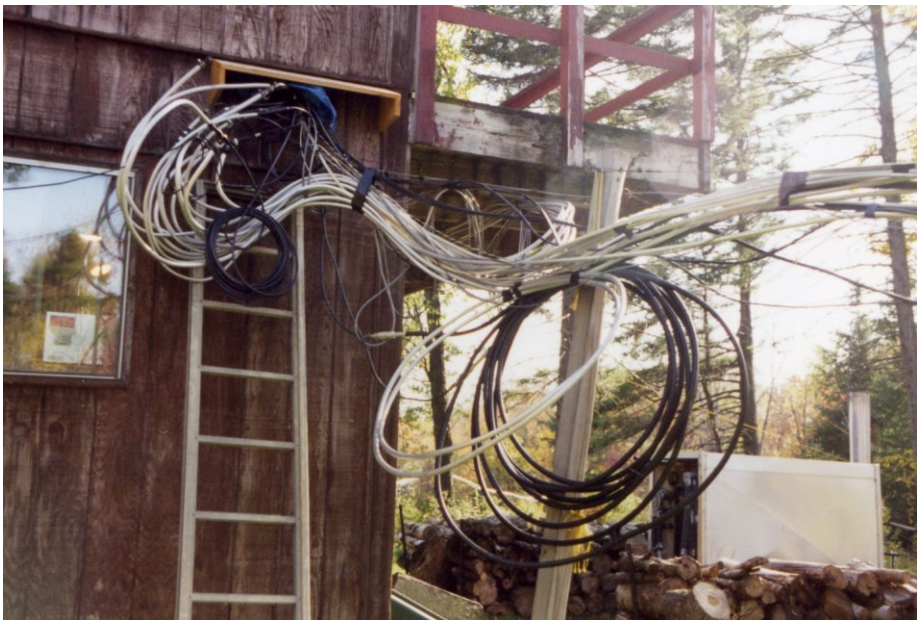


Figure 100 The cables just keep getting thicker.

Oh yeah, this was also the year of the 80m beam.

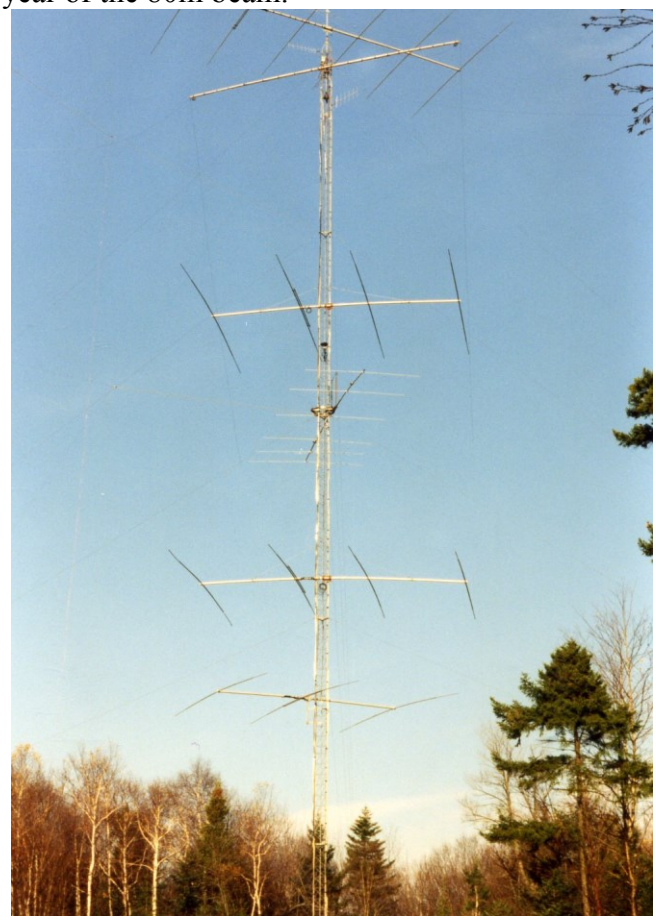


Figure 101 The 20m stack and 80m wire beam

This was built on an old Telrex 40m boom from the W1AW aluminum pile. It was a reversible design adapted from an ON4UN "Low Band DXing" book design. His design used loops, I used inverted V's to get a better pattern and reduce the wire and rope necessary. This was another disappointing antenna in the long run. It was slightly better than the 48' tall base loaded 80m 4-square array most of the time.

But when the 4-square pipes were replaced by a raised radial wire vertical array it was rarely better. And after it broke I don't think there was much difference between it and the single inverted V that replaced it.
Did I mention yet that lots of operators means lots of food? Sometimes I even have produced a full turkey dinner for CQWW CW for those who just didn't get enough of it at home before coming for the contest. After all, I would hate for anyone to miss eating all those turkey leftovers just because they were playing contest for the weekend.

Figure 102 A light dinner for the operators.

Figure 103 Why wait for spring to start the chainsaw?

Sometimes the chain sawing didn't wait for spring to really be here… especially if there was a lot of snow.

Figure 104 Raise the drawbridge

The summer of 1995 was the year for the second 120' tower. This tower was straight back behind the house so there wasn't any way to get there that wasn't blocked with cables. And lots of cables can mean problems getting heavy equipment in place. This job called for a drawbridge to get the cement truck back to the tower.

Figure 105 base in place for second 120' tower.

By this time I had this tower building thing down pretty good. This tower went up pretty quick.

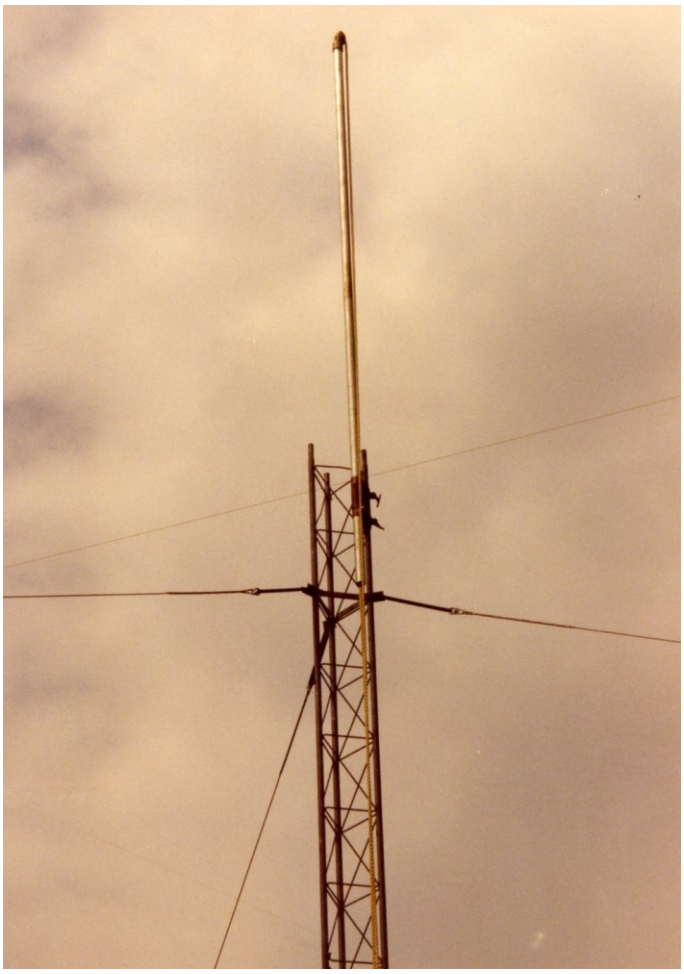


Figure 106 Gin pole on the way up

Figure 107 last section in place, now for last guys.

Notice the rather ominous looking clouds in the back as I was getting ready to bring up the guy wires? About an hour after this we got hit with a line of thunderstorms called a 'Bow Echo'. This storm started around the Canadian border in upper New York and took about 2 hours to cover almost 200 miles leaving a swath of destruction across New York and into western Massachusetts. The power went off for a couple days while they put back up power lines around the county, this was one of the longer power outages I have had here. Fortunately I do keep a generator handy so I can at least run the well pump and get on the air if needed.

Figure 108 Tram rigged on tower, with back guy in place.

Figure 109 The 15m monster ready for the tram ride.

Figure 110 Another masterpiece!

Like the 6 element 20m this one was re-optimized with YO and ended up as a really long boom 5 element with 3 wind balance directors. The birds seemed to enjoy watching from their 120' perch.

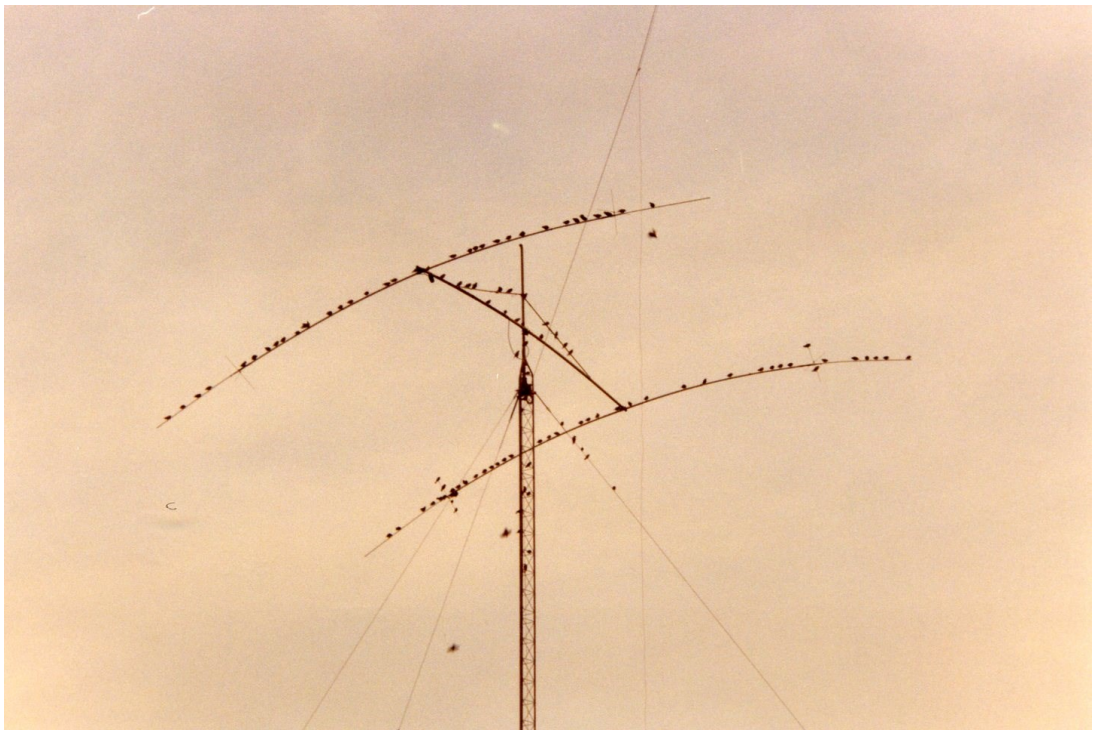


Figure 111 Lots of on-lookers.

Under the 8 element 15m antenna the tower was crowded with all the aluminum I could salvage from the N1CQ stash. This included three 4 element Yagis fixed at Europe, two 4 element Yagis fixed at Japan, and a 3 element one fixed south. Yes, I do think this tower was just a bit overloaded.

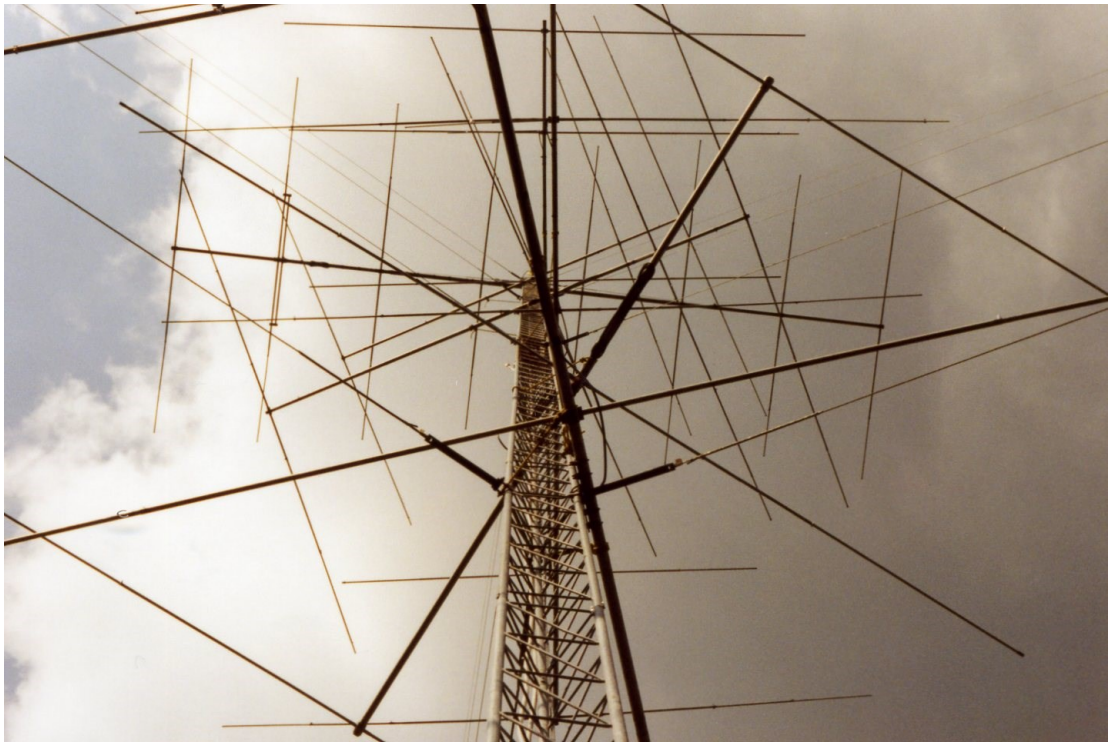


Figure 112 A few elements anyone?

This view up the 15m tower was really a sight to behold!

Figure 113 Time Out!

Figure 114 GO AWAY! This is no place for you!

Back to reality… Oh yeah, sometimes having lots of operators means digging cars out of the snow.

Figure 115 A little snow.

WPX in 1997 was the first attempt at SO2R by KQ2M from here. He brought his own set of manual switches and used two computers. How he was able to keep this up through the whole contest was something to watch.

Figure 116 KQ2M with first SO2R setup.

The winter of 1996 TIC had a special sale, I bought 3 of the 1022 rings. Two of them I kept the other went to the Wiz station. These have been in several different locations. The first interesting application was to have two independently rotate able antennas on a 120' tower.

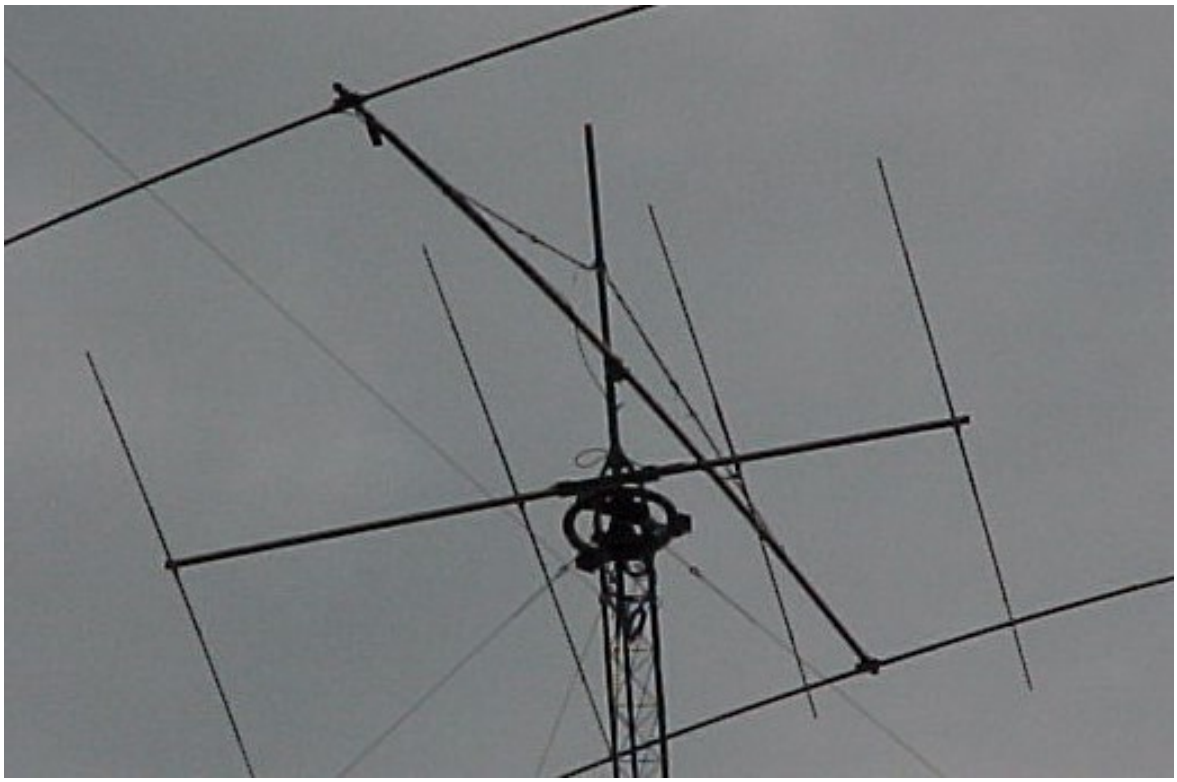


Figure 117 10m on ring under 120' 40-2cd.

By 1998 the skyline of Peru was looking pretty good.

Figure 118 Peru skyline

From left to right… 90' (now gone) tower, the 120' 15m tower, the 120' 40m (now 10m) tower, the 150' 20m tower, the 60' temporary tower. Also visible are a couple of the 40m verticals poking just above the trees.

Figure 119 A dry summer, rock on left is usually well under water.

And despite a summer drought that dropped my pond to the lowest I have ever seen it
I actually had good luck with a garden, though I ended up having to truck water up from the pond when my well started to complain.

Figure 120 Well irrigated garden

One more big growth spurt!

GET OUT THE CHAINSAWS! Its time to build a tower! Well, maybe just a little bit of chain sawing this time. But two towers had to move for this one. The 90' tower that was in the field was removed and shipped to Grenada. And the field day left over 50' tower next to the shed was moved to the other side of the house. This made room for the biggest tower yet, 180' of Rohn 55.
I had learned a bit about concrete forms. This one was not going to bulge or split on me! I think the concrete delivery driver still thought I was crazy.

Figure 121 180' base ready for concrete.

Figure 122 Anchor form and rebar

But I did have problems with water in at least one of the anchor holes. This time I pumped it down before pouring with an old sump pump.

Figure 123 KC1XX raising Rohn 55 section

I started construction but was running short on summer and still needed to get antennas and stuff ready. So I called in the professionals, KC1XX of XX Towers. I had everything laid out and my gin pole up at 70' where I had stopped before they arrived. Matt and one helper showed up about 8am and were quickly raising sections. KB1W was there also and we helped running the guy wires and other stuff on the ground. That nifty little capstan sure made it go quick.

By noon the top section was up and they were putting on the star guy bracket. KB1W went to get subs for lunch and by the time he was back they were pretty much done and just tightening up the guy wires. It is a bit tricky tightening that star guy since not only do you have to get it so the tower is plumb, but you also have to balance it out so there is no twist. And with 6 wires that takes a little bit of coordination.

That bracket is really a nice addition on that tower, it makes the top extremely stable and should make it very solid for when I finally put a BIG 40m antenna up there… maybe next year.

Figure 124 KC1XX's assistant mounting star guy

Figure 125 Guyed and ready for antennas

Figure 126 A big roll of wire.

Why do they call this ‘wireless’. Sure seems like it takes lots of wire. Fortunately if you have good friends you can often find it cheap or free. This roll was donated by one of my regular groups of operators who had it sitting around. Moving it was a chore though.

Figure 127 A small van.

Well, its down hill, just give it a push!

Figure 128 See, it does fit!

They even had some real connectors for it… or so they thought. The connectors were close, but probably for the next larger size cable so they needed a little bit of shimming to fit just right.

Figure 129 Local rabbit control watches over garden.

It sure didn't take the local hawks long to realize they had a nice new perch. Yes, that is the moon in the background. When I first tried gardening up here I had lots of trouble with rabbits. I fenced the garden, I tried other stuff to keep them out, but of course nothing really worked. Then a pair of hawks started nesting in a big pine tree at the corner of the field… no more rabbits! Now if they could just keep the deer away from the garden.

Hawks can be interesting to watch when you are up a tower also. They usually keep their distance but I have had them come pretty close on occasion. The ones I don't like seeing while up a tower are the vultures. I always wonder if they are circling waiting for me to make a wrong move or just looking for something else.

Figure 130 New Peru skyline

The skyline sure looks nice with a new tower. But 180' of tower sure looks empty with only two 40-2cd's on it!

Figure 131 Ice builds up even faster at 180'.

The winter of 2000 had a bit of ice. Fortunately I had followed most of the plans for reinforcing the 40-2cd's and they survived.

Figure 132 And sure is exciting when it slides down the guy wires.

This is some of the ice that slid down the 180' top guy wires. Note how it splayed the ends of the EHS cable above the cable clamps… Remember the cable clamps I said I put above the big grips, well this is what they are for.

December of 2000 I had to go up the 180' tower for some reason that must not have been very important and took my camera up… Something I rarely do. So here is what it looks like 180' above Peru.

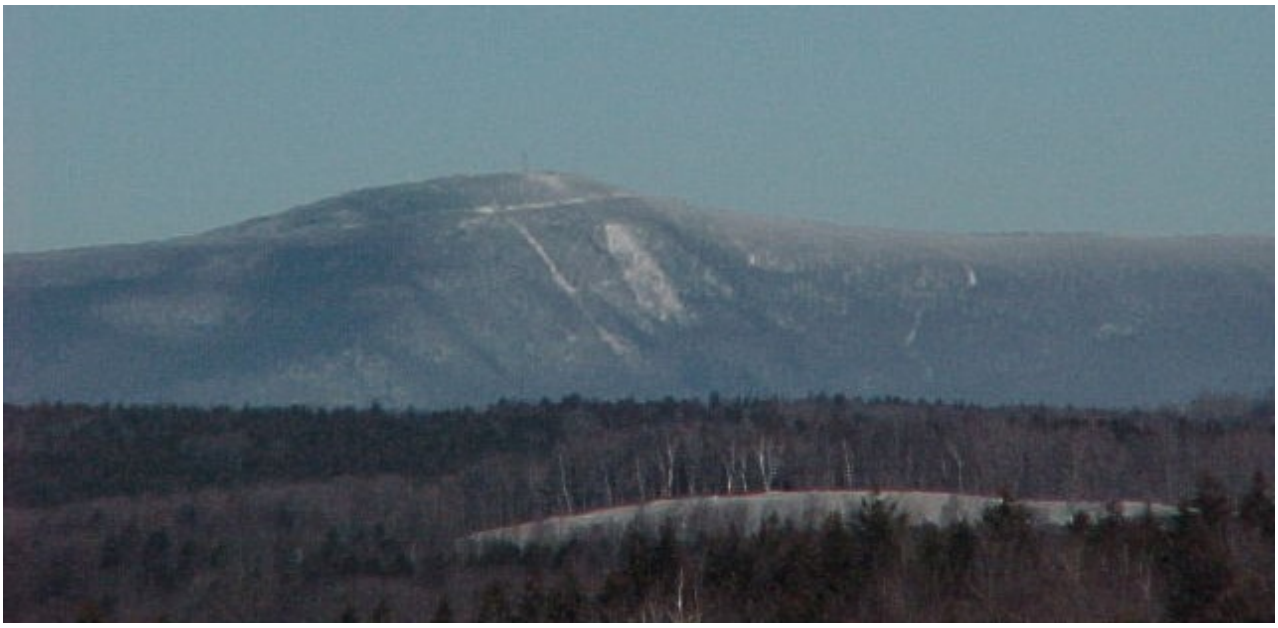


Figure 133 Mt Greylock from 180' over Peru (beaver pond clearing in foreground)

Figure 134 The house from 180' with frozen camera.

Figure 135 The pond and 120' 10m tower from 180'.

The winter of 2001 we got some snow. Didn't I mention that once or twice already?

Figure 136 Just a little bit of snow

Oh, and sometimes it is accompanied by a bit of wind.

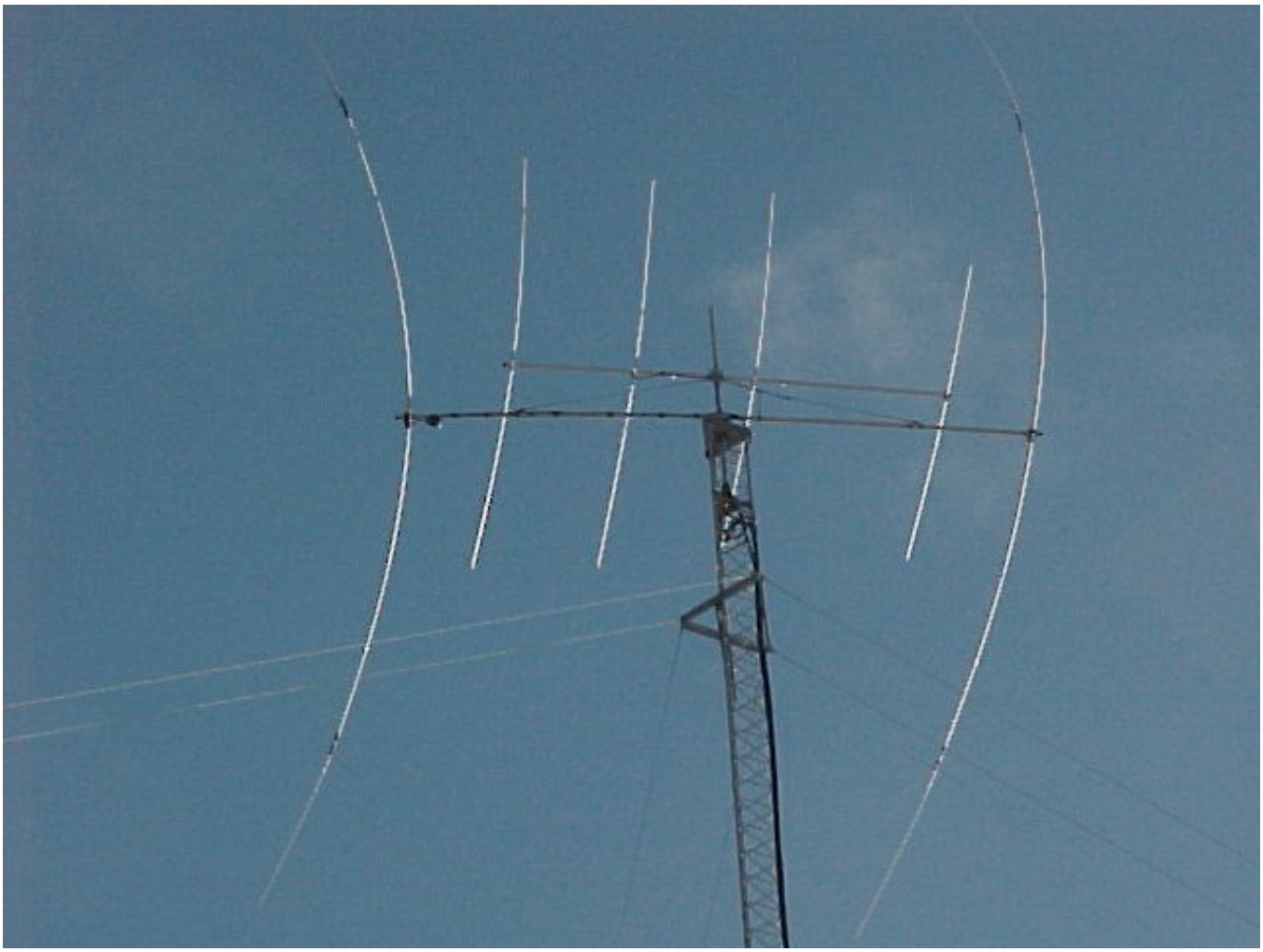


Figure 137 A little bit of a breeze.

A couple notes on this one. First, the 10-4cd above the 40-2cd is missing part of its 2nd director due to fatigue failure of the aluminum. Also note that the two antennas are pointing 180 degrees from each other. This was a trick I learned from K2TR. Point the 10m antenna over the 40m one the opposite direction. This way in the morning when the 40m op is pointing his antenna to the west for the morning stuff in the Pacific the 10m antenna is pointing at Africa or Europe where it is needed. And in the evening when 40m is pointing at Europe the 10m one is pointing at the Pacific where it is needed. This 180' high 10m is often a good band opener and closer, sometimes letting us work Africans 15 to 20 minutes before they could be heard on the 120' high stacked antennas.

And Still Growing? Well, not for a while.

Well, not much growing for a while, the current tower arrangement seems adequate, but the antennas are getting old.

Fall (2002)… did I mention that we got ice here sometimes? This one was the end of the 80m wire beam.

Figure 138 80m beam boom broke.

The ‘fix’ for this for the winter was to finish folding the boom up toward the tower and tie it off till spring. Fortunately it didn’t break off and damage anything below it.

Figure 139 15m rotor needed constant adjustment.

Winter 2003… Want a good reason for the summer plan to get rid of the 15m monster? It was about zero degrees F for this picture when I was fixing the 15m rotor, again.

Spring (2003)… so much to do, so little time to do it. Plans for this summer were to clean up and replace lots of old aluminum. This included removing the broke 80m beam, remove the JA stack from 15m and turn the two broke ones into one good one, replace the 8 element 15m Yagi with a 4 element built from the JA pieces, move the 80m 4-square, and replace the 6/4/4/3 stack on 20m with a 4/4/4/4/4 stack. There were so many things to do and so many dependencies in the process that I actually planned out the whole summer using Microsoft Project. Not so much for the timing but to make sure that everything got done in the right order. There were things like lowering the 160m inverted L rope that had to be done before any of the 20m Yagis were removed, and removing radials to get them out of the way. Just too many things that could have caused delays if they weren't done before the ground crew arrived for any of the big antenna moves.
First, replace the 15m 8 element monster. Break out the tram hardware. Getting ready, this shows the tram cables attached and the pulley almost up to the top before rigging the antenna.

Figure 140 15m monster with tram to bring it down.

Here the tag lines are in position and the antenna is attached to the pulley getting ready to lower.

Figure 141 Rigging 15m monster

Figure 142 On its ay down.

On the way down. Note that one of the directors is missing it's last section. This was getting stuck on the top guy wire so I had to remove it.

Figure 143 Back on the ground.

And touchdown, the first of the summer's monsters is down.

Figure 144 Replacement on the way up.

Its hardly worth it, but since the tram is there, we used it send up the replacement 4 element.

Now, time to replace the 20m stack. The old Telrex stack was showing its age and the top one was the major suspect in the sub harmonic interference hunt. (See that story later on.) So, now its time for new aluminum. After much hunting around I settled on the M-Squared 4 element Yagi design. Boy those things have lots of parts. And each element tip must be drilled twice according to the tuning you want to use… that is a pain, but with a drill press and a small jig it went pretty quick.
The scariest rigging up a tower I have ever done was the removal of the damaged 4 element 20m Telrex. This one had been bent for years at the first director joint. Remember with Telrex the elements go through the boom and there is a reinforcing sleeve around the boom that the element also goes through. Before I put these up I had replaced the tiny sheet metal screws with ¼"x20 bolts and added 2 more bolts at each sleeve. This was a lesson learned from having elements tear up the boom when the sheet metal screws would work loose from vibration. In any case, I decided that I didn't want to remove the boom brace when taking this one off the tower since I thought it was all that was holding the second director and boom section in place. So without loosening the boom brace I rigged it to the lifting rope so that it was kept in tension as the antenna was picked off the side of the tower.

Figure 145 Kinked boom 4 element 20m Telrex rigged to lower.

It actually made it to the ground in one piece.

Figure 146 It made it down in one piece.

The lower antennas were quickly replaced with the new aluminum.

Figure 147 Nice shiny aluminum on way up.

However doing the top ones would have to wait as it was getting a bit breezy that day.
A week later and its still breezy, but not quite as bad and the ground crew is back, so time to finish up. The 20m monster was not going to cooperate. This thing was a pain to get up and it was just as bad coming down. The first problem was that it tilted the wrong way when the last bolt was removed. I had tied it so it should have tilted down toward the tram so the elements would clear the top guy wires, for some reason it wanted to go the other way.

Figure 148 20m monster getting ready to lower

It took about 10 minutes for me to get some rope on it and coax it back to level so we could start lowering it.

Figure 149 Taking off D1 element tip

Then of course it was going to catch the guy wire so it needed a bit of modification to get it down. First remove two element sections from D1.
Then remove two element sections from D2 so they were clear of the guy wires.

Figure 150 Taking off D2 element tip.

And finally, it's on the way down!

Figure 151 Finally clear of tower on way down

Boy is that thing big!

Figure 152 Coming down.

Big enough to serve as work platform to get the last new aluminum ready to go up.

Figure 153 Rigging replacement using the monster as work table.

And takeoff of the last new one.

Figure 154 At last, top of new stack on way up.

Fortunately it slides right into place.

Figure 155 Nice new shiny stack all in place.

Moving the 80m 4-square was rather uneventful. Just lots of rope and wire to keep from tangling up. The reason for this move was to improve the ground system. I could have done it where it was, but it was over top of the Beverages and it didn't seem like a good idea to add more raised radials over the Beverages. So down it came from the 15m 120' tall tower, and up it went around the 10m 120' tower. I had to trim a few trees in the process, just a little chain saw work. Then, time to improving the ground system. I bought an MFJ-269 to help with the analysis. So I started with one raised resonant radial which means really 2 radials if you count the shield of the feed line back to the ComTek box. I made a bunch of measurements of impedance and bandwidths. Then added essentially 2 more radials by connecting the bases of the 4 verticals and made the measurements again… very disappointing change. Back to the drawing board. Lets see, doubling the number of radials again should help some more, but boy that would add lots of wire in the air, very ugly and hard to maintain. Wait a minute, ON4UN said his worked so well because it was over his 160m ground screen, so what about a screen on the ground? I can do that, buy a bit of wire and lay it down on the ground… how much? Well, how does about

22,200' sound? Oh, and I want to be able to roll it up in the spring and roll it out again in the fall. Ok, that takes about 15 minutes… no problem. Roll it out and make all the measurements again, NOW there is a definite change for the better. Unfortunately, now the bandwidth of the verticals are much narrower than they were, and the resonance is higher in the band, so I decide I need to add a piece of wire to the vertical and raised radial to retune for CW. I play for a bit with just adding to the vertical and don't get satisfactory results, so I figure out I also have to add to the single raised radial also, then everything retunes nicely for CW. Oh yeah, some of you are probably asking how to roll and unroll over 22k feet of radials in about 15 minutes?? Easy, it is 600' of 2"x4" galvanized fence wire. Under each vertical there is a 100' piece from the middle out under the raised radial, then a 50' piece crosses that piece at 90 degrees under each vertical. Under each vertical I put a 4'x10' blue tarp to keep the grass and weeds from growing through the wire when it is rolled up in the summer. The wire is just connected straight up to the ground at the vertical feed points.
I also put together a new SO2R setup this year to get rid of the KQ2M switch mess.

Figure 156 New and improved SO2R setup.

This setup includes band decoders and a 6-pack switch under the table top, a pair of switched band pass filters, and the SO2R Master audio and cw switching system. A leaf put between the two tables makes room for the rotors and 6 band's antenna selector switches.

It was sometime before the winter of 2003 that I started running a webcam full time during contests. The view during contests can't be all that interesting, but it seems to get lots of hits on the web site.

Figure 157 Contest Cam during CQWW CW. WO1N on 10m, W1DSW on 40m, W1ES standing, W3SM on 15m.

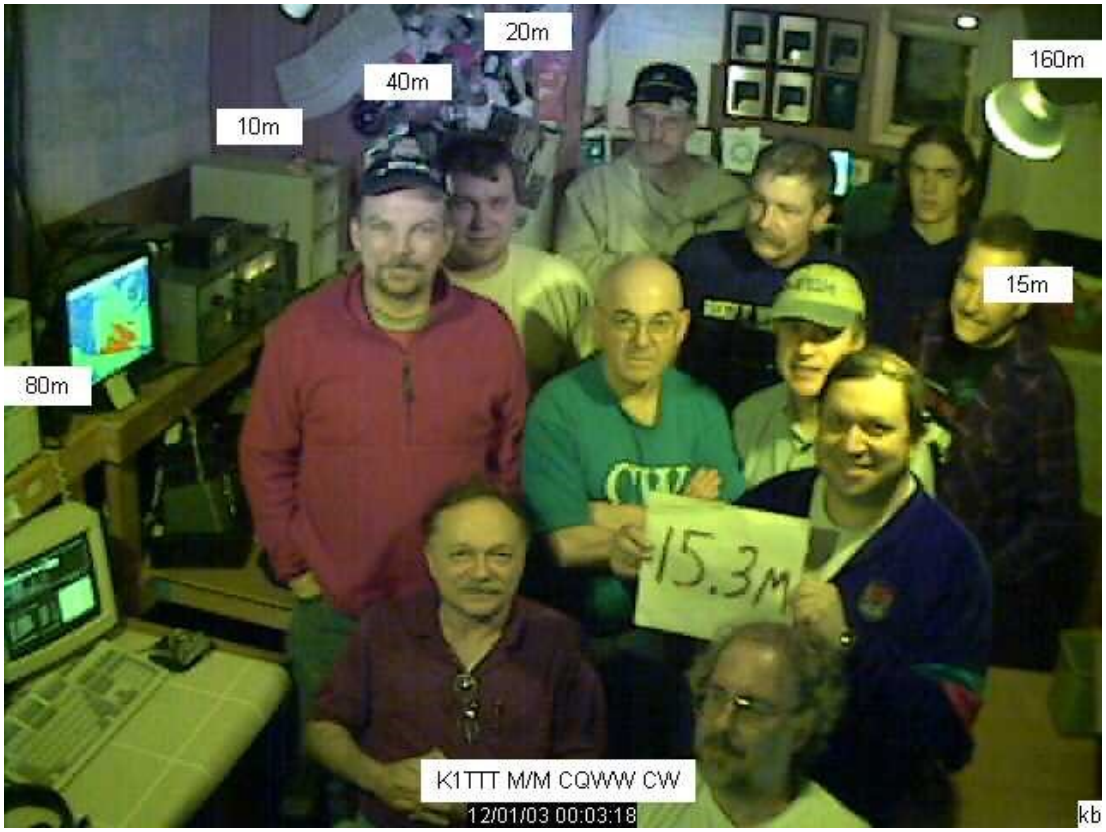


Figure 158 End of contest picture. Front-Back K1TWF, Me, N1IW, K1WD, W3SM, NT2X(holding score), N2OW,W1ES, WO1N(behind 15m label), NF1D, W1DSW.

Since around that time I have also been making time lapse movies of major contests. Some horribly compressed versions of these are available on my web site, and may later come out in a special DVD edition!

Ah, spring (2004) again… and once more a ham's thoughts turn to… NO, not this spring. This spring they are turning to doctors, neurologists, surgeons, and getting one of my poor abused carpal tunnels fixed up. 20 years of chainsaws was just too much I guess.

A little carpal tunnel operation won't stop construction for long though. My surgeon would probably have had a fit if he knew I was out XC Skiing before the stitches were out, so a little tower work a couple months later wasn't any problem.

That summer was the time to replace the 15m stack. This included 5 new M-Squared 4 element Yagis and new feed lines on the tower. First remove old antennas.

Figure 159 Cleaning off 15m tower.

Figure 160 Next 15m ready to come down.

Figure 161 And another one. Looking pretty empty now.

And then throw up the new ones.

Figure 162 Mounting new 15m in ring rotor.

Figure 163 Another new one on way up.

After those monster Telrexes on 20m last year these seemed like toys.

Figure 164 N2KW on 40m with Mono CGI DOS based CT logging on 386DX 25 MHz machines

The last big improvement to hit the station was a conversion from the old CT DOS based 386 computers with nice new P4 machines with N1MM Logger, wireless networking, flat panel LCD displays, and RigBlasters all around. A big advantage of LCD displays is that they are immune to magnetic fields from amps and other power supplies. The old CRT monitors had to be carefully positioned and in some cases shielded from amplifiers and other magnetic field sources to keep them from jittering and giving ops headaches. LCD displays are not only smaller but much nicer to look at for long periods, and they are in COLOR!

Figure 165 W1MJ with New Flat screen LCD P4 systems with N1MM Logger on 20m

Figure 166 N2OW at the SO2R setup with new computer setup

Figure 167 WM1K at the SO2R Setup for NEQP 2005

Figure 168 RX9UL on 15m during WAE CW 2005

Figure 169 N2OW on his knees praying for better propagation in WAE CW.

Figure 170 YCCC Picnic August 2005

Happy Birthday!

2005 marks 21 years of station building. The big presents for this year? My 6th Commander HF-2500 amp, thus making the first time that I have a full house of identical amps. And for outside, a NEW 4 element 40m beam to make that 180' tower look a bit fuller.

The M-Squared 40M4LLDD has a LOT of parts. I unpacked it in the garage where it almost completely covered the floor by the time all the parts were sorted out. I started assembling the elements in the garage, this process used up many of the small nuts and bolts, but it didn't take long before the elements were sticking out the front so I couldn't close the door. I then moved the parts to the old garden area in front of the shed where I figured we could lift it off from. Once the elements were laid out next to the boom it became obvious that it wasn't going to fit, so it got moved over behind the house. Here the final assembly was completed. LOTS, and LOTS of parts!

One big step in assembly of this antenna is locating the balance point for the boom-mast plate. This was done using a third tripod in the middle to temporarily lift it .

Figure 171 4 legged tripod for finding balance point.

This is a good sized antenna. It is a 4 element linear loaded Yagi with dual driven elements. The boom is 42', the reflector is 50' long, and it weighs in at 142 pounds. While it looks well designed I decided to put it first as the lower antenna in the stack and test it for a year, then maybe next year put another one up top on a big ring rotor. In any case this is still a job for a tram. This tram was going to be a bit different than the ones in the past though. The idea with this was to take advantage of working in the middle of the tower instead of on top. So the tram wire was attached to the guy bracket above where the antenna was going to provide about 30' of clearance to get the elements over the guy wires. However, to get the antenna down to where it was going to be attached it would have to be removed from the tram. It was also going to end up on the other side of the tower from the tram rigging so it had to be able to be swung around. To do this the tram wire had 2 come-a-longs attached to the anchor point. The rigging from the tram pulley to the antenna was also meant to be taken off easily up the tower.

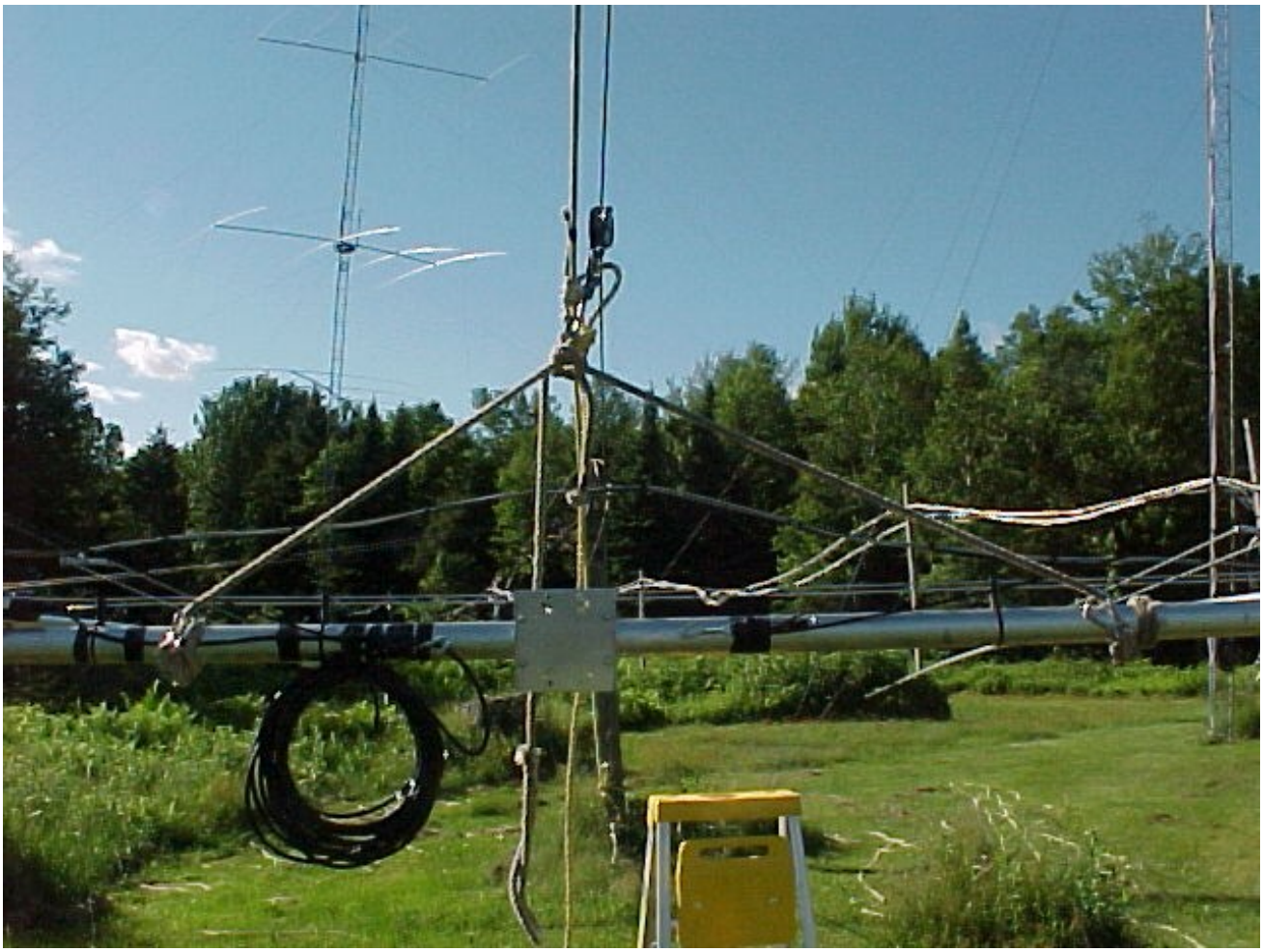


Figure 172 4 element 40m rigged to tram wire.

Note that the large line is attached to two points on the boom about 8’ apart to reduce the force on the boom when it was going up. When getting ready to launch the antenna was sitting on the tripods and the tram wire was loose.

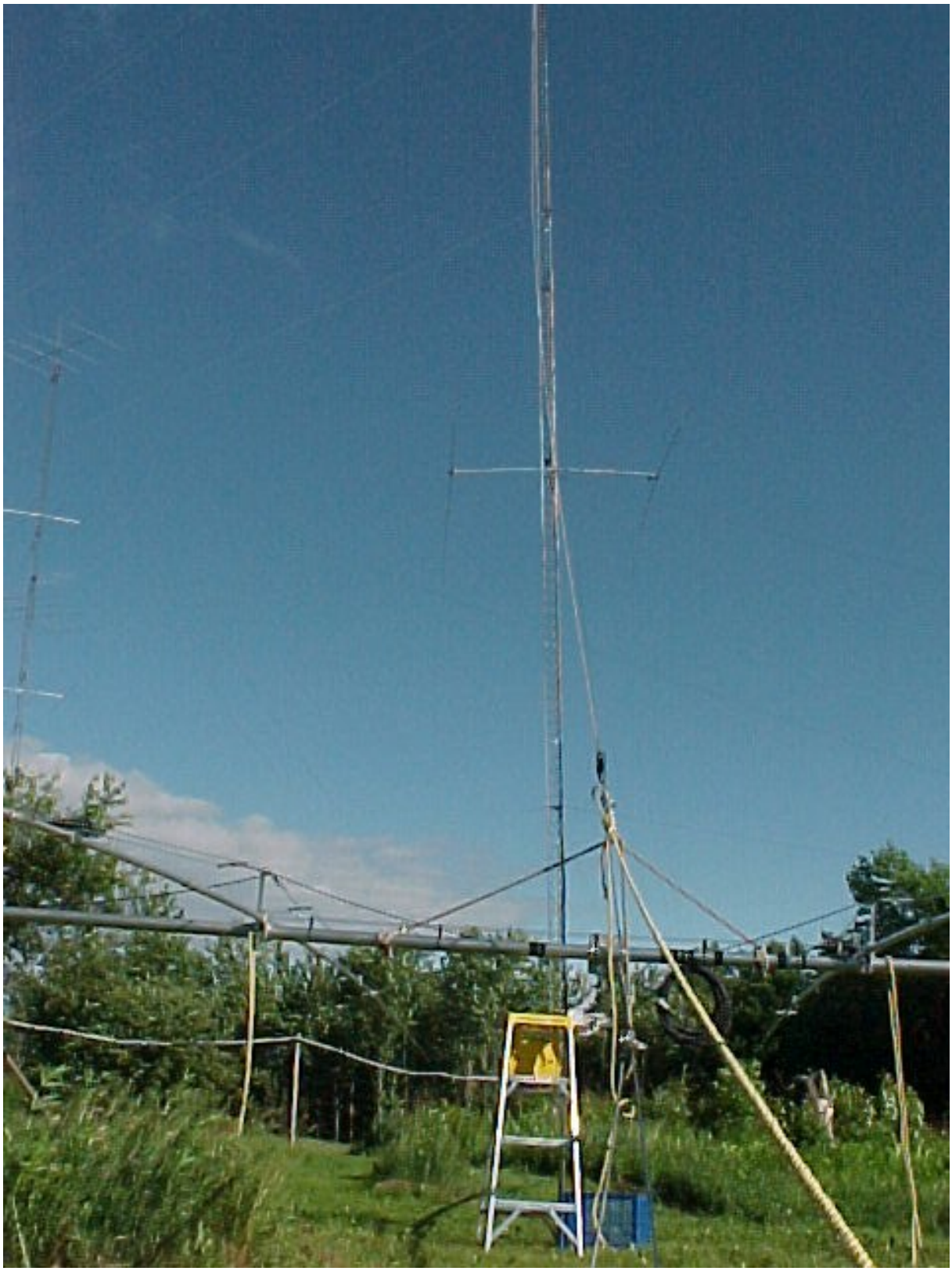


Figure 173 View from tram anchor at pulley and tower.

Once the ground crew was ready the slack was taken out of the lifting rope, THEN the tram wire was tightened with the come-a-longs. This lifted the antenna off the tripods without it sliding backwards. It then was pulled up the tram until it was about 30’ from the top of the wire. The come-a-longs were then released and the antenna swung in to the tower just above the point where it was going to be attached.

Figure 174 Tram wire has been let in to the tower

Then remove the tram pulley.

Figure 175 Antenna off tram wire, swinging around tower.

And swing the antenna, now hanging from just the lifting line, around the tower so it was pointing the right direction.

Figure 176 Tip and turn to get past guy wires

Then its just a simple matter of attaching the boom-mast plate, taking down the tram wire, removing the tag lines, removing the lifting rigging, attaching the boom braces, attaching the feed line, and bringing down the lifting line.

Figure 177 Finishing up boom braces.

That gets us up to date through the Summer of 2005. Future plans? Another 4 element 40m on a ring rotor at 180' next summer maybe. This would give a nice stack and replace the aging 40-2cd's. Why a ring rotor? Did I mention that we got some ice and wind here at times? And that those 4 element 40m antennas are still big even though they aren't quite full size? Also, much like the old arrangement when I had a 10-4cd on a ring below the 40-2cd at 120' this would give two independently rotate able antennas up there. And it is nice having that 10m one at 180' for opening and closing the band.

Figure 178 The 'Lucky' dog.

Figure 179 More of the 'Lucky' dog just for you dog lovers out there.

Continuing On… 2006

Just a few things in the plans for the summer of 2006. The big change will be replacing what is probably the oldest antenna still in the air, the 40-2cd that starts the year at 180'. Some of you will remember this antenna as the one that was broken in an ice storm around 1985. It was converted to 4 verticals, rebuilt, reinforced, and has worked its way back up from 60' to 180' where it has been since that tower was installed in 1999. The replacement is an M-Squared 40m4LLDD just like the one installed in 2005 at 105' fixed at Europe on the 180' tower. Since this one held up ok to the wind and ice I decided to go with another one. To turn it I will be using a TIC 1122e ring rotor.
The first order of business after running up a big bill on the credit card is to unpack the 40m4LLDD. This is a couple hour project and requires the full expanse of my garage.

Figure 180 40M4LLDD parts

The 15 bags of assorted hardware show just how many pieces there really are to this project.

Figure 181 Just the hardware for a 40M4LLDD.

There are a couple essential tools to doing this job without losing parts.

Figure 182 Essential tools.

This is a typical use of one of those tools during element assembly.

Figure 183 Sorting nuts and bolts.

The different size screws come in separate compartments of the hardware bags, but since some of them are only 1/4" different in size a short ruler is also necessary to be sure you have the right ones for each step. Note above that the locknuts are all the same size, but there are so many of them that they don't fit in one cup of the tin at the start. They also supply two tubs of the conductive grease stuff, so you won't run out even if you are as sloppy as I am putting it on. An old toothbrush is a good tool for that job. Since the first Saturday I had to start assembly was a bit wet I started putting together the elements in the shack. This is what you get when you assemble the elements up to the point of adding the element truss/linear loading clamps and spacer.

Figure 184 Partially assembled elements inside.

There are a lot of parts that go into the insulator and loading bracket section. (did you ever notice that its hard for an auto focus camera to lock in on shiny aluminum??

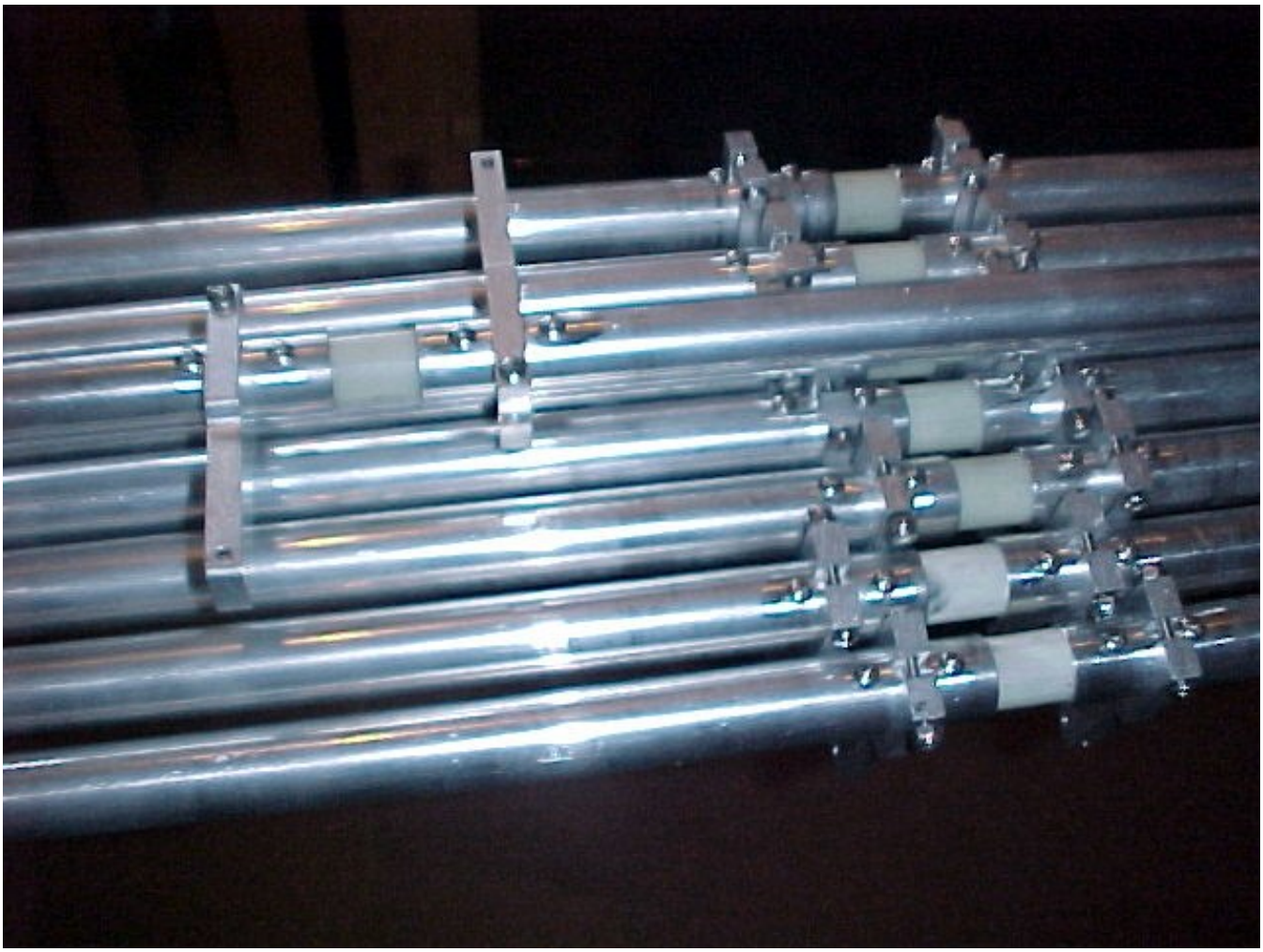


Figure 185 Details of insulated elements.

The first transplanting takes those element sections out the shack window to the first staging area where another 5' of tubing is added that wouldn't fit well in the shack.

Figure 186 Move assembly outside.

Next I start the boom assembly on the trusty old tripods.

Figure 187 First part of boom assembly.

There is just one minor problem I realized at this point... I temporarily attach the ring rotor cradle and boom brace struts and realized that the phasing line that should go on top of the boom will have to get around the struts somehow. This is what the front driven element bracket looks like looking back at the reflector. The U bolt is where the balun mounts. The two clamps on the elements are where the phasing line rods attach, they are then bent around the balun and through stand off insulators down the boom to the rear driven element.

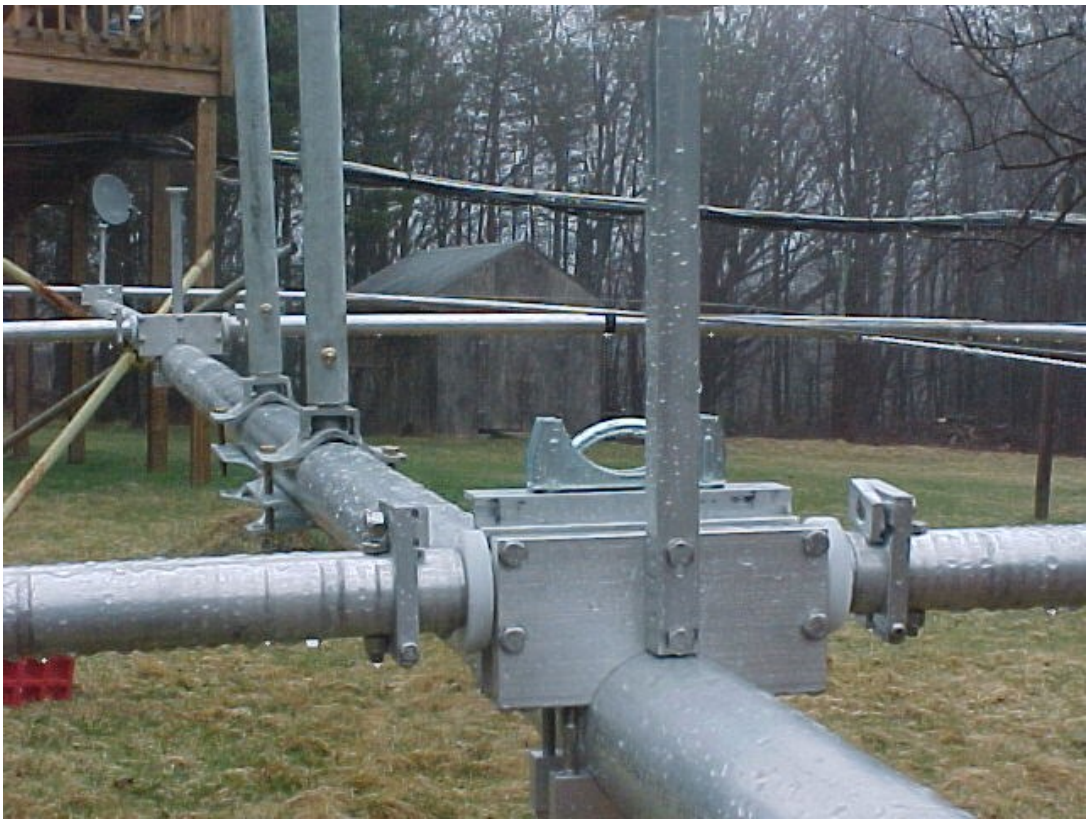


Figure 188 TIC Boom cradle and trusses.

A possible solution being explored. The phasing line insulators should normally be on top of the boom, but obviously that isn't going to work.

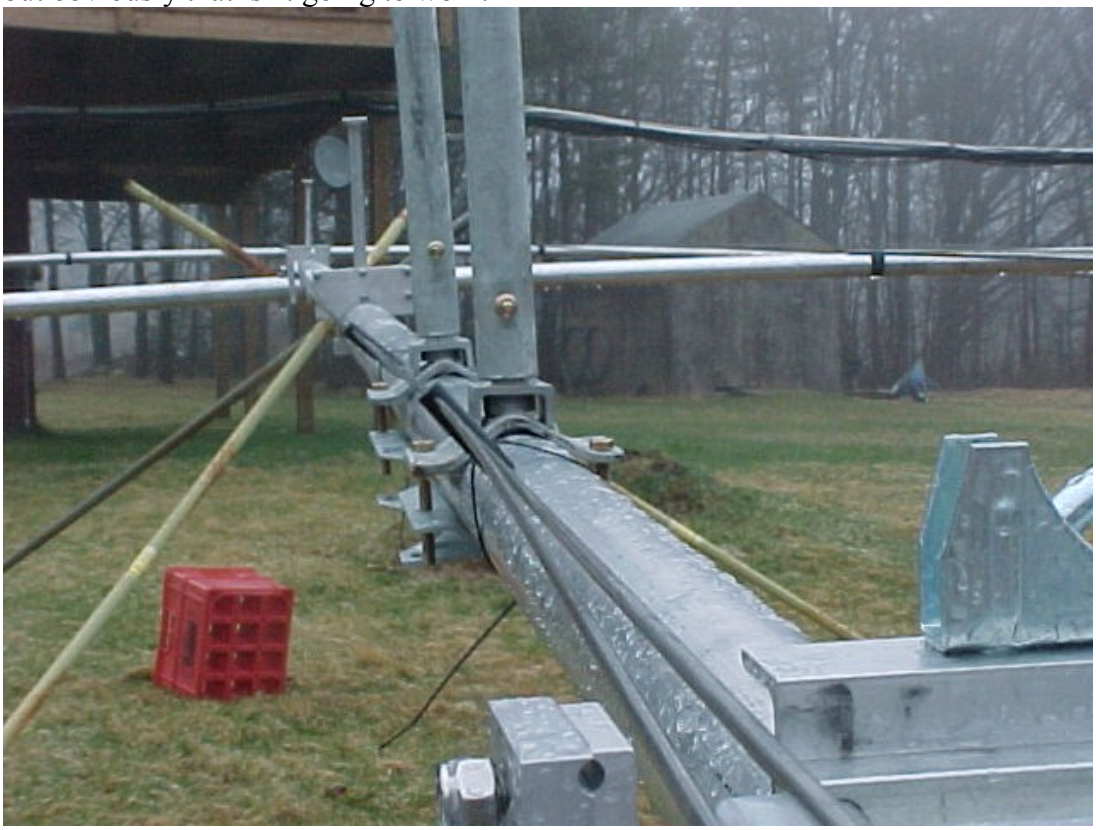


Figure 189 Getting phasing line around boom trusses.

Figure 190 Another angle.

The summer that wouldn't start….

Rain, rain, rain, and wind, and more wind. This was definitely the summer that wouldn't start. I got lots of little things done in the shack, the garage, the shed, but not in the air. There was so much time that I decided that the 40M4LLDD wouldn't be able to get up past the guy wires from the house side of the tower... so I cut a bunch of trees down and made a new launching pad on the pond side. The tram was rigged up over the guy wires, and the cable was just barely long enough to be able to attach to the antenna when it was staged just above the guy anchor point. Finally in the middle of June a nice weekend forecast, some quickly recruited ground crew, including pulling a neighbor out of the shower, and we got to work. Then it rained on my while I was up fastening down the antenna. Loads of fun all around.

In any case, the work had to start by removing the old antennas. The ground crew (W1TO and KJ1K) was pretty busy for this so we didn't get many pictures. But here I am doing the normal method of handling a 40-2cd. Take it off the mast with the driven element down, lower it till the reflector is in reach, remove the reflector and tie it to the boom... then lower straight down. The little twist on this one is that the tram wire was below the top of the tower, so the antenna had to be tipped and tucked under it to rig it for lowering.

Figure 191 Removing 40-2cd.

We got the old 40-2cd and 10-4cd off the tower ok, and then raised the 10m4dx and the 2m porcupine. I hate all those little elements, they are always poking in the wrong places. In any case, this is what the top looked like with the tram wires and rope with the 10m and 2m in place on top after we were done Friday afternoon.

Figure 192 Tram and Rigging in place.

After getting the little stuff up I then started rigging the 40M4LLDD to get it lifted on Saturday. This is the rigging of the pulley to the tram line and boom. The lifting rope is the white one going to the right, the yellow one going down to the left is tied to a big pry bar driven into the ground as a stake. It is holding the antenna down and back on the tripods so the lifting rope doesn't take it off before we were ready. At this point the tram wire is very loose. Note the two wood 1x2's taped to the bottom/back side of the boom, these were meant to prevent damage in case the boom landed on the guy wires. These were needed, I had to stop the lift twice to take more tension on the tram wire to pull the antenna off the guy wires. I didn't want to start with it any tighter then necessary, but as it turned out there was plenty of margin in the rigging. Also note the supervisor in the background checking out the work.

Figure 193 Rigging the 40M4LLDD to tram.

The same rigging from the other side.

Figure 194 Another view of rigging.

The lift that wouldn't end...

Saturday dawned calm and mostly sunny as predicted. But we were slow getting started and the weather was going down hill quickly. We finally got the ground crew assembled (W1TO, N1SR, and Chuck Wood, then W1EQO near the end). When we were getting ready to lift the sun came out. But it quickly clouded up and the wind picked up. There were showers in NY, but they were far enough away and shouldn't make it here till we were done. "Shouldn't"... famous last words as it started dripping on me as I went up the tower to secure it on top of the tower.
The sun is out, the ground crew is assembling.

Figure 195 Ready and waiting.

Ground crew still waiting, not sunny any more.

Figure 196 We have liftoff.

Finally, LIFTOFF! The lift started by taking up tension on the tram wire, this lifted the antenna 25-30' straight up. Note the perfect tilt angle on the element, just right to slip over the other guy wires.

Figure 197 Up, Up, and away.

Hard to tell from this angle, but the perfect angle at lift off has turned into an upside down antenna. But we press on anyway.

Figure 198 flipped antenna.

The other guy wires and the 160m V help us out and stand the antenna up vertically, of course now the new 10m antenna is in the way. But here it is just about at the level of the star guy bracket.

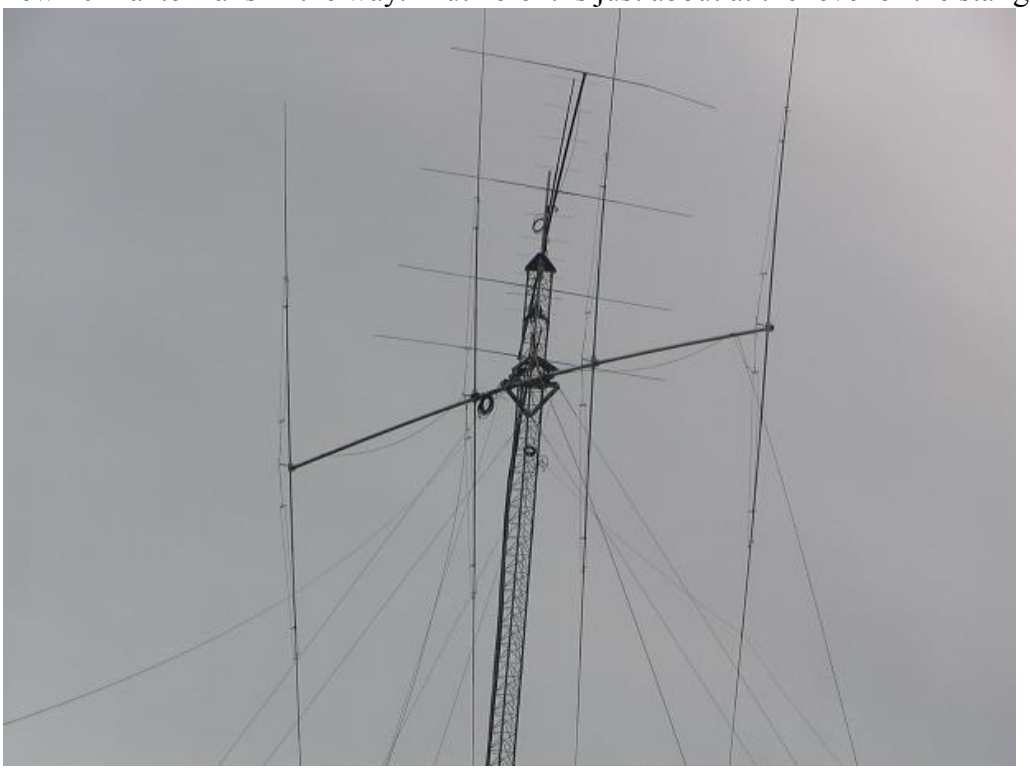


Figure 199 Vertically polarized 40M4LLDD.

Me, on the way up... just to put it all in perspective. Right about now I started to feel the first few rain drops.

Figure 200 It was a dark and stormy day.

Here I am, just about up to the antenna... taking a good look at it and figuring out how to get it in the right orientation. The wire on the right that is helping to straighten it up is the 160m inverted V... I had lowered it out of the way to make sure it wouldn't get in the way of the element had it come up the way it lifted off. Instead it helps out a bit tipping it the other way.

Figure 201 Push and Pull.

Here I am up at the top, starting to maneuver it around to get it flipped over the right way.

Figure 202 Still upside down.

It took me 3 tries to get the 10m antenna to stay on side and out of the way after this. I thought I could just flip it up and it would stay there, but the wind had other ideas. I finally had to tighten it down to make sure it stayed put. Now it is almost vertical and picked up to above the ring, we had to release some of the tension on the tram to let it into the tower to settle down in the boom cradle.

Figure 203 Flipping the 10m beam on its side made room to level it off.

Now its sitting in the cradle, but still on side. At this point I cut off the wood and the extra safety rope.

Figure 204 In the TIC Boom Cradle.

Finally, in the cradle. The wood pieces are removed and both clamps are installed.

Figure 205 removing temporary rigging.

After this I just tied the boom brace ropes to the tower and untied the lifting rope and big tag line. The two positioning lines were left on for removal later. Then I came down a very wet tower.
Finishing up...
The lift that wouldn't end picked up again the next morning. This time just me going up to do all the little stuff like:
Put the 10m4dx back horizontal
Connecting the 10m4dx coax
Connecting the 2m coax
Aim the 10m and 2m the right direction
Make up rotor loop for 10m and 2m
Connecting the 40m coax
Installing the boom truss posts
Attaching the boom truss to the posts
Adjusting the boom in the cradle, it was about 6" off center.
Remove tram wires
Remove steering ropes
Remove lifting rope
Check rotation of the ring with rotor loop
Engage ring rotor drive motor
Use several rolls of tape to secure everything
Take a few pictures
And probably a couple other misc things.
In any case it was about 4 hours up the tower... but it was a beautiful day, and well worth it.
Here is a nice view... looking west down the boom of the 10m4dx.

Figure 206 The long view.

A view looking down on the 150' tower.

Figure 207 150’ tower from 180’ tower.

This is the 40m boom struts from above. Note the piece of tape on the boom between the struts, that is the center of balance. I had to slide it to the right to get that in the middle. You can see the 40-2cd on the ground up in the corner of the field.

Figure 208 TIC Ring from above.

Here is the tower quiz... What is this, and why? Answers a bit later, so don't read too far ahead.

Figure 209 Tower Quiz 1.

Tower quiz part 2. What are these?

Figure 210 Tower quiz 2.

Now, back to the work. Remember in part 1 I was trying to figure out how to fit the 40m phasing line around the boom struts? Well this is what it looks like when its all done.

Figure 211 phasing line and boom struts final.

And from the other side. Note an oddity of Ring Rotors, the coax goes up the boom strut and the rotor loop is above the antenna, and has to be long enough to wrap half way around the tower each way.

Figure 212 Boom in cradle with feed line.

Now the cleanup... This is how I coil and store rope. The lifting rope, all 600' of it coiled and ready for storage.

Figure 213 lifting rope coiled.

To do such a neat job takes just a few simple steps. You start with a pole through the tower legs, in this case a broken shovel handle. And add a piece of PVC tubing to it. Tie one end of the rope to the tubing. Stand sideways and take one or two arm lengths of rope and wrap it over the tubing. Get a good swing to it and you can coil up a lot of rope very quickly and neatly this way.

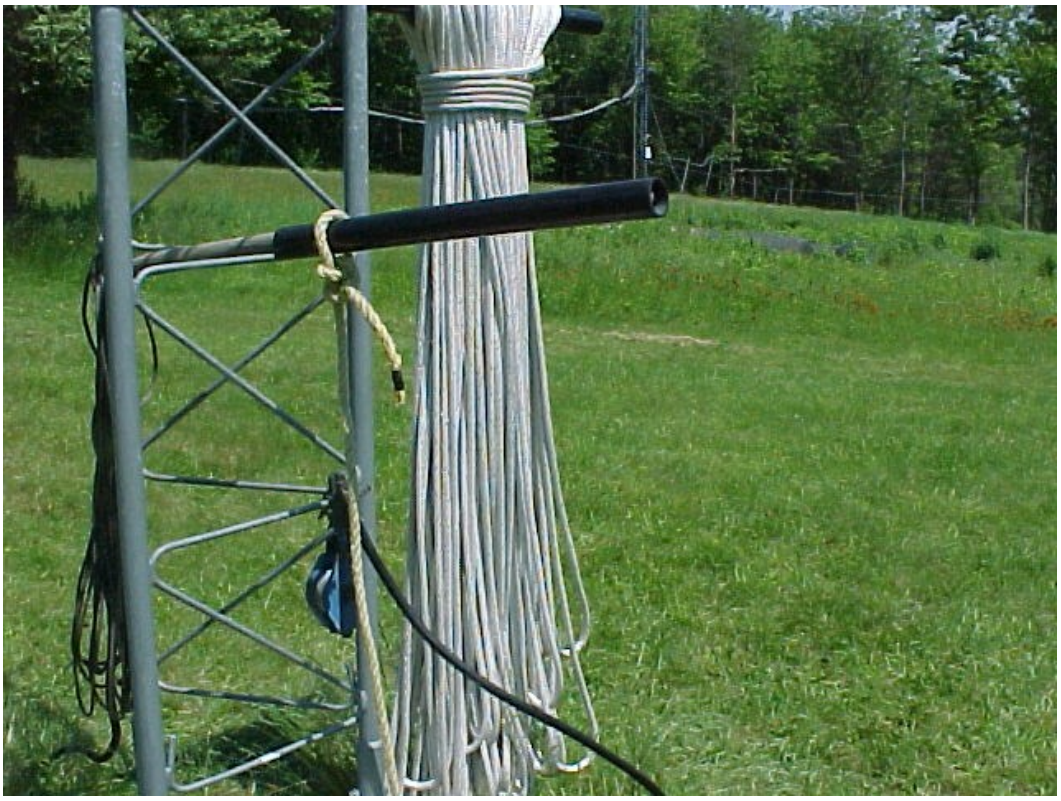


Figure 214 How to coil, step 1.

How it hangs when its done. Note the shorter tag lines I do in one arm span loops, the lifting line is in 2 arm length loops. Use the last few feet to wrap up the coils and then slide the tubing off the pole and carry to the storage shed.

Figure 215 How to coil, step 2.

The coils hang in a clean and dry place out of the sun when not in use. The PVC tubing hangs from wire loops on eye bolts in the rafters.

Figure 216 Proper rope storage.

Here is what it was all for, and what you are all probably waiting for... 4 over 4 on 40m!

Figure 217 Finally 4/4 on 40m.

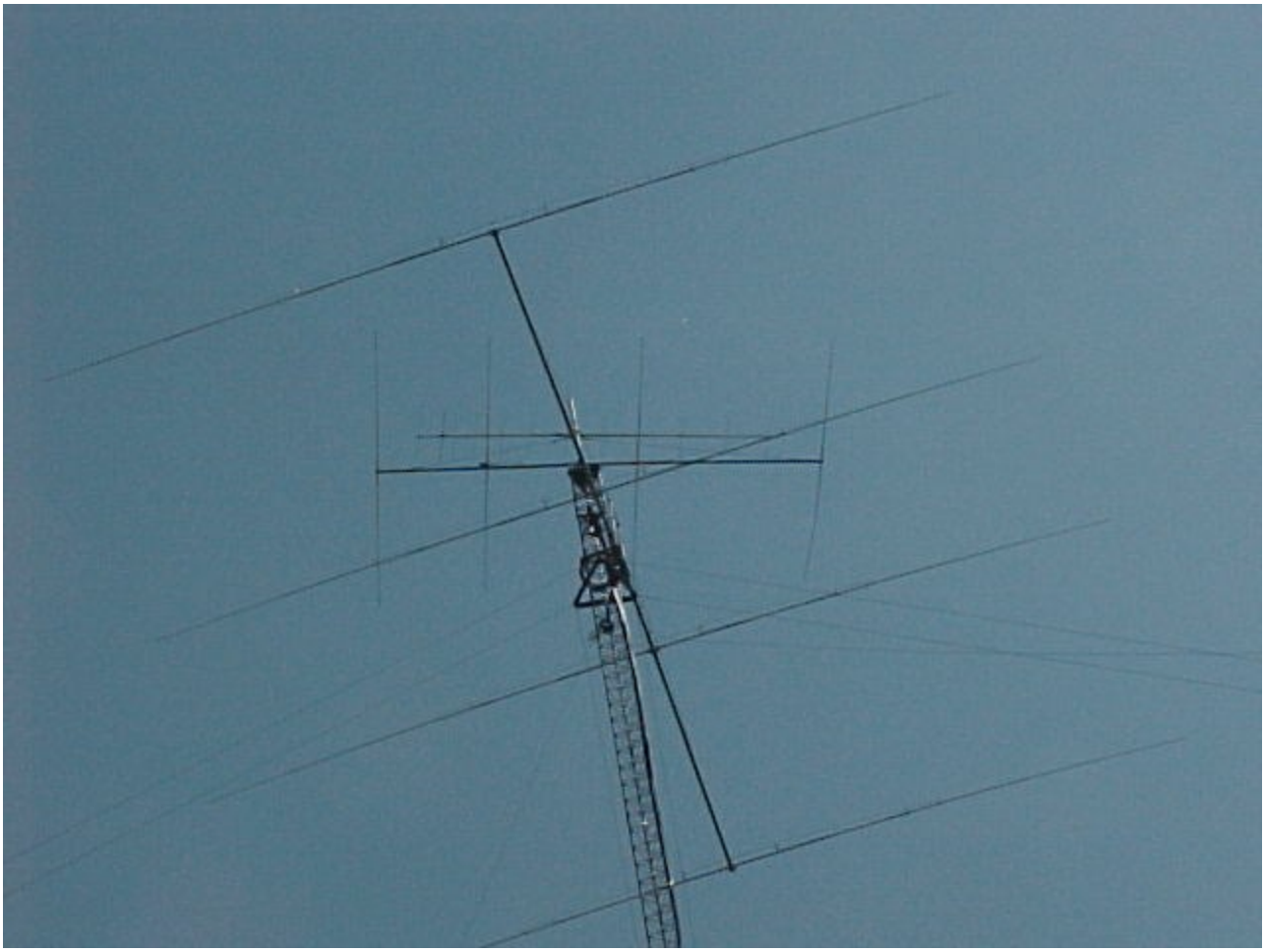


Figure 218 40M4LLDD at 180’ close up.

ANSWERS:
The first 'what is it' is a ball of rope and tape that is hiding the clamp bolts on the Rohn thrust bearing on the top plate. Since the rotor loop has to hang down from the antenna and somehow get over the edge of the top plate it means there has to be a fair sized loop, unfortunately it could get caught under those bolts. The 'fix' is to make a big round ball out of it using some rope and lots of tape. The new coax is in the front, it needs to be well covered in tape or some other abrasion resistant material so its not damaged on the other bolts or edge of the plate in the wind. The second 'what is it' are the hard line connectors for the 10m and 2m antennas at the top of the tower. You can only see the middle of the body as the top and bottom are well sealed.

New antenna selector boxes

Not quite on the tower, but necessary stuff...
I finally decided to clean up the antenna switching system this summer also. I was interested in protecting against hot switching, and also getting rid of the little knobs from those MFJ control boxes. I looked at some of the commercially available boxes that had ptt protection, but they also did lots of other stuff and were way too expensive for the quantity I would need (10 boxes). So I inquired on a couple reflectors to see if anyone had a simpler solution, preferably one that didn't need a bunch of

integrated circuits that could generate noise or need filtering from RF, no micro processors to program, just a simple relay system would do. I was told it couldn't be done with just relays, and of course then had to prove that it could be done. After prototyping a simple relay circuit I found N5QQ who was interested in building a set of them for me. After some negotiations we settled on a design and housing and he went off and built me 10 boxes. There were only some simple changes to the original design I came up with due to differences in latching and unlatching speeds of the relays that he used. The boxes were delivered in August and only took a few hours to wire in and replace the existing switches for transmit and Beverage antennas. So no more hot switching worries now, much bigger and easier to read labels, and also no more guessing which Beverage you are on because the switch knobs were loose. The basic schematic.

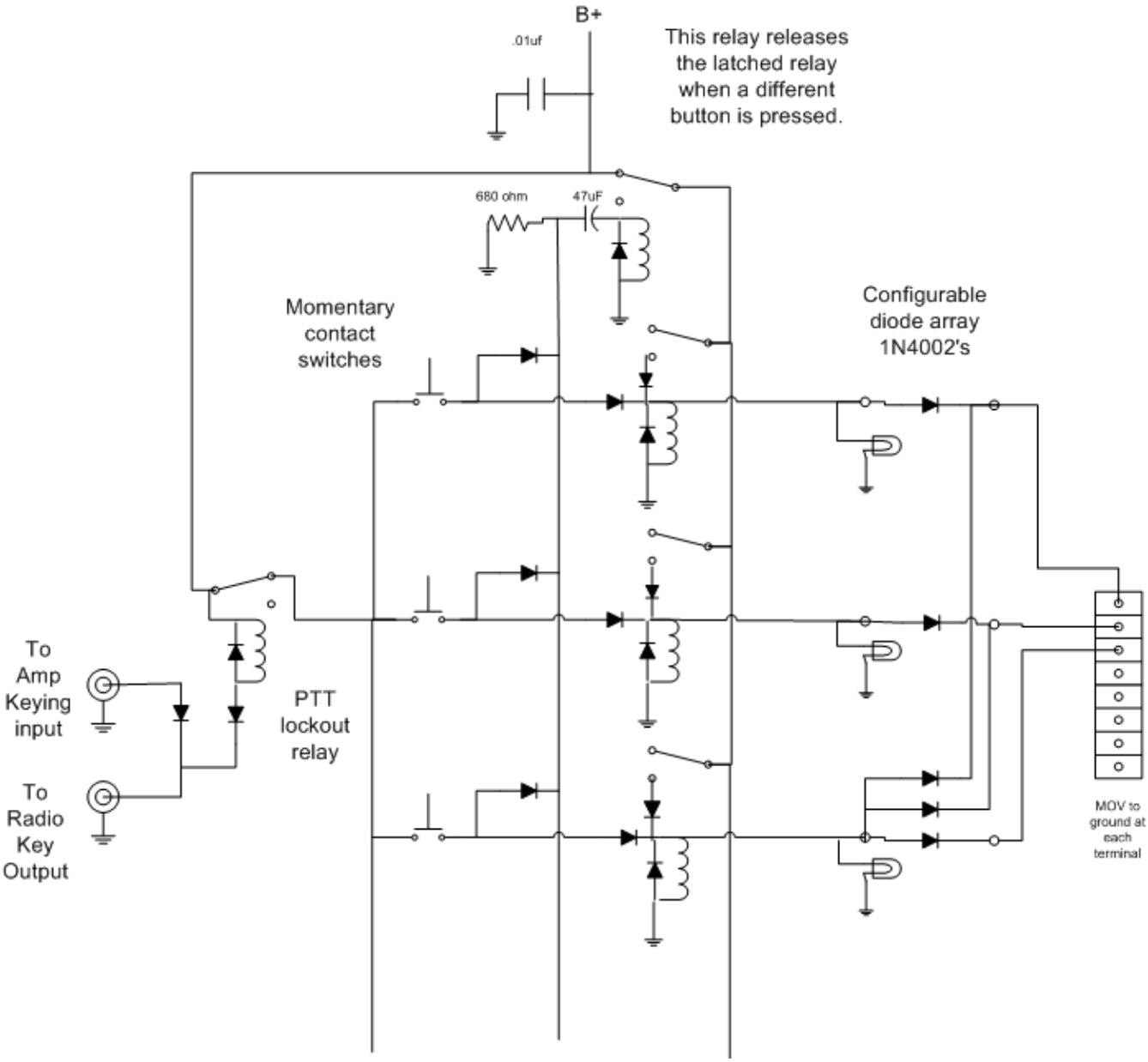


Figure 219 New selector schematic.

The insides with the cables hooked up. The diode matrix is under the wires where they come in. All connections are to those wire clamp blocks on the left side. Note the little slip of paper on the right with the wire colors and terminals. That is put inside the box so its always handy when changes need to be made!

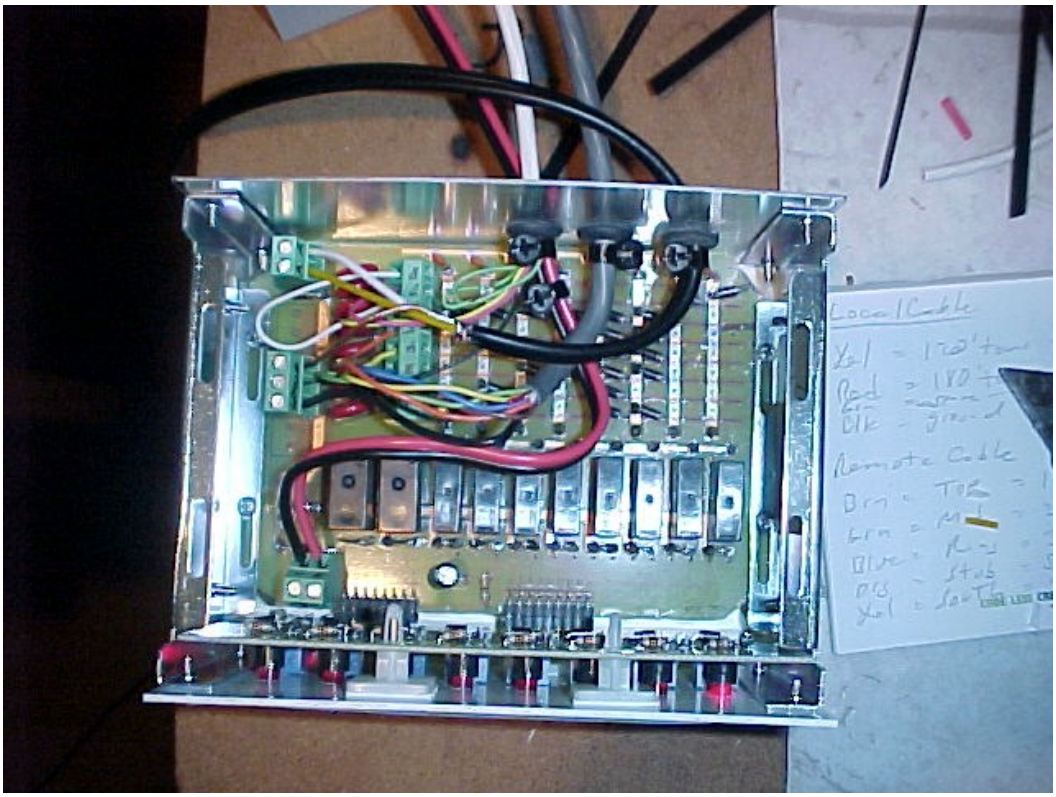


Figure 220 Pretty new boxes wired up.

The 40m TX antenna one sitting on the new TIC Ring controller.

Figure 221 40m Controller in place.

20m box close up showing label. I went for a box that was probably a bit taller than needed to be sure there was plenty of room for a good label.

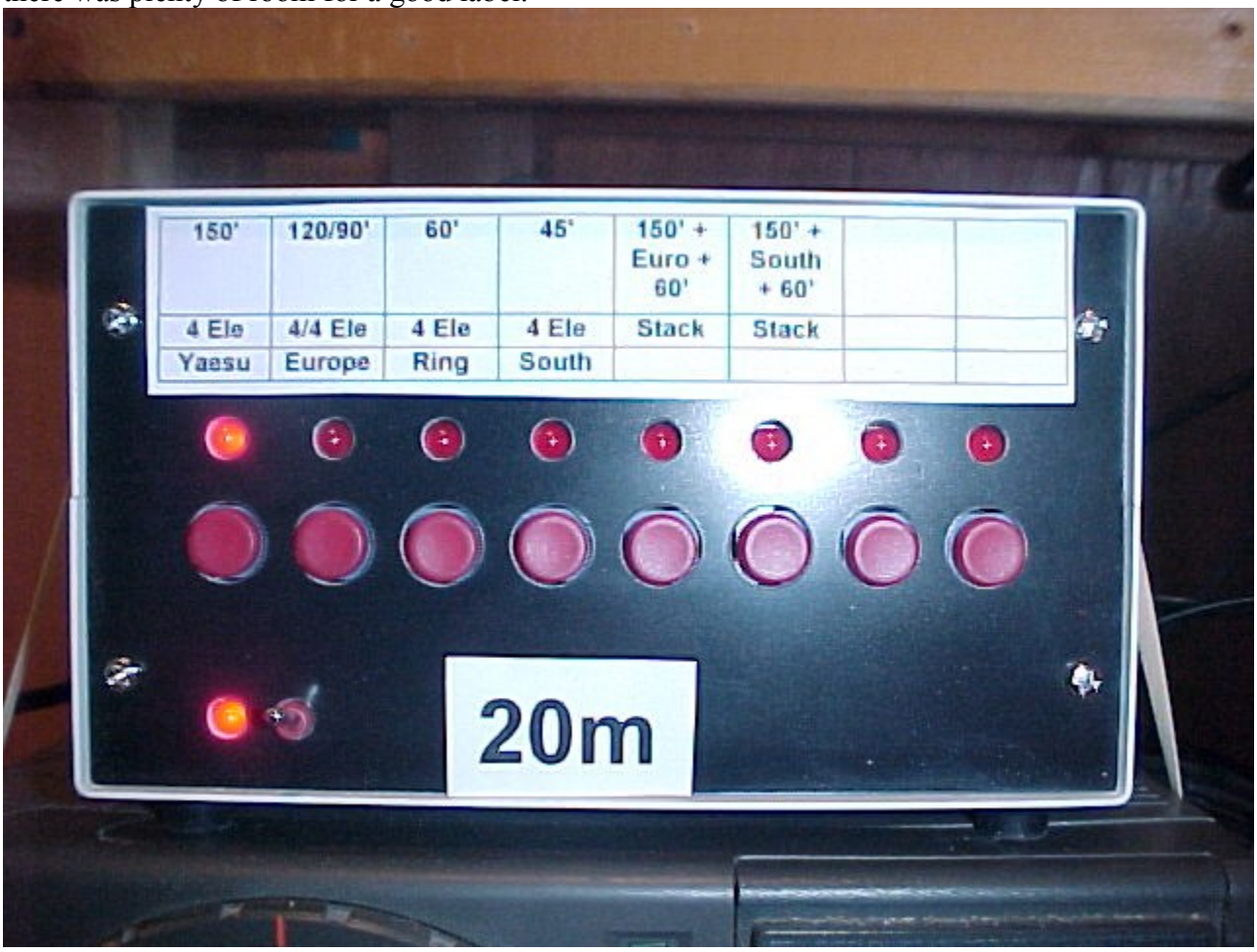


Figure 222 Close up of front panel.

2006 Picnic

Official minutes:
A regional meeting/picnic for the Yankee Clipper Contest Club was held on July 29, 2006 at the station of Dave Robbins, K1TTT in Peru, Massachusetts. The picnic started officially at noon. A brief business meeting began at approximately 1:30 p.m.

Tom Wagner, N1MM, was on hand to demonstrate the N1MM Contest Logger. Dave continues as an active member of the N1MM Contest Logger Software development team. His multi-multi station uses this software for all major contests. Tom gave an overview of the software operation and then demonstrated its operation in the IOTA Contest. Several of the group gave the software and station a test drive.

A tour of towers and antennas was conducted after the business meeting. During the tour discussions of construction techniques, grounding, stack

design and switching were conducted.

Dave's new deck is a great place to hold a cookout and view the extensive antenna farm. There were plenty of burgers, hot dogs and brats from the grill and lots of other good food.

Our goal to attract new members was successful. Three new members were voted into membership. The new members are: K1SFA, Khrystyne Keane; WS1V, Clinton Spaar (a returning member) and KD1EU, Donald Casella. Completed application and dues will be forwarded to the secretary and treasurer.

This celebration also marked the first anniversary of the Berkshire Insulator Gallery.

Many attendees took pictures and some will be posted on www.k1ttt.net

There were twenty-three YCCC members and guests attending. The sign-in sheet will be forwarded to the Secretary.

Figure 223 K1TTT Starting the cooking.

Figure 224 FOOD!

Figure 225 Some of the eating.

Figure 226 W1TO at the grill.

Figure 227 More eating.

Figure 228 Even more eating.

Figure 229 N1MM even made a return trip to the grill.

Figure 230 N1MM answering questions about the N1MM Logger.

Figure 231 The walking tour stops in the shade.

Figure 232 Besides beverages the tour saw the Beverages.

Figure 233 After the picnic there was some time for fishing lessons.

Figure 234 There were a few small showers.

Figure 235 The Lucky Dog enjoying the activities.

Figure 236 Final stop of the tour was at BIG .

2007 – BIG Changes Inside

Well, after 20 years or so of M/M operation it was about time to finish the shack. I had the windows replaced in the whole house a few years ago, and when I did that I also replaced the old thin paneling with drywall and new paneling. I had never done the shack though. So now it was about time. The drop ceiling was getting ratty from all the cable changes over the years also, and the carpet was starting to fray.

Demolition Day 1... Remove drop ceiling. This is one time I will break out the dust masks, gloves, and goggles. I hate this stuff. Hopefully I can find something that is nicer to work with than this 20 year old rock wool type of panels. Besides the frayed edges there were 20 years worth of dust and mouse droppings on top of most of them.

Figure 237 Old wiring.

Note in the above photo, not only the unsecured wiring that was above the drop ceiling, but also how narrow the opening between the rooms is... that will change shortly.

Figure 238 Above the ceiling.

Now where is that box of wire staples???

Figure 239 Stripping the walls.

Starting to strip the walls. Note the remove control ShackCam on the corner of the station table. I finally added the coffee pot circuit to the last open slot in the breaker box.

Figure 240 A new wall.

The first new wall.

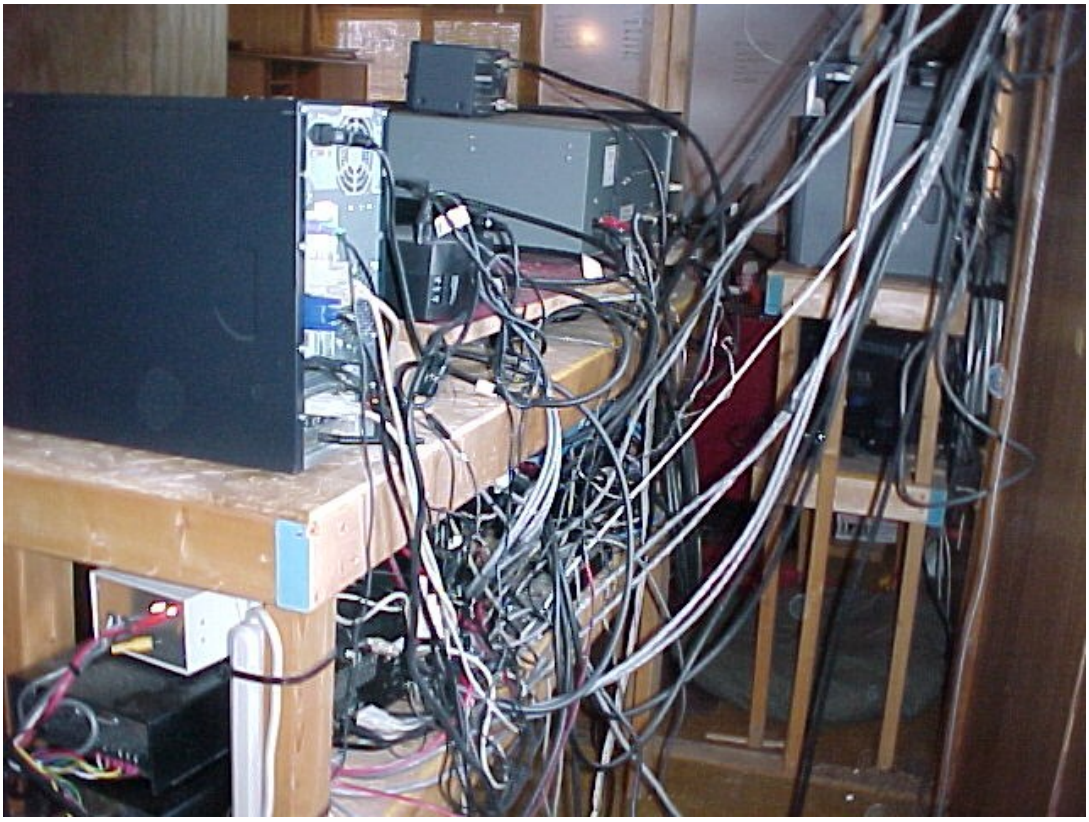


Figure 241 This is wireless?

The back of the SO2R station table. This could probably use some cleaning up while I'm at it.

Figure 242 Looking better.

Well, Phase 1 completed! Of course I don't really know how many phases there might be for this project. But half of the room has new walls and has the carpet and drop ceiling removed. The tables on the left are not all the way back against the wall yet so I can get behind them to sort out wires. Notice how much wider the opening is between the rooms now. It makes it feel so much more open between the halves of the room now.

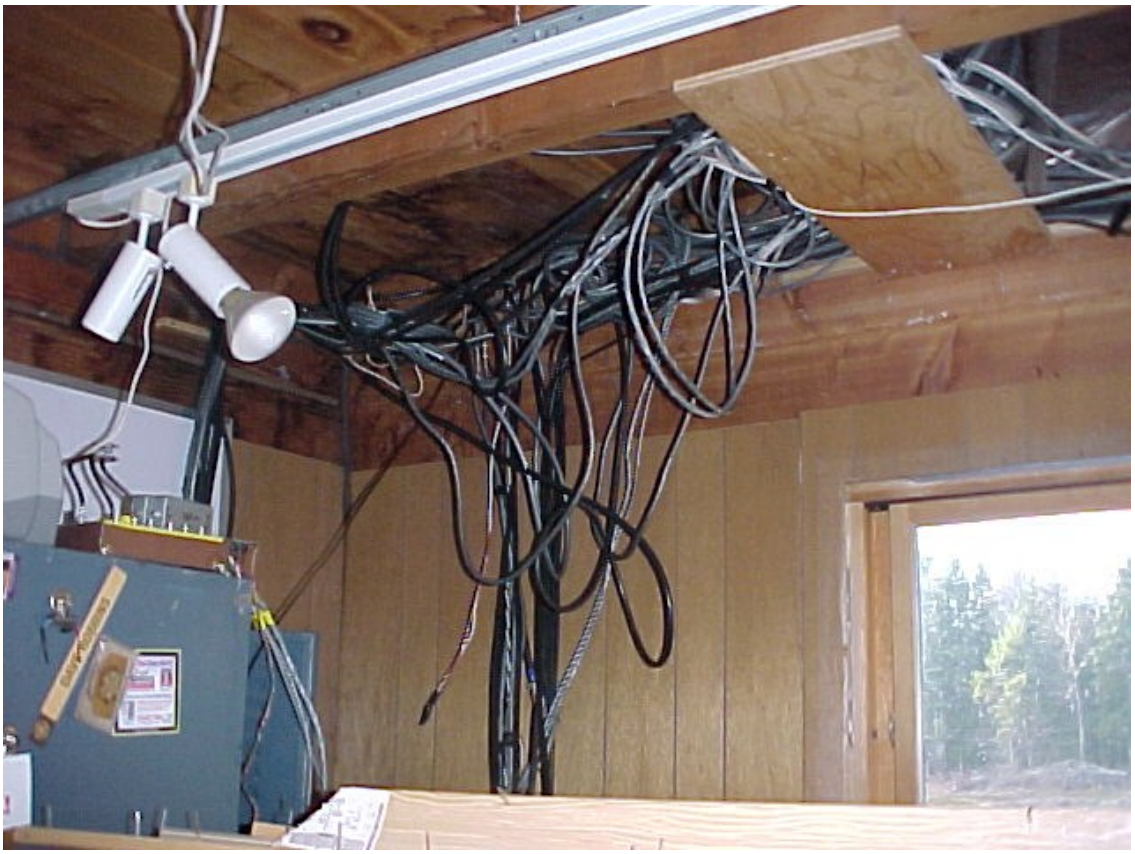


Figure 243 main wire entrance.

The main wire entrance.

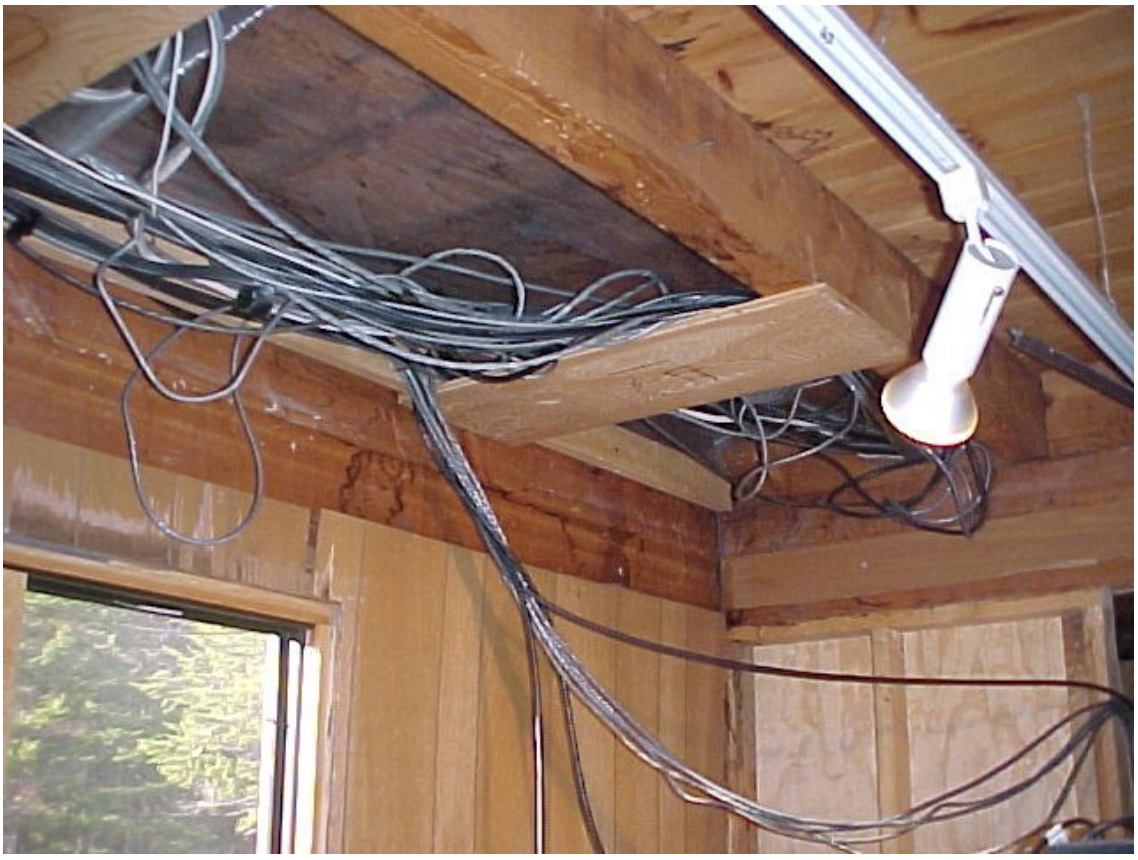


Figure 244 Raceway to other half of shack.

Figure 245 Temporary storage.

Where did all the stuff go? Well, lets just say that I am not open for over night visitors unless they like the couches.

Figure 246 More storage.

Figure 247 Last corner done.

Phase 2 done! I guess. Thanks to some help from W1TO and W1EQO all the paneling is in place now. Just a few trim pieces to do and outlet covers to finish up and the walls will be basically done.

The saga continues...

But first a word from our sponsors.

(Loud announcer voice is up to you) **Does your shack look like this??**

Figure 248 wires out of control.

Are your wires out of control?

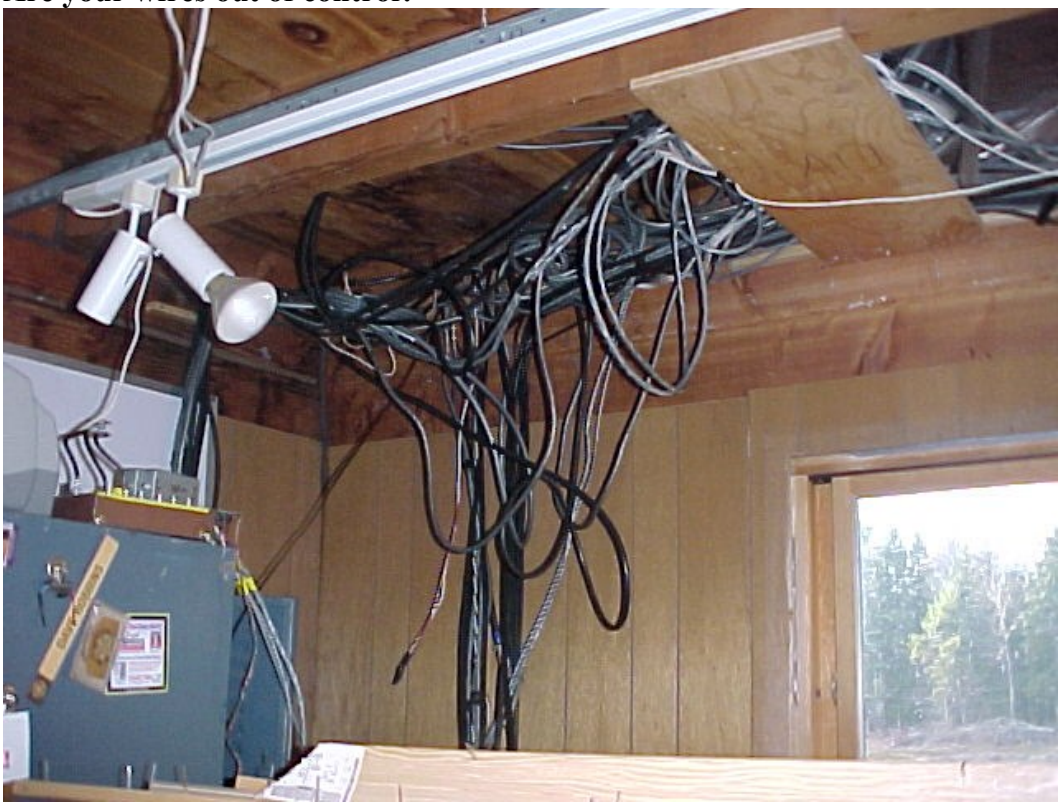


Figure 249 Entrance bundle again.

With the un-patented K1TTT Wire Management System you can go from out of control to this in only days!

Figure 250 Magic wire minders!

And you can get your worst out of control wiring back under control and looking like it was actually designed to be this way! Just look at the results!!

Figure 251 Cleaned up wire entrance.

And for only $9.95 we will not only give you 10 magic wire organizers, but we'll throw in a box of special wall attachment screws at no extra charge! Pay only $99.95 shipping and handling and we'll supply you with a free life time supply of Super Flex cable labeling tape at no extra charge!

Argh, enough of that. I hate those commercials. It is amazing though what you can do with a few slices of ABS drain pipe and some sheetrock screws. Add a bit of big wire molding and it should look even better in another week or so. Almost time for the new drop ceiling and then carpet.

A contest in the middle of all this... Of course! NEQP, and we had to defend our perfect winning streak in the M/S class. Envision this... Friday the drop ceiling material arrive and construction begins. By Saturday afternoon the installation of wire ducts and drop ceiling transformed the above to this:

Figure 252 pretty wire molding.

And this:

Figure 253 New ceiling up.

The contest kind of looked like this... through a camera with an almost dead battery:

Figure 254 A contest in the midst of chaos.

Monday... Carpet panels arrive and installation begins. By Wednesday the room is starting to look like this:

Figure 255 Carpet panels in place.

Figure 256 Just about done.

Notice the cardboard under the table legs above. This made it much easier to slide the tables around on the carpet and also protected the carpet from the rough ends of the 2x4 legs.

Almost time to start moving back in.
Another day of putting furniture back together, reconnecting cables, and lots of vacuuming, and it looks like a radio shack again... now for some new tables???

Figure 257 All done!

2007 – BIGGER Changes Outside

The tower season started early in 2007. January saw 2 big ice storms that damaged both of the 40m4LLDD antennas. In the first storm the top one had one of the element trusses break:

Figure 258 Broke 40M4LLDD element truss.

Fortunately this was followed by an unusually nice stretch of weather so we were able to quickly get together a crew and take it off the tower before it was damaged any more. The crew assembled on a nice sunny January morning.

Figure 259 Ground crew briefing.

I had already rigged up the ropes and tram wire, but was hoping to be able to do a temporary repair without removing the antenna from the tower.

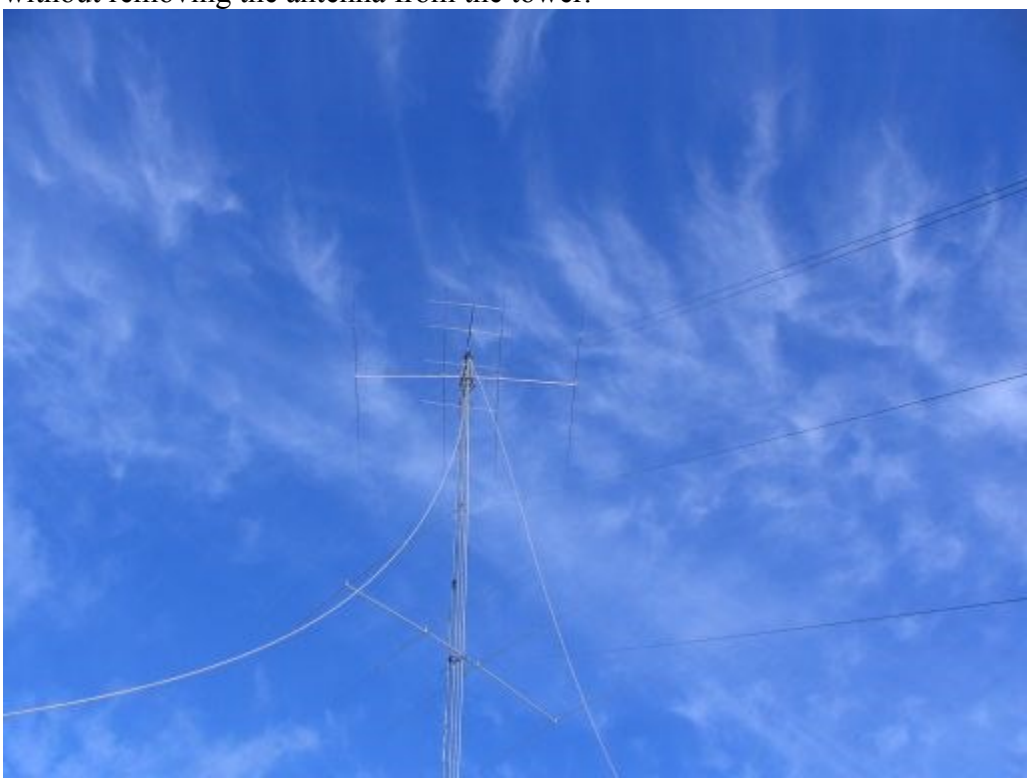


Figure 260 rigging.

With everything disconnected from the tower and the wind starting to pick up I decided to abandon the repair option and just get it off the tower.

Figure 261 liftoff.

So down it came:

Figure 262 Downwardly mobile.

The damaged part:

Figure 263 Broke Philly.

What it should look like:

Figure 264 A good one.

What I didn't get pictures of...
The next ice storm a week or so later broke 2 element trusses on the lower beam that was still up on the tower. The weather had turned back to a normal Peru winter so I called KC1XX to come remove that one, which he did on a day where the high temperature might have been +10f with 20-30 mph winds. Ironically the one on the ground broke a second truss in the same storm while sitting 5' off the ground on my construction tripods.
I adopted the N1IW modification route which consisted of drilling out the center clamp hole to 1/4" and adding a stainless steel shackle, eye, and 2 cable clamps to make a proper clamp for the Phillystran cable. When removing the old cable for the modification ALL 12 pieces that hadn't broken had cuts in the jackets on the first inside bend. When talking with the M2 people at the Dayton Hamvention they said they had a new strain relief mechanism but didn't have one there to take a look at.
The modification looks like:

Figure 265 Modified shorting bar and attachment.

The lower antenna was modified in the snow and put back up the tower at the 70' level for the ARRL DX contest. I was originally going to put it back at 105' where it had been, but it got caught up in the guy wires on the way up so it ended up just above the 70' guy wires where I was thinking of moving it anyway to make it rotatable on a ring rotor. The TIC ring was installed later in the spring. The upper one didn't get raised back up until Friday before WXP CW... when we again had enough ground crew to take a few pictures.

The picture below shows the rigging for the tram pulley. The tram wire in this case was just barely long enough to reach the guy anchor for the tower where the antenna was sitting on the tripods. So the pulley in the picture below is on the tram wire just above the dead end, the cable to the right is 1/4" aircraft cable going to the come-along. I connect to the boom with the heavy rope in an upside down V arrangement so there is room to sit the boom in the ring rotor cradle without removing the rope. I also think this helps spread the load on the boom a bit and makes balancing easier. The rope down to the right from the pulley is a safety line holding the beam down in the tripods until we are ready to have it take off.

Liftoff in this arrangement is done by tightening the come-along. This pulls the tram wire tight and lifts the antenna up to about 20' above the anchor point before we start to pull it up the wire with the jeep. All hands were busy for this part so sorry, no pictures. Once it is off the ground and moving up the wire its just a matter of keeping it pointed at the tower. As you can see below, this was a perfect May morning for this job, not a cloud in the sky and very light winds. You can see the two tag lines and the white lifting rope below, but the tram wire is hard to see.

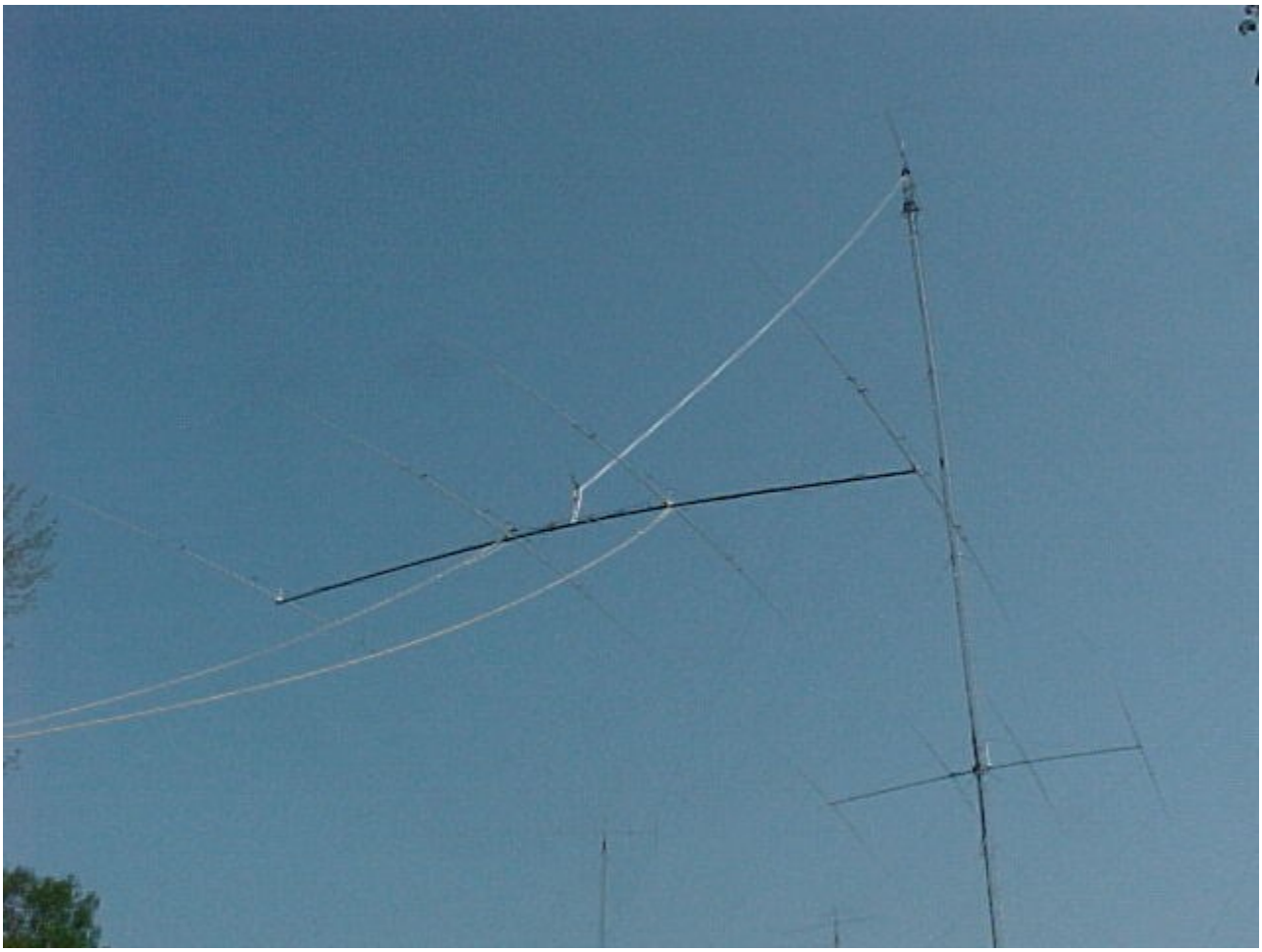


Figure 266 This antenna got lots of frequent flyer miles.

As the antenna goes up the force on the tram wire increases. We had to stop two or three times to take a few more pulls on the come-along to raise the antenna above the guy wire that it was over. The only problem this time was that the rigging I had planned to tip the antenna a bit to get the elements above the top guy wire didn't work well enough so I had to go up and give them a bit of help.
Once sitting in the cradle of the rotor it just takes a short time to hook up the boom brace, the 8 bolts for the boom clamps, and level it out. The star guy bracket makes a nice chair to sit in while connecting things up:

Figure 267 Back where it belongs.

Then all the tram wires and ropes have to be lowered and put away... The ground crew cleaning up: KB1W gathering up one of the 3 come-alongs (2 in series on the tram wire because one wasn't long enough, and 1 on a backstay).

Figure 268 KB1W with come-a-long.

KJ1K and a neighbor in the shed watching the final connection. K1MK was behind the camera.

Figure 269 Ground crew relaxing.

Time for a contest!

80m 4-Square

Besides putting the two 40m4lldd's back up in the air the biggest project planned for this year is the new 80m 4-square. It is going to be 4 Rohn-25 towers with insulators 10' off the ground. The chosen site is behind my pond which will keep it well out of the way of other towers and antennas. It unfortunately will need about 800' of feedline to get there.

Figure 270 Peru chainsaw massacre 2007.

This is where it began early in the spring. The latest episode of the Peru Chainsaw Massacre, this time with W1EQO at the saw. Notice the tangle of branches that make it impossible to walk through there, just ask the Lucky dog about how much fun he was having! All of that has to be removed before installation of towers can begin.

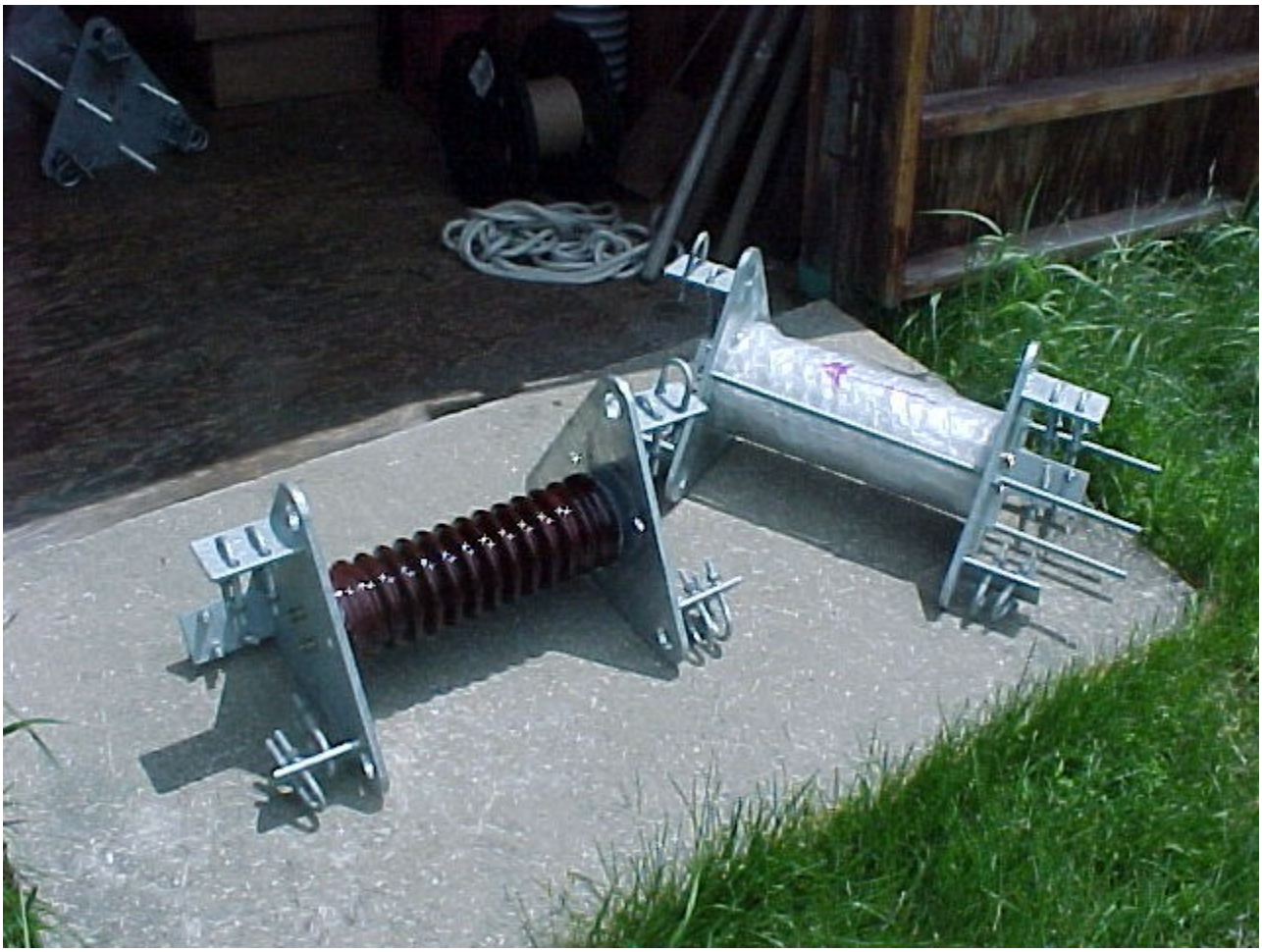


Figure 271 Pretty insulators.

In between dragging branches out of the firewood I started pre-assembling pieces of the towers. These are the insulators and their mounting plates. Since the insulator is porcelain which is of course prone to chipping I am leaving the bubble wrap in place to protect them for now. The one on the left has the wrap removed for the picture. The one on the right has the wrap, with 'up' arrow, and also 3 stress relief rods. The rods are just 1/2" threaded rod bolted through the plate and are meant to keep side stresses off the insulators while standing up the towers.

Figure 272 New bridge for access.

There was so much firewood to be moved that I just couldn't see hauling it piecemeal across my old wooden bridge. The bridge was slowly sinking anyway due to erosion under it from the spring thaw. So I took a week out from moving brush to install a new culvert pipe and make a vehicle worthy bridge. Now W1EQO can drive right up to the wood to load it up. The old bridge was rolled over twice to get where it is now, I'll probably drag it over the stream flowing into the pond as a walking bridge. The buckets I was using to water the gravel to help settle it in quicker.

Figure 273 Preassembly of bases.

These are the insulated base sections assembled and waiting for room to be cleared.

Figure 274 Insulators all in place with rods.

A close up of the insulators. I only got enough rod to brace 2 insulators from the local hardware store. Since we will likely only stand one up at a time I can just move the rod from tower to tower to put up each one.

Figure 275 The area.

The chainsaw massacre continues, temporary piles of firewood grow as I sort out firewood from brush. The brush gets piled around the perimeter of the area. This is what it looks like on Field Day weekend, about 3/4's of the trees are down and probably a bit more than half the area has had the brush removed so its almost safe to walk Right in the middle of the picture is a stake with an orange flag that is the North East vertical location, more or less.

Figure 276 Putting up Gin Pole tower going up.

Well, enough massacre for now... time to build something. Because of how heavy the insulators are, and I want to keep the side loads off them as much as possible I decide to use a crane to put up the first parts of the verticals. A 30' crane made of Rohn 25g that is. Pulling up 30' of tower is relatively easy with a few simple tools... start with rope.

Figure 277 Ground end rigging.

Add a few pulleys. This one is the turnaround one at the guy anchor. They anchor rods are 1" cold rolled steel 4' long. The limb under the pulley is to keep it from pulling itself down into the dirt.

Figure 278 'Gin Pole' tower base.

Add another stake and rope to hold the bottom end in place. Note the duct tape over the ends of the legs... I need to use this section for one of the verticals later so don't want it full of dirt.

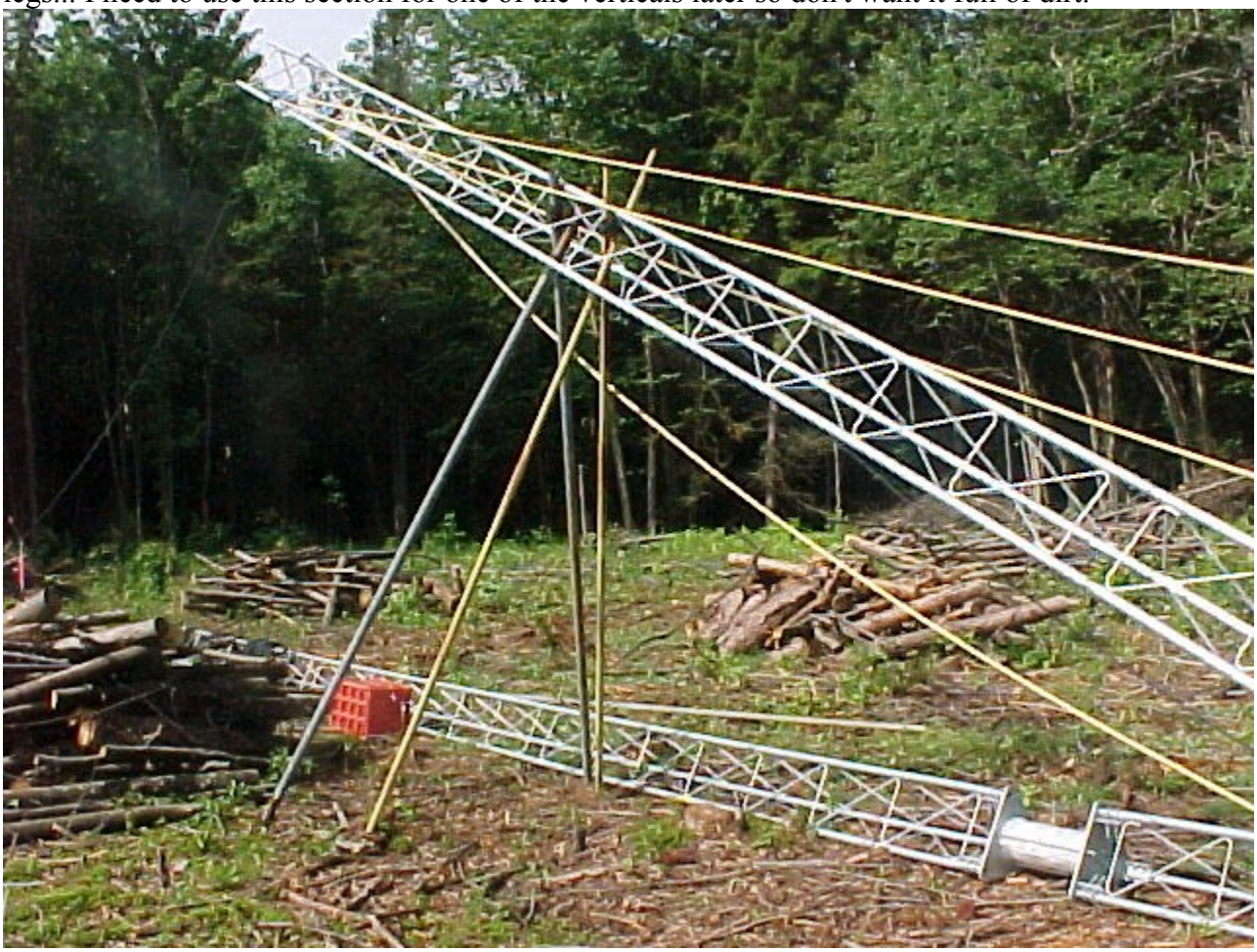


Figure 279 V poles pushing up.

Add 2 more pulleys on the top of the 3 sections and 2 bipods to walk the section up to a reasonable angle, and away it goes. A 4:1 mechanical advantage on the rope makes pulling it up past that point easy. Just tie off the 2 side guys with a little slack and pull on the lifting rope a bit... and up it goes.

Figure 280 Up it goes.

From this point the sequence is:
Pull lifting rope tight.
Walk to one side anchor and let out a foot or two of slack.
Walk to the other side anchor and let out the same amount of slack.
Throw stick to keep dog out of the way.
Repeat.
5 or 6 repetitions and its vertical.

Figure 281 Ready to lift.

Then comes the rearranging of the ropes:

Figure 282 Rigging the real base.

Only enough pulleys and rope to get 2:1 advantage on this lift. Because its up and over the top of the crane tower there are 2 pulleys up there just to change the direction of the rope. To get 4:1 would take double the rope and 4 more pulleys, 1 on the load, 1 at the anchor point, and 2 more to feed the rope over the top of the crane. I think with the added height from the crane there should be enough of an advantage to make this not too hard to lift with a couple people.
By the way, moving the assembled tower sections from where they were put together at the left side of the above picture to where they are now was done using a garden tractor cart and a couple bungee cords... but not the tractor, too many stumps in the way. Basically just bungee cord one end in the cart, pick up the other end and play like driving a ladder fire truck.

Figure 283 Skip to one complete vertical.

Finally the first of the verticals goes up.

Figure 284 Insulator finally insulating something.

Even the insulator looks better when its vertical.

Figure 285 Parts for 2nd one.

Tower and Gin Pole ready to top off 2nd vertical.

Figure 286 Supervisors Lucky and KB1W.

Figure 287 Doing guy ropes.

Figure 288 Installing Gin Pole.

Figure 289 Section heading up.

Figure 290 Top set of guys in place.

Figure 291 Topped off.

Half way done. The 2nd vertical topped off, only 2 more to go.

Figure 292 Roll of hardline.

Staging area. Roll of hardline ready to pull and guy ropes for the last 2 verticals hanging on the cable run just to keep them off the ground.

Figure 293 All 4 up!

Figure 294 Lucky DogCam enclosure.

The new Lucky DogCam

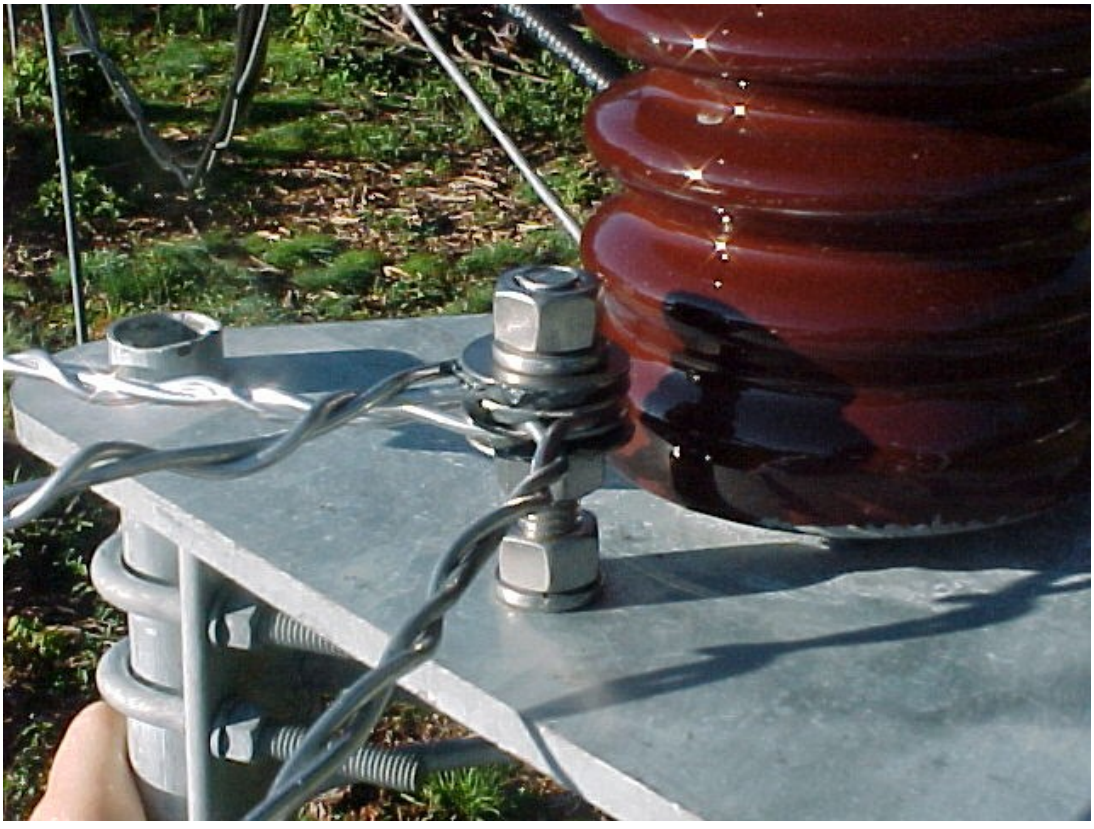


Figure 295 Radial connection points.

Connection point for 3 radials. The hardware is 1/2" stainless. It is in the holes that were made for the rods that were used during erection to keep the stress off the insulator. Between each radial is a flat washer that is dipped in noalox type gunk. There is also more gunk under the washers holding the bolt to the plate.

Figure 296 Feed connections.

The feed connection. Same 1/2" stainless hardware and washers. The cable ends are soldered on eyes. The feed cable goes up to a carrier rope that is tied to the first rung of the vertical. I figured that was less likely to stress the connections when the rope/cable are coated with ice than if it was below the insulator. It also keeps the feedline higher off the ground.

Figure 297 Radials looking down.

Figure 298 Radials again.

View from above of another feedpoint..

Figure 299 Pretty 4-Square.

View 'across the pond'... If only this were the 'big pond'!

2007 Picnic

The 2007 Picnic was held on a hot August day. Fortunately Peru's cooling breezes kept blowing for most of it and kept it from getting too hot, but plenty of cooling beverages were consumed anyway.

Figure 300 Picnic discussion.

W1EQO and W1AUV deep in discussion over a couple cold ones. W1BS in background. Probably W1TO's pants in the middle and an unidentified ear on the right.
Along with plenty of food... I think this was the end of the fresh pie.

Figure 301 W1TO eating pie.

W1TO finishes off the pie.
Good use was made of the shade under the tarps over the deck.

Figure 302 On the deck.

Left to right more or less... Tom, N1MM Standing, Pat N1LZH sitting under Tom's chin, Steve N1SR standing in back, Sigurd KJ1K sitting, Mike K1MK standing, Bruce N1YCW sitting, the back of Jim W1EQO's head, Joe W1BS standing, Tom W1AUV sitting, and Gerry W1VE on the right.
K1RX and W1TO presided over a short YCCC meeting to induct new members and pass out door prizes that included some mugs, maps, and books.

Figure 303 Club officials.

Mark K1RX and Tom W1TO.

There was a little bit of operating going on, but it was pretty warm in the shack even with the window fan going.

Figure 304 In the shack.

Chuck W1HIS at 20m station, Tom W1TO standing.
And of course the Lucky Dog took the pack on a tour of the antennas.

Figure 305 Walking tour.

Left to right.. Matt W1MAT, Mark K1RX, John WA1ZHM partially hidden in back, Tom W1AUV, Will WC2L(ex NA2NA), Jose N1BAA (ex N4BAA), Eric KV1J, Me, Lucky Dog leading the way... He knows the antenna tour path pretty well by now.

The tour started at the new 80m 4-square site. Most people kept safely to the shady side of the clearing.

Figure 306 Shady view of 80m 4-square.

Left to right... Sevi, son of N1BAA, a couple arms I can't identify, Tom W1AUV, John WA1ZHM, Joe W1BS, Frandy N1FJ, Jim W1EQO, Jose N1BAA, Gerry W1VE, Mark K1RX, Eric KV1J, Matt W1MAT.
Its definitely hard to get a good picture of this antenna.

Figure 307 80m 4-square.

There were a few shady spots to view the rest of the antennas. I'm not going to try to identify all the backsides.

Figure 308 The long view.

Figure 309 keeping cool while looking at towers.

This is pretty much the same group as above... Left to right.. N1SR, W1MAT, KV1J, W1VE, W1AUV?, W1EQO, K1RX, W1BS, N1FJ, WC2L, N1BAA, Sevi, WA1ZHM. The Lucky Dog lets the tour narrator do his thing while everyone else stands in the sun. He was nice and cool from a dip in the pond.

Figure 310 the backside. L-R Lucky Dog, Me, Unidentified Gut.

2008 – The year of repairs!

There is a big change of format for this year, I started using the free Screwturn Wiki software that lets you edit right from the web site. I flip flopped a couple of times on how to present this, first adding new stuff to the bottom with just links to pictures, then putting pictures in-line, then putting new stuff on the top, and finally going back to adding on the end…. Pictures also changed formats from 640x480 to 320x240 with links to full size ones. This is a lot wordier than previous years, lots of notes on little things instead of just pictures of final results or big events. But this is the life of a Super Station owner.

We'll see how that turns into a published page now. I didn't start it right at the first of the year so the dates in the beginning are a bit incomplete and some are estimates and summaries… so here we go, the year 2008 in review.

1/1/08 Start the year with everything working I do believe. One insulator on the 80m 4-square is broke and all 4 of the verticals are splinted with 2x4's just in case, but its working fine.

1/4 Set up for RTTY Roundup NP3D s/o

1/11 Set up for NAQP CW K1MK s/o

Mid Jan - 180' ring rotor won't turn. Find 2 bolts missing from one corner bracket which let the bearing sag and the ring to pop over the other two. Have to pry ring back under bearings and then spend about 1/2 hour trying to line up the first hole to get new bolts in. Used spare bolts from emergency bag, need to replace with proper ones.

1/18 Set up for NAQP SSB and Jan VHF SS for WB2JSM M/2

1/25 Set up for CQ 160m CW m/s and also BARTG RTTY Sprint so2r

Ice

Late Jan/Early Feb 3 ice storms with wind in 2 weeks. Top 40m has all 4 elements bent on one side. Bottom 40m has reflector bent. All bent at 2nd tubing section out from the boom. Also on all 5 bent elements one of the loading rods breaks off at the shorting strap when the wind bends the element while the elements are bent so the rods are below the element. 120' 20m also has 4 bent elements, top 20m has one, and 90' one has one bent one. File insurance claim for all the damage.

2/1 throw 40m inverted V up in middle of 180' tower. Almost lose N2KW in snow bank when he falls through ice crust. Set up for FOC Marathon

2/2 Pictures of the 40m damage in progress:

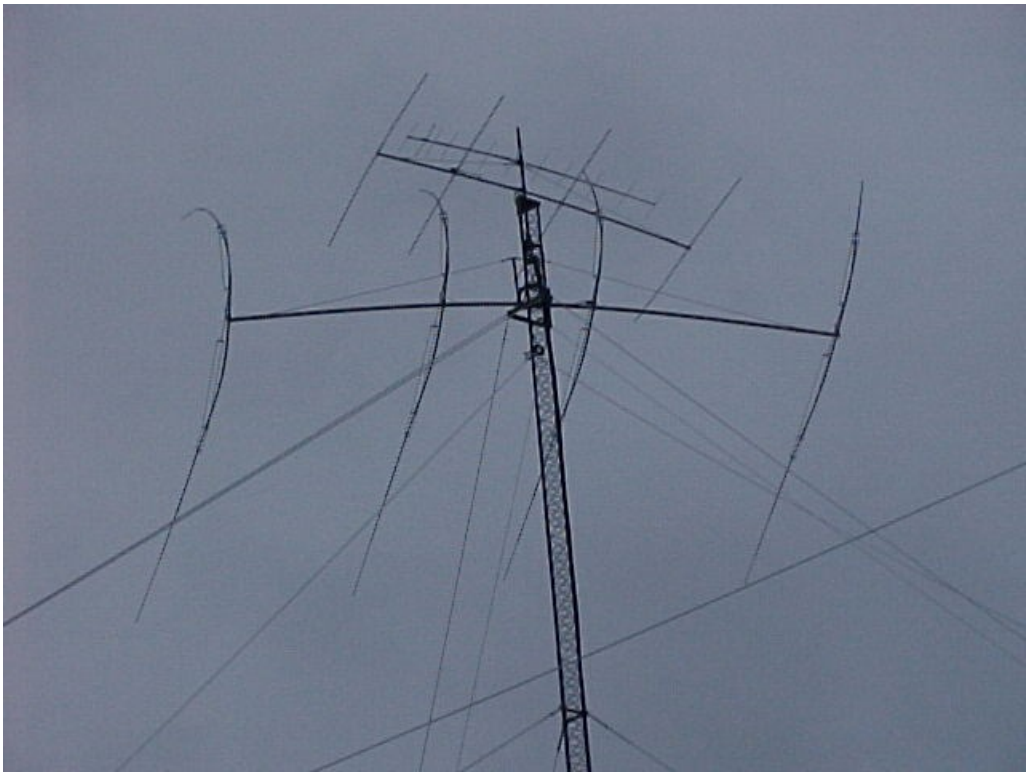


Figure 311 Top 40m with ice and wind.

Figure 312 Top 40m with ice.

Note how on the left side all 4 elements are bent at the same place and the loading rods are below the element tubing.

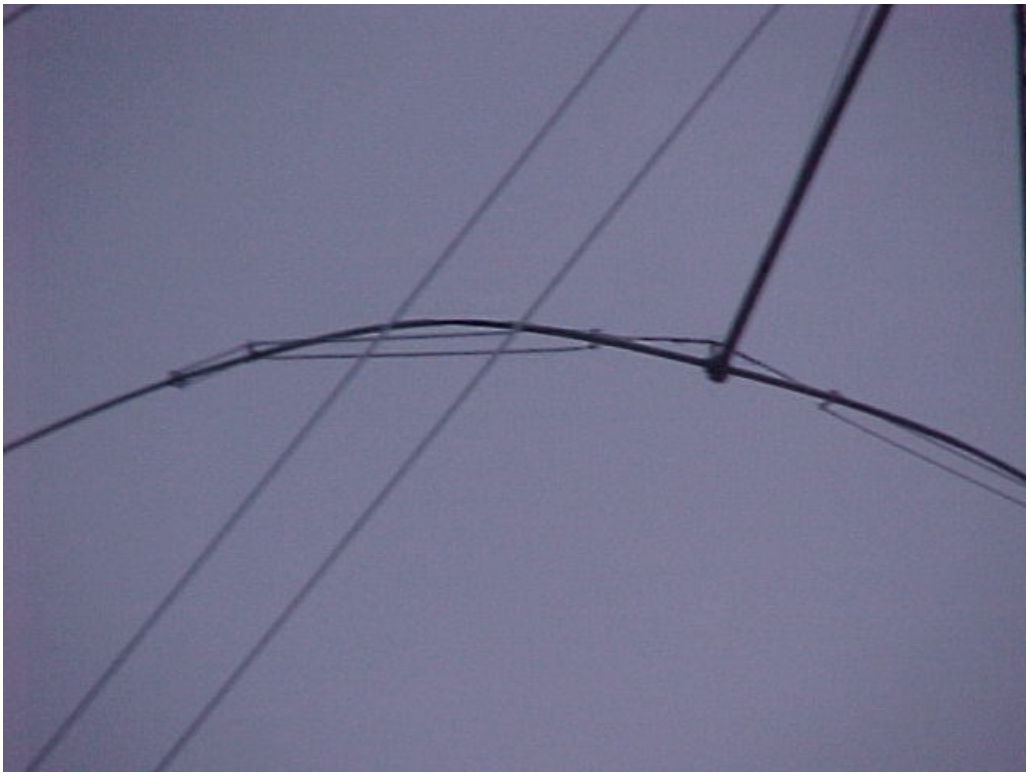


Figure 313 Top 40m with ice element close up.

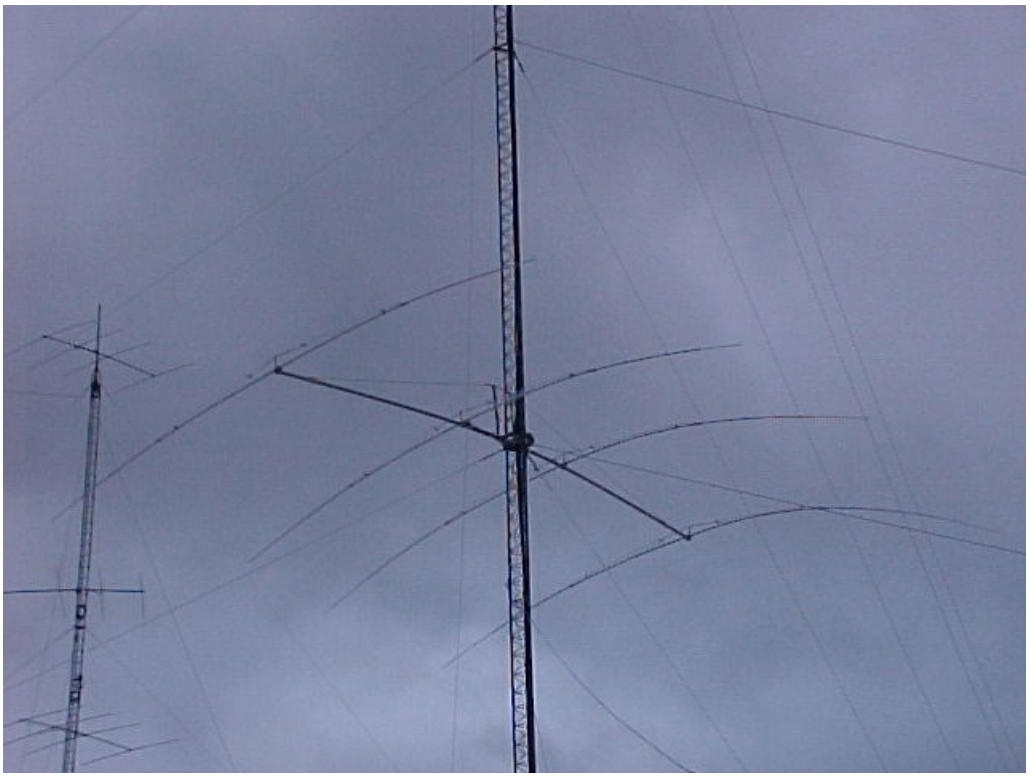


Figure 314 Bottom 40m with ice.

2/7 Pictures of the 40m damage in progress:

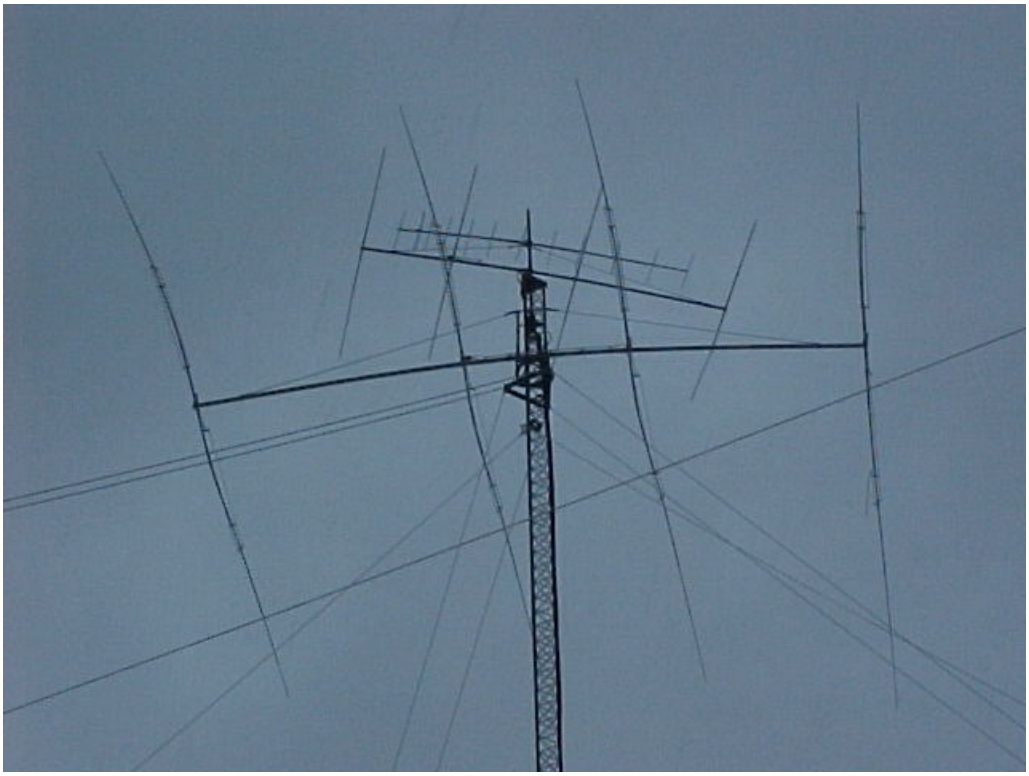


Figure 315 Top 40m with ice and wind.

Round 2 of the storms you can see the 1st loading rod broke on the right element

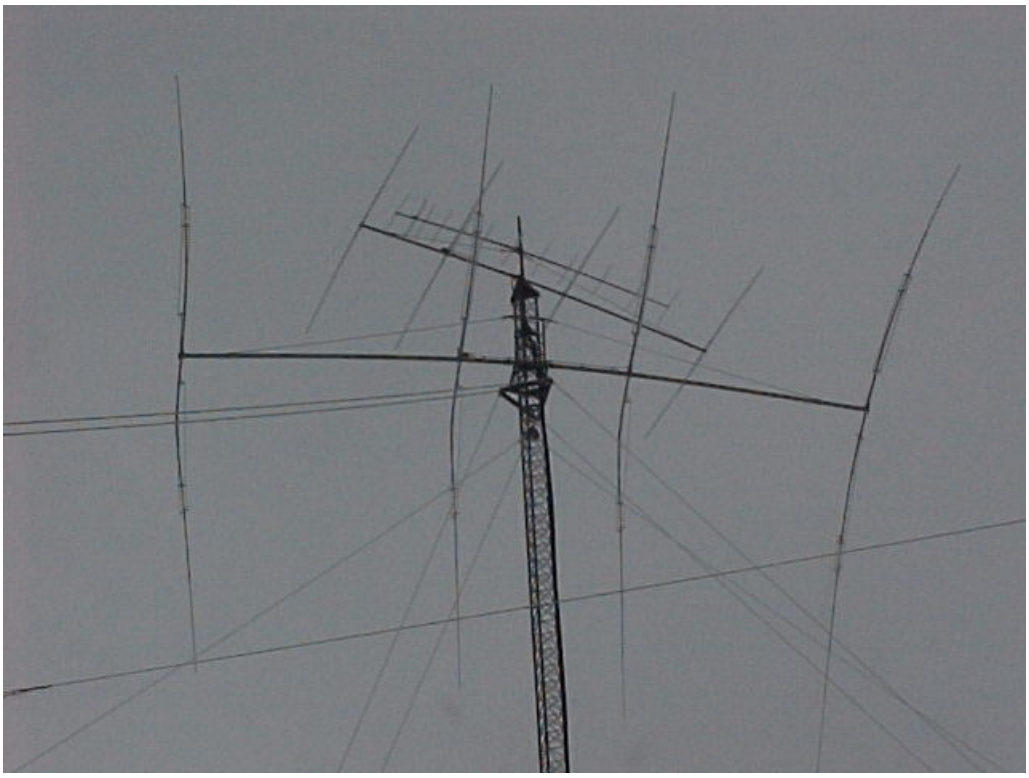


Figure 316 Top 40m with ice and wind, slightly crooked elements.

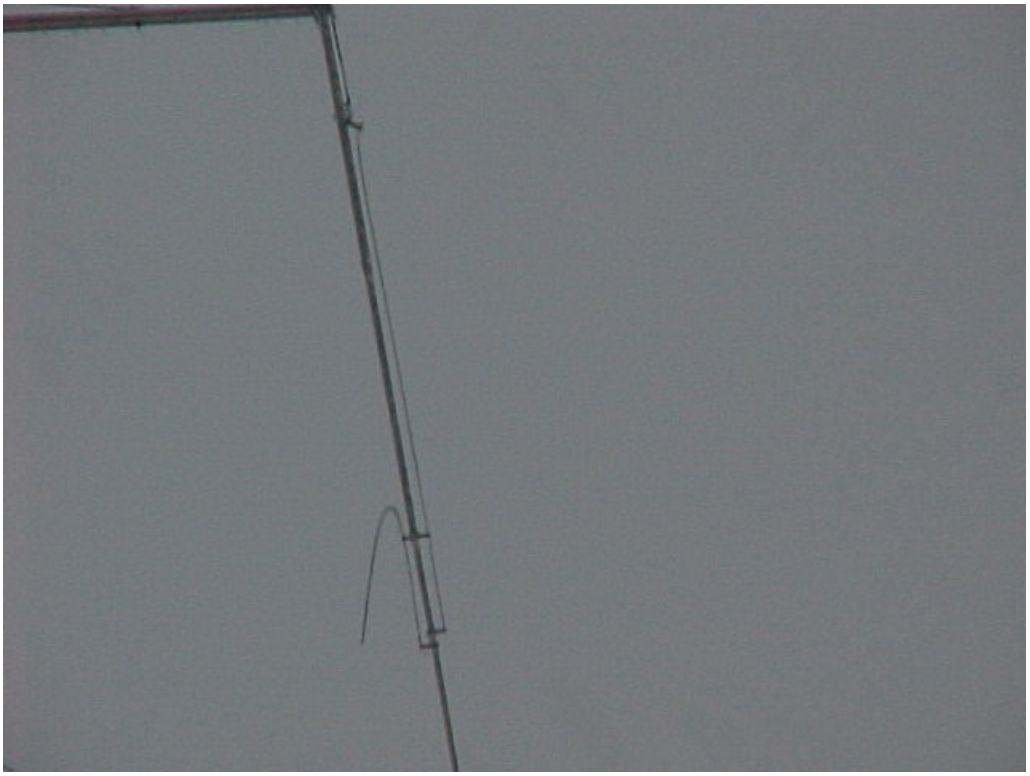


Figure 317 Top 40m broken loading rod close up.

2/8 Set up for WPX RTTY W1UE so2r Remove small broken pine tree and branch from over one of the 80m 4-square guy ropes.

2/15 Set up for ARRL DX CW m/m 180' 10m reads open circuit, reflectometer points to hardline connector at top of tower.

2/22 Set up for CQ 160m SSB W1EQO s/o and some rtty thing just playing around. Order new 40m4lldd 125mph to replace top 40m and new 20m4dx(for parts).

2/29 Set up for ARRL DX SSB m/m. 180' 10m is working again, should probably open up and check for pin location and water later.

Repairs

3/7 Go up 180' tower, remove feedlines from both 40m beams. Remove old 40m inverted V coax that wasn't being used. Swap connections on remote switch box so they line up with control box properly. KC1XX comes and takes down both 40m beams in about 2 hours. I buy 1000' of 1/4" EHS he used for tram to replace my too short tram wires. Turned out to be a perfect day, right around freezing and almost no wind. So the snow on the ground was well frozen, otherwise we would have been up to our knees or more.

Figure 318 Rigging bottom 40m.

Tram line is cable coming down to left.

Figure 319 Bottom one coming down.

Figure 320 Bottom one wide view.

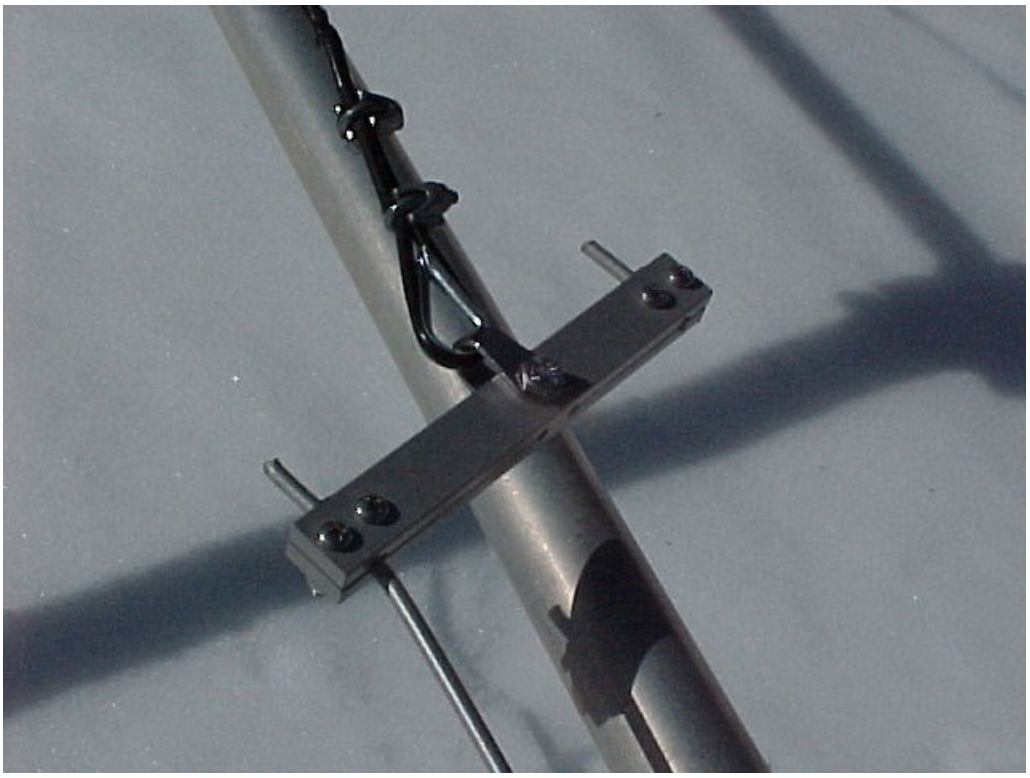


Figure 321 Close up of broke loading rod end.

Close up of broke loading rod end, its really not pulled out, the shorting bar held and the rod broke. The ss saddle and eye arrangement on the Philly cable is my modification to prevent the Philly from being

cut on the side of the small holes it used to go through on the shorting block. M2 has modified the design with a strain relief to prevent that on new ones.

Figure 322 Rigging the top 40m.

Tram line is hard to see but comes down between guy wires toward bottom.

Figure 323 Rigging top, wide view.

Figure 324 Liftoff of top one.

Figure 325 Top one starting down.

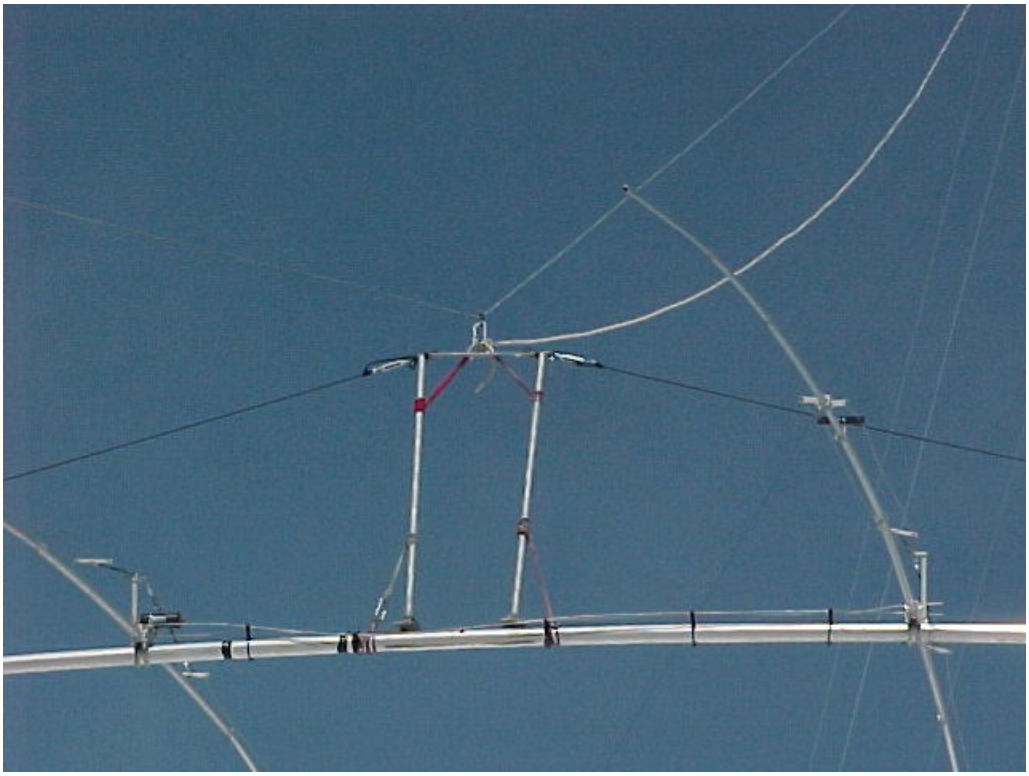


Figure 326 Interesting rigging.

Use ring rotor supports and boom brace to spread load to 4 points on boom.

3/14 set up for RDXC m/2 Order aluminum from Marmon/Keystone to upgrade bottom 40m...

- 4pc 12'x1.375"x.058"wall (to put inside 1st section of element)
- 8pc 12'x1.25"x.058"wall (will go from center all the way through and also replace 2nd element section)
- 4pc 12'x1.125"x.058"wall (for inside 2nd element section)
- 4pc 12'x1.0"x.058"wall (for inside 2nd element section)
- 4pc 12'x.875"x.058"wall (maybe for inside short pieces around element insulators)

This will triple the walls on the first 2 element sections, and double the next section if I do that part. This will pretty much make the elements as good as the 125mph version.

3/17 rope for 160m inverted L's breaks. It finally rubbed through where it hits the upper guys of the 180' tower. Spend evening untangling it and getting it back up before it freezes into the snow.

3/20 send 2 headsets to the Heil Hospital for repair. One with broke mic boom, the other with intermittent cable.

3/21 install 2nd 220v outlet under 40m table... why didn't I do this last year???

3/22 replace indicator drive motor in one of the Yaesu rotor boxes. Set up for BARTG RTTY so2r without moving rotor boxes.

3/24 Start disassembling top 40m beam, stack it next to shed. Take unbent half of reflector and swap with bent one on bottom beam.

3/25 Replace foam on one of the cheap RS guest headsets. Buy another one to replace the one I took to the office.

3/27 Heil returns refurbished headsets. New insulator for 80m 4-square arrives from K0XG. Take director and reflector boom to element clamps and center splice from top 40m to replace ones from bottom 40m. The old bottom one had 2 spliced pieces of tubing clamped in boom-element clamps, the top one had solid 1" aluminum rod as center splice... I like the solid rod much better than the double wall tubing. Start disassembly of bottom 40m beam to start rebuild.

3/28 Set up for WPX SSB NE1C M/M. Have to wait around for heating repair guy in the morning. Pick up aluminum from Marmon/Keystone after lunch, horrible drive in slush until I get a way down the hill. Get back just a few minutes before K1SFA shows up for the contest. When turning on amps the 15m amp goes into thermal runaway, one tube must have an intermittent failure and melts part of the air duct around it, lots of fun to remove it from being melted into the duct. Install new tubes and the amp works better than it had been before, must have had a weak tube for a while.

3/30 Unload aluminum from car to pile next to shed. Nice pile of bright tubing!

4/1 South Beverage is down, top of a pine tree is on it and frozen down. Removed a big branch from a radial on the 80m 4-square. Started checking materials for bottom 40m antenna repair.

4/2 Update 2008 Scores web page with recent contest scores and pictures.

4/3 Continue with disassembly and staging of materials for repair of bottom 40m4lldd.

Shown next to a mechanical pencil for size in the image below, this tool, out of all my toolboxes, was uniquely suited for one job in disassembling the 40m4lldd.

Can you:
Identify the tool's original purposes?
Figure out what it was used for during disassembling the antenna?

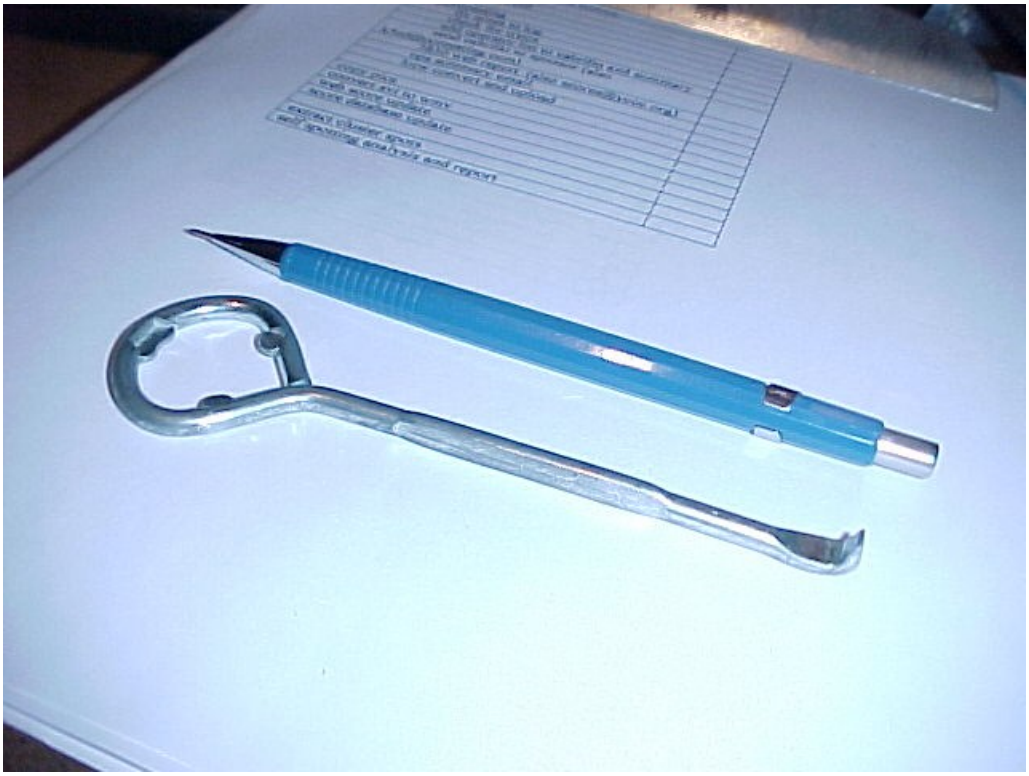


Figure 327 Mystery Tool

4/4 This is what you get when you try to work on antennas in April in Peru... April showers bring May flowers, but do April snows sprout May Yagis??

Figure 328 Repair of bottom 40m

Since it doesn't look like a nice day for antenna work, I have finally added pictures of the ice and 40m takedown. Look up the page for links to pictures taken on 2/2 and 3/7.

SDR-IQ arrived, interesting tool. Works nicely with CW Skimmer version 1.1. Lots of spectrum monitoring possibilities.

4/5 Assemble first prototype new element for the bottom 40m. (click on image for larger view)

New vs. old element tubing:

Figure 329 Old (left) vs. New (right) element pieces.

On the left is the old element and the right is the new one.

The old element-boom clamp had 2 pieces of tubing spliced in the middle, then 2' of 1.375" over it, and a 5' 1.5" first section. The first section is swaged down to take a 5' 1.25" second section. The second section is swaged down to accept a 2' 1" piece that has the .875" fiberglass insulator in it. The second section is the one that bent in all the failed elements.

The new element has a solid aluminum rod in the middle, these were salvaged from the broke top one which was newer than the bottom one. I made a longer 1.375" insert to go all the way to the swage in the 1.5" section. Then a new 1.25" piece goes all the way from the end of the center rod to where the old 1.25" one ended, but is not swaged. Inside that is 6' of 1.125" flush with the outer end which then accepts the 1" piece that goes to the insulator. And inside that is a 6' 1.0" piece that butts against the 1" piece with the insulator. Not shown in the picture is a short .875" piece that doubles up the 1" piece up to the fiberglass insulator. I haven't decided if I want to double the wall on the next 5' 1" piece yet or not, I have the aluminum to do it so I probably will, it will just take more disassembly after the insulator.

Assembled element:

Figure 330 One assembled element, 7 more to go.

Answers to yesterday's mystery tool questions:

The original use: Paint can and bottle opener is correct. These were given away for years by various paint stores. Some called it a 'church key' but I believe that is more properly applied to a combination flat top can (with no pull top) and bottle opener.

My use: On the 40m4lldd the butt end of each element has a 24" 1.375" tube inside the swaged 5' 1.5" main element tube to add strength. This combination is held to a short rod that is held in the boom-element clamp by a 1/4" bolt. Due to slight flattening of the tubing and distortion of the hole the inner piece on most of the elements was stuck pretty well inside, and they were either flush or slightly inside the outer piece. That tool was perfectly made to grab the inside of that 1/4" hole in the inner tube and pull it out just far enough to get it started. It could also then be inserted through the hole to finish pulling stubborn ones out.

4/6 Cut and cleaned the rest of the pieces for the sections out to the insulators for the other 7 half elements. Had to substitute one of the 1.5" pieces from the top antenna for one that had some dings in it that prevented inserting the 1.375" sleeve.

4/7 All the new elements are assembled and bolted down. This went smoother than I had expected with only two of them giving me any problem sliding the sections together.

Also got notified that the new top antenna should be delivered Thursday afternoon... then there is lots more assembly to do!

Flipped this blog upside down so now the new stuff is on top and it gets older as you go down. Move the TO DO list to it's own page.

4/8 A big advantage of the new stiff elements... they line up much easier than the floppy ones did. Basically the stiffness pretty much eliminates 8 degrees of freedom in adjusting them, the turnbuckles on the loading rods has very little effect now on the alignment. The bottom one is almost ready to raise now, I think I am going to replace the rope boom truss with aircraft cable or EHS just because the elements are much heavier than they used to be.

4/9 Changed boom truss on bottom 40m to 1/4" aircraft cable.

4/10 Ah, nice spring day in the Berkshires... so I had to take the afternoon off to sit by the phone waiting for the trucker to ask for directions. I did take some time to turn on the phone in the shed and sit out there taking apart the broke elements to salvage parts for other possible projects.

The 40m4lldd(125mph) and the 20m4dx arrived. The 40m4lldd box was damaged and a couple parts were missing... glad I have plenty of spares!! But also the boom tubing was damaged. Spent 2 hours getting the stiffener out of the center section of the boom because the tubing was dinged in the middle and the stiffener wouldn't go in the way it was supposed to... why didn't they ship it installed properly instead of pushed to one end of the section??? Why isn't it the full length of the center boom section anyway instead of 3' shorter?

On the plus side, on the 4th try the heater repair guys finally stopped the leak in the condensate trap on the upstairs heater... if they had just ordered the $11 part the first time they sure would have saved

themselves lots of grief, and at least 2 return trips that I didn't have to pay for.

Check out Skimmer Spots to see some of the skimmer spots from those of us testing the CW Skimmer with wideband radios. I will have mine running only when I am around since the antenna the SDR-IQ is on doesn't have any lightning protection.

4/11 Ah, absolutely yucky day in the Berkshires. Cold, rain, breeze. M2 says they will rush to get me replacement boom sections and parts. I can't get one of the stiffener rings out of the center boom section so not much I can do but wait for it. Hopefully this weekend I can get the elements assembled anyway so they are ready. This one has a different element taper after the insulators than the lower rated one so not all those parts are interchangeable.

Had to replace one reflector tip after the newly repaired one slid off one of the cable reels it was sitting on as the snow melted out from under it. Turned the reels on their side for now so that can't happen again as the rest of the snow melts.

4/12 Ah, started yucky, ended nice... got the element halves of the new 125mph 40m4lldd mostly assembled. Some problems with hole alignments and one bad piece of aluminum, they must have gotten a wrong piece in some shipment that had too thick of a wall so the next piece won't slide in. Sent M2 another email to report bad pieces and other minor problems in assembly.

Finally got the south Beverage out from under the pine tree top that broke of and landed on it. must have been 6 or 7 insulators that came off from that.

4/13 More snow today, continued pre-assembly of the element halves in the garage. The boom on this new one is 3" diameter. The center section has a 2.5" insert for stiffening. To center the stiffener in the boom there are 5 rings around it held in place with set screws. When I got the stiffener out of the damaged section one of the rings stayed behind... stuck on the ding in the tubing of course. Spent another two hours coaxing that little ring out, the neighbors must have thought a blacksmith had moved in with all the metal on metal hammering.

4/14 Argh, shipper says I have to file the damage claim because it came COD. Insurance claim on the insurance claim replacement!

4/15 Cleaned up center section of old top boom and, very carefully, and with much lubrication, inserted the cleaned up stiffener and rings into it. Got call from air freight inspector, he will come tomorrow afternoon to view damage.

4/16 Inspector for air freight company came and looked at banged up aluminum and agrees that its scrap... all 37# of the 2 boom sections. Now to see what they will payoff on it. Meanwhile I assembled the new boom from the old one plus the new stiffener. And replaced the one with the bad wall thickness with a piece of the tip of one of the old ones just in case they don't get me a replacement before this is ready to go up. Snow is melting quick now so hopefully will have the bottom one ready to raise by this weekend.

4/17 Put tram wire and lifting rope at 105' to get ready to lift the bottom 40m beam into place, probably on Saturday.

4/18 All the ice finally melted on the pond, still some snow piles along the bottom of the field and in shady spots. Finished tightening and aligning the bottom 40m Yagi. Got it rigged up to lift bright and

early tomorrow morning. Took the snow blower off the green machine and will try using that instead of the jeep to lift with. Assembled the boom brace for the new top 40m, they only use 1/8" aircraft cable on this one, I have 1/4" (just because I had it already) for my modified one.

4/19 The WX is too nice to be doing this work. 72f, clear, nice breeze... KB1W and W1TO came this morning and in less than 2 hours the bottom 40m beam was back on the air. They also moved the partially assembled boom and elements for the new top one down to the final assembly area. The new green machine did a find job of pulling up the antenna, it didn't even sound like it was working very hard. And the new rigging method I learned from Andrew of XX-Towers made it nice and stable all the way up... See the pictures from the lowering of them down below for how it was rigged so that the boom brace and struts are all assembled and ready to go.

After lunch, started final assembly of new top 40m Yagi down at the bottom of the field where it will be hoisted from.

4/20 WX man goofed again, nice WX unless you are a fireman. Brush fires yesterday and today all around the county. Continued assembly of new top 40m Yagi.

4/22 Yes, I took yesterday off. Tonight I aligned the elements on the new top 40m and added the tips.

4/23 Rolled out new tram wire for lifting side. The one used for the lower antenna lift will be the back stay. Installed new ACOM2000A... Now I have to learn how to set it up to make it easy for antenna changing and band changing. It does tune quick, that’s for sure.

4/24 Playing with new amp got cut short by the season's first t-storm last night. No bugs yet tonight so went and rolled up the ground screens under the 80m 4-square. That stuff is starting to show it's age now, starting to show some rusty areas.

4/26 Hoped to be able to put up the tram wires for the top 40m raising, but it was showering at dawn and the wind didn't drop off as predicted. So spent the day doing misc stuff. I think all the snow is melted so I put the mower deck on the new tractor, cleaned the house a bit, did laundry, cleaned up in the yard a bit, walked the Beverages and fixed a few insulators from branches that were down. Charged up the MFJ-269 and did a quick check on the new 40m antenna. Played with new ACOM for a while. Set the station up for SO2R for NEQP next weekend. And basically puttered around doing little stuff. The afternoon when it was supposed to rain turned sunny and breezy so I did the final assembly check and bolt tightening on the new top 40m so its ready to go up now.

4/27 Well, this was the wx promised for yesterday. Calm and cloudy. Nice day to pull up the tram wire, back stay, and lifting rope for the top 40m. Now I just need another nice day and a few extra hands.

4/29 1.79" of rain since Sunday night left the field pretty wet, but the sun came out after dinner so I went and got the pulley on the tram wire and cut it to length for the 40m lift-off pad down by the pond.

4/30 Added thread lock compound to the tip compression fittings on the new 40m... just in case.

5/1 Ah, the best way to get an antenna up the tower... have someone else do it. KC1XX bumped another job off his schedule and put up the top 40m this morning, while I watched from the office. Well, I could see his truck and them coming and going to the shed, but that was about it. This new heavy duty one sure looks nicer up there, the elements are nice and straight, and the boom is really straight instead of sagging like the old one did. Now I just have to hook it up and align the rotor and make some impedance

measurements, hopefully tomorrow.

5/2 KB1W came up to push buttons and I got the top 40m connected and the rotor aligned and tested. It needs some more tape, and the double nuts on the ring mount, it was just too cold, breezy, and damp to do it all at once... but it works.

5/3 Perfectly yucky day outside... Got rid of pile of SASE's that have been sitting around for a while and got ready for NEQP.

5/6 Reconfigured station to m/m for CQM.

5/9 Set up logs for CQM. Clean up a bit in shack and bunk rooms. Order parts to repair DR Brush Mower.

5/10-11 CQM Contest. Clean up shed and garage a bit, put away all tools from previous word to get ready for next jobs. Cut grass under 40m 4-Square, the green machine actually handles that junk where the old one wouldn't. Stack up left over aluminum from 40m work.

5/14 Unpacked new 20M4DX to get replacement parts for all the ones bent by the ice and wind over the winter. Pre-assembled element halves.

5/15 Started widening the parking area. Received visit from another big insulator collector who was interested in some of my surplus insulators.

5/16 Sold a bunch of surplus insulators, cleaned up storage area and used left over materials to enlarge the aluminum and pipe storage area. More yard work.

5/17 Took pictures of each station for hardware pages then reconfigured the station for SO2R for WPX CW next weekend. Repaired DR Brush Mower, most of the way, had to order more parts.

5/18 More work on widening parking area.

5/20 Visit by PA1T and PA1M.

5/23 More work on widening parking area. Clean up inside shed a bit to make some room to work. Set up log and test antennas for K1MK to do WPX CW.

5/24 Ordered materials to reinforce 80m 4-square insulators. More work on widening parking area, about ready for gravel now. Testing new version of CW Skimmer that prevents self spots and fixes a bandwidth bug... the SDR-IQ does get blown away pretty badly by in-band transmissions but still gets some spots if you aren't transmitting too much. Finally got last parts for DR Brush Mower, took it for a test cut around 40m 4-square and pond.

5/25 Fired up the new chainsaw and started cleaning up dead and broken trees and junk around the 40m 4-square, and some stumps around the 80m 4-square. Measured, gooped, and glued up the replacement 20m elements. More cutting of new brush starting to grow around 80m 4-square.

5/26 Nice day, but windy again... Glad I got the 40m stuff done early, its been windy or raining just about every day I've been around since then. Did more cleanup of tools and cable in shed. Ordered replacements for Beverage transformers. Started looking at using leftover pieces from 40m project for

verticals for receiving 4-square(s). More yard work. Cut some more trees down around 150' east end anchor that were too close.

5/27 Picked up parts for 3 screw jacks for replacing the broken 80m 4-square insulator. The hardware store guys know enough to not even bother asking what I'm going to do with two 36" pieces of 1" threaded rod, 3 nuts, 3 couplings, 6 washers, 3 1"x4" nipples, and 3 1" pipe couplings.

5/28 Still windy, but have to get off the ground... so went and leveled the crooked 15m Yagi on the bottom ring. Ordered cables to replace Beverage feed lines. Had fun with tools, cut 1" threaded rod with circular saw, welded couplings on one end, ground down ugly weld beads to make the end flat again... made enough noise the neighbor had to come over and see what I was up to. Hopefully these will work to replace the broken insulator.

5/29 Received fiberglass for 80m 4-square reinforcement... started cutting into rough lengths so I could get spare pieces to practice making the ends square. Old table saw bearing seized up after 3rd or 4th cut. Guess its time to go TOOL SHOPPING!

5/30 Finally a nice day. Went up 180' tower, double nutted the top 40m beam boom cradle. Taped things up better. Replaced ungraded temporary bolt in top ring frame with proper one. Found loose nut on one of the rollers on the top of the top ring and tightened that up. Still could use some more adjustment on the roller opposite the motor on the top ring. Measured impedances at the 40m switchbox. Determined there is some interaction with the 'temporary' inverted V on 40m, will take that down next time I go up I think. Went up to the bottom 20m beam and checked that the new element tips have the same hole locations and what tools would be needed to replace them. And all that before 10am.

6/1 Cut more trees down around East 150' guy point. Re-plumbed the 80m 4-square to prepare for insulator replacement and reinforcement.

6/2 NEW TOOL! Bought Makita miter saw, should make quick work of chopping up that fiberglass. Of course before unpacking it in the shed I had to make some room, which meant cleaning up some old junk, which meant cleaning up lots of squirrel and mouse debris, then I had to reinforce the table that was getting a bit wiggly, etc, etc, etc... Didn't get anything done, but the saw does make nice smooth cuts in the fiberglass.

6/3 Started rip out of old Beverage transformers and cables. Mounted new DXEngineering transformers on the pole. Received new cables from DXE for the Beverages also.

6/5 Connected up new Beverage feedlines. Hooked antennas to switchboxes. Now I need to mount an expedition to the far end of the Beverages to connect the new reflection transformers. Anyone want to ride shotgun for that one?? Bring your own bug spray!

6/7 I had to pick the warmest, most humid, morning of the Spring so far to get dressed up in long pants, long sleeve shirt, boots, mask, goggles, hearing protectors, and hat to chop up fiberglass into little pieces then glue it all back together. It was either that or go out into the woods to replace Beverage transformers. Either way I was going to end up itching. But I did get 12 braces for the 80m 4-square insulators glued up.

6/8 Ditto... except this time I went wandering back in the woods, crossed the Beaver ponds a couple times, and replaced the Beverage reflection transformers. Had to take shower in bug spray before going out, then came back soaked from sweat, dew, and mud, with a dog that was wetter than I was. Also

cleaned up the shed from recent work a bit more. Ordered V-Bolts to attach the strongbacks to the 80m 4-square legs across the insulator gaps. Why isn't Tessco on my favorites list??

6/9 I thought I heard a tree come down in the thunderstorm Saturday afternoon. Today I carried the big stepladder down to the 80m 4-square and the South Beverage was fine, Lucky went for a swim, we walked up the road a bit and back, Lucky took another swim. (The 11 Canadian Geese in the pond were NOT happy) And on the way up to the house from the pond I see insulators are off a half dozen posts. The sound I heard must have been it breaking off the last branches, then tonight (Monday) it finally fell, right across the South Beverage where it crosses the stream, pulling the wires about 4' below ground level. I was able to pull it around just enough to pop the wires over the end of it and put back on all the insulators without losing a single one.

6/11 Unclamped the glued up strongbacks. Staged some tools and materials for 4-square work Friday. Gravel for driveway delivered across the road, Carl will help move and grade it tomorrow or Friday.

6/12 Finished staging tools and stuff for the insulator replacement.

Repair 80m 4-Square

6/13 With the help of KB1W, WA1ZHM, and KB1OEV, I replaced the broke 80m 4-square insulator. Fairly straight forward operation, loosened the bolts on the old one, stuck 3 home made screw jacks between the plates, lifted it about 1/4", slid out the old one and slid I the new one. Just about 1/4" of prying needed to align the holes, put in the bolts and lowered the jacks. Then removed all the extra bracing and ropes while installing the strongbacks. Installed strongbacks on all 4 of the 80m 4-square verticals. Sure looks lots nicer down there with all the 2x4's and extra ropes gone.

Figure 331 The new strongbacks in place.

Figure 332 Close up of one end of a strongback.

They are 2"x2"x1/4" FRP angle. The 3 small pieces are to provide spacing because of the overhang of the insulator plate.

Figure 333 Broken insulator and tower jack.

The broken insulator and the 3 jacks used to lift the tower. The jacks are 1" threaded rod with a 5" pipe nipple and coupling over the top and a rod coupling on the bottom for a wider base and for something to grab while turning the lifting nut.

6/14 Finished up parking area expansion with the help of Carl and a borrowed backhoe. Played in VHF contest.

6/15 Played in VHF contest some more, nice 6m opening. Split Wiki into Station and Operator areas.

6/18 Caught up putting scores on web page. Cleaned up some other old emails and stuff.

6/20 Built 8 verticals out of the remains of the 40m4lldd pieces. Now to get some 4-square controllers and figure out where to put them. Finished setup for AA CW for W1UE.

6/21 Cleaned up the shed and aluminum/wood racks. Did the (kinda) annual tour of the anchor trees. This is where I make the tree-huggers either happy or mad. They can be happy that I at least go around and regularly move ropes that tie things to trees so they don't get strangled. Or they can be mad that I tied something to a tree in the first place. If you are of the latter kind I DON'T recommend that you read the parts of my book where I talk about the various episodes of the Peru Chain Saw Massacre and how I heated with wood cut down from clearing land for towers for 13 years.

6/26 Been busy this week with brush mowing and other yard work in between showers. Changed station set up to M/M configuration for ARRL FD and IARU HF coming up. Added Spot station to the M/M configuration on all stations. Will start testing skimmer integration during FD and IARU.

6/27 VACATION! Taking a week off to do nothing but work! Doesn't that make sense? Anyway, started

by finishing cutting trees that were too close to the East guy wires on the 150' tower. And also cut a stump near the house to get ready to grind next week... Anyone ever run a stump grinder? I'll have one here 7/3-4. Ordered parts for a receive 4-square, DXE box, phasing lines, coax. Will probably be here by next weekend to setup before IARU.

6/28-29 Play with FD and CW Skimmer, boy does it find lots of FD stations on 20m, too bad we didn't have a real CW operator to work them all, but using CW Skimmer on the local audio helps quite a bit when I do play a bit on CW.

6/30 Replace some old fence rail pipe on one of the feed line runs with 2x4's to get the 40m 4-square feedline up a bit more. Straighten up some of the leaning and wobbly feedline support posts.

7/1 Yard work, also moving firewood out of 80m 4-square area to prepare for stump grinding. The supervisor doing his job:

Figure 334 The supervisor hard at work.

7/2 More preparation for stump grinding, mostly down around the 80m 4-square. Made insulated bases for 4 verticals for the first receiving 4-square. Received adapters from Radio Shack for the receive 4-square. Now I just have to figure out where I am going to put them. Upgraded both Wikis to the latest version from screwturn, old version was 2.0.21, new version is 2.0.33. See screwturn history for info on

changes.

7/3 Grinding stumps. Parts for receiving 4-square arrive, unpack and start pre-assembly of cables.

7/4 More pre-assembly of cables and center post. Now if I only knew where I was going to put it. More stump grinding. Please, if I EVER say anything about renting a stump grinder again someone remind me of this time and that stump grinding is worse than grass cutting. Time to call in the professionals!

7/5 Perfectly yucky wx... Made a change to make WinTelnetX work better with CWSkimmer and IRC.

7/6 Put up listening 4-square in a temporary location... now if there were just some good signals to test it with.

Repair HF-2500 Lowband coil

7/9 One new coil for HF-2500 arrived. Start disassembly of the first one to be fixed. Decide I need to go TOOL SHOPPING!

7/10 Got new Craftsman Dremel like tool set to do some modification to the chassis of the HF-2500. Modify coil support and chassis and reinstall.

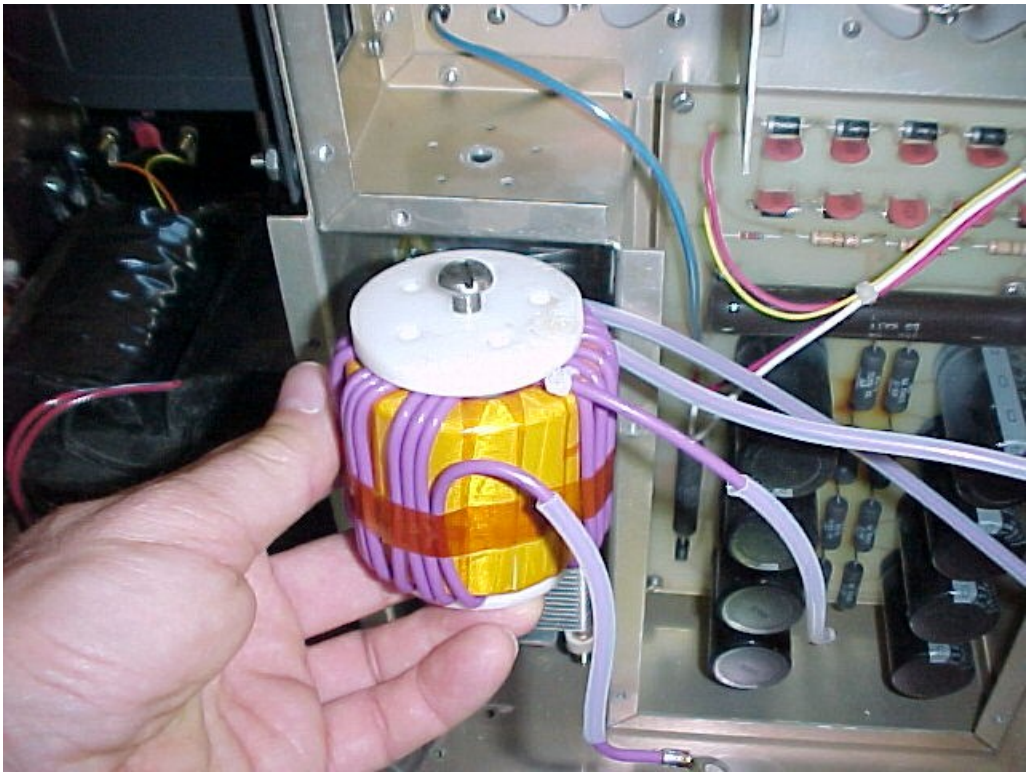


Figure 335 A good coil.

Note the gold colored wrapping on the core. It mounts in that orientation on the bottom of the plate that is the front of the RF deck just above it. The 5 holes in the Tecaform spacer are supposed to line up with

the 5 holes in the front of the RF deck, but weren't all just right.

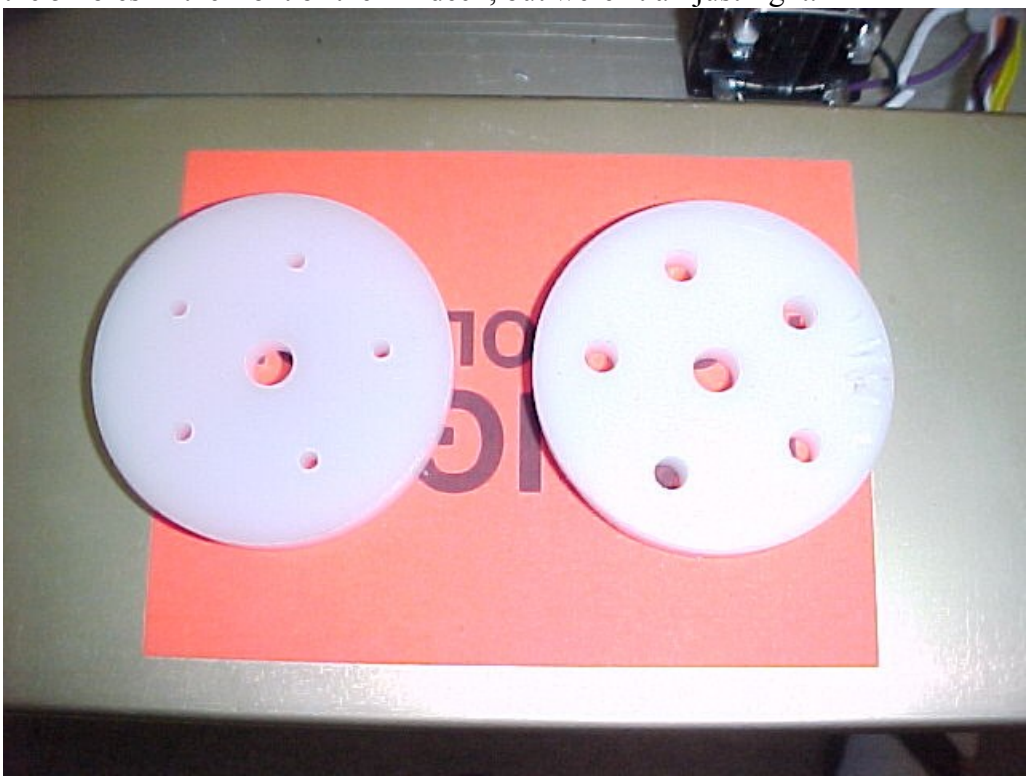


Figure 336 Original and modified spacers

The spacer supplied with the new coil, the small holes match the ones in the RF deck. The one removed from the amp that had been previously repaired at the factory. They must have enlarged the holes to try to get more air through. I countersunk them to make them line up with my enlarged holes.

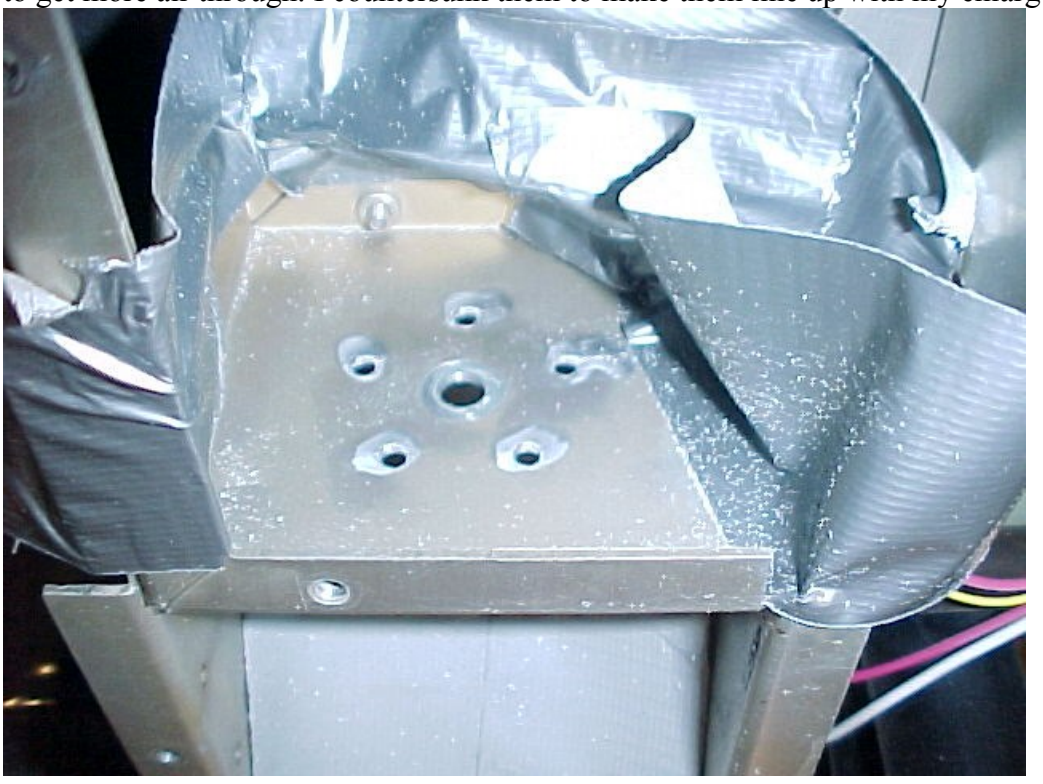


Figure 337 Another use for duct tape.

A way to keep aluminum shavings out of the HV supply and tube sockets while grinding bigger holes.

Figure 338 Modified coil core.

Figure 339 New and Old coils.

The new and old coils. Note the melted down core and front retainer and the blackened wrapping on the melted core.

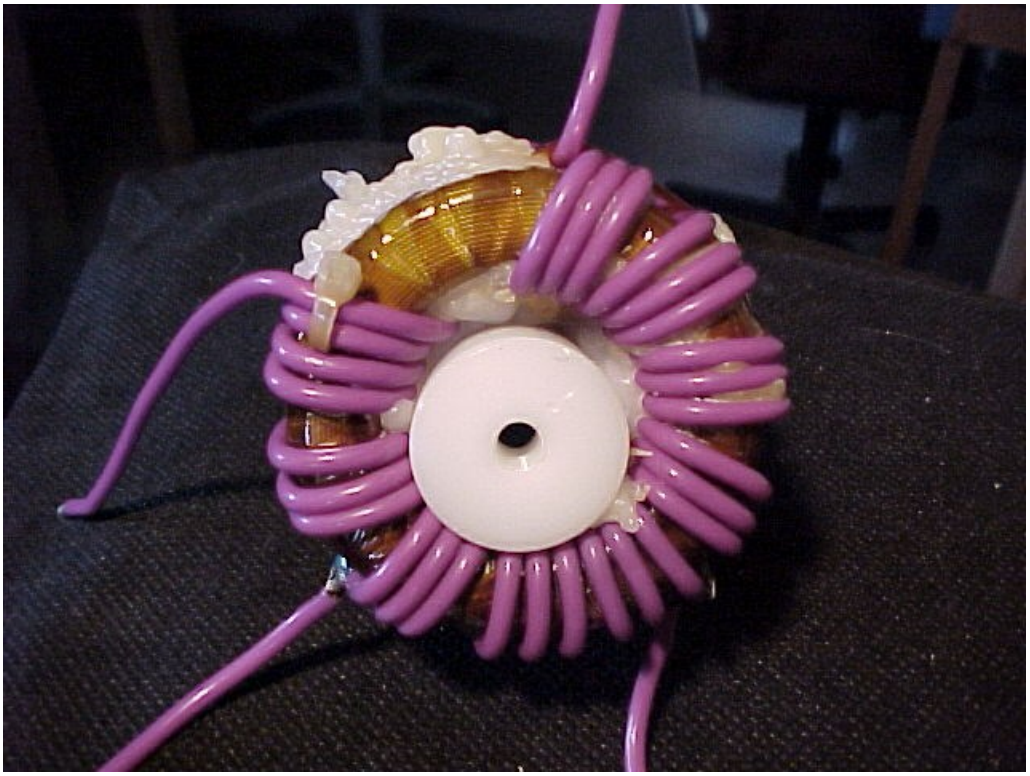


Figure 340 Back view of melted coil support.

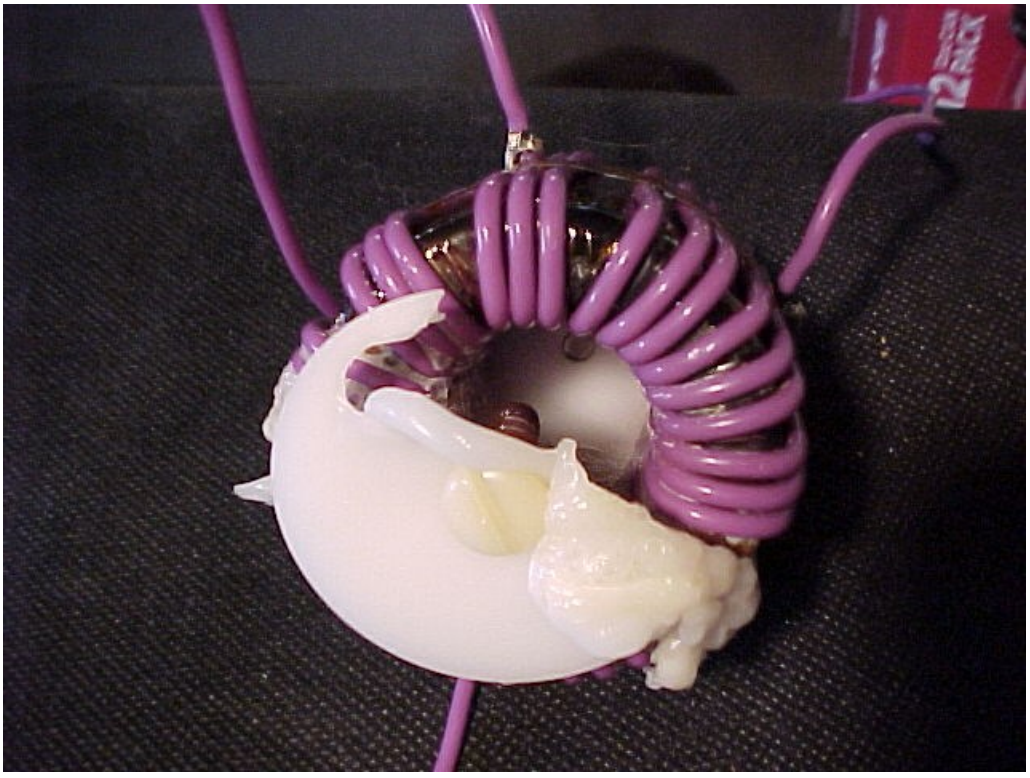


Figure 341 Front view of melted coil support

Over half the core was melted down, except in the very back where the screw was holding it in.

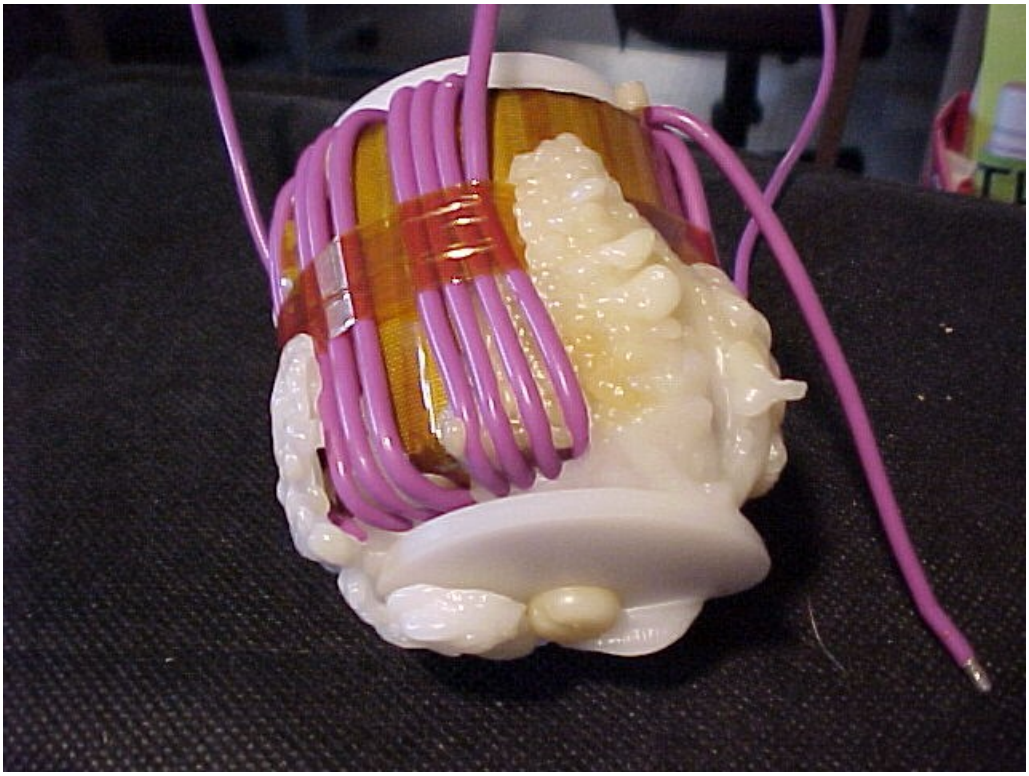


Figure 342 Bottom view of melted coil

7/11 Nice off-Friday morning! Did inspections on 10m and 15m towers... notes:

10m Tower
- Needs 30' and 60' guy wires tightened, top 2 sets ok.
- G-1000 mast clamp bolts are rusted pretty badly but still holding fine.
- All leg bolts rusted
- Lots of light surface rust
- South 10-4cd is old one with plated boom-element clamps, they are all badly rusted.
- Top 10-4cd is slightly tilted, has been for a while. Boom clamps too badly rusted to try to fix.
- 40m 4-square control cable is badly cracked and needs to be replaced.
- There is a spare 1" hardline and 2 wire control cable to the base of the tower (used to be 80m 4-square)

15m Tower
- Long coil of rotor cable at base that could be removed.
- Ring Rotor cradle missing 2 bolts on one boom clamp plate.
- Spare 5/8" CATV hardline at 60' (2 tape markers)
- 90' 15m4dx reflector is a bit crooked
- G-2800 mast clamp bolts rusty but holding fine.
- TB3 mast clamp bolts rusty
- upper sections have some light surface rust
- some leg bolts rusted

Finish re-assembly of HF-2500 and retests just fine. Attempts to increase airflow did not slow down

heating of coil as measured on outside with IR thermometer. It is apparent it is the wire that is heating up not the core. It is interesting that the older amps had smaller wire that did not pack the inside of the core like this newer wire does... none of the older amps have had a melting problem with the smaller wire either.

Set up for IARU HF contest.

7/15 Quiz of the day... in the snippet of the schematic below what is the effect of the right side wafer of the band switch shorting out the right half(on 80m) or 3/4's(on 40m) of the L2 inductor on the current in all 3 sections of the windings? (click on it for larger image)

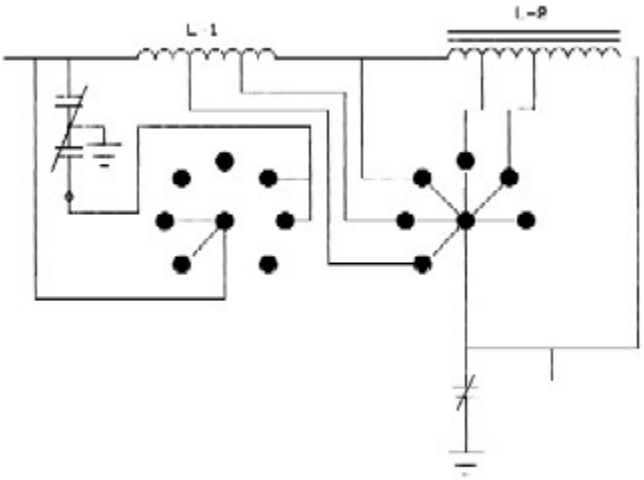


Figure 343 Amp Pi network

7/17 Took apart another HF-2500 that had a melted down coil support. I was able to knock the melted down piece out of the center of this one and salvage the coil for experimentation. Wired it up temporarily as single band 80m leaving the 40m and 160m taps open.

7/18 Made new covers for the 40m and 80m 4-square dump resistors... not pretty, but better than nothing, or a melted plastic bag. Set up the modified amp on 80m to test... but too many thunder storms around to start that tonight. Look down the page to 7/10 for pictures of first repair I just got sorted out on here.

7/19 Ok, the results are in. I did two runs of 10 transmissions at 1500w afsk rtty on 3595. Each transmission was 30 seconds, followed by 10 seconds off so I could record temperatures. One run was with just the 80m turns on the coil connected, and one with the 160m turns shorted the way the original design works. Because of inductance changes when the 160m turns were shorted the tuning was different as noted below. Temperatures were measured with a Craftsman Professional 1400 Degree IR Thermometer... that one had one of the smaller spots, the laser pointer, and as an added bonus has a type k thermocouple input that can be read simultaneously.

Just 80m turns used:
- Power 1500w
- Ip=800ma, Ig=25ma, Vp=2450v, drive=40w

- Tune cap = 21 Load cap = 48 (on scale of 0-100% meshed from front panel)
- Temperature of the 80m coil wire on outside of core = 174f on inside = 220f
- Temperature of the 160m coil wire on outside of core = 122f on inside = 150f
- Ferrite temperature = 150f.
- I suspect the temperature rise of the 160m wire was just due to the conduction from the hot core as it slowly increased as the test progressed. Some of the temperature may be just reading the IR from between the wire from the core also.

With 160m turns shorted:
- Power 1500w
- Ip=950ma, Ig=20ma, Vp=2350v, drive=50w
- Tune cap = 33 Load cap = 62 (on scale of 0-100% meshed from front panel)
- Temperature of the 80m coil wire on outside = 221f on inside = 330f
- Temperature of the 160m coil wire on outside = 144f on inside = 210f
- Ferrite temperature = 185f.
- This time the 160m coil wire temperature shot up as soon as the test started instead of heating with the core... so yes, there is current in it, and yes it does do something bad.

The reduction in plate current with the 160m turns open is interesting. I expected some tuning difference due to the inductance change caused by the open turns but wasn't sure how the network would respond to that. Obviously the range on the tune and load caps was enough to handle it in this case, I would have to check the full frequency range and expected load variations to be sure there is enough range to cover the band. Or I could adjust the turns just for 80m single band use so it had the same inductance as the coil with the shorted turns.

Some inductance measurements: 80m section by itself with 160 section open = 16.5uH. With 160m section shorted 12.9uH

Started cleanup of yard and house for picnic. Set up for NAQP RTTY SO2R.

7/20 Continued cleanup for picnic. Setup station in M/M configuration for IOTA contest during the picnic.

Removed high band loading coil and connected just 80m turns of the toroid in the one amp to try that out. It tunes fine up and down the band anyway.

Removed the 3 power supplies that I bought to temporarily replace the Radio Shack recalled supplies. They would not tell me that 2 wires had to be switched, nor could they do the fix in the store, they had to be sent out for a couple weeks. And since I couldn't go without them for a couple weeks, and they couldn't just exchange them, I bought 3 replacements and told them I would return them when the repaired ones are back. Well, they are back now so I'll return the supplies tomorrow and get mine back. It would have been so much easier if they just published the fix for those who know how to take out 6 screws and swap 2 wires that are on push-on connectors.

7/21 Picked up repaired Radio Shack supplies and put them back on their stations. Put up tarp on deck for picnic.

7/22 Rainy night. Did some shopping and stuffing of the fridges for the picnic. Updated web site scores page.

7/23 More rain. More cleaning and preparation for picnic.

7/24 More rain. Clean up shed and get tables and chairs for picnic.

7/25 FINALLY SUN! Set up deck for picnic.

7/26 PICNIC! Perfect WX... Sorry, no pictures, maybe someone else got some?

7/27 Clean up from picnic and relax.

7/28 Changed station setup to SO2R for upcoming s/o contests.

7/31 Removed temporary setup of the listening 4-square to prepare to move it to a better site. Received 3 new low band coils for the HF-2500 amp repairs.

8/1 Tested antennas for NAQP. 40m 4-square dump resistor is shot. North-East Beverage seems to be way down. Everything else seems to be working.

8/2 Beverage problem may have been a temporary splice at the shack end. Sounds better after removing the splice this morning, and resistance through reflection transformer seems normal. Will see how it works before trekking into the woods. Cut some small trees and brush to make more room for the listening 4-square in the wooded area between the driveway and 40m 4-square. Cut small trees and brush growing up under the 40m 4-square feedline.

8/3 Installed receiving 4-square in its new, hopefully permanent, home. Used the single piece verticals, fed at the base, with just a single radial on each one for now. Seems to hear better than the center fed verticals did, but not much f/b during the day. Will have to see how it does later when the arrival angle is a bit lower.

8/4 NE Beverage still way down. Took a walk tonight and checked the wires, they are all up in the air still. I have swapped coax at the shack end to check the inside wiring. I swapped coax at the transformer boxes to check them. I even swapped two of the transformer boxes. Must be the reflection transformer, it measures ok wire to wire, perhaps the ground is broken. Will have to mount an expedition back there to see what the problem is.

8/5 Well, I was right. The ground wire was broken. Good test of the effectiveness of those reflection transformers, the signals without it were s0 where they were s9+ on the others. The story is better than the problem though. After doing all the shack end troubleshooting I could I decided to mount an expedition to the far end... not an easy task as there is a big new beaver pond in the way. And not knowing what the problem may be I wanted to take a spare reflection transformer with me. So I went to the end of the South Beverage, down past the 80m 4-square. When I got there the can that I had put over the top of the stake and transformer was missing. Not just blown over, completely gone... strange. I disconnected the transformer and after finding a narrow spot to cross the stream down past the beaver pond I beat my way through the brush and trees to the SW Beverage end. The can was off that one also! But this time it wasn't missing, it was just a few feet away, rather crumpled and with some big holes in it! Not wanting to meet up with the owner of the teeth that punched those holes I quickly figured out that the bear had pulled the transformer sideways enough to break the ground wire. I replaced it with a piece of wire I had brought along 'just in case' and beat a hasty retreat back the same way I had come. I put the South end transformer back in place and went back home. I knew there was another reason I didn't like

wandering around out there in the summer. Unfortunately this is an important Beverage direction for the upcoming WAE CW contest and needed to be fixed.

Figure 344 Bear bitten coffee can.

I just wonder if the bear was looking for his morning coffee, or did it not like me littering his territory with my stuff. I wonder if this is the same one that flossed on that same Beverage a few years ago?

8/6 Quick service from Comtek, ordered dummy load Saturday, received today. Replaced 40m 4-square load, now its better, but I think something still isn't quite right with it. While the SWR is better, it is distinctly higher on 2 directions than the other 2. It does seem to have a good pattern on receive though.

8/8 Finish checkout of everything for WAE CW. General work around the yard. Move some of the firewood from the 80m 4-square up to the driveway.

8/9 Run new control cable from 40m 4-square up to the shack. Replaced all tape on that long run with fresh stuff. Removed old deteriorated control cable. Moved some more firewood out of 80m 4-square area.

8/10 Moved more firewood out of 80m 4-square area. Mowed down some of the suckers and weeds growing up in the 80m 4-square area. Dressed up the cables to the listening 4-square. Added 4 more radials to the listening 4-square, connecting the bases of the verticals. It had 4 radials, one outward from each vertical. With just the 4 radials it was better than the temporary place I had it set up before, but still not what I would hope for... Now to do some more testing.

8/13 Pulled new control cable over to the 40m control box and wired it up. Had intermittent high SWR. Went down and tested all positions and checked dump power, everything is working fine. Cleaned up some of the loose cables under the 40m table.

8/14 Did some more testing with melted down modified amp. I melted some of the Tecaform in the toaster oven until it started to break down, it went limp at about 350f but it made very little odor even up to 600f surface temperature. The stink when the coil overheats appears to be coming from one of the tapes wrapping the ferrite cores. I stripped all the tape off one of the melted ones and re-wrapped just a single coil on it for 80m, about 13uH, then tested that. With the same 30 seconds on 10 seconds off 1500w cycle it still got the wire up to 350f and melted off one of my Nylon tie-wraps, but didn't stink. That modified single band amp should be good for this fall season anyway.

8/15 Set up tools and rigging stuff for possible work on 20m elements on Saturday.

8/16 Wx is cooperating, nice calm morning. Replaced all 4 bent element halves on the 120' 20m4dx. This was a tip and tilt job to get the 1st joint on each element in to range to reach from the tower. It was starting to get a bit breezy by the time I was done about 10am, but not enough to be a bother.

8/18 More experimenting with amp problem.

8/19 More experimenting and measurements of amp coil.

8/20 Move more firewood out of 80m 4-square area, figured out how to get more access with tractor without taking off mower deck to get to some of the farther back piles.

8/21 Move more firewood out of 80m 4-square area. Set up for evening sprint.

8/22 Another nice morning on a day off! Replaced element halves on the top 20m4dx. Inspected 150' tower from top to bottom. Ring rotor is pretty rusty. Note spare 1/2" catv hardline with female UHF end and black/white twisted pair spare at 140', also 5/8" catv with bent over end that will need a new connector at about 135'. Moved more firewood out of the 80m 4-square area.

8/23 Big day at Boxboro... Long day also. Left about 6:30am, dropped off mast for KE1FO along the way, didn't get home until 8pm. Bought some ceramic standoffs that shouldn't melt down to replace the Tecaform in some of the amp coil supports. More calculations by K1MK say there could be as much as 250w of heat loss in those toroid, with no air flow inside the coils that would definitely be enough to heat up that core.

8/24 A bit breezy, but not enough to stop me from replacing the last bent 20m4dx element from last winter. The south one still has some bent ones from falling ice, but those can stay that way until I salvage parts from the others and replace those.

8/25 Cut about 2/3's of the brush in the 80m 4-square area. Still got more firewood to move out of there.

8/26 Moved firewood out of 80m 4-square area.

8/27 Moved firewood out of 80m 4-square area.

8/28 Moved firewood out of 80m 4-square area.

8/29 Cut some stumps and long pieces and moved firewood out of 80m 4-square area. Cut more of the brush out of the 80m 4-square area.

8/30 Cut more brush.

8/31 Moved more firewood, got last of unstacked wood and brush cleaned up in the 80m 4-square area.

9/1 Cut last of brush except for what is under last few wood piles in the 80m 4-square area. Put back up a radial for the North end 160m Inverted L that was taken down for cutting trees around the 150' tower guy wires. Taped back up one of the feedline bundles to the 150' tower and pulled it back to the top of the drawbridge posts.

9/6 Installed RTTY supplemental cooling fan on the ACOM amp, gave it a bit of a test in the Russian RTTY contest.

Single Band 80m mod for HF-2500

9/7 Well, tropical storm Hanna blew through over night, while waiting for things to dry up I finished packaging up the HF-2500 80m modification for the Fall contests. This should prevent the overheating we have seen in RTTY.

Along we K1MK we did some modeling and measurement of the coils and cores. We think the core is a -2 powdered iron mix. There are 2 T225 cores stacked in the form wrapped in fiberglass and then a clear tape. It appears the tape wrappings are the source of the stink, the Tecaform when it melts gives of some fumes but not as bad as what was in the tape when I unwrapped the core. The wire is 12ga silver plated Teflon insulated and was not damaged at all from the heat. With the core as shown in the pictures below I measured a Q of about 100, which gives a series loss resistance of about 3 ohms. K1MK modeled the pi network in SPICE and given the current in the coil this results in heat dissipation in the coil of about 250w. As you can see from the earlier pictures the wire is pretty well packed in between the wrapped form and the Tecaform support which probably doesn't give much room for airflow.

Figure 345 Testing coil Q

Coil measurement setup with MFJ-269 meter using the tune capacitor to resonate the coil for Q measurement.

Figure 346 Single band 80m modified HF-2500

Single band 80m modified amp. The area where the coil is now is usually occupied by the high band air core coil, the toroid is usually tucked below the tune capacitor.

9/13 Straighten up the 80m 4-square elements a bit. The one that was broke was a bit off vertical still. Cleaned up this page a bit, some of the early pictures were just links, now they are in-line so you don't have to click on them to view them.

9/14 Replaced low band loading coil in another HF-2500. This one was an older design that switched in capacitors for the low bands and had different numbers of turns in the coils. I had to remove a few turns for 40m and 160m and was able to get 80m close enough by spreading the turns on the coil a bit.

9/18 Tested latest repaired HF-2500, tunes up fine on all bands. Change station from SO2R to M/M for CQWW RTTY. Moved some more firewood out of the 80m 4-square area.

9/19 Finish running coax above ceiling for receive 4-square. Put shack ceiling back together.

9/20 Get updates to N1MM Logger, including some beta test ones for CQWW RTTY. Get updated supercheck, country list, and call history lookup files.

9/21 Well pump died, in middle of load of wash of course... No service available until Monday morning. 10m Roofing filter dead, remove it from radio, we probably won't miss it there anyway next weekend. Software mostly working, a few oddities reported.

9/22 Replaced well pump, contractor was only 2 hours late and came alone... this was definitely a 2 man job! In the process we had to rewire the well power switch and pressure switch for it in the basement...

who in the world would connect white to black and black to yellow and red to ground??? Anyway, I now have plenty of water again. Got my money's worth out of the old pump, the date stamp on it made it 32 years old.

9/23 Trimmed some branches from a tree blown down around the 80m 4-square to get them away from the radials. Mail roofing filter back to InRad for repair/replacement.

9/27 Roofing filter returned from InRad... Now that is quick service!

9/28 Replaced roofing filter in 10m radio. Noticed that the 20m Sub-Harmonic IS BACK! ARGH! See 2003 Tower Work and Subharmonic Generator experiment for info.

10/2 Moved more firewood out of 80m 4-square area.

10/3 Moved the LAST of the firewood out of the 80m 4-square area. Replaced the low band loading coil on another HF-2500. Played musical amps, put the newly repaired one on SO2R position, tuned on all bands to test it out. Put the other recently repaired one on 15m and made the one that was on the SO2R position a spare, it is one of the oldest ones with different wire on the low band coil. Set up for CQP.

10/4 Cut the last big stumps in the 80m 4-square area and brush mowed the last of the stuff growing up through the wood piles.

10/5 Went up 20m tower looking for the Subharmonic Generator. Tried grounding shields of the 2 jacketed hardlines to the tower at the base, 60', and 120', and regrounding the connectors at the top better. No improvement, and maybe it got worse. Must be something different doing it this time! Double ARGH! Thanks to W1UE who was doing CQP for running the tests from the shack while I added grounding up the tower.

Hunting for Sub-Harmonics

10/6 Did more testing with rotating and switching antennas to find the Subharmonic Generator. The lowest threshold powers are with either the top or 60' 20m rotators pointing south, but the next lowest is pointing north. The only switch or rotator other than 20m that seems to affect it is switching on the 150' 80m inverted v. When that is selected the threshold increases a bit. However, the SWR on the south 20m is much higher than it should be and appears to be intermittent at times... perhaps something in the balun or feed point??

10/7 Curiouser and Curiouser... more testing of Subharmonic Generator. For those of you who haven't seen this little gremlin it kind of works like this... Somewhere there is a diode connected to something that is nearly resonant on 40m. As the 20m power increases it will suddenly hit a threshold where the diode starts conducting. This puts a pulse of voltage on the resonant element, this pulse goes somewhere and reflects back to the diode just about the time that the 20m exciting voltage hits its next peak... this time because the voltage reflected back arrives about the same time as the next 20m voltage peak the diode doesn't conduct, or at least not as much. The waveform this generates is an ugly 1/2 of the exciter frequency mixed with the exciter that then makes the 15m 3/2's harmonic that started this whole hunt again.

This time I tried putting 20m power into other antennas to see if any of them were particularly sensitive

to creating this effect... figuring that if there was a bad joint, or flakey balun, or something like that it would stand out. The various thresholds for starting the oscillation look like this:

- 20m top pointing west = 550w
- 20m top pointing south = 100w
- 20m European stack = 350
- 20m ring pointing west = 300w
- 20m ring pointing south = 100w
- 20m south = 70w
- 80m inv v at 150' (on 20m tower) = 100w
- 80m inv v at 70' (on 40m tower) = 60w
- 80m 4-square = ~300w
- 15m stack ~300w
- 10m at 180' on 40m tower = blew up balun first
- 160m inv V at 180' on 40m tower = 500w
- 160m inv L's beaming E-W = 150w
- 160m inv L's beaming N-S = 240w
- 160m single inv L (the south one) = 400w
- sloper on 60' tower = 10w

Say what??? 10w! Time to go take a look at that sloper and the 60' tower! Oh, and replace the 10m balun, darnit... its probably good that I didn't try individual antennas on the 15m tower first.

10/8 Its a Witch Hunt in Peru, just the right season for it I guess. Tonight I went up and cleaned up the top of the 60' tower. I took down the sloper that was there and shorted out the 2 left over guy insulators, then while I was at it tightened up the guy wires and checked the ground connections... no change. I also checked the feed point of the nearby 160m inverted L, no problem there. Then I started on another tact, maybe if I transmit into 2 antennas on different bands, rather than forcing 20m power into the wrong antennas... So I transmit on the 20m ring rotor antenna with a threshold of around 200w by itself. When I transmit on 80m with 100w on the South and West beams of the 4-square and on the low inverted V it raises the threshold a little bit. Transmitting high in the band on 40m the threshold raises to about 500w when transmitting on the lower beam, about 400w on the top beam, about 400w on the inverted V, but goes up to over 1000w with as little as 10w into the 4-square. Go check all the connections on it, everything seems ok. Try it again, now 100w into the 4-square only raises the threshold to about 500w! ARGH! Next one, about 10w into the single 160m inverted L raises the threshold to about 1000w! Now what? Check the connections on it, they all look ok, and no change, about 10-20w into it raises the threshold over 1000w. Getting too dark now, more tomorrow probably. But at least the 60' tower looks better now with nice tight guy wires... and a bunch of connections have been checked tight.

10/9 The hunt is still under way. Tonight was a nice warm autumn evening so I went up to replace the Balun on the South 20m Yagi that I thought was intermittent. Well, that was only part of the story. The Balun got replaced, but I'm not sure it was the real problem. In the process of starting the replacement I found that the coax connector had never been soldered on that cable. This was one of a dozen or so identical cables I had made that are now used on the 20m, 15m, and 40m stacks. This is the second one I have found to not be soldered so far. Quick Tom, I need some 6 sigma training or something! So after coming down the tower to get the torch, going back up and soldering the connector, finding the SO-239 in the old Balun was loose, I had to disconnect the old Balun wires that go to the elements. Doing this loosens the clamp that holds the hairpin tubing in place, when that is loosened the tubes on both sides almost slide out of the shorting bar! Both setscrews in the shorting bar are loose! So I put some more goop on the Balun connections and tighten them down, then spread some more on the shorting bar end

and tighten the set screws as much as I can with the end of a pair of wire cutters shoved in the Allen head screw, then tape up the joint to keep the goop in the gap... That had better last for a while. But now what about the other 4 of those beams up above it????

10/10 Well, another night of Witch Hunting... still no success. Tonight I pretty much eliminated the new listening 4-square. I laid down all 4 elements on the ground, disconnected the control and coax to it and still had the harmonic. Just for good measure though I regrounded where it was connected to the hardline and old control cable at the 10m tower base. If nothing else when this is done I'll have everything a lot better grounded than before. Put station back in M/M configuration.

10/11 3 hours up the 180' tower, about an hour of that beating on a hardline connector to get the center pin back where it belonged. The problem with the 180' 10m beam was not the balun, I first disconnected the hardline connection and measured the beam with the MFJ meter and it was fine. This was the final failure of the hardline connector that had been intermittent the last couple years. The center pin of the N connector on the hard line had backed out until it was just barely making contact, the high SWR from trying to pump 20m RF into it fried the tip of the pin and broke the circuit. So I had to take the hardline connector apart and pound the insulator back up to where it belonged and then reseal everything. I also grounded the 3 jacketed hardline runs at the top of the tower. I checked all the bolts on both ring rotors, there were several loose ones on both of them... that probably answers the question about where the 2 bolts went from the top one last winter, those flanged lock nuts don't seem to hold very well. And I finally removed the 40m emergency inverted V. But after that there is still no change in the Subharmonic Generator. After lunch I went and grounded the shields of the 3 jacketed hardlines going up the 180' tower, still no change. But I am getting lots of stuff done that should have been done one time or another anyway!

10/12 KB1OEV got me a couple of discarded workbench static mats. They fit nicely on the station desk sections and are nicer than the pieces of linoleum from the last bathroom remodeling. The surface is softer and a bit textured so they make nice mouse pads, so you don't need a separate pad and can use the mouse anywhere on the surface of the desk. The surface is also a very good non-skid surface for paddles, they almost act like they are stuck down on it instead of sliding around on the hard flooring surface.

10/13 Bought a Grundig G5 to go sniffing with. It works fairly well as a field strength meter with the antenna retracted and the sensitivity on 'local'. Rigged up a pair of HT's to trip the vox on 20m and went walking around hunting. The strongest signals seemed to be around the Beverages so I disconnected everything from that post, no change. The lowest power that makes the Subharmonic is when the top or ring antennas are pointing at the 15m tower, so went up there and checked all the coax connections, no change. Sniffing back from the Beverage post found even stronger signals at the corner of the house where all the cables go in, so maybe it is really inside... sniffing inside found that when pulling off some of the 10m cables the threshold changed, but never stopped... completely disconnected all the 10m coax and checked it, no change. Figured it wouldn't hurt to improve the grounding at the entrance a bit so connected the 5 jacketed hardline shields with that .125" aluminum wire directly to the ground, cleaned up some other connections. No change, if anything it is happening at even lower powers now. While moving around hardline I found 2 of them had rubbed through their shields and taped them up to protect them... all the entrance connectors and those big loops should probably be cleaned up, maybe next summer.

10/15 Up 150' again. Cleaned up 80m inv-V connections. Checked at each 20m antenna going up for the noise and it was fairly weak all the way up on the west side of the tower. When I got done with the 80m inv-V I started checking everything around the top and found strong signals from an unused twisted pair

that used to be the controls for the 80m inv-V beam. Grounding it seemed to change the noise intermittently, but after removing 350' of it from the tower to the shack it didn't change. I do seem to get stronger subharmonic signals near the various power and control cables, but is that being generated up the tower or just conducted from below? I need to go up again and check the 20m switch box and replace the coax T that has been taped together for years after the clip ring popped out so maybe I'll find something there.

10/17 A bit cool and breezy this morning, feels like 160m wx! Too breezy to climb so decided to finish pulling out that unused twisted pair. Pulled it in through the shack entrance and at the 80m station it disappeared into a hairball of assorted wires all bundled up with tape and tie wraps. Well, it may have been a mistake but I started taking the splice and extra loops of wire out and by the time I was done I had about 50' of cut up spare wire, more than that in old sticky electrical tape, done a bunch of resoldering, and almost completely rewired from the 80m control box to the 2 cables going to the switch boxes.

Made some more measurements on the subharmonic last night just after some rain:
- Top - south = 70w
- Ring - south = 75w
- South = 600w!!
- Europe stack = 1500w

Then again this morning before sunrise
- Top - south = 45w
- Ring - south = 100w
- South = 300w!!
- Europe stack = 600w

And again after the sun was up for a while(about 9am)
- Top - south = 45w
- Ring - south = 90w
- South = 150w!!
- Europe stack = 900w

So yes, it is probably moisture sensitive with the biggest sensitivity on the south antenna.

I went around again and disconnected each coax coming into each station, nothing notable there. I also unplugged each of the rotors and shorted out the ring rotor cables with no effect. I did notice some interference on the low 80m inv-V at high power on 20m so I went up and cleaned up it's connections. They were a bit corroded, but cleaning them up made no change. It is interesting that transmitting on relatively low power (<50w) on the low 80m inv-V raises the threshold. Also transmitting on the south or west 80m 4-square beam raises the threshold. I went around the 80m 4-square and the South Beverage run with nothing interesting on the sniffer, signals were generally weak except right next to the Beverage wires. Disconnecting the reflection transformer on the Beverage didn't do anything either.

I went up to the 20m switchbox and replaced the T connector for the matching line, it wasn't as bad as I thought, but it got replaced anyway. I also inspected the 20m relays, they all look fine. The Subharmonic signals up at that level on the tower were weak. On the way down I inspected the inside of the TIC Ring Rotor connection box, everything seemed fine in there. I got much stronger signals from the coil of spare rotor cable, but moving it around and putting it on a different face of the tower didn't change anything. On the ground I went around the 150' tower guy points and twanged all the wires, no change. I twanged guy wires on the 15m tower and the north west set on the 180' tower with no results. The signal does seem strongest around the 160m inv-L, but moving around and retightening the radials on the

North L didn't change anything.

10/18 A real nip in the air today, 32f at sunrise. Rewired the 40m antenna box to remove the inverted V, just add a diode from that output to select the top beam instead so there are no buttons without a valid antenna. Unrolled the 80m 4-square ground screens. That is a much easier job now that all the brush and tall stumps are gone.

Continuing testing the Subharmonic Generator... Neat new stuff, it also generates an 80m subharmonic at 1/4 the frequency, but it takes about double the power to do it. This could explain the 80m noise during CQWW RTTY. The 80m one is also more sensitive to transmitting on the 160m inverted L, it takes less power to stop the 80m subharmonic than the 40m one. This should narrow the search down a bit, now I need something that is resonant on 80m also. And what do you know, even though its out of the band there is one on 160m also. And no, these can not be generated by adding or subtracting regular harmonics... now it should be easier, I need something resonant on 160m... and there are only 3 of those(at least intentional ones) out there! I hear it on the inverted L's on 160m, but its weak on the 160m inverted-V. It is also much louder, like s-8, on the low 80m inverted-V but only s-1 or so on the high one, it is strongest, about s-5, in the North lobe of the 80m 4-square and weakest to the South. So that makes sense I guess, its somewhere near the house... yeah right, like that helps!

Time to divide and conquer! One piece at a time:

- Disconnect South end 160m inverted-L. No change on 40m and 80m, but I don't hear it on 160m now.
- Disconnect the radials from the South 160m inverted-L. This is harder because they are all twisted together after wrapping around the pvc pipe, but get them all separated ok... no change.
- Disconnect the radials from the South 160m inverted-L that were tied to a guy wire and a cable run carrier wire. Inspected radial end insulators, they all look ok. No change.
- Disconnect the North end 160m inverted-L. No change.
- Disconnect the North end radials and check the end insulators. No change.

Well, completely divided but not conquered!

Next, check 15m antennas again. Set to tx on the top 20m near the threshold level, about 50w now. Turn the top and bottom 15m antennas around. Top one seems to get signal strongest from the East. Bottom one may also get strongest from that direction, but has interesting null at about 160 deg where the threshold goes up to about 100w. Switching antennas on there also changes the threshold. Did I not find something my last time up there?

Next, rotate 40m beams. On the top 40m there is are deep nulls in the signal when pointing North or South-East, and maybe a dip to the West, but the threshold doesn't seem to change. On the bottom 40m there is very little change in the signal as the beam rotates.

Lower the low 80m inverted-V wires down to the tower. Now I get a broadband noise on the high 80m inverted-V and 4-square when transmitting, but only the clean subharmonic on the low inverted-V... very strange. But the 40m threshold seems about the same. Short out the ends of the low 80m inverted-V to the base of the tower, no change. It appears the wideband noise is from the amp at very low powers, turning off the amp or retuning it seems to get rid of it.

Break for lunch.

Try transmitting on 15m and 10m and rotating those antennas to see if they can excite the resonance. Neither one of them on any antenna seems to excite the Subharmonic Generator... Both of the rings

generate some cracklies while rotating, but nothing oscillates.

Lower the ends of the high 80m inverted-V, no change. Lower the 160m inverted-L rope about half way down, no change. Put back up both 80m inverted-V's and the 160m inverted-L's. Short the 160m inverted-L's to the feedline run under them, no change.

You know, this is starting to get annoying.

Restore 160m inverted-L feedpoints with nice new clamps and lots of conductive gunk. No change.

Another interesting one... I can make a Subharmonic when transmitting on 40m from the lower antenna. Its lowest threshold is about 600w pointing at Europe. It doesn't do it from the top or when using both or from the 4-square.

And to round off the set... I can make a Subharmonic on 160m when transmitting on 80m with about 500w from the low inverted-V but not the high one or the 4-square. The signal is louder on the inverted-L's than the inverted-V though.

10/19 Starting to run out of antennas to test now. Lowered the 160m inverted-V down, got the North leg which is connected to the coax shield straight down the tower and the South leg down pretty far, but I didn't want to pull that rope back across the pond to get it all the way down. When I did that the 20m power threshold to start the oscillation didn't change, but the tx power into the 160m inverted-V to stop it was reduced from about 50w down to <10w... now that is interesting. Pull it back up and the stop threshold goes up again to 50-100w. I took this "opportunity" to move the North leg farther away from the 180' tower top guy wires and out a bit farther. I was able to get it over to the 150' tower base to tie it off just at the end of the existing rope. That seems to have helped the tuning on that antenna a bit. Its too windy to go up there this morning, it was almost too windy to pull the 160m inverted-V back up to where it belonged. If nothing else I am getting some of the 'To Do' list stuff crossed off.

Now, what does this mean? The threshold to start the oscillation is the lowest when the top 20m is aimed just about at the 180' tower. The top 20m antenna is at 150' and that one has the lowest threshold to start the oscillation. What is up there? The 2m beam, the 10m beam, the 40m beam, the 160m inverted-V, a TIC 1122 ring rotor, and a G-2800SDX rotor. Pulling the plug on the Yaesu rotor does slightly change the threshold for starting oscillation. This might point to something in that rotor or cable, that it only changes the threshold slightly is not too surprising, when I went through this before and found the coax connectors that would stop it up the tower when they were grounded the end of the cables in the shack didn't affect it much at all.

Investigating the 180' 10m rotor. There are 2 extra wires in that cable. It is an 8 conductor cable, but only 6 are used by the G-2800SDX. Resistances between the various wires seem ok. Grounding some or all of the wires in the cable slightly changes the oscillation threshold. Sending <10w of 160m RF up the cable raises the threshold.

10/20 Back up the 180' tower with a pocket full of capacitors and ferrites. Do a 6 wire bypass on the G-2800 rotor control cable, add 4 split ferrites around it, and ground the 2 unused wires... no change. Then clean up and add gunk to the 160m inverted-V connections. No change. On the way down I check a couple places and try sticking an ohm meter pointy probe through the hardline jacket to ground it, no changes there. I get strong signals on the G5 around the coax switch so do a 6 wire bypass on that one also. No change.

10/21 Do shopping for CQWW SSB, start cleaning house.

10/22 Finish most of the house cleaning.

10/23 Go up 15m tower, inspect top rotor connector, no change in subharmonic when it is disconnected, but it did get louder when I touched the shell. Checked all the hairpin shorting bars to be sure they are tight, try touching elements and shorting them out with reach rod, no change in subharmonic. Inspect switch box inside, seems ok, no change in subharmonic while touching each lead. Check ground rod just outside shack, run hose on it for a few minutes and no change. Hose down feedlines around shack entrance and toward the listening tower, threshold goes up from 50w to 75-80w just after hosing.

10/24 Set up station for CQWW SSB M/M. A beautiful day in the Berkshires... 50f and light breeze, it doesn't get any better than that this time of year. Went up the 20m tower and did a 6 wire bypass on the top rotor cable. It was in bad shape, must have been twisted and quickly taped for soldering later and never was... rewired it and bypassed all wires to ground. No change in subharmonic.

FINALLY! The Gremlin has been slain! With K1MK here early for CQWW SSB we started doing some more testing with him running the radio and me doing stuff. We started with hosing down the feedlines and stuff outside. It did raise the threshold from 50w to 100w or so in a couple steps, but nothing dramatic. Then we started looking for higher harmonics again, we found an odd one at 49MHz and got a null with the 6m antenna sideways at the shack. We found one just above 2m, but couldn't get any bearing on it. Not having a VHF-AM receiver I tried the HT that went above the band and could hear it on FM in the shack. So loud that the rubber duck was too much... so switch to the paperclip and scan the shack. Its the strongest around the 10m station, mostly near the stubs, so disconnect those. I've been here before a ways down the page so didn't really expect to find anything new... but kept disconnecting stuff and the threshold kept going up and up, but wouldn't go away. It seemed to be most sensitive to the SWR meter being in the circuit, yes some of you did suggest those, but I had already disconnected all the meters from the antennas and still had the subharmonic... so that just couldn't be it. Put the meter in, 100w or less, take the meter out 1000w or more... but it wouldn't go away. Put the meter in and pull the 12v supply to it, 1000w threshold! Pull the power from the 80m meter, threshold goes up some more. Pull the power from the 40m/SO2R pair of meters, and it goes up more. Pull the 15m meter power and it goes over 1500w... pull the power from the 20m and 160m meters just in case... SILENCE! I'll test more after CQWW SSB, but my best guess is that something in the PEP circuit that gets 12v power was rectifying and resonating with the coax stubs on the different stations... 7 sources, all in the shack! Well, I did get lots of ugly stuff cleaned up outside anyway... maybe there were some other sources outside also... in any case now we can have a nice quiet contest without QRM from ourselves anyway!

10/25 Friday night there was a broadband noise on 10m and 15m, not able to get much direction except basically East on 15m and maybe North on 10m from the 120' tower. Went walking a couple times with the G5 receiver and it seemed loudest around the house. Finally found a noisy switching laptop supply on one of the operator's machines.

10/26 Big wind and rain storm over night, measured 44mph at about 10' above the house, but it was probably double that 100' and above. Got some broadband noise from 20m on the stack occasionally this morning, but it doesn't seem to be on any individual antenna. Also broke one of the 80m 4-square insulators over night, but the fiberglass prophylactic braces held just fine. I think those insulators are not adequate for this type of no-concrete tower. I'll probably double up the fiberglass on them in the future just in case.

Top 40m ring rotor didn't want to turn clockwise past North about dawn. It was nice so I got dressed

ready to go up and see what was wrong, but watched it with a telescope while an operator in the shack turned it. It went West ok, then turned all the way East with no problem. Turned it back and forth a couple times and it looked just fine. Maybe it has a tight spot around North and bound up when making a small turn... seems fine now anyway.

On the plus side the intra-station interference seems to be way down in general this weekend. Those meters may have been doing more than just the sub-harmonics that I was chasing.

Modified 80m amp gave up Sunday night, power output went down and heat went up... maybe lost a tube or that toroid changed value so much it wouldn't tune. will test later. Replaced with ready spare to finish the contest.

10/27 Car died on way home today, and I just don't feel like doing the log processing... Took a look at the meters that were causing the sub-harmonics. These are relatively new Daiwa CN-801 HP meters. I'm not sure what was doing the resonating, but I can see the rectifiers now. Its a classic pin-1 problem. There is a 12v unpolarized power input to the meter for the light and PEP circuit. They made it unpolarized by keeping the incoming wires both separate from ground. Instead of the normal way of grounding the shell of the connector to the case they run both wires to the circuit board and into the AC inputs of a full wave bridge rectifier chip. Then the negative output terminal of the chip goes to the circuit board ground and then the case. This means that two of the 4 diodes are cutoff between the 12v negative power supply, which is grounded to the shack ground, and the +12v supply. So whatever RF gets picked up on the power cord, or on the few feet of cable between the amp, meter, and switches ends up turning on those diodes. Of course at that point there are all sorts of possible things to resonate in the shack, most likely the coax stub filters are part of the circuit. A single .01uF cap from the incoming power wires to case ground eliminates the rectification up to 1500w at least, where without it the subharmonic starts under 50w. I am betting that some of the odd interactions, like transmitting on 160m would stop the subharmonic from 20m to 40m were caused by higher levels of RF keeping the diodes either conducting or cut off enough to prevent the circuit from building to a resonance.

And just to show that it works in the wild just like my contrived experiment at: Subharmonic Generator(see below, the link is broken). This is what the voltage on the positive and negative lines of power cord look like when its not connected to the meter:

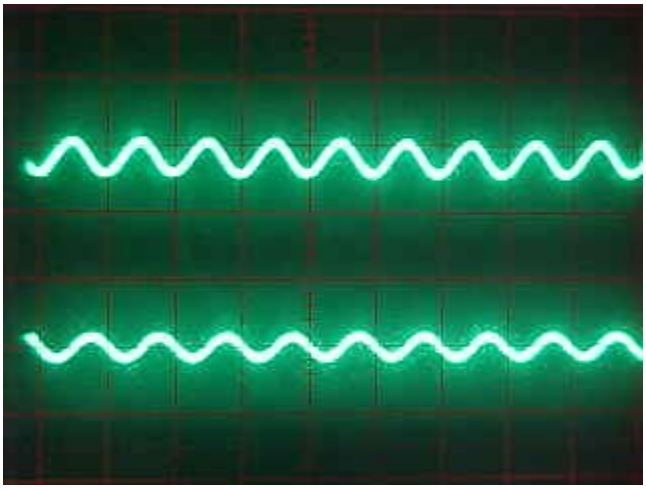


Figure 347 RF on power line when disconnected.

And what it looks like when it is connected:

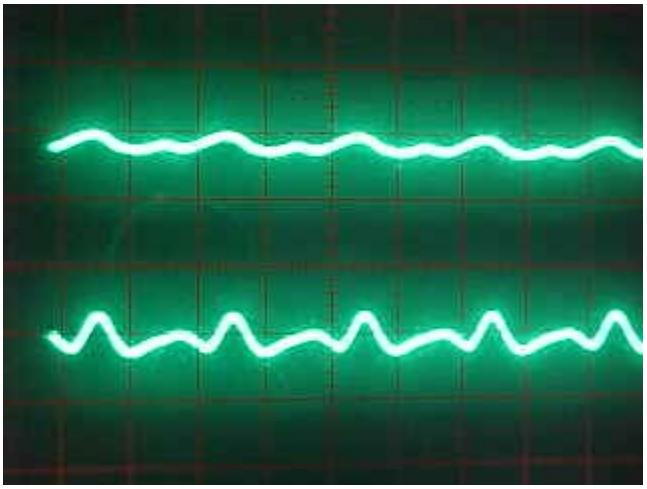
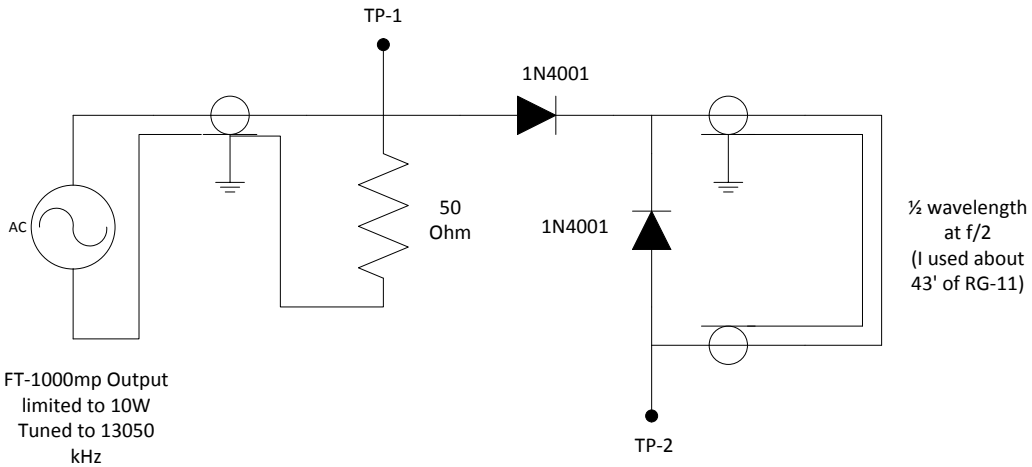
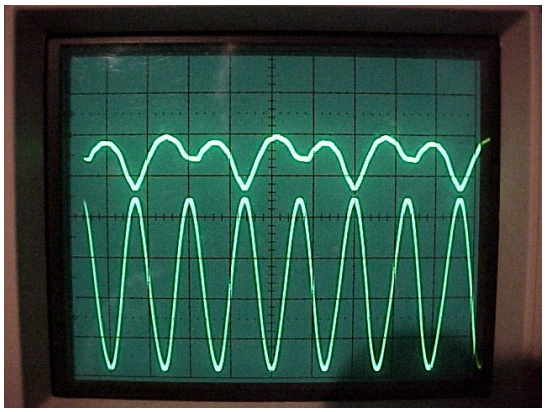


Figure 348 RF with subharmonics when connected to meter.

Note the alternating squashing of one peak of the 20m rf which results in the 40m sub-harmonic.

This is an experiment I set up to try to passively generate a subharmonic. The 50 ohm load is to keep the transmitter happy. I think simpler circuits would be possible, but at least this shows that just a diode or two and a resonant coax section are needed.





TP2 On top showing f/2 component at 6525 kHz

TP1 on bottom showing 13050 kHz pump frequency.

10/28 No hardware work, process log and spot database for CQWW SSB.

10/29 SNOW! about 2" over night. There was lots of wind last night, and the change from rain to snow left a bit of freezing junk, but all elements are still in place today. Of course the rental car had no scraper and mine is in the shop with my car! Car still broke, so another commute in the rental. Help out N4ZR with a WinTelnetX setup for the CW Skimmer.

Fix single band 80m HF-2500

10/30 HOT AMP! Fired up the modified 80m amp again. It wouldn't tune, too much plate current, caps max mesh, no dip in plate current. Pulled toroid out, failure mode was obvious once the wire was moved out of the way:

Figure 349 Overheated and cracked toroid.

At least the dealer finally found something definitely wrong with the car, a shorted wire in the injector harness. But now when the downstairs heater comes on it makes a loud vibrating noise, call service place and get a promise for someone to show up Friday sometime.

10/31 Setup station for SSCW SO2R. Attempting to contact Palstar who apparently is the new owner of the Command Technologies amplifier line to find out what those cores are. Service guy for tractor shows up with new fuel gauge, that's not the problem, must be the sender unit, back to order more parts... not that I worry about a fuel gauge on a tractor, but it is a new Green Machine so it should be working. Service guy shows up for heater, pulls mouse out of induction fan, proceeds to do full cleaning and test on both units while he is here instead of coming back in 2 weeks when it was scheduled. Put tools away in shed from all the tower climbing from the subharmonic search. Put snow blower on tractor. Clean up other left over parts in shed and make room to park the DR Mower in there for the winter. Now I'm ready, let it SNOW! I think its supposed to get up into the 60's next week.

11/1 Check tuning of 160m inverted-V after it was rearranged during the subharmonic hunt. Its better now without the extra 1/4 wave 50ohm transformer in line so I take that out. Hmm, that gives me a long enough piece of coax to put back up the 40m inverted-V down where it should be for SS that starts in a few hours. So run that up the tower and install the 40m inverted V at about 45'. Tunes a bit low in the band, but it will be ok for CW, it will need some trimming before SSB though.

11/2 Start work on 25th anniversary edition of the Building A SuperStation book.

11/4 Fiberglass and Teflon arrived from McMaster-Carr today. Now I just need some wire and cores. Got reply from N8PH at Palstar that now owns the Commander line, the cores are T225-2B, so ordered a dozen (minimum order) from Micrometals. Stuck one of the removed coils that was still good, but a bit black, in place of the cracked one to test the tubes. The amp tuned up just fine, so at least I don't have to get more tubes right now.

11/5 Installed more of the static mats on the other stations. Nice white non-skid table tops now, but for how long?

11/6 Teflon wire arrived from Surplus Sales of Nebraska.

11/7 Stapled static mats under front of tables to keep them from hanging out. Set up station for WAE RTTY SO2R. Plate fuse blew in so2r HF-2500 amp when first tuned up, swapped it with 80m amp and replaced fuse, its functioning ok.

11/8-9 More work on book update. Visit by DH1TW.

11/10 Setup station for m/m operation for SS SSB. Found interference to bedroom radio on shortwave, the webcams are noisy. Shutting them off gets rid of lots of noise in the shack and up in the bedroom. They don't seem to be heard outside the shack at least.

11/11 Cores from Micrometals arrived.

11/12 Wound new inductor for 80m single band amp. 16.5uH on 2 cores in series. In a short test it seems to run much cooler, has a lower plate current at 1500w out, and a better tuning dip. I'll have to rerun one of the timed tests after it cools down all the way, maybe tomorrow. There are 16 turns of 10ga silver plated copper, Teflon insulated wire on two T225-2B cores from Micrometal. They are sitting on a 1/4" thick 3"x3" piece of Teflon. For future reference, that took 10' of that wire, but is not wound very tight, that wire is just too slippery to pull by hand very well.

Figure 350 Two toroids in series with fresh cores and wire.

11/13 Reran a temperature rise test on the modified single band 80m amp. This is 1500w 30sec on 10sec off for 10 cycles. The original coils ran up to temperatures of 220-230 deg with up to 350deg on the inside. This one only got up to 141f at the hottest point I could find. The left tube does seem to be running a bit hotter than the right one during the test though, this would seem to agree with more

discoloration on it's fins than on the right one.

11/14 Just need to set up computers for SS SSB, so cleaned up old TV and Satellite cables in the attic. Removed the zip cord loop from the upstairs bedroom and put a sloper off the TV tower for the SWL bedside radio. Replace the wire stuck in the SO-239 with the mobile antenna on a piece of flashing in the attic for 2m from the bedside radio. Green machine gas gauge finally fixed.. it was the sender that went bad. More work on book update. More work on website, updated VRML station model.

11/15 Finish setup for SS SSB. Everything working.

11/16 80m FT-1000mp keying relay sticking, keeping amp in TX. Swap radio with spare (that I thought had a sticky relay earlier but had been behaving itself on the spotting station when I tested it)... Sure enough, its relay is also sticky, just not nearly as bad. Time to make some new cables and key the amps from the band data jack instead I think. 20m ring rotor turned north-west and wouldn't turn back. Played with it a bit and got it back south-west. Voltages seem ok at the controller.

Well, it was worse than I first thought. The 20m ring is wind milling. A bit windy, but I grab some rope and go up to tie it down so it doesn't wrap up the coax or something else. Send query to TIC General about what parts are available for a 1989 vintage 1032 ring.

11/18 Rewired the 80m FT-1000mp to key the amp from the band data jack instead of with the relay. Except for the odd DIN plug why didn't I do this before. sure is easier than sending them out to be repaired. Swapped back to the 80m radio that started sticking bad during SS because it already has the key click mod. Swapped 80m amps back to the re-modified single band one, so now the spare amp is an all band one.

11/21 Removed the broke ring rotor drive assembly from the 20m tower, unfortunately it made it down the tower before I did resulting in a broken plastic housing. Query sent to TIC about how to proceed with repair/replacement. Motor seems to run, but output doesn't turn, must be in gear train somewhere. The good new is that Carl at TIC says that they replace all the plastic when they upgrade the drive unit.

11/22 Test all rotors, turn bottom rings back to Europe for CQWW next weekend. Top 40m doesn't want to move initially, once wind comes up and buffets it a bit it moves ok. Must have been some ice in the rollers or something. Order 2nd drive motor from TIC just in case to give it some extra torque up there. Do more work on book update. Run listening 4-square cable over to 20m table to try during CQWW CW.

11/23 Ah a beautiful morning in the Berkshires. 13f, light breeze, clear blue skies, sun peeking between the trees, snowing, perfect time to go walk the Beverages. Only one insulator knocked off by a branch that came down. Started cleaning house for CQWW CW.

11/24 Shipped 20m ring motor and mounting to TIC for upgrade. Started stocking the fridge for CQWW CW... I hate shopping this week!

11/26 Clean house for CQWW CW.

11/27 Continue setup and tuning for CQWW CW.

11/28 Finish setup for CQWW CW.

11/29 20m amp developed noise while in receive mode, about s-6 wide band crud. Replaced with spare amp.

12/1 First ice storm came early this year... one 160m inverted L broke at the knee, and some branches and a small tree are down on some of the 80m 4-square radials and Beverage, but not causing any problem right now.

12/2 Ah, the old love story... Car meets deer, deer runs off, car dies of broken heart. If anyone finds a deer out there with K1TTT embossed on its left side, I want some of that pre-tenderized steak!

12/3 Nice afternoon, got home early after cleaning out radio and stuff from old Cherokee before it got dragged to the junk yard. Fixed 160m inverted-L rope so that is back up in the air anyway. Surfed the web comparing new cars.

12/4 Bought new Wrangler... things sure have improved since the last one, the dealer could do all the registry work, loan paperwork, insurance, etc, in house. No need to even send someone to stand in line at the registry to transfer the plates, even though it did take them a while to figure out how to enter the K1/TTT Ham Radio vanity plate into the system. On the way home there was ice and snow so I got to try out the 4wd. And the rest of the herd must have been jealous of the one with the K1TTT imprint and took a run at the new one so I got to test the ABS also!

12/5 Cut down a couple of the bent over trees around the 80m 4-square. Installed 2m/70cm radio in new Jeep. Did some more work on the book update.

12/6 Doubled up the fiberglass strongbacks on the 80m vertical with the broke insulator. Only had to break off 4 of the 12 V SS V-bolts due to galling when they were put on. Started trying to troubleshoot noise on 20m amp from CQWW CW... First simple test of turning it on and doing a couple minute warm up resulted in nothing.

I really, REALLY hate intermittent problems like this... it wouldn't do it cold. So I started warming it up, after 1/2 hour or so I got the transformer up to 225f, the rf deck surface about 150f, the tubes about 130f, the case was nice and toasty... and I got about 15 seconds of noise from all of that. It may have been modulated a bit by line voltage fluctuations from the 160m contest op on the next station, but wasn't dependent on it. There was no measurable grid or plate current when it did it. I did get to cycle the stby/op switch a couple times and the noise dropped but didn't go away when I went to stby... so perhaps it could be something in the control board oscillating when it hits some particular temperature, but its darn hard to reproduce.

12/7 Got instructions from Palstar (the new owner of the Commander amp line) to modify the control board with some more filter caps on the 12v supply to prevent oscillation. Need to pick up an electrolytic to do it.

Modify 12v Regulator on HF-2500 control board

12/8 After a suggestion from KI6SZ of Palstar who now owns the Commander amp line I picked up some electrolytics at Radio Shack on the way home today, yes, they actually do have some fairly well stocked parts drawers. Installed .1uf caps on the input and output of the 12v regulator and a 220uf 35v electrolytic on the output. Before installation there was a rather strong oscillation at 3MHz with a strong 6MHz harmonic component as you can see below, horizontal = .1usec/div, vertical = 1V/Div. This was

measured on the 12v output jack on the back of the amp. I was able to hear it wandering around even through the 14MHz bandpass filter between the rig and amp. This could explain some of the other odd birdies I have heard and could never quite trace down before they would run out of the band.

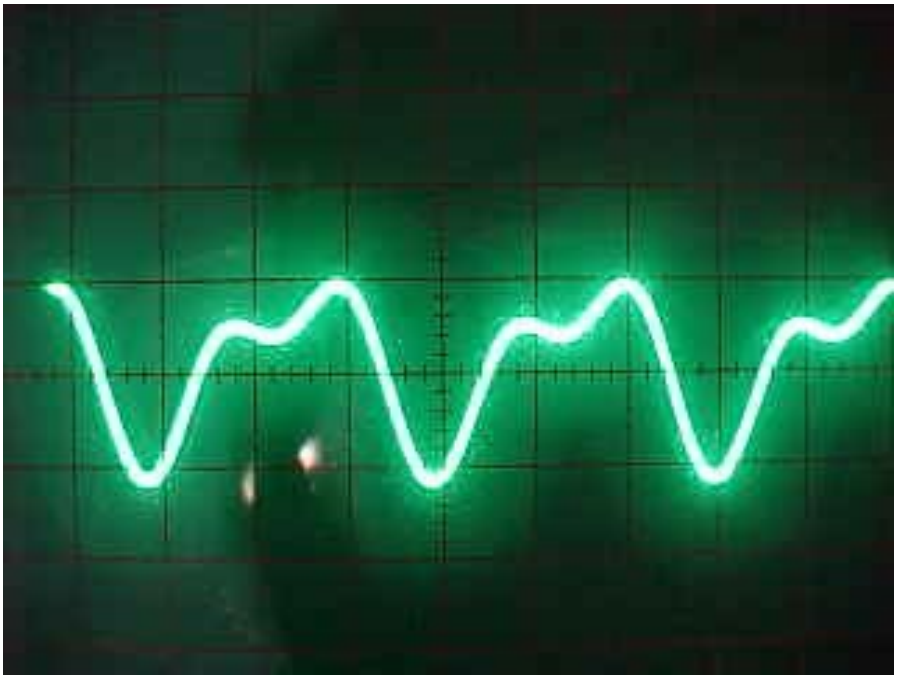


Figure 351 Oscillation on 12v regulator.

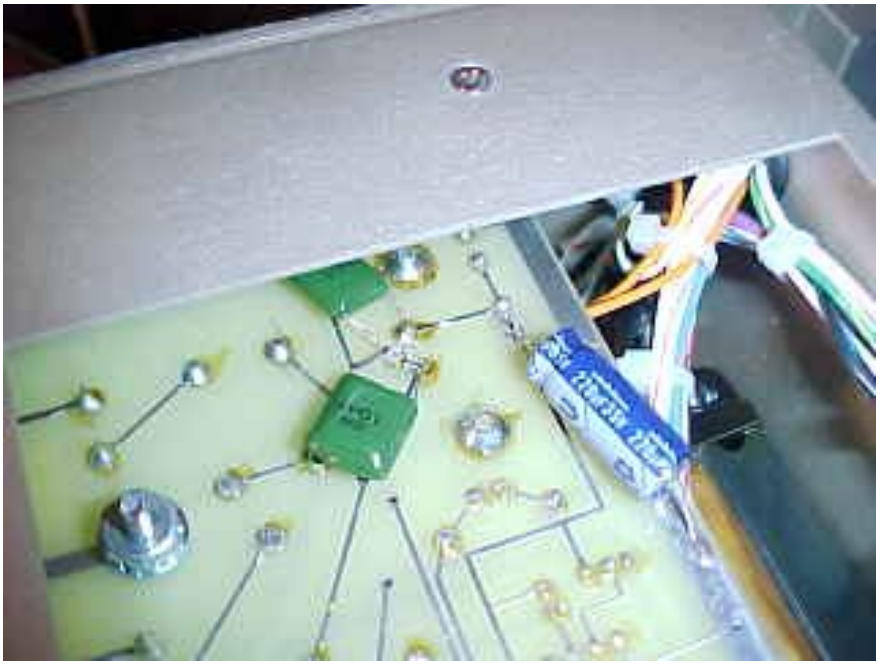


Figure 352 The capacitors installed on the back of the circuit board.

I also tested the amp on the right hand radio of the so2r setup and it didn't have anything on it's 12v output. I'll keep the scope handy and check the others later.

12/10 Top 40m ring rotor is stuck on North again.

12/11 Looks like top 40m ring may have a ring joint aligned with one of the bearing plates. Still won't

move so will plan on going up there soon to check it out. Ice storm predicted for tomorrow, I'll wait till after that is gone at least. Tested the other 5 HF-2500's, none of them showed any oscillation on the 12v output.

I took Thursday off just in case it started early, Friday was our regular Friday off on my work schedule anyway. Thursday I fired up the generator once just to be sure it was ready, but ice wasn't too bad. Maybe 1/2" by dark. But temperature dropped and it kept raining over night.

More Ice!

12/12 ICE! 1" plus lots of icicles over last night. Just barely got up to 32f, then dropped down and started blowing. Both 40m beams, the 180' 10m, and 2m are scrap, top 20m has broken elements, one 15m has a broken element, 160m inverted L's are down because the pulley broke on the 10m tower end. The Beverages pulled so hard they broke the 6x6 post and pulled out the F connectors on all 6 of the new cables, plus they are down probably most of their length... I don't dare go into the woods yet, there are still trees breaking and ice falling, sounds like a battle zone and looks like a tornado has been through.

At 1am N2KW work me up to tell me power was off, he was here getting ready for the 10m contest and had been playing on the low bands. When I got up in the morning power was of course still off so I started the generator to cool off the fridge and warm up the house. Started freezing ice in freezer to be able to put in fridge to extend generator off times, and waited. At this point all antennas were still intact except the 160m inverted L's whose pulley had broken and the Beverages. The Beverages had pulled so hard that they broke the 6x6 post at the shack end off at ground level, this jerked off the F connectors on the coax for the transformers, but doesn't look like it did any real damage to the boxes. There was a little bit more rain Friday morning. Late morning Friday after the rain was pretty well over the neighbors and I got out chain saws and cleared our road so we could get out and trucks could get in. I took a short drive to survey other damage and got about 1/4 mile each way on the paved road before it was blocked. Stayed home and ran generator off and on. About mid day the wind came up and broke the elements off the top 40m beam, all 4 of them on one side so it tipped over the other way into the guy wires. That also started breaking elements on 20m and 15m Yagis that were bent like horseshoes to start with.

Surprisingly I found that the neighbor's phone across the road was working Friday afternoon. A couple hours later my phone and DSL came back on. Apparently Verizon is parking trucks for temporary power at the roadside CO box to keep it powered until the line comes back. Late Friday afternoon I tried the road again and found it was open. It was an obstacle course of ducking under low trees, going around down wires, and not much fun, but it was open out to the main road where we saw some tree service trucks still working their way up rt-143. Apparently it was National Guard troops that cleared the trees out of the road.

Friday night there was more wind, and it switched around to come from the west. Saturday morning revealed that the bottom 40m boom brace had failed on one end and the boom broke. Its now leaning badly and most likely has damaged the ring rotor due to the unbalance load. Later on one of the European 20m antennas boom broke also.

Figure 353 Top 20m before wind came up and broke the elements.

Figure 354 Top of 180' tower before the 10m beam broke also.

40m beam has all 4 elements broke off on the left side and dangling from their loading lines. The weight tipped the other elements down.

Figure 355 The Beverage post that broke off at ground level

The post in the foreground was pulled over by the rope from the low 40m inverted V.

Figure 356 Close up of 160m inverted L rope.

The rope is 1/4" polyester, so you can gauge scale.

Figure 357 Bottom 40m beam, before the wind came up.

Figure 358 View looking back toward the house from the pond dam.

Those were about 50' tall Scotch Pines that literally pulled themselves out of the ground.

Figure 359 Under all those trees is the bridge across the pond outlet.

Figure 360 80m 4-square with ice.

The 80m 4-square lost some radials, but otherwise was standing intact all day.

Figure 361 The bottom 40m after the wind came up.

Figure 362 The top of the 180' tower after the wind, 10m and 2m are both broke.

Figure 363 Natures thinning and pruning of the trees.

Figure 364 Broke and twisted 15m European antenna at 90'.

12/13 Cold! Temperature dropped to 11f, fortunately the wind dropped off so it wasn't too bad. N2KW made it out late Saturday morning after working a half dozen contacts in the 10m contest. With rotors frozen and ice all over the antennas they weren't working very well, and my generator doesn't like amps so he was only on low power. With colder temperatures coming it was probably best that he left then. I also had come down with a nasty stomach bug...

Saturday night I think I slept for about 12 hours, but was feeling better when I work up. That G5 radio runs for quite a while on 4-AA batteries.

12/14 Sunday morning and still running the generator for an hour or two at a time. The node and web server are only on while the generator is running. Temperature up a bit and may get above freezing today. Supposed to be warm tomorrow. Sunrise pictures below (click on them for full size version):

Figure 365 10m tower, at least all the elements are still in place here.

Figure 366 40m tower.

All 4 elements broke on top 40m, top 10m broke, and 2m bent badly. Bottom 40m boom broke when truss broke. It looks like the boom end bolt broke, the cable is still there with an empty eye.

Figure 367 15m tower, a few twisted and broke elements on these.

Figure 368 20m tower.

Top one is missing half a reflector and has other bent elements. Next one down at 120' has a broke boom.

Figure 369 Close up of top 20m.

Figure 370 Close up of 120' 20m European antenna.

Figure 371 Close up of top 40m and 10m.

Figure 372 New clear view of 80m 4-square!

At least I now have a good view of the 80m 4-square, could only see tips of 2 of them before.

Figure 373 Insulator on the deck.

Recovery operations are already underway...

Figure 374 New Beverage post installed.

Used big old screw jack to pull out stub of post that was left and slipped spare one down into the hole. Added back stay since its hard to pack dirt down around it now. Put 3/4" rebar stake next to closer post, its broke below ground level, this should keep it up for the winter.

Figure 375 Beverage transformers melting.

DX Engineering Beverage transformers removed from old post and brought in to melt off before getting reinstalled. Will need to re-terminate the 6 cables before these are needed again.

Ordered RG-6 stripper, connectors, and crimper for the nice F connectors DX Engineering uses.

12/15

Current broke list:

- 40m4lldd at 180'(all 4 elements snapped)
- 40m4lldd at 70'(boom folded when truss broke)
- 10m4dx at 180'
- 2m at 180'
- 20m4dx at 150' broke and bent elements
- 20m4dx at 120' broke boom
- 15m4dx at 120' broke and bent elements
- 15m4dx at 90' broke and bent elements
- 160m inverted L's pulley broke
- All 3 Beverage runs flattened, 6x6 pressure treated post broke off just

above ground level.

- One 2x4 radial support post broke on 80m 4-square
- Most radials down on 80m 4-square
- 40m feedline stuck under down tree, but still ok I think.
- Branches down on 40m 4-square radials
- Branches down on 160m Inverted L radials

Saturday or Sunday I didn't like the looks of the 60' listening tower guy wires. I think the 160m inverted L rope may have loosened them or pulled one of the screw anchors out a bit. I drove some stakes on two of them that seemed loose and added some extra ropes just in case.

So far I have replaced the 6x6 Beverage post because the ground was loose enough to do it and I wanted

it done before it froze in. I repaired another broke coax run post that broke. I replace an 80m 4-square radial support post that broke for the same reason.

Tonight I lashed the 70' 40m4lldd hoping to keep the boom from breaking off and causing more damage and to take the unbalanced weight off the ring rotor. And I lashed down the broken boom half of the 120' 20m that was starting to flap in the breeze before it could damage anything else (I hope).

12/16 Power was restored about 1pm today, only 4.5 days off, not bad for as much damage as there was. Some areas may still be off a few more days around here.

This afternoon W1EQO came with chainsaw in hand and cleared the trees and branches off the 80m 4-square radials. When I got home I put back up the 160m inverted L's, the 40m inverted V, tied the ends of the Beverages to the new post so they don't get lost in the next snow/ice storm tonight, then went and got all the radials for the 80m 4-square back up in the air. W1EQO also cleared the N-S Beverage from the 80m 4-square to the end, that's about half the length of it that needs clearing, there is still a bunch of stuff down on it between the 4-square and the shack end.

12/17 DX Engineering connectors and tools showed up today. Cleaned a few low hanging branches and downed stuff from the 2nd driveway entrance. Got repair quote from XX-Towers for insurance claim.

12/18 Nice WX this afternoon, but a blizzard forecast for tomorrow, so I took the afternoon off to see how many wires I could get up off the ground before they got lost. Started with the chainsaw on the 40m 4-Square. Got all of its radials and the feed line back up off the ground and in reasonable condition. The radials should be replaced next summer probably. Then started on the N-S Beverage run because W1EQO had most of that finished already. Got it cleared and back up on the posts, only about 2/3 of it on the insulator rods, the rest just tied up with rope, but since the wire is insulated anyway it shouldn't really matter. Installed the 3 DX Engineering Beverage transformers on the new end post. Got all the 160m inverted-L radials off the ground and pretty much in the clear. Got the South ends of the 40m and low 80m inverted-V ropes out from under big branches.

I know I have mentioned this before, but here is the worst example ever... When something is broke or shouldn't be used for some reason I use a cheap homebrew tag out system, just red electrical tape over the button or switch. Or for things like rotors that shouldn't be turned I'll pull the plug and wrap that in red tape. This is what the boxes look like before getting the 160m inverted-L's back on line.

Figure 376 Tag out system in operation.

12/19 Amazing, Central Tractor had exactly the number of fiberglass electric fence stakes I wanted, and the right insulators for them, and the right drill bit. To repair the Beverage posts I need to drill a 3/8" hole through a pressure treated 2x4 the wide way, so a normal little twist bit won't do it, you need one of the longer auger type bits or one of the long shaft flat ones... I got one of both just to be sure. Nice heavy snow tonight.

12/20 Yep, nice snow. 8" or so of nice light stuff. Phone repair guy shows up before I get driveway cleaned to fix the eye that pulled out of the beam in the ice. Note to self, put antenna receipts in folders with instruction sheets, the insurance company now wants to see receipts to get the original values... spend an hour or so hunting through 5 year old bags of receipts and paperwork to find the 20m and 15m ones. I must have gone over some 'pay it off quick and get him out of our hair' limit on this one, they are actually going to send an examiner out to look at the antennas.

After lunch its up to 13f, so I fire up the chainsaw and tackle the SW-NE Beverage run. About an hour to cut my way to the back end. About 1/2 hour to cut 10' of one wire out of the beaver pond ice that it got frozen into. That was fun, using a chainsaw to cut ice on the pond that has about 3" of slush on top of it. Then breaking up the ice with an improvised pry bar made out of a cut up branch. Playing in slush and water at 13f is not always a good idea. By the time I'm done my gloves are soaked, my hat fell in the water, my boots are soaked, and so is most of my snow mobile suit. And then its a very exhausted walk back up to the house. I hurt, but its a good hurt. Hopefully tomorrow the hurt will be gone and I can get that one tied back up to the posts. Take a hot shower and throw all the clothes in the wash... sit down and have a hot chocolate with 100 proof peppermint schnapps in it... yummmmm.

12/21 A Nor-Easter forecast for this afternoon, and its only 11f and snowing and blowing at sunrise. Decide to go get the SW-NE Beverage off the ground early. Take a bucket of rope and some insulators and trek on back that line again. Fortunately it doesn't take long to get it tied back up on the posts. Lucky Dog was definitely not happy, but followed along anyway. I would not have played in the water this morning like I did yesterday, the east wind is making it feel much colder than yesterday.

12/22 Cold, very cold... time to hibernate.

12/23 Wind chill got above zero during the morning, and the forecast for tomorrow is freezing junk and rain, so I took the afternoon off from work and got the NW-SE Beverage up off the ground. Of course this one had some huge trees across it, one of which will be there for a while, wedged about 10' up between a couple others. This is the only one that broke one of the ropes, the far end anchor rope for one side broke... the limp wire made it harder to dig out since it kept sliding through my gloves.

12/24 Nice warm afternoon, up to 40f when I got home from work. Finished hooking up the Beverages. Had to tighten up the ropes so the jumpers would reach, then hook up the jumpers to the DX Engineering boxes. Ran a new ground wire to the rod. Installed new F connectors on all 6 coax runs. Reconnected and tested. Of course they were backwards, so had to swap all the wires end for end to get them pointing the right direction again.

12/25 Tighten up the temporary guy ropes on the 60' listening tower. Fix chain saw tension adjuster. More editing on 25th anniversary book.

12/26 Added a couple feet to the 160m inverted-L rope to move the south L out from under the guy wire. When the wind blew strong from the west it was pushing the wire up into the top guy wire causing arcing.

Went up the 180' tower. Disconnected the feedlines for both 40m4lldd-125's. Removed the two broken halves of the driven elements from the top one. All 4 elements are broken in the same place, right at the start of the swaging of the first tubing section. This is the one spot where there is only one thickness of tubing in the section of the element out to the truss/loading line connection point. On my design that was on the bottom one this gap is bridged by 3 sections of tubing from the next tubing out.

Figure 377 Broken swaged joint on 40M4LLDD-125

You can see above the end of the broken off element of the 40m4lldd-125. This is the swaged down part of the first tube out from the boom. The 2 inner pieces of tubing reinforce the 2nd tubing section. The first tubing section 2 inner sections also, but only the swage covers that one joint. The nuts were on the bottom of the element, the top of the tubing (on the right) was torn by the wind and ice which folded over the bottom(on the left) which then quickly broke off in the wind.

Figure 378 The scrap aluminum pile starting to grow.

12/27 Another perfectly yucky day. Caught up on QSL card pile. N2KW here for Stew Perry 160m contest. Made adapter plugs to key all the amps from the FT-1000MP Band Data jacks. Had to rewire the SO2R band decoder plugs because they were insert able pin types and didn't have all the pins included.

12/28 More editing of 25th anniversary book.

12/29 Had visit from insurance adjuster.

12/31 What a way to end the year... a bunch of crumpled aluminum still up in the air and piled up on the ground while waiting for the insurance company to do their paperwork. Its been too cold and windy to do much anyway even if there was new aluminum available.

2009 – The year of even MORE repairs

1/1/2009 Starting the year in a deep freeze. Good time to work on publishing the 25th anniversary book edition and cleaning up for the RTTY RU this weekend.

1/2 Up the 150' tower early to turn the 60' 20m antenna west for the RTTY RU. Finally get south rope for the 160m inverted V untangled from a couple tree tops. Trying to get DVD for book uploaded, 7 hour uploads are a real bummer, I need a faster internet connection!

1/3 Temperature 21f, winds 25-35mph, blowing snow... too windy to climb, so went and added 8 more radials to the 40m 4-square. Finished setup for RTTY RU.

1/6 I should have come home from work earlier. Got home about 3:30pm, it was 26f and almost calm. Grabbed tools and lots of rope and went up 150' tower. I dissassembled the broke half of the 120' 20m4dx to bring it down. Then I used the boom brace to lift up on the driven element/reflector end of the boom while sliding it in toward the tower through the boom-mast clamp. Got it in so I could reach the driven element and take the coax off, but it was getting too dark to dissassemble and bring it down.

1/9 KC1XX said last night that his 2 guys would be here at 10am... I hope not, still 1/2-3/4" of ice at tops of towers, winds 25-30mph and gusting higher. The wind did do one job, it broke off the other half of the 150' 20m reflector, so that doesn't have to be removed now and should make that one easier to handle to replace elements.

Well, the XX Towers guys showed up. They said there was no wind until they came up the hill into Peru. With the ice and wind they decided to come back another day. But at least they got to see what they were up against.

Went through last year's bent pile and the box of left over parts from a 20m4dx I bought last year to replace elements from. Found enough parts to assemble a full set of 'relatively' straight elements, and one brand new boom for the 20m4dx. Straightened out a few pieces to make replacement parts of elements for the 15m4dx's that have broken elements. Now if the ice would just melt and the wind would stop.

1/10 Found another broken insulator on the 80m 4-square. Scraped off the ice and doubled up the strong backs on that one. Set up for NAQP CW for K1MK.

1/12 Set station back up for multi-op for NAQP-SSB and VHF contest.

1/13 Nice (relatively) day. Took off work early and finished reinforcing the last 2 80m verticals. I guessed about right on the stainless V bolts, I figured about half of them would be galled and need replacing, and sure enough all 4 bolts on the last leg of the last tower galled and used my last 4 spares.

1/16 Set up for NAQP M/2 and Jan VHF. Installed a new printer, an HP Deskjet 6980, that old 970c was just refusing to feed paper most of the time. Unfortunately this one doesn't have drivers for Server 2003, so it is just on the wireless network. Drivers are on 40m, k1ttt-ibm(xp-shared), my laptop, and k1ttt-compaq(vista-shared). I also picked up some cute little optical mice for all the computers, but when I opened the first one I found the USB cable was only about 2' long. It barely reached from the front jack of the computer down to the operating table with the cable in front of the monitor... kind of worthless. They will go back to Staples the next time I am past there. How are you supposed to open those hot

melted plastic cases those things come in so the are in re-saleable condition to return them??

1/22 Set up for CQ 160m CW with 2 stations and BARTG Sprint as SO2R for small multi-op. Found that 160m radio seemed a bit hard of hearing, swapped with spare.

1/23 Nice calm day, 25f, went up the 150' tower and replaced the reflector and D1 on the top 20m antenna. Broke the fiberglass on the 2m vertical and bent one 70cm element in the process though. Ordered Elecraft XG2 receiver tester.

1/24 Somethink arcing on 160m intermittantly. Go out in 0f wind chill and trim some branches, tie off some of the inverted L radials so they don't blow into trees, and then find a loose connector at the switchbox that was definately arcing.

Take down broke 40m

1/27 Nice day, KC1XX and Andrew come to take down the 40m antennas. The broken aluminum pile grows quite a bit. But both come down without a hitch. After they leave I take the elements off the bottom one and the boom from the top one and start assembling a replacement. Not many pictures as the battery on the old Mavica is virtually dead, ordered a replacement finally. The XG2 receiver tester arrived, I was busy when the UPS guy showed up while the lower 40m was coming down, he seemed to be in the driveway for a long time, maybe watching the show?

Figure 379 KC1XX bundled up as ground crew.

Figure 380 Andrew removing an element on the top 40m.

Andrew rigged up the lifting line and tram wire to one end of the top 40m. Then he took off the first element on the other end. Then he took it out of the ring cradle and slid it down on the other side. When the end of the boom got down to him he took off the end element and we slid it down the tram.

For the lower one Andrew had rope everywhere. Matt and I pulled up enough to level out the boom, then Andrew undid the last bolt from the ring cradle. It stayed together as he swung it around the tower. He then hooked it on the tram line and Matt and I pulled it out from the tower with the come-a-long on the tram and lowered it to a perfect landing. It tried to fold back up, but pulling on the end of the first element I could grab straightened it back out.

1/30 Set up for FOC Marathon in wires/qrp class. This means disconnecting stubs on 40/80/160, turn off bandpass filters, bypass tuners, and disable automatic band decoding... so operator can pick any of the 40/80/160 antennas to use on any band.

Broke the rebuilt 40m4lldd out of the ice. Found good use for the extra piece of plastic culvert pipe, cut it in half and cut notches in one end, now it supports the boom of the 40m4lldd very nicely. I think I'll get a bigger piece and make a couple taller ones like that.

Built the XG2 receiver tester... It worked at first then the 80m position stopped working. Figured out it had to be a bad crystal. Contacted Elecraft and they sent a new one.

1/31 Since I had the 40m stubs/jumper combo out for N2KW to use the wires on other bands I decided to rebuild it into something prettier than the spliced together mess that it was. It was tuned a bit off the bands also, so trimmed it down to size and put on all new connectors.

2/1 Looked at cleaning up 10m stubs... too ugly, will need 2 hardline connectors, 2 75 ohm short jumpers, 2 T connectors, and one or two 50 ohm jumpers to do it right, then retune them. Tuning seems ok on them so leave them alone for now, the big ugly taped up splice ie hidden behind the table anyway.

2/2 Sick... New crystal showed up for XG2, replaced it and its working fine again.

2/6 Been sick all week so haven't done much. Tested a couple MP's with the XG2, the one I thought was bad seems to be ok. Set up for RSGB 160m and WPX RTTY for next weekend.

Double checked 160m cables and switching after all the arcing in the CQ contest. Found a couple connectors blackened, particularly the one on the switch box end of the cable from the shack. Replaced that connector. Used TDR to check cables, they were all ok, but it did show a high resistance connection at the switch box. Ordered a new RCS-8v to replace the existing one that has lots of burnt contacts now. Checked and cleaned up other connectors in the shack and at the switch box.

Broke the pipes for the tripods out of the snow bank to thaw.

Found u-bolts for the 120' 10m beam since I expect they will need replacing when I go to level it out.

Ah yes, spring is coming, and the days are getting longer. There was even enough sun after dinner to assemble two tripods and get the 40m4lldd-125+ up on them.

Ordered replacement aluminum from M2.

Insurance company finally got repair quote back from adjuster... Of course he found a company that would do the labor much cheaper than XX Towers. As before, they do dishes and business band radios... my size antennas are 'a bit beyond our expertise'. Sent that quote back to the insurance company.

2/7 Almost perfect execution... 19f and dead calm, left the ground just after 7am to watch the sunrise on my way up the 15m tower. Replaced the broken half of the driven element on the top as the wind started to increase. Replaced the broken half of the D1 on the 90' one, but decided against straightening the reflector as the wind was getting annoying. And leveled the D1 on the 60' one. So only 1 element badly out of alignment now on 15m, the reflector at 90'. Many are still a bit bent but they should work until replacements arrive. Got back in the shack about 8:10am... plenty of time for a shower and to take Lucky for a walk before leaving for the YCCC meeting.

Got XX Towers scheduled for 2/17 if wx permits to put the 70' 40m4lldd-125+ back up.

2/8 Put tools away from 15m and 20m element jobs. Aligned and tightened elements on the 40m4lldd-125+, its ready to lift now. Played for a couple hours in the XE RTTY contest to test out latest N1MM Logger updates.

2/9 New RCS-8v boxes here. Wired in fresh one for the 160m remote switch.

2/10 Nice evening. Went up the 10m tower and leveled out the 120' 10m Yagi. Had to replace both U-bolts that broke when trying to loosen them.

2/11 Great day, 51f, light winds... Spent about 2 hours at 180'. Installed slave drive motor on ring. Had to gnaw my way through the big sealed heat shrink on the original one to do the splice. Only burned myself once with a solder blob when doing the splice. When I tried turning the ring with a drill battery it wouldn't turn. The original motor output was jammed, the motor was running but not moving the output gear. So had to bring down the original motor and package it up to go back to TIC. Also ordered a set up updated corner bearings for the top ring to get it to fit better. And ordered a new truss assembly to replace the bent one from the bottom ring. Checked the 70' ring on that tower, looks to be undamaged from the broken boom besides the bent truss pieces.

2/13 Set up for WPX RTTY and RSGB 160m.

2/15 Did some more testing on the 160m radio I had removed because I thought it was half deaf. Seems to be ok. Must have been how the rx signal was getting divided between them with the T connections and protection relay for the 2 radio setup. Swapped it back onto 160m because it has the key click mod where the spare that was there didn't.

Did final check of 40m4lldd-125+. Found the balun was intermittant, replaced with one of the spares. Interior inspection showed corrosion on so-239 and obvious over heating of the coax and inside of the pipe it was built into.

Put up bottom 40m

2/17 Andrew and Bill from XX Towers were here and put up the 70' 40m4lldd-125+. They also took down the last half of the 120' 20m4dx thats been hanging around up there since December.

Photos by N2KW:

Figure 381 Andrew taking the lifting rope up the tower.

Figure 382 Me manning the come-a-longs on the tram.

Figure 383 Almost lift-off. of the 70’ 40m.

The tram is the left wire going up, the rope is on the right, and there is a sling from the lifting rope down to the first driven element to help tip it up.

Figure 384 Lift-off, just a bit too much lift on the tipping sling made for a tough start.

Figure 385 The sling was too tight and tipped the antenna all the way up sideways, I'm not the only one that can do that I guess.

Figure 386 Me working the tram come-a-longs.

The tree it is tied to is one that was brought down in the ice storm and is still frozen into the ground. The snow under the top ice layer was still about knee deep down there.

Figure 387 It took a bit of tipping and turning to get to the troublesome sling to take it off.

Figure 388 Finally leveled out.

Figure 389 Almost in the cradle.

Figure 390 Level it out and bolt it down.

Andrew could reach the 2nd driven element that got out of alignment on the lift-off to put it back in line with the other elements.
After Andrew got it bolted down I went up and connected it and ran a quick test on the rotor. It seems to rotate ok, but could probably use some small adjustments. Before they left they also took down the other half of the 120' 20m4dx to get it off the tower.

2/19 Started setup for ARRL DX CW.

2/20 Finished setup for ARRL DX CW. Turned 60' 20m to Europe. Took tuner off low 80m V to use on 20m, the SWR with the bent up elements is a bit higher than usual on there.

2/25 Rebuilt motor for the 20m ring rotor is in, along with replacement bearing corners for the 180' 40m ring, and replacement boom truss struts for the 180' 40m ring.

2/26 Prepare the 20m ring motor for installation. Had to clean up threads on bolts and nuts and chase the threads on the welded on nut. Tested rotation and indication with spare controller. Tip... write color code on rotor case with permanent marker. It won't last long outside but saves carrying a piece of paper up that could get lost.

2/27 Installed replacement motor for 20m ring. Set up for CQ 160m SSB. Ordered aluminum to modify the new 40m4lldd that is in the mail now.

2/28 Set up for NAQP RTTY. Cleaned up the shed a bit. Cleaned rx side of relay in the 80m amp.

3/6 Set up for ARRL DX SSB. Relay on 80m amp intermittant again, swap it with the spare.

3/7 Aluminum from M2 arrives. Check relay on 80m amp, find thread from cleaning pad stuck in contacts, put it back on the station.

3/8 Start unwrapping M2 aluminum. Took apart more of the broken antennas.

3/12 Ordered forged eye bolts for 40m4lldd-125+ mod at Fastenal. Cleaned up more leftover stuff from winter work in the shed to make room for building this spring's projects.

Rebuild Antennas to Peru Specs

3/13 Marmon-Keystone's timing is perfect. I was just about to call them to see when the aluminum would be delivered when the trucker called asking for directions. Now I really have a garage full of aluminum!

Started building new elements for 20m.

Figure 391 These are the stock 20m element center pieces.

The outer 3 pieces aren't shown since I am not planning on modifying them. The reflector on the left consists of a 1.25" tube swaged down to accept the 1" tube. The next one to the right is the driven element where the 1" tubes go on a 7/8" fiberglass insulator. The two directors have a 7/8" center splice tube that the 2 1" tubes slip over.

Figure 392 This shows the additional and changed aluminum.

The center of the reflector will have a 30" piece of 1.375" tube over it, then the 1" tubes will have 30" of 7/8" tube inside them. The driven element will have 30" of 7/8" tube butted against the fiberglass insulator. The two directors will have the 30" of 7/8" splice increased to 48" and it will have 3/4" tubing inside it.

Figure 393 Drilling rig. The V notched 2x4 is clamped down and centered under the drill.

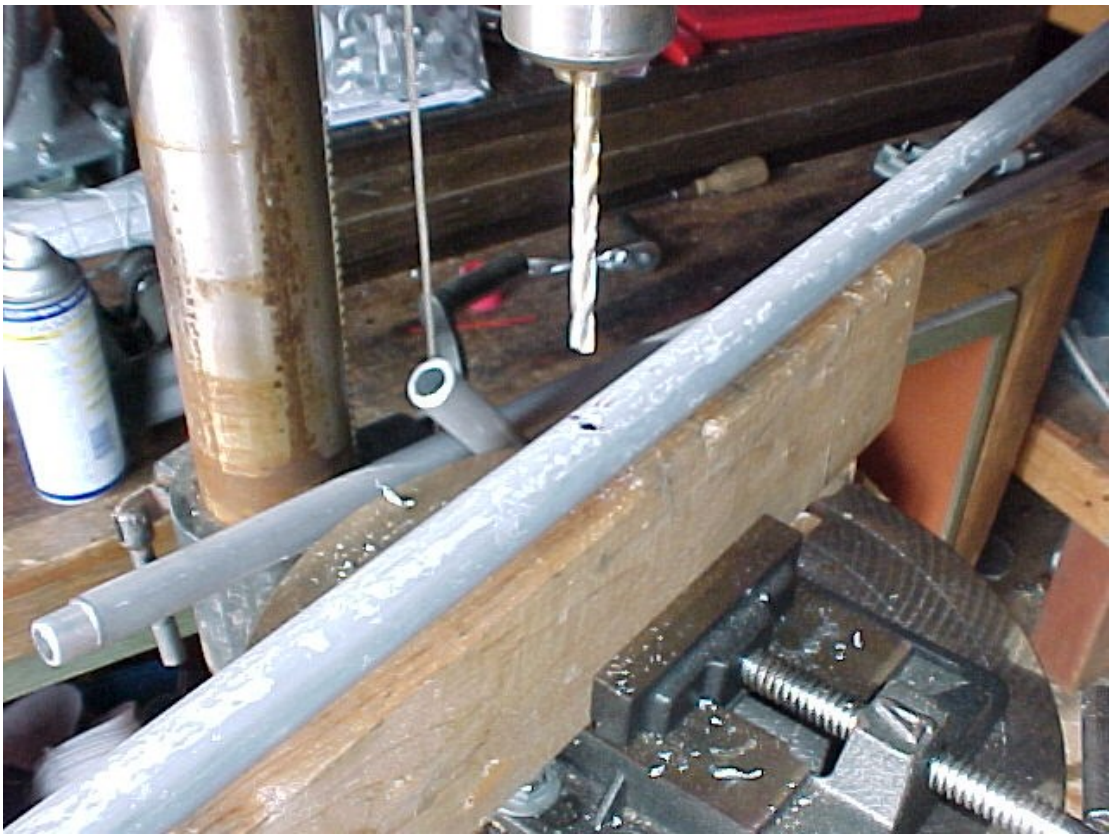


Figure 394 For the director inserts and the reflector sleave I drilled one hole based on a measurement from the center.

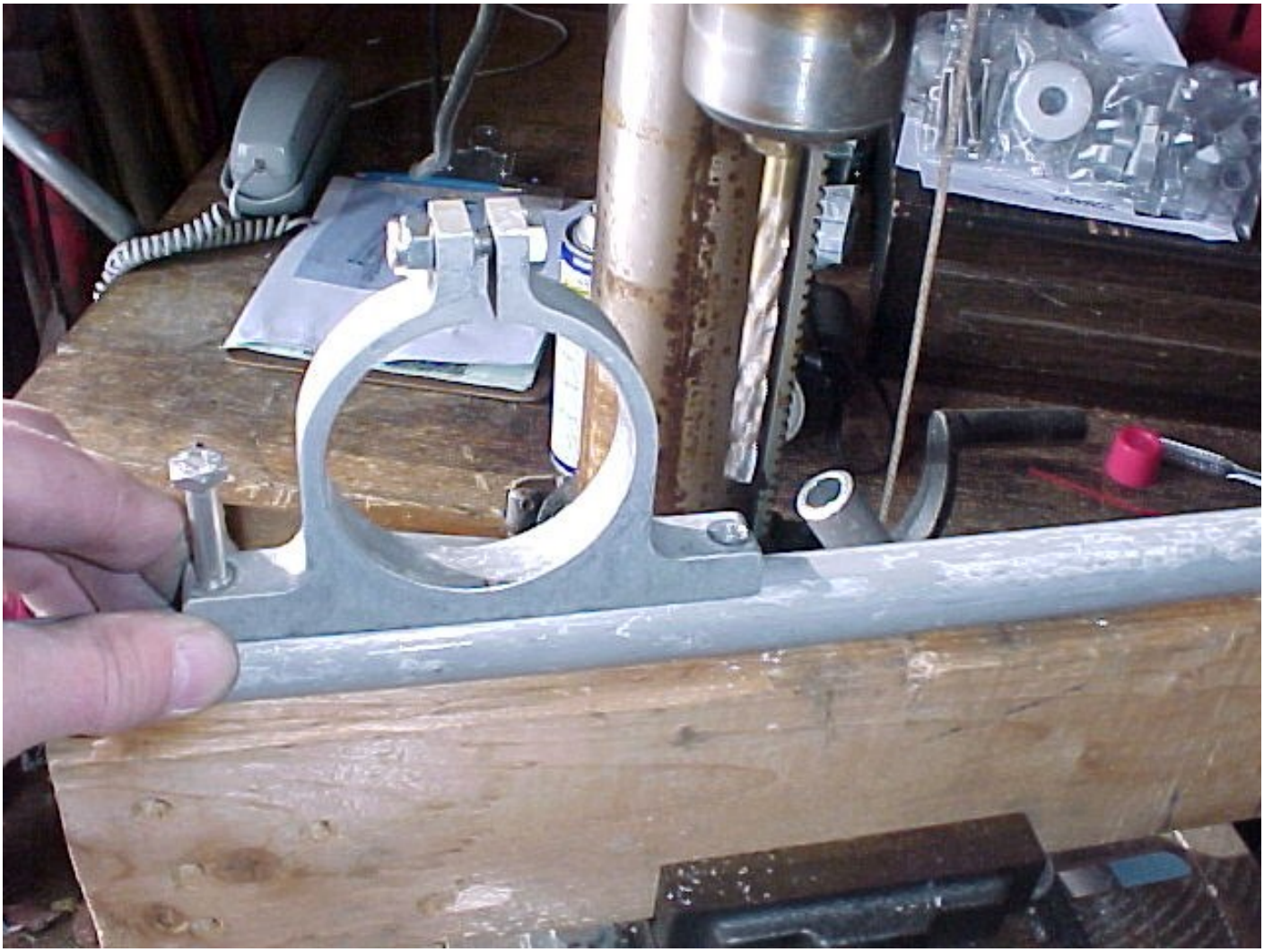


Figure 395 The second hole was lined up by putting a bolt in the first one and using an old boom-element clamp as a guide.

Figure 396 12 partially assembled elements with reinforcing in about 4 hours, including salvaging tubing from the scrap pile, cutting, fitting, and drilling.

3/14 Assembled 20m element sections, the outer 3 pieces, in the shack while waiting for it to warm up a bit. After lunch I assembled 3 full sets of elements and set the replacement boom up to get ready to populate it.

3/15 Salvaged some parts from the broke element of the top 40m4lldd-125 that will make building the new -125+ a bit easier. This includes the element to boom clamps, though the truss supports will probably have to be replaced. The first insert into the first element tube. The shorting bars and some of the truss rods that weren't bent, and the first section past the element insulator that has an insert piece reinforcing it that I can't easily reproduce.

Figure 397 Salvaged parts.

Figure 398 What is it??? Or should I say, what WAS it??? Answer in a day or two probably...

Figure 399 Pile of mostly bent bigger pieces, broken booms, and lots of element tips that may be at least partially salvagable.

Figure 400 Pile of what I think is mostly good aluminum.

Lots of pieces from the broke 40m4lldd-125 inner element tubes, 2-5' long from 1.5" to .875"... probably enough for a few more sets of verticals or light duty elements... or some really heavy duty elements. One of the two sets of verticals made from last year's pile is on the cable reels on the right. On the left is most of a boom from an old 40m Telrex beam and a spare 10-4cd.

3/16 Tied 2 sets of 20m elements up to the deck posts to get them off the ground and out of the way for now. Set the 20m boom and it's elements up on culvert pipe supports to line it up.

3/21 With help from NT2Y we put together the 15m and 10m elements and the 40m boom. The 40m boom is set up on the tripods at the bottom of the field where it will get lifted from. We aligned elements on the replacement 120' 20m antenna and moved it over near the 150' tower where it will probably get lifted from.

3/27 Last of the needed aluminum for the 40m4lldd-125+ project arrived today. Set up the station for WPX SSB contest.

3/28 With help from a couple of the NE1C operators I got the tubing assembled for the 40m4lldd-125+ elements out to the section past the insulator. Lots of drilling for these of course because of all the new tubing.

3/29 Assembled new Philly element truss pieces. Too wet to do much outside.

3/31 Put element trusses on. Put partial elements on the boom. Had to replace one of the boom-element plates that had a bunged up screw hole in the bottom, then it of course had a galled bolt that had to be replaced... each of which required a walk from the bottom of the field up to the shed.

Oh yeah, the answer to the latest whatsit... Maybe this will help identify it.

Figure 401 Those were the 3/8" eye bolts that held held the boom truss for the lower 40m4lldd... The one with the broken boom.

4/2 Nice night, 55-60f, light breeze, NO BUGS, and light enough to work outside till after 7pm. Added Loctite to all the clamps on the 10m, 15m, 20m, and 40m replacement elements. Tightened up all the nylocked screws to their final set on the 10m, 15m, and 20m elements. Added the element tips to the 40m4lldd-125+ and did round 2 of the 'line up the elements' game. All the tubing is now attached on the 40m4lldd-125+, just adjustments to the element and boom trusses, add the phasing line and balun, and it should be ready to go up.

4/4 Snowy and windy Saturday. Set up station for SO2R for upcoming contests. Cleaned up some stuff in the shack. Did a little cleanup around the yard from winter ice damage. Had short visit from S56A.

4/5 Walked the Beverages on this side of the stream, picked up a pocket full of insulators and moved some of the smaller brush out of the way. Almost every post needs to have the fiberglass rod replaced.

4/8 Kind of cool and breezy, but at least not snowing too heavy, so I went and installed the balun and phasing line on the 40m4lldd-125+.

4/9 Nice evening. Went up to 120' on the 20m tower and brought down the RG-213 jumper for that antenna. This will let me test it since those are one of the older outside pieces of coax, and also let me attach it to the antenna before it goes back up. This will make that reinstallation easier since those feedpoints can't be reached from the tower. I also brought down the piece of boom brace rope that has

been up there flapping in the breeze.

4/10 Did the final element alignment, final bolt tightening, assembled the boom truss, and checked measurements on the 40m4lldd-125+, so it should be ready to go up the tower now.

4/11 Cold, windy, drippy Saturday. Did some cleanup of downed trees and branches around the 40m 4-Square. Did some work on the web site.

4/12 Cold, windy, and snow flurries. Did some more work on the web site. Transfered all the station information pages to the Wiki. Fired up the chainsaw and started to clean up a bit around the 40m 4-square and around the pond. Boy this new saw runs a long time on a tank of gas.

4/13 More cleanup of down branches around pond.

4/14 And yet more cleanup around pond... this could get repetitious, so just assume that any nice day I'm dragging branches or cutting up downed junk.

4/15 Moved tram wire to go over the 40m4lldd-125+. Layed out the backstay wire. Put the rope in place so N2KW can lay it out while I'm at work tomorrow. Got tools and stuff ready to replace bearings on 180' ring rotor.

4/16 Went up 180' tower and moved tram wire to leg closer to 40m4lldd-125+, installed back stay, and lifting rope and pulley. Replaced bearings on ring at 180' also.

Put up more repaired antennas

4/17 Andrew and Bill from XX Towers were here from about 9:30am to 2:30pm, the 180' 10m is fixed, the 40m4lldd-125+ is up at 180' and connected up, and the 120' 20m4dx is up and connected. Now at least the right number of elements are in the air. A few of them are still a bit bent, but hopefully the wx will cooperate either Monday or Tuesday so they can replace the bent up ones.

Figure 402 Andrew with new 10m elements getting ready to repair the 180' 10m4dx.

Figure 403 The 10m boom is now vertical and he is replacing elements.

Figure 404 A nice straight 10m antenna again!

Figure 405 A bend up pile of aluminum coming down.

Figure 406 The 40m4lldd-125+ almost up, with a UFO or two in the picture.

Figure 407 The 20m4dx ready to go up using the top guy wire as a tram.

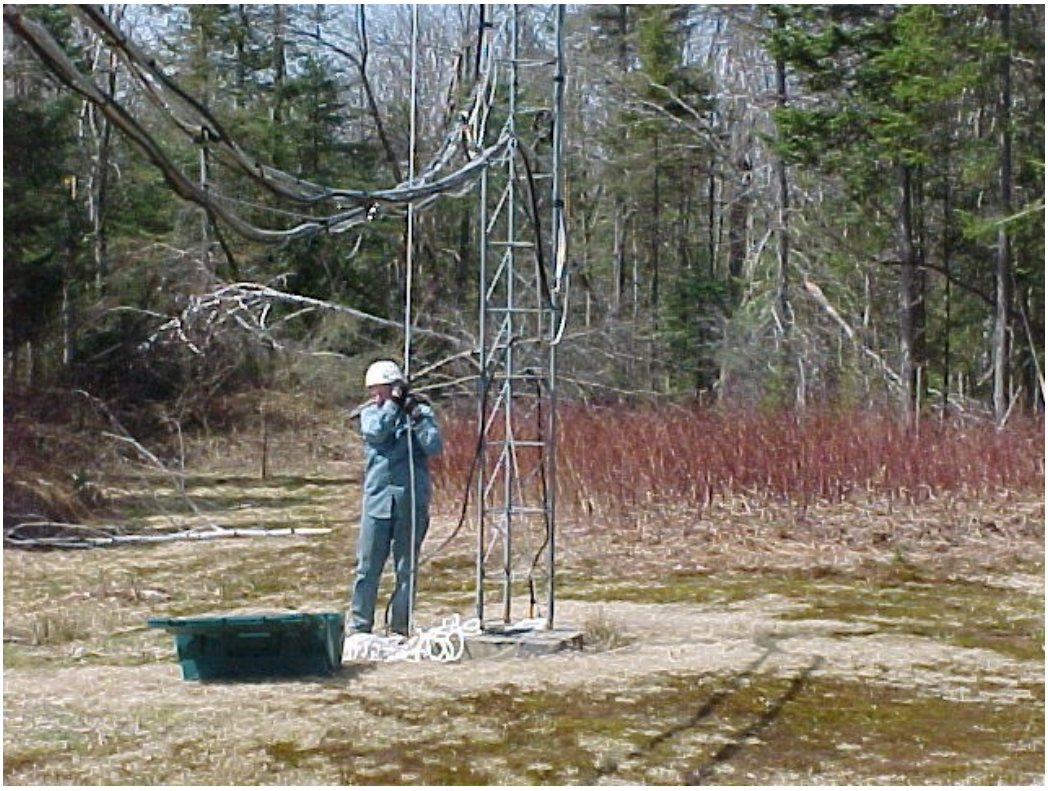


Figure 408 Bill is left holding the rope.

Figure 409 120' 20m4dx just about in place.

No more pics today, I was busy rolling up tram cables and putting away tools.

4/19 Ran another tank of gas through the chain saw.. thats about enough.

4/20 Bill and Andrew here again today, now almost all of the elements are straight again! It was a cool and breezy day, cooler and breezier than I would have like for climbing, but Andrew was dressed for it and knew how to handle the antennas in the wind. Fortunately the forecast rain held off till after they left at 4pm.

Figure 410 Andrew getting started at 150'. Note the extra boom truss rope on the right side, that is to stop the boom from fluttering in light winds.

Figure 411 D1 is off and the antenna rotated. D1 is just in the way of tipping and twisting since it is so close to the balance point. So it is taken off first and put back on last.

Figure 412 Finishing up the 90' 20m4dx. The 120' one just above it is the one that was put up last Friday.

Figure 413 Starting on the 120' 15m4dx.

Figure 414 Bill is still holding the rope.

Figure 415 Working on the 90' 15m4dx.

Figure 416 Almost done.

Figure 417 More aluminum for the scrap pile.

I will check for good pieces in these, I need a couple tips for the 60' 20m4dx and one section for the 60' 15m4dx. The rest of the scrap pile is in the background.

4/24 More cleanup around the 40m 4-square, 80m 4-square, and 150' tower. Disassembled the bent elements removed on Monday. Salvaged a few pieces for future use. Set the station up for FQP.

4/25 W1TO came over to help out. We fixed up the N-S Beverage posts, and the NE-SW one on the station side of the stream. We did a couple posts on the NW-SE one, but that still needs some chainsaw work back in the woods. We also piled up some brush around the 80m 4-square and the back side of the 150' tower. We also started cleanup and assembly of the Telrex 2m antenna that N2KW donated.

4/26 Fired up the chainsaw again and cut up the last of the stuff around the NW-SE Beverage path. Also cut up lots of stuff that was blocking the path between the ends of the Beverages. Still haven't gone across the stream to check the far end of the NE-SW one, that probably needs a bit of cleanup still also.

5/2 Took advantage of a cool, breezy, morning with no bugs and went back across the beaver pond to finish up repairs to the SW-NE Beverage antenna. Set up SO2R station for NEQP. Also finished repairs to NW-SE Beverage. So now, except for one slightly bent element on the 60' 15m4dx I think all the ice storm damage is repaired... so now on with the improvements for this year!

5/3 Did more cutting and dragging of brush. Put one of the hardline connectors on the piece thats going to go up to 150'.

5/5 The lawn mowing season has officially started now.

5/6 Planted a 2x4 support for the end of the 2 new radials for the 40m 4-square that go towards the pond. They had been laying on the ground because there was nothing in the right direction to tie them to.

5/9 A perfectly dreary Saturday. No one here for CQ-M so I went and cut up the 3 big pine trees that came down by the pond. I moved the trunks out of the way of grass cutting and pulled the big parts of the tops out of the pond. After the tops dry off a bit I'll cut them up and get them out of the way.

5/10 Big thunderstorm line and high winds over night. The 120' 20m4dx is now tipped almost vertical, the boom bolts must not have been quite tight enough. I'm going to be feeling this weekend all week... Today I rolled up the 80m 4-square ground screen to get ready for summer grass cutting. Since it was so nice and cool and windy I also went around the Beverage connector trail and cleaned out the stuff I cut up a couple weeks ago. On the way back I cleaned up the NW-SE Beverage trail, so now they should all be realatively easy to walk/ski. Spent a couple hours taking apart bent elements and booms. Salvaged lots of good aluminum out of the scrap pile.

5/11 Took down the damaged 2m packet antenna. Made the 120' 20m4dx level again and added the spacer to hold it on the right beam heading. The packet station is now temporarily on the 2m beam at 180', that is the feedline that will get the new/repaired packet antenna.

5/12 Took apart and dried out the F23A packet antenna. The feedline stub was soaked and water was down inside the antenna of course. Painted the fiberglass shell and left to bake in the garage for a day.

5/13 Cleaned up the innards of the F23A, there are 7 set screw joints in that thing! Reassembled with the nice clean painted fiberglass. Tested tuning and it is perfect, the SWR is < 2:1 across the band and about 1.1:1 at 146MHz when its on the 3' sidearm. Made a new top stabilizer for it out of a piece of that fiberglass angle stuff from the 80m 4-square... its much lighter than the big aluminum angle plate and bulletproof plastic that was on the 150' tower. Cut 25' pieces of RG-213 for the F23A and for the Telrex 2m beam. The F23A will have a PL-259 on the antenna end and an N on the hardline end. The Telrex 2m one will need an N on the hardline end and a split end to attach to the T-match. Also cut a piece to make the 1/2 wave balun for the Telrex 2m.

5/15 Spent a couple hours up the 180' tower today, while W1EQO loaded wood and pushed buttons in the shack... more to do up there, but not much. Took down the bent 2m beam. Repaired the hardline connector that used to feed the 2m beam, the center conductor had pulled the pin back out of the connector like the 10m one did last year. Installed the F23A at about 170' on the South side of the tower and hooked it up to the hardline that used to feed the 2m beam. Installed the 2nd drive motor on the ring at 180', adjusted the side bearings a bit tighter, it seems to run much smoother now. Added lock nuts to the ring cradle bolts. Note, the ring itself is actually bent, one side seems to be bent up on the bottom 1/4-3/8" or so. It doesn't seem to affect rotation though as there is enough vertical room in the rollers to let it turn. Also inspected the 120' 10-4cd when I was up level with it, its boom is bent a bit also, so something will have to be done with that one. I do have a spare one of those sitting next to the shed, but that isn't really a high priority now as it still works and there isn't much on 10m anyway. Still to do at 180', the boom truss on the 40m beam needs to be adjusted a bit, one end is pulling the boom up a bit... it will take readjusting the aircraft cable because the turnbuckle is all the way out already. And I'll want to take another look at the ring before next winter anyway so I'll adjust it then.

5/16 Rebuilt the 2m beam taken down from 180'. I'm not sure what model that is, but the boom

aluminum is identical to the 40m element aluminum except that the center piece is swaged on both ends. I used some salvaged 40m elements and reinforced the 2 sections that had bent. The elements are the same rod as the 40m element loading rod also so the same keepers fit. This was a case where a drill press is a necessity, there just isn't a better way to drill the through-boom holes for the insulated elements. Tested tuning and it is best at the bottom of the band where it should be. Cleaned up the shed a bit while looking for a better boom-mast plate and u-bolts for the rebuilt 2m beam, the one that it had was kind of small and it was hard to get to one of the mast bolt nuts because the boom was in the way. I have a whole shelf of M2 parts and hardware in there now from both 20m and 40m repairs and replacements.

Found half of a 15m4dx D1 element in the salvage pile so ran up to 60' and put that one on so the 15m stack is all straight now.

Unpacked the new TIC 1122E Ring Rotor.

Now, what should I do this afternoon?

Took it easy in the afternoon... just did pre-assembly on the TIC Ring, tested out the motor and controller, and brought the reel of rotor cable into the shack to wire up the tower end of the cable.

5/17 Sorted out mess of color code notes for ring rotor cables. Now there is a single card for each ring rotor cable in the folder with the manuals. Wired up the TIC motor disconnect to the new Belden 9405 cable to pull up the 150' tower. Put N connectors on jumper for repaired 2m beam to go at 150'.

5/18 Attached feedline stub to 2m beam. Rigged ring rotor parts for lifting. Unrolled heliax and rotor cable to go up 150' tower. Staged rope and pulleys at the bottom of the 150' tower. Now if the wx just cooperates tomorrow night...

5/19 George(neighbor) came over to help after dinner... Pulled heliax and rotor cable up the 150' tower. Left lifting rope in place to pull up ring rotor parts. Taped cables up to cable run back to shack.

5/20 Stuck new rotor cable into the shack. Put connector on heliax.

5/21 Staged rope and tools to put up ring rotor.

5/22 Ran control line for ring rotor over to 20m station and wired it in to the controller. Moved 150' 80m inverted V down about 3' to get it below the new ring rotor. With N2KW, NT2X, and RZ6AU helping I put up the ring rotor at 150'. But it was too windy to move the 20m antenna on to it. Stored ropes and stuff back in the shed.

5/23 Added jumper for new heliax into the VHF station. Replaced old 9913 jumper from 1/2" hardline that used to be the packet vertical with new one and routed it to the VHF station also. Added ground lead to the heliax at the shack end. Will have to reground all the VHF/UHF hardline connectors up the 150' tower when I switch them around since I had to disconnect most of that to move them out of the way of the ring rotor. Took the spare 10-4cd out of storage to see what work it would need to replace the one at 120'... the gamma match needs to be rebuilt, but otherwise it looks pretty good.

Something is wrong with the top 20m Yagi. It was arcing and now has high SWR across the band. Most likely the balun or the hairpin is open. Fortunately I have to dismount it to put it on the ring anyway so I can replace the balun then and check the stub.

5/24 Replaced the relay box on the 20m tower. The old one looks good, the contacts only have a small burn spot and measure ok now. But while it was up the tower I could make it give a high swr on the MFJ meter by pushing a bit on the one set of relay contacts. I'll clean it up and keep it as a spare for now.

5/25 Nice morning. 50f and 0mph wind at 6:30am when I started up the 150' tower. I moved the 20m4dx down to the ring rotor and installed the repaired 2m beam where the 20m one was. The wind started picking up just after I got the 20m beam in the ring cradle, good timing! I moved all the VHF/UHF hardline connectors around so they were out of the way of the ring so they would be easier to work on. When I was connecting up the VHF stuff I switched the 6m antenna to the new heliax and put the 2m on the bigger stuff that was there from the old packet backbone project. Both of them seem to be working better than before. 20m didn't work at all though... Had to recruit the neighbor and train him how to read the TDR while I went back up to 100' to replace the T connector. I must have kicked it on the way down because it was open, this had been temporarily fixed years ago, but that must have finally killed it. I bent the hardline around to get it in a safer location this time also.

So after all that now the 20m4dx at 150' has its own rotor, and all the VHF/UHF Yagis are on one rotor (well except for the 6m one on the 60' tower). So the VHF/UHF station can have the 150' rotor full time and doesn't have to share with 10m or 20m any more.

Figure 418 This is what the top of the 150' tower looks like now

Figure 419 And this is a cactus that N2KW gave me that decided to flower a couple weeks ago:

5/27 Yucky, foggy, drizzly, cold evening. Cleaned up a bit in the shed and worked on web page updates from latest changes.

5/29 Set up for WPX CW SO2R with skimmer and packet for K1MK/WK1Q.

5/30 Replaced 2 of the 4 radial support poles along the pond for the 80m 4-square. The original ones were single pressure treated 2x4's and one had broken in the ice storm and another bent quite a bit. The replacements are two 2x4's screwed together in a T arrangement. Much stronger than the single ones. Added another support post to the 40m 4-square feedline at a low spot.

Made up the 1/2 wave phasing line and feedline stub for the Telrex 2m Yagi.

6/2 Replaced the last broken 2x4 radial post on the 80m 4-square. Went around and tightened up some of the ones that stretched from the branch and ice load to get them off the Beverage wire again. Received new batteries for the logging computer UPS's.

6/3 Replaced batteries in 5 of the logging station UPS's. The one on 20m is dead. Swapped the 40m one to 20m and put the Belkin that I also put new batteries in on 40m. 3 or the Tripplite batteries from the logging stations are definately dead, and one of the two in the Belkin was dead.

6/5 Who still sends "Brown paper packages tied up with strings"?? Box 88...

Figure 420 Favorite Things.

Figure 421 Russian DX plaque

Setup for Alabama QSO Party. Test some N1MM Logger digital mode changes.

Pulled jumper for the 150' Yaesu rotor out of ceiling and rerouted the cable for it directly to the VHF station.

6/6 Reguyed the 60' tower. Put one of the spare screw anchors as a backup at each anchor point. Replaced the one that pulled part way out in the ice storm. Took out all the temporary stakes. Put everything back in order after testing RTTY stuff.

Then after lunch... Took down the 60' 10-3cd and the RCS-8V switch box. Put up the Telrex 2m Yagi at 60'. Pushed the 6m one up another foot or so on the mast.

6/7 Started on setting up games for picnic. Mystery switchbox should be interesting. Given a TDR and MFJ 269 and an ohm meter the objective is to figure out what is on all 5 ports of an RCS-8V coax switch that is hidden at the end of a cable. Now to go count nuts and bolts for the jar of hardware guessing game.

6/9 Did some shopping on the way home, a couple turnbuckles, some 1/4" cable clamps, 10 more rolls of tape, and ordered a snatch block pulley. Too wet to work outside so cleaned up some more of the M2 spare parts pile.

6/10 Filled up jar with left over nuts and bolts from winter repairs. This will be used at the picnic to award a copy of my book dvd to whomever guesses the closest to the number of items in it.

Figure 422 Count the hardware jar

6/13 Major cleaning of tool shed... you can actually see lots of the floor now and walk around in there. Set up for VHF Contest. W1EQO came up and started clearing trees hanging over bridge to 80m 4-square.

6/14 While playing in VHF Contest... Clean up web pages for towers, antennas, and station equipment so towers and antennas are only listed in one place each.

6/16 Nice night to work outside. Installed new 2m/70cm antenna on the Jeep and added a mount for the Hustler HF antenna also. Pictures to come soon, its too late tonight to compose the whole story.

6/17 Two nights in a row... got the power run from the battery for both a TS-2000 and the TM-V71A. Now I have a new installation from battery to antenna for VHF/UHF in the new Jeep. Maybe I'll get the pics up tomorrow.

New Jeep mobile installation

6/18 Ok, now we are back to normal, rainy and cool all day today. So here is the story on the mobile installation.

My problem was that the 2009 Jeep Wrangler X I bought has an aluminum/plastic removable roof. So I couldn't use the trusty mag mounts on it. I also didn't feel like punching holes in the side, and I couldn't really use the rear bumper because the back door swings out over top of most of it and it was wrapped in plastic trim also. The obvious place to mount antennas was the spare tire bracket on the back door, but there wasn't much room to work around the big spare that mounts on it. This is what I am starting with when the spare tire is removed:

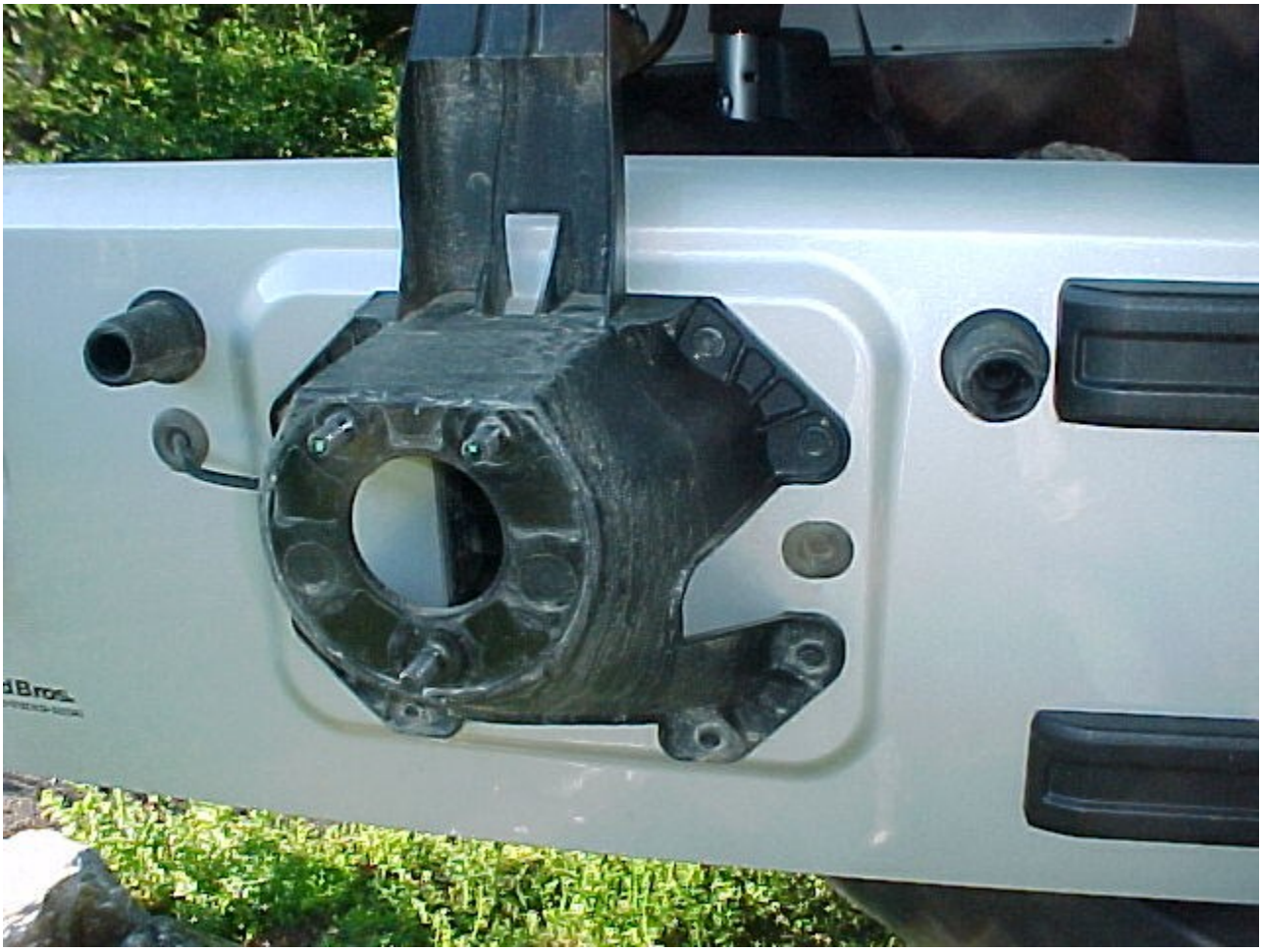


Figure 423 Jeep tire mount

Note that the rubber bumpers on the top of the door are squished under the tire when you tighten it on the 3 bolts on the mount, so you can get an idea of the space available. Fortunately someone else has solved this problem. Arizona Rocky Road produces a mount for Wranglers that fits nicely in that gap. They are nice and solid and set up to take advantage of the existing bolts that hold the spare tire mount to the back door. This is a pair of them ready to be installed:

Figure 424 Jeep antenna mounts

The white rings around the bolt holes are where the paint is removed to make good ground contact. Note there are different ones for the left and right sides of the mount. The one on the left has the VHF/UHF dual band antenna. Most of them come with PO or NMO mounts these days instead of studs, but NCG makes an adapter that works like this:

Figure 425 Jeep VHF antenna mount

The female UHF connectors and insulator for it is supplied by Arizona Rocky Road. It has a standard 3/8" stud that sticks up and they supply a 1" long threaded nut/socket for it so you could screw into it, or just remove their nut and mount anything that goes on the stud directly.(They also supply mounts drilled for PO and NMO) In this case I took off their nut and screwed on the NCG AD-35M adapter, added a UHF barrel connectors to it and screwed on the Comet SBB-5 antenna. I then had to add a ground strap because the Comet needs the ground for its matching network. All metal-metal joints are treated with anti-corrosion goop. Later I added duct seal and tape over the exposed barrel connector joint and on the PL-259 connection.

When removing the bolts from the spare tire mount a minor problem showed up. There was a plastic washer under the metal one. This would be in the way of making the expected ground contact:

Figure 426 Jeep bolts

The washer was removed and installed under the 3 washers that ARR supplied to put between their mount and the spare tire mount. Before installing the right one I took advantage of a spare body hole and ran the 2 pieces of coax into the rear door cavity.

Figure 427 Jeep coax entry

These were easily fished down and out the corner by the hinge with an old bent coat hanger.

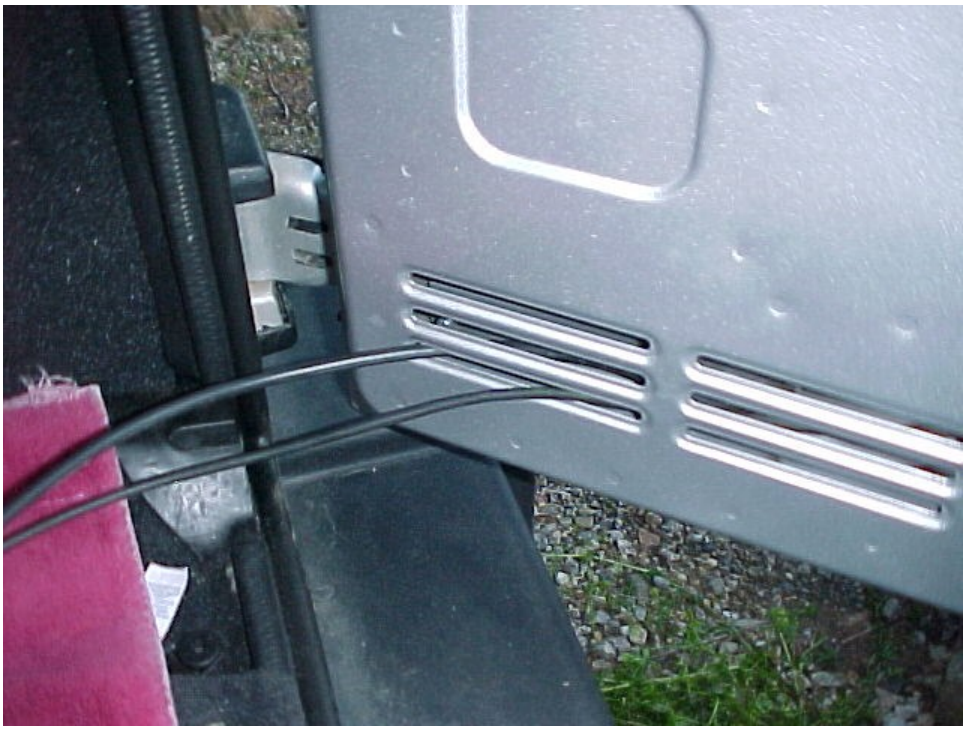


Figure 428 Jeep coax exit

The RG-8x is a tight fit through the vent slots, a slight bend in the horizontal piece above the cable makes it slide through easily and easily is undone. Here are the two of them in place with the cables run.

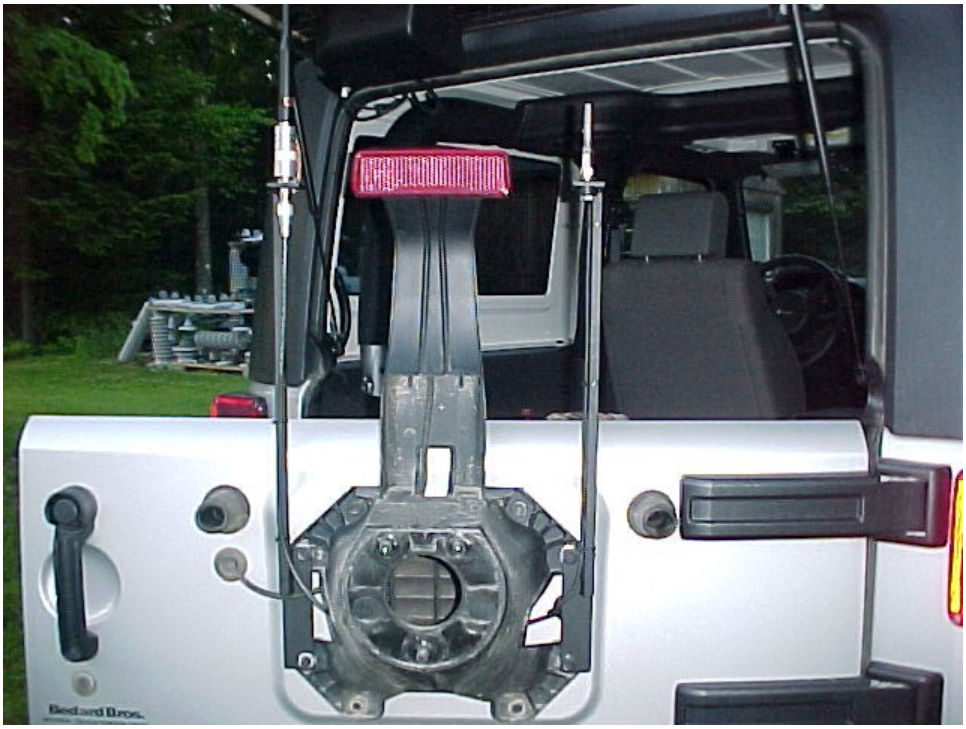


Figure 429 Jeep mounts in place

This is the side view with the tire back in place:

Figure 430 Ready to roll

You can see above there isn't really a lot of room in there to avoid the tire and stay out of the way of the rear wiper. The view from the back with the Comet on the left and a Hustler with 75m loading coil on the right:

Figure 431 Back view

The radio radio is a TM-V71A which mounts nicely using one of the center console mounting bolts. There is plenty of room to hide power cables under the center console and passenger side dash. And there is a large firewall wire hole just under the battery so the run to the battery is short and easy. The power cable for the TS-2000 is tucked up out of the way until I want to go HF mobile.

Figure 432 Inside VHF radio mounted

6/19 Set up for AA CW for W1UE to do SO2R.

6/20 Started building a rack to get spare aluminum and other stuff off the ground next to the shed.

6/22 Darn you L.P. Adams... you aren't supposed to deliver the wood the same day I order it! It wasn't raining after dinner so I just had to continue building the aluminum rack. I got up 2 more layers of racks and the top 2 side rails before it finally started to rain.

6/23 Darn you wx! Rain stopped after dinner so I ended up spending a couple more hours on the aluminum rack.

6/24 Wx did it again! Added carriage bolts to cross member joints and trimmed up the side rails. Moved BIG aluminum to the top rack so it is out of the way. Started stacking more of the other pipes and things on it.

6/25 Double darn you wx! Rain held off too long again so ended up finishing the rack. Used some deck stain on the bottom shelves. Put landscape cloth around end posts, cleaned off the rest under the rack. Cut up the broke 6x6 post from the Beverages and put that in as a support for wood to keep it off the ground. Broke up one wire reel and put it in the compost pile. Put all the bent and other aluminum in the rack to get it out of the grass. Put the culvert pipe supports out of the way under the rack. Cut the grass

around the shed for the first time this year... whew... It looks nice anyway.

Figure 433 Spare aluminum before sorting

Figure 434 More spare aluminum

Figure 435 And then after building rack

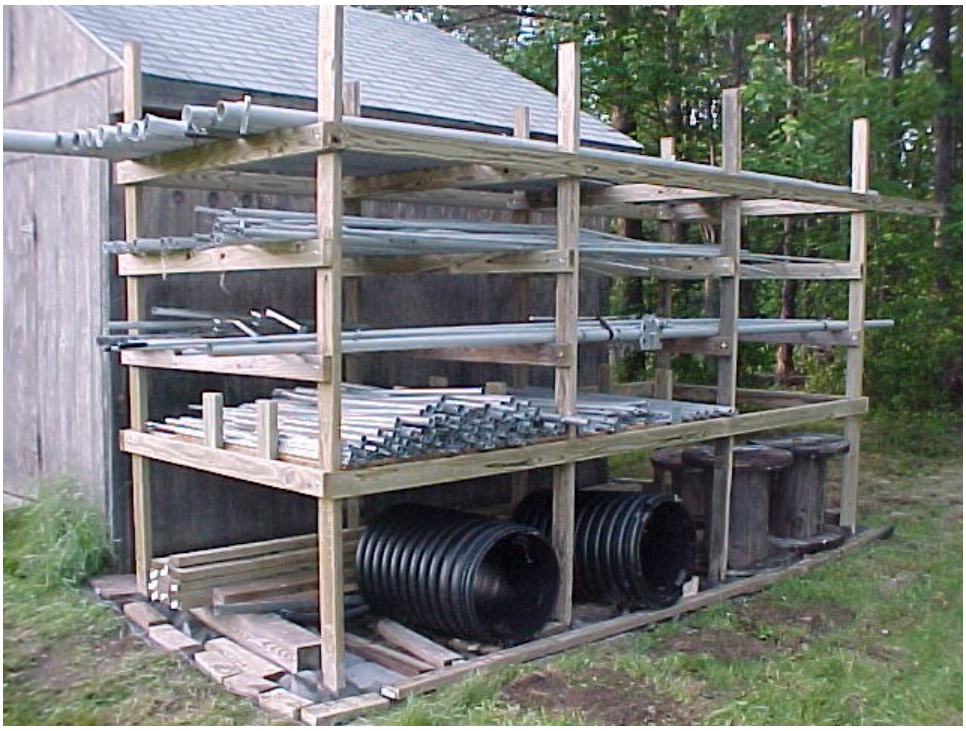


Figure 436 Side view of aluminum rack

Now I just need to sort out and dissasemble the bent stuff and... there is always something else.

Plaque Racks

6/26 Now the wx gets bad! Everyone out setting up for FD and there are severe thunder storm warnings

and even some tornado warnings all over New England. Well, in my nice dry FD station the display rack material arrived to fix up the contest plaque display. I am using the Gridwall system from Allen Display. The only thing that has to be modified are the hooks. I took the 4" hooks and chopped them off to about 1/2" with bolt cutters then ground a notch in the top to fit the grooves in the back of the plaques. The result looks like:

Figure 437 Plaque racks

Boy its hard to get a good picture of a bunch of shiney things in a confined space. In any event it looks a lot better than the other wall that was full of nails and didn't have room for expansion. Now I have more racks I can put on that wall to expand in the future. I also have on order some acrylic sign holders that will replace the spring clip to hold recent certificates.

6/27 Installed a set of the Gridwalls on the old wall where the plaques used to be. Split the plaques between the two walls to give them more room. Set up for Field Day.

6/28 Took apart most of the remaining bent elements so I can better sort out the bent stuff that might be salvageable. Ordered a QS1R to try out the new multi-band CW Skimmer Server.

7/2 Added some track lights to the plaque racks to help brighten them up a bit.

7/3 More cleanup in the shed. Took rolls of guy wire off the outside and put hooks inside on the back wall for them. QS1R arrived and downloaded Skimmer Server Alpha test software to give it a workout. This combo can do 96khz (maybe 192khz on some computers) of up to 7 different bands at the same

time. I ran out of cpu when 40m opened so had to cut it back to 48khz. It also does 6m which the SDR-IQ wouldn't do.

7/4 Did some more testing on the rx 4-square. Fixed a broken element connection on one of the vertical feed points, and replaced an F connector on one of the vertical cables where the center conductor pulled out. It really doesn't seem to have much directivity on any band even after those fixes. Well, a snip snip here, and a yank yank there, and a receive 4-square becomes an omni directional skimmer antenna. I removed the phasing line, 3 verticals, and the 4 separate feedlines. Then put a short end on the main feedline and connected it to the one remaining vertical, then pulled all the radials from the other 3 over to the one so it now has about triple the ground radials. It works reasonably well and I don't have to think about switching directions.

7/5 Set up SDR-IQ and CW-Skimmer on the laptop computer to play with it some more. When it seems I'm not making many entries on here its probably because I'm doing yard work. Today I cut down a couple big broken branches and cut lots of grass since we finally had a couple nice dry days in a row. Still very cool and breezy, but at least it isn't raining.

7/11 Set up for IARU HF Contest. 70' 40m beam is sticking a bit. It didn't want to turn from west to east. Went up the tower and took a look at it and it seemed ok, maybe a bit tight. Will have to test it some more when its not so windy. SO2R HF-2500 amp has an oscillating regulator. Will have to do mod on it like I did on another one last year.

7/12 Started cutting brush around 80m 4-square since it is so nice and cool and breezy.

7/14 Set up 2nd TS-2000 for CQ VHF M/2. Had to make up Yaesu-Kenwood mic jumper and looped back RS-232 adapter.

7/17 Setting up for CQWW VHF multi-op. Removed spotting FT-1000mp, will use TS-2000 for that in the future. Removed unused control cables from spotting position. Moved V7 that had been on the spotting position to the server rack and moved 2m/70cm vertical from spot to server ceiling drops.

7/24 Setting up for RSGB IOTA and the Picnic.

Picnic

7/25 See special page for the Picnic Pictures…. Just kidding, keep reading…

The Big Top was set up on Friday. At least it looks like most of the rain is gone by noon Friday.

Figure 438 The Tent

Ah, only .75" of rain Friday night, so things were a bit damp in the morning. But the sun came out and it was the perfect day for a picnic.

The Harrington's Restaurant catering crew set up in the shady spot next to the shed with their portable grill, keg and other food.

I will try to get calls for as many as I can recognize quickly in the first pass, but I am doing this early Sunday morning and my eyes are still a bit blurred. If you want to help fill in please send me notes for the rest of them.

Figure 439 Food setup. N2KW waiting at the grill, W2FK and WA1ZHM on the right.

Figure 440 Close-up of the food. N2KW still waiting at the grill and W1DWA at the fixin's table.

Figure 441 Under the big top. WS1V, W1UE, K1EBY, W1HIS, and Lucky Dog

Figure 442 K3GM and XYL.

Figure 443 K2BB, W1TO, and WA1ZHM.

Figure 444 N2JFS, His son KC2HQH, K1SFA.

Figure 445 The pie for W1TO.

Figure 446 W2FK and W1DDW.

Figure 447 N1LZH, W1BS, KB2SAE.

Figure 448 K1RQ and Joe.

Figure 449 One of the Harringtons helping KG2A/JJ1RJR.

Figure 450 Everyone gathered for YCCC meeting, announcing the winners of the games, and door prizes. Front table from the white shirt going cw... W1HIS, W1UJ, N4XR, K1VR, WA2AAU, K1EBY

Figure 451 Kei, KG2A introducing himself to YCCC.

Figure 452 KG2A, N2JFS, N1FJ, KC2HQH, K2BB.

Figure 453 Some operating in the IOTA contest. K2GA on 40m, KK1L on 20m and AA1IZ on 15m.

Figure 454 KK1L with 4th and 5th harmonics Sophia and Isabel working on the Mystery Load puzzle.

Figure 455 KK1l harmonics heading for the 10m tower in the Scavenger Hunt. K2BB on left.

Figure 456 The 80m 4-square and W2FK and W1DDW walking around pond.

Figure 457 K1RQ, KB1W, and Joe Stergis (back to camera)

Figure 458 Most of the farm from near the 80m 4-square, tent is on right.

Figure 459 Kei KG2A on left, N2JFS(back), K1SFA (standing), my legs, W1TO (drinking), KB2SAE (in sun), K1MK behind pole, Lucky Dog in shadows, KK1L's harmonics (I think), and someone staring up at towers.

Figure 460 K1RQ, Sue (Harmonic of K1RQ and XYL of NJ1F), AC2AC

Figure 461 More door prize and game awards... KG2A, some other face, N2JFS, KB1VLC, Harmonic of KB1VLC & KB2SAE, Me(sitting), K1SFA, W1IM, W1TO (taking notes), K1MK.

Figure 462 KG2A, KC2HQH, NJ1F getting SS Mug from K1SFA, My hat, W1IM, W1TO.

Figure 463 The aluminum rack and shed all cleaned up for the event.

Figure 464 K2BB still here Sunday morning on 80m

Figure 465 AC2AC/PY2AAZ also still here Sunday. K1MK, K1SFA, and KG2A were also still here but were sleeping in.

The Mystery Load Game... See if you can figure out what is on the 5 ports of the switch. Given the Time Domain Reflectometer and MFJ-269 meter figure out what is connected to each of the 5 ports of the RCS-8V relay box on the other end of the cable. DO NOT change settings on the TDR, it should be set to adequate resolution to determine the loads.

More info:

- There is about 20' of RG-8x from the connector to the relay box. Velocity factor of RG-8x is about .78.
- All coax connected to the relay box is RG-8x.
- Each control wire going to the relay box powers only one relay.
- The relay box has been modified with a single jumper addition.
- You are allowed to examine the back of the control box but not the relay box. (the back has a diode from terminal 4 to 2)
- The inside of the control box has not been modified.
- Some useful (maybe) formulas and constants:
- Resonant frequency(Hz) = $1/(2*\pi*\sqrt{(L*C)})$
- c = frequency*wavelength ≈ 300,000,000 m/s
- V=I*Z
- $Z0=\sqrt{(L/C)}$
- E=mc2
- RC Time constant = R*C
- Rho = (ZL-Z0)/(ZL+Z0)
- |rho| = (SWR-1)/(SWR+1)
- SWR = Vmax/Vmin = (1+|rho|)/(1-|rho|)
- 3 RC Time constants ≈ .95

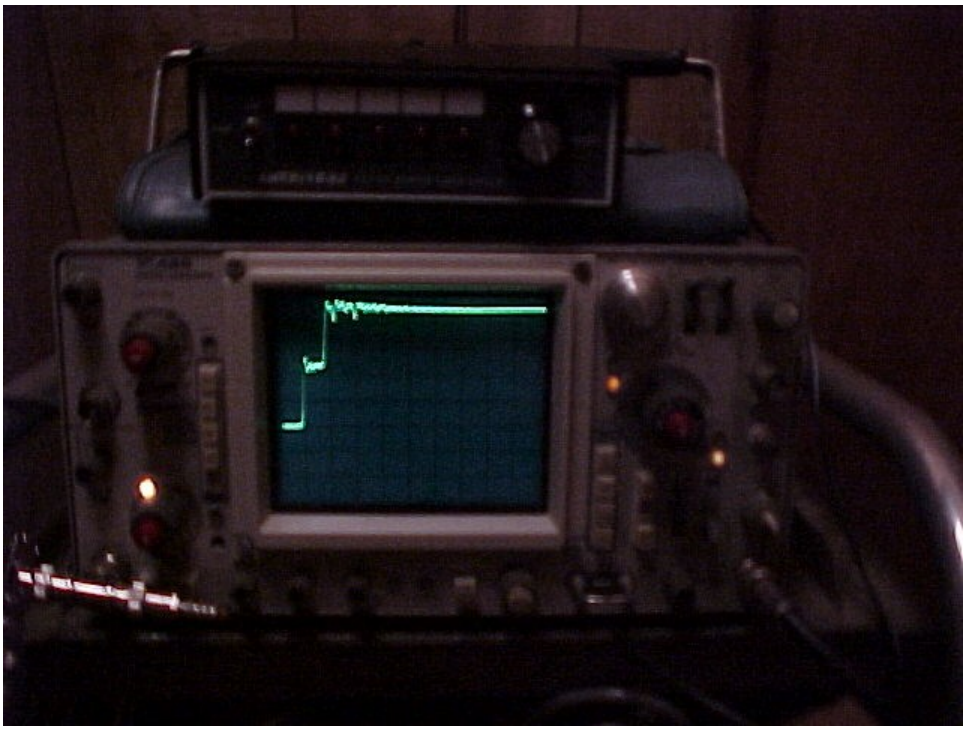


Figure 466 Control power off.

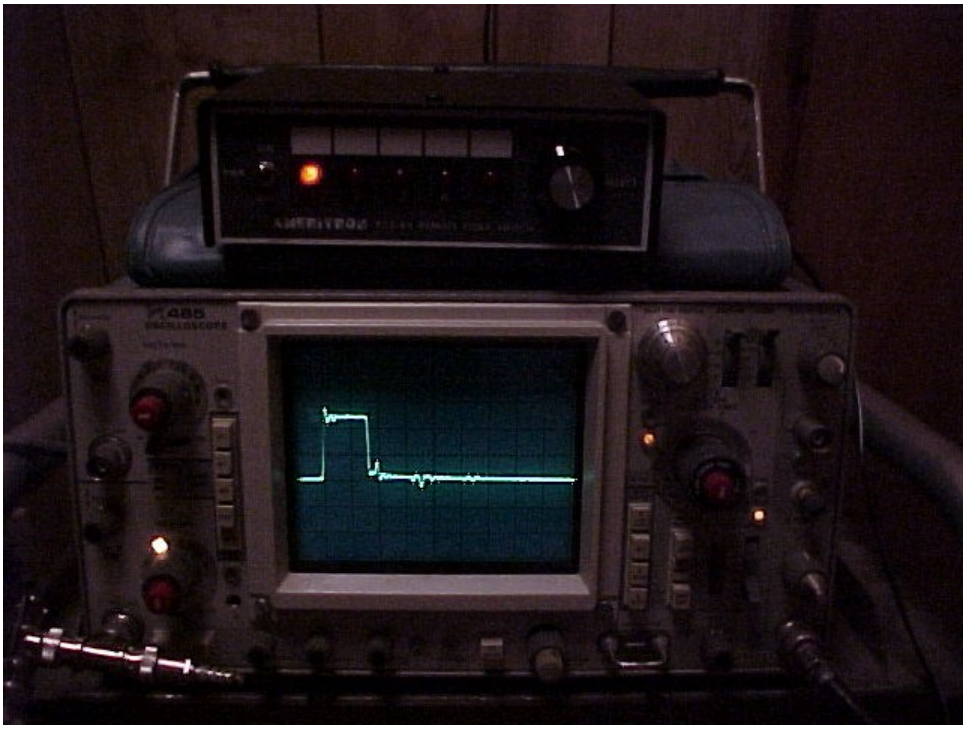


Figure 467 Position 1.

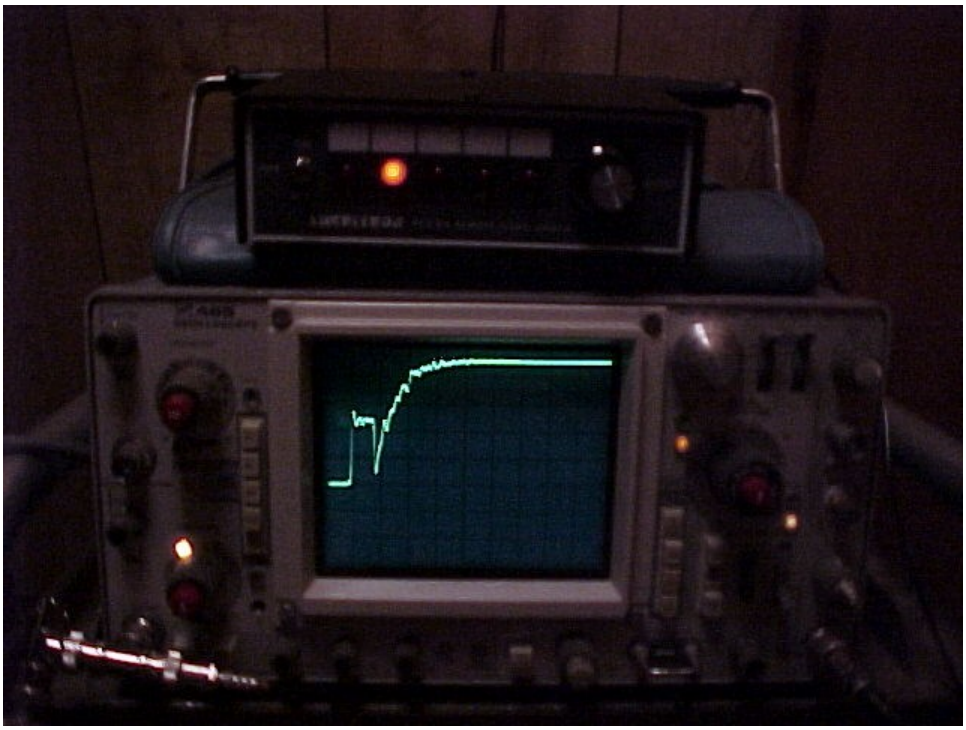


Figure 468 Position 2.

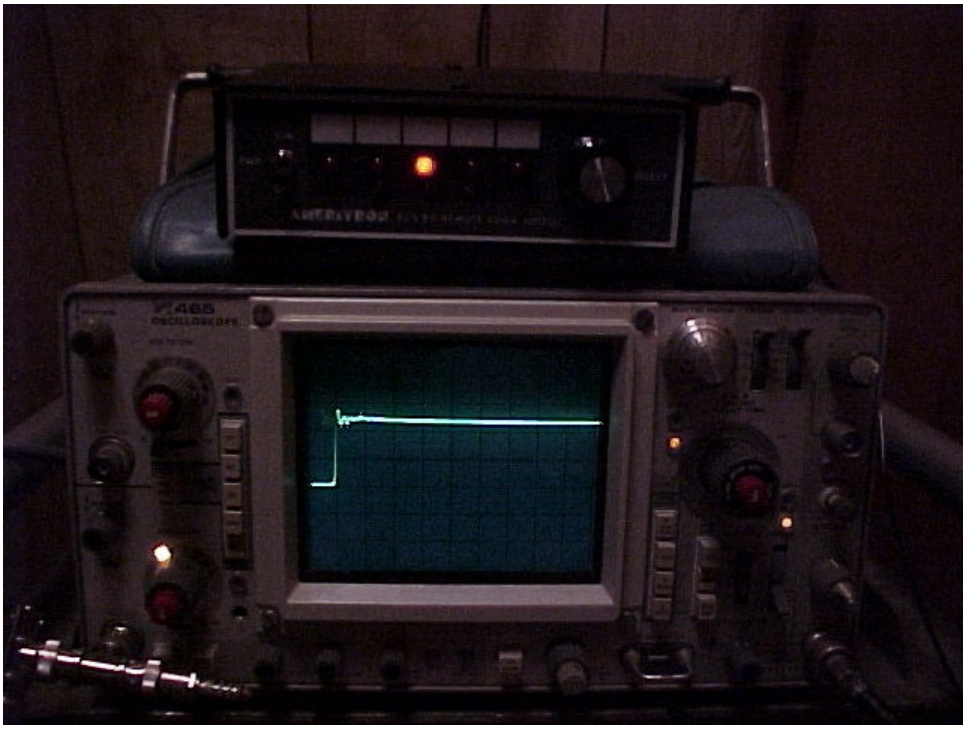


Figure 469 Position 3.

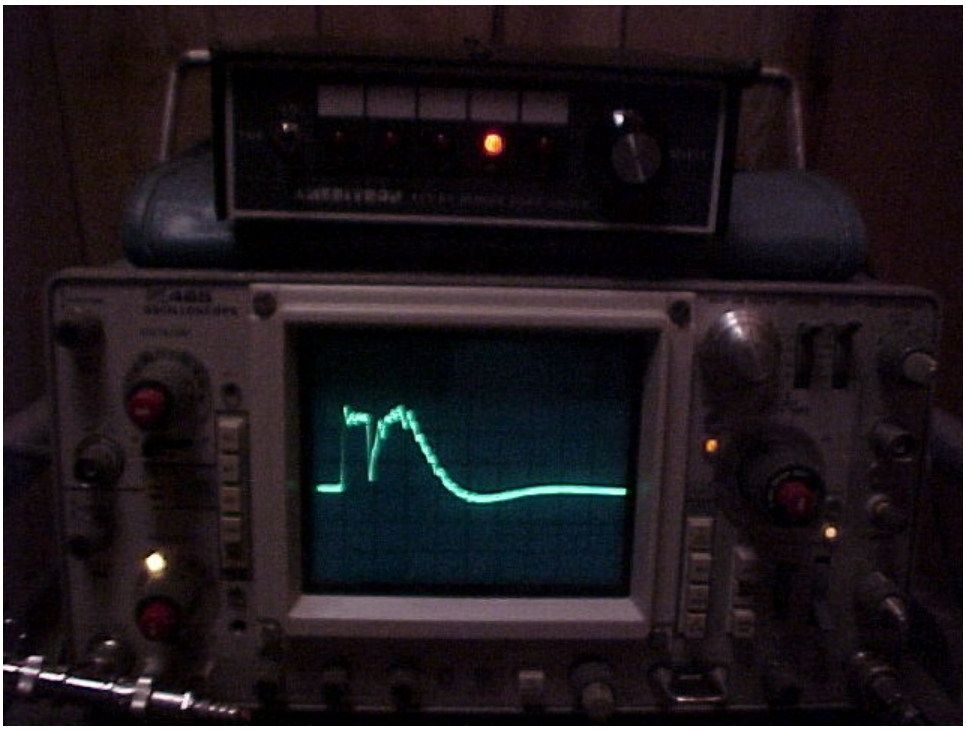


Figure 470 Position 4.

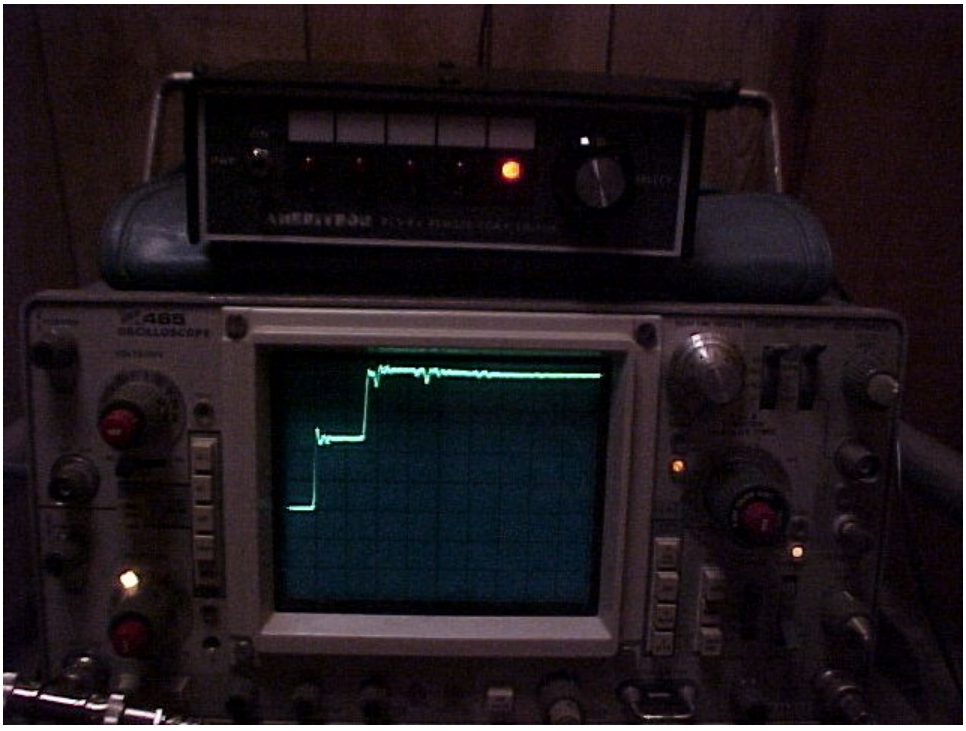


Figure 471 Position 5.

Answers later...

Winners of the games:

- Fast QSO Race = K2XA (4 min 49 sec)

- Knot Tying Race = N1FJ (1 min 23 sec)
- Mystery Loads = KK1L
- Scavenger Hunt = AC2AC
- Guess the Number of nuts and bolts = KA1HSP

In addition W1TO got a copy of the 2007 CQWW RTTY Plaque for his wall. And NJ1F got his 75th Sweepstakes coffee mug.

The Scavenger hunt answers:

- 1 = The flag was on the Ground Rod - 5pts
- 2 = The tower sections were 10' (9' 9" was acceptable) = 2pts, 10'+8' top = 5 pts
- 3 = There were blue Pulleys = 4pts, Pulleys plus shackels = 5pts
- 4 = Under the can is a dummy load = 3pts, stating it was 50ohm or adding other detail=5pts
- 5 = the wire is a radial = 5pts
- 6 = the Beverage box is from DX Engineering = 5pts
- 7 = The rope holds the end of an antenna = 2pts, a 160m inverted V =5pts
- 8 = the top antenna is a vertical = 2pts, VHF vertical 3pts, VHF/UHF vertical = 4pts, Diamond VHF/UHF = 5pts.
- 9 = hardline = 3 pts, Andrew LDF 4-50 = 5pts (the name and size was on the back of the cable right by the flag)
- 10 = The radio is from Kenwood = 2pts, add 146.91 = 3pts, also add 449.425 = 5pts.

The Answers for the mystery loads:

- 1 = 20' of coax shorted. Actually it was connected from port 1 to port 5. Port 5 on the box was modified with a jumper to short that port when it was not selected for use as a matching section for a stack.
- 2 = a 1000pf capacitor
- 3 = 50 ohm dummy load
- 4 = a 2.7uH inductor. The diode on the back of the control box powers port 2 and 4 when you select 4 so it made a parallel resonant load at about 3MHz.
- 5 = the same 20' of coax going to port 1, but this time it looks like an open circuit at the end because port 1 is not modified.

List of attendees:

- N2KW, Allen
- W1DWA, Don
- WS1V, Clint
- KB1W, Len Bean
- W1UE, Dennis
- W1TO, Tom Homewood
- N1FJ, Frandy Johnson
- K3GM, Tom Hybiske
- K1SFA, Khrystyne Keane
- K2BB, Alex Malyava

- KK1L, Ron Rossi
- KK1L – Harmonic, Isabel Rossi
- KK1L – Harmonic, Sophia Rossi
- WA1ZHM, John
- W1UJ, Jay
- N4XR, Vic Paounoff
- K1EBY, Frank Collins
- KC2HQH, Gabriel Hammarquist
- K6ND, Will Angenent
- KB2SAE, George Bourassa
- Walter Bourassa
- K6NDV, Pamela Angenent
- N2JFS, Hans Hammarquist
- N1LZH, Pat Pietrowsky
- W1BS, Joe Pietrowsky
- KB2VLC, Diane Bourassa
- PY2AAZ/AC2AC, Fabio Santos
- Glenna Clark
- W2FK, Mike Lankin
- KB1PHW, Jim Wolfgang
- W1IM, Blake Edwards
- KE3HT, Tim Ertl
- K1UNF, John McHugh
- AA1IZ, Steve Rosenthal
- K2XA, Saul Abrams
- NJ1F, Brian Szewczyk
- KB1PQX , Sue LaCombe
- KB1NWH, Carroll (Ed) LaCombe
- KK1W, Jim Mullen
- KA1HSP, Joe Plante
- AA1AR, Mike Pietrowsky
- W1HIS , Chuck Counselman
- WA1ZAM, Ed Landry
- K1RQ, Dana Cobb
- KG2A/JJ1RJR, Kei Fukuda
- Joe Stergis
- WA2AAU, Dick Frey
- W1DDW, Tom Legault
- NJ1F XYL, Susan Szewczyk
- NJ1F Kid, Kate Szewczyk
- KJ1K, Sigurd Kimpel
- Neighbors, David and Tammy
- Neighbor, George

W1TO YCCC Meeting report:

To celebrate the 25th anniversary of David Robbins' amateur radio station in Peru, MA a picnic and amateur radio filled schedule of activities was held on July 25, 2009. As a part of the activities a regional meeting for the Yankee Clipper Contest Club was held. The picnic was scheduled to start at

noon; however, some of the guests arrived on Wednesday. At least four continents were represented. The food/drink and tent/tables were provided by Harrington's Restaurant of Adams, Ma. They did an excellent job with a portable grill and beer tap. Dave had 5 games setup for the participants. Each of the game winners received a prize.

- Guess the number of nuts and bolts in the jar. Winner = KA1HSP
- Mystery Loads – Given a Time Domain Reflectometer and MFJ-269 meter figure out what is connected to each of the 5 ports of the RCS-8V relay box on the other end of the cable. See Dave's website for a better description of this. Winner = KK1L
- Scavenger Hunt – identifying a series of radio related questions at various sites on the grounds. Winner = AC2AC
- QSO Race – Given a set of equipment get on the air and make a contact. Winner = K2XA
- Knot Tying Race – Tie a pipe hitch around a ground rod without stepping off the 180' tower foundation, the ground rod was about 10' from the foundation. Winner = N1FJ

A brief meeting was held to allow new members to be considered. Two new members were added to the roles: KG2A/JJ1RJR, Kei Fukuda and N2JFS, Hans Hammarquist. KG2A was an active contester in Japan and is now working in New York. Hans is another addition to the Vt contingent.

Dues were collected from the new members and several others. All have been forwarded to the Treasurer. The new member applications have been sent to the Secretary.

In addition to prizes for the games there were several door prizes awarded by a drawing from a YCCC hat. The prizes were provided K1TTT.

Several station and antenna tours took place. The IOTA contest was in process and several operators passed out QSOs.

The attendees were: WA1ZHM, NJ1F, K1SFA, W1UE, W1HIS, K1MK, N1LZH, W1BS, KJ1K, W1TO, K1TTT, N1FJ, N2KW, W1DWA, WS1V, KB1W, K3GM, K2BB, KK1L, W1UJ, N4XR, K1EBY, KC2HQH, K6ND, KB2SAE, K6NDV, N2JFS, KB2VLC, PY2AAZ/AC2AC, W2FK, KB1PHW, W1IM, KE3HT, K1UNF, AA1IZ, K2XA, KB1PQX, KB1NWH, KK1W, KA1HSP, AA1AR, WA1ZAM, K1RQ, KG2A/JJ1RJR, WA2AAU, W1DDW, Walter Bourassa, Isabel Rossi, Sophia Rossi, Glenna Clark, Joe Stergis, Susan Szewczyk and Kate Szewcyzk. Fifty two people signed the sign in sheet.

All in all it was a great day. Thanks to Dave for hosting this fine picnic.

Pictures and more info at: http://wiki.k1ttt.net/2009%20Picnic.ashx

Tom Homewood Western Mass. Area Manager

7/30 They finally came and took the tent away today. Interesting thing, shackcam #2 has been acting up recently. It appears to be a hardware problem. I figured that since it was 2 years or so old it would be out of warranty, but believe it or not their warranty is 3 years... so back it goes.

7/31 Put station back in SO2R for NAQP and the next couple of weeks worth of contests.

8/1 The second nice Saturday in a row, how did we deserve this? Too nice to stay on the ground so went up the 60' VHF tower to straighten out the crooked 6m element and do some extra taping of the feedlines and control cables.

8/6 Set up for WAE CW. Decided to put voltage regulator mod in the SO2R HF-2500, checked for oscillation but couldn't duplicate what we have heard before... but started to take it apart anyway. One of the hex heads is stuck so hard I'll probably have to cut it or use an easy-out on it. Replace the SO2R right radio amp with the spare HF-2500.

8/14 Set up for SARTG Contest SO2R. Not much else going one. Have ordered a 2nd drive motor for the bottom 40m ring rotor, and more heavy aluminum wire for radials to replace the 160m and some of the 40m ones. Other than that I have a new pile of insulators and hardware for BIG! that I am cleaning up and organizing.

8/22 Out of town for a few days... Webcam returned from repair, but was broke in shipment, guess it goes back again now.

8/23 At least for a while I am running two Skimmers off the same antenna to allow comparison of decoding. Both of them are feeding spots to the reverse beacon network now. I will keep them running as much as I can, but won't guarantee availability of both. The equipment/software is:

K1TTT: QS1R and skimmer server v0.94 (available at k1ttt.net port 7300) monitoring 48khz starting at 1800, 3500, 7000, 14000, 21000, 28000, 50091khz.

K1TTT-1: SDR-IQ and cw skimmer 1.4 (maybe available at k1ttt.net port 7301 please let me know if this works) set for 96khz sample rate, using wd5eae scheduler to rotate between 1825, 3525, 7025, 14025, 21025, 28025khz depending on time of day.

Both are on a 25-30' vertical. Both are set to minimal validation.

On my first quick look it seems that the SDR-IQ is more sensitive and generates more spots. Though sometimes the QS1R gives better SNR values.

8/28 Cut down some damaged trees around the far side of the 80m 4-square area to get them out of the way before winter. Set up for SCC RTTY. Ordered new computer to try the Skimmer Server on to see if it can do full bandwidth on all the bands.

9/3 Finally got QS1R and Skimmer Server running on a new 64 bit 4 core box. Had some problem with installer for QS1R USB drivers not finding some file it needed, poked around in it until I got it to install. Skimmer Server seems much happier with 4 cores to process in.

9/4 Got new wide screen monitor for SO2R station. Makes it much nicer, especially for RTTY with all the extra windows on the screen. Set up for Russian RTTY contest.

9/5 I have a new 64 bit Vista quad core running the Skimmer Server beta software now. It took a bit of playing to get the QS1R USB drivers to install, but now it seems to be working quite nicely. CPU load is only 10-15% with 500 decoders running generating 80 spots in 30 minutes right now. For comparison purposes I have a CW Skimmer on an SDR-IQ running in parallel.

They are both just T'ed off a single vertical right now, no buffer or preamps. They are both feeding spots to the http://www.reversebeacon.net/ web site.

K1TTT-1 = SDR-IQ using W3OA's SkimScan to rotate bands every 3 minutes. Set to 96khz sampling rate and frequencies 25khz up from the bottom of the bands on 160/80/40/20/15/10m. Band schedule depends on time of day. You can telnet to it directly at k1ttt.net port 7301

K1TTT = QS1R set for 48khz decoding on 7 bands at once. I'll change bands as I play around and think about it. You can telnet to it directly at k1ttt.net port 7300.

Has anyone got the CW Skimmer running on a 64 bit Vista machine?? It seems to have trouble here, probably with the USB interface.

9/6 Nice early Fall day. Its been dry for a week now so the streams and swamps are down to their late Spring levels. I took the pole saw and went for a walk around the Beverages. Lots more branches down. Had to clear the trail between them in a few spots. The SW-NE path was the worst, several branches on it and insulators pulled off. I was able to reach the branches over the middle of the beaver pond to get them off the wires at least. Still lots of broken branches up in the trees to come down, it could be a long winter of putting Beverages back up on their posts.

9/7 Lashed a 3/4" fiberglass rod about 5' long to the slightly bent boom of the 120' 10m Yagi. That should keep it through the winter. The 10m stack is in the plans for replacement next year anyway, assuming we start seeing some sunspots!

9/11 Received two USB-RS232 adapters to try out with TU's for RTTY.

9/12 Set up for VHF contest and played in it for a few hours. One of the TS-2000's is deaf on at least 6m, so took that out of service and ran with one radio.

9/13 Played more in VHF contest. Ran brush mower around 20m and 15m towers, the big field, and the path next to the 80m 4-square. Found N/S Beverage had a big branch on it, replaced insulators to put it back up.

9/15 Shipped TS-2000 off to Beltronics for repair. Bought a new coffee pot and Bagel guillotine.

9/16 Gave away about 10 years worth of CQ and QST back issues to a good home.

9/17 Started cleaning up and setting up for CQWW RTTY. Put new wide monitor on 20m to make more room for RTTY decoders. N2WQ sent two HAL DXP38's up to try. They will run in parallel using one of N1MM's new rtty decoder windows.

9/18 Spent a couple hours with both sledgehammers, big pipes for bending things, and the arc welder fixing up the brush mower deck. Now it runs straight and level again so I can finish up the mowing around the 80m 40square before winter.

9/19 Change station from SO2R back to M/M for CQWW RTTY. Dragged W1EQO's big cherry logs out from under the South Beverage so I could cut the weeds and brush. Finally finished cutting brush and weeds around the 80m 4-square, still working on other areas of the yard.

9/20 Cut down a couple more trees that were damaged last December. One was drooping over the 80m

and 40m low inverted V's. Did some more cleaning up around the shack. I will remove the 'spot' station from the network this year, it wasn't used much except by me to watch the network and is now running the cw skimmer pretty much full time.

9/23 Start setting up computers and radios for CQWW RTTY. Clean house.

9/24 Do shopping for weekend.

9/25 Finish setup for CQWW RTTY. Take walk around Beverages, leave with 2 insulators, replace one missing one along the way, and come back with 3.

10/2 Setup for CQP SO2R for W1UE. Poor Lucky Dog had minor surgery yesterday and is now a cone head... He is trying to help with cleanup of BIG!, but mostly is just getting in the way.

Figure 472 Lucky with more insulators for BIG!

Received the YCCC SO2R box kits, minus circuit boards and one IC.

10/6 Cut more brush around 15m and 20m towers.

10/9 Removed the Lucky Dog cone head, it was getting on both of our nerves. He doesn't seem inclined to bother his incision anyway. Surgery removed a benign tumor of some unpronounceable doggy gland that was bothering him when he sat down.

It only took 3 trips to the left coast, but Shackcam 2 is back on line.

10/10 A perfectly dreary day. Good day to clean out the garage and make room to park the Jeep in there. Took off and cleaned up the mower deck, put on the snow blower. First snow is forecast for Monday. Did more weed and brush cutting around the 15m tower.

10/11 Now this is better. Heavy frost and a nice clear morning. Walked the Beverages to clean up branches downed in wind this last week. Rolled out 80m 4-square supplimental ground screens for the winter.

10/14 Cleaned some more dead branches off the Beverages.

10/16 Cut more brush and weeds around 15m tower. TS-2000 returned from Beltronics after getting it's front end repaired. Swapped it for the other one and packaged the other one up to go to get its lamps and channel switch fixed.

10/17 Cut small trees and stumps around 15m tower that the mower couldn't handle. Cut down some damaged trees that were leaning toward the back anchor of the 15m tower. Set up for WAG Contest.

10/18 Nice light snow this morning. Took walk around Beverages, no more damage found this time.

10/21 Start cleaning and stocking fridges for CQWW SSB.

10/22 Finish cleanup for CQWW SSB.

10/23 Check Beverages again, do inside setup for CQWW SSB. Found 40m 4-square needed some attention so had to go down and tighten up the feed points. None of them looked bad, but there must have been some corrsion in one of them. Also found the 10m switch that routes the antennas to the SO2R station wasn't working in the normal position. Took it apart and found the inside of the one SO-239 connector was rotating in the shell which misaligns the contacts. Tightened it up and it is working ok again.

10/27 New drive motors for ring showed up.

10/30 Unpacked and checked motors for ring. I did get 2 of them instead of 1 so will put them both on the bottom 40m ring and save the one that is on there now as a spare. WX was foggy all morning then got windy so didn't get any climbing done. But did have PLT guy here to service the tractor, brush mower, and generator. Did another hour of brush cutting until the belt broke.

10/31 Another drippy dreary morning. After taking trash to the dump I though I would put a new mower belt on to be ready to do another few hours of cutting before winter... but found the tension spring was lost. Parked the mower in the shed and called it quits for brush mowing for thise year.

Well, that was a mistake. I took 'one last' walk through the area I had been cutting to see if I could find the spring, and did. So of course I had to put it on, drag the mower back to the garage to jump start it, and then spend an hour or so mowing around the 20m tower.

11/1 Walked the Beverages again after windy day yesterday. Plumbed the verticals and tightened up guy ropes on the 80m 4-square.

11/6 Started setup for SS CW. W1UE wants to use his K3 on the SO2R setup so spent a while putting good labels on all the MP and SO2R cables so I can put them back easier.

11/7 Cut more brush around 20m and 15m towers. Parked the DR Mower for the winter. Finished setup for SS CW with W1UE's K3. It won't control the antenna band selection but it keys the amp ok and the interface to N1MM works fine.

11/13 Got Clifton Labs Norton preamp for the QS1R. Tested against the SDR-IQ and it makes the QS1R slightly more sensitive than the SDR-IQ.

11/14 Reconfigured the QS1R and Norton amp to be powered off the pc power supply, that makes it nice since no outside power is needed. Moved the whole thing to the server rack. Took the SDR-IQ off the VHF logging machine and put it temporarily on the laptop with a rubber duck antenna to use for monitoring local noise and TX signals.

11/15 More getting ready for winter. Took another walk around the Beverages with the loppers and cut off more branches and new undergrowth. Cut a bunch branches and undergrowth around the 80m 4-square and along the feedline for it through the trees up toward the 10m tower. Late morning it got too nice to stay on the ground. Went up to the bottom 40m beam and replaced the old drive motor with two new drive motors. The ring was definately bent from the ice storm last December, about 1/4" down on the cradle side. It still clears everything, but is a bit tight which is why it was probably binding occasionally before.

11/21 Set up for RSGB 160m and SS SSB. 160m computer won't boot all the way. Gets the wallpaper and mouse but never gives the task bar or desktop icons. Some things can run from task manager, but others crash it. Safe mode kind of works, but some stuff still screwy. Reinstall windows, and when it gets to the point where I have to install the wireless card it won't load. Give up for today, set up N2KW's laptop to key through rigblaster for 160m contest. Had 2 of the 2 port MFJ manual switches fail open when switching back to m/m arrangement, pulled them out of line for now. One of them wouldn't let go of the coax so had to swap the short jumper out on 15m also.

11/22 Replace wireless card in 160m box with one from the vhf station and then it finishes loading and comes up ok. It may have been that card all along, but were very strange symptoms. Reloading didn't install the hardware drivers for some reason so had to do those manually.

11/25 TS-2000 returned from Beltronics after repair. Set it back up on VHF station.

11/27 Set up for CQWW CW.

11/29 Big winds the last couple nights. Gusts clocked here at 50mph at 50' above ground, sustained winds up higher were strong. Lots of dead branches came down, had to put back up one of the Beverages that had a good size tree top come down on it. Branches removed from other Beverages and access trails also.

12/3 Replaced wireless network card in VHF station that was taken to fix the 160m station computer.

12/4 Had annual heater service done. Had project engineer here to survey for Solar-Electric installation. Set up for ARRL 160m for N2KW s/o.

12/5 Did a bit of cleanup in the shed, putting away tools and bringing battery powered stuff into the house for the winter. Tried to get new webcam working in my webcam pages but it won't work because of browser security restrictions on scripting. May just have to frame their server page in my headers and footers or something like that.

12/6 Sunday is a safe day to walk in the woods in Mass... no hunting still on Sundays. Went back and reattached the reflection transformer on the NW/SE Beverage. Not quite enough snow to ski and not bad to walk in yet. **12/11** Got in some misc parts for new computers that will replace the hub and upstairs boxes that are getting a bit overloaded in contests. The CPU's are backordered but will hopefully be in next week.

12/15 Started setup for OK-DX RTTY for K1SFA & K1MK.

12/16 New computers showed up. Did basic installation and setup.

12/17 Finished setup of new computers. Did computer setup for OK-DX RTTY.

12/18 Finished setup for OK-DX RTTY. Installed new computers upstairs and in the old hub location.

New SO2R Boxes

12/24 Assembled the 2 radio version of the K1XM SO2R Box.

12/25 Built first radio cable for SO2R box. Found error in SO2R Box documentation, the mic pins in the DIN plug are backwards. This causes a bad ground loop because it hooks the ground from the computer up to the mic input on the radio. Still had some problems with switching not working.

12/26 Switching problems on SO2R box were software setup errors. Built second radio cable for SO2R box and finished testing with 10m and 80m radios. N2KW setup for Stew Perry 160m contest on SO2R station so will install box later. Replaced long cables and multiple adapters between the QS1R and preamp, and between the preamp and RX protector with short AAA RF BNC-BNC cables. Cleaned up from construction of SO2R box. Yucky WX, snow and freezing fog, only 29f at lunch time and about 1/4" of ice on top of towers.

12/27 Power went off about 0130z and was off till some time before 0600z when the generator ran out of gas. Fun part was that about 0200z the electrician I have engaged to install a new auto start whole house generator called in reply to a voice mail from a couple days ago. He was surprised when I asked if he could bring it up right then since the power was off!

41f in the morning, still rain and fog, but at least everything is melting.

Installed second monitors on 10m and 160m stations using StarTech USB to VGA adapters to see how they work. They make use of the spare monitors that had accumulated after upgrading to bigger ones on 20m and 40m. I tried to put one on the new Win-7 Hub machine but it didn't seem to like it... It probably needs updated drivers for Win-7.

Created contest score summary page for the year. Doing it in the Wiki now, will probably merge it with this blog next year to make one big one for the whole year's activities.

12/28 Installed K1XM SO2R Box. First a step back and look at the radio cable construction. All the cables going to a radio from the SO2R box come from one 8 pin DIN connector. I hate DIN connectors, but they are a decent way to cram lots of wires in a small connector... something like this:

Figure 473 Snuggie

Oops, sorry, thats a Lucky Dog in a snuggie that doesn't fit. This is what is inside the DIN connectors:

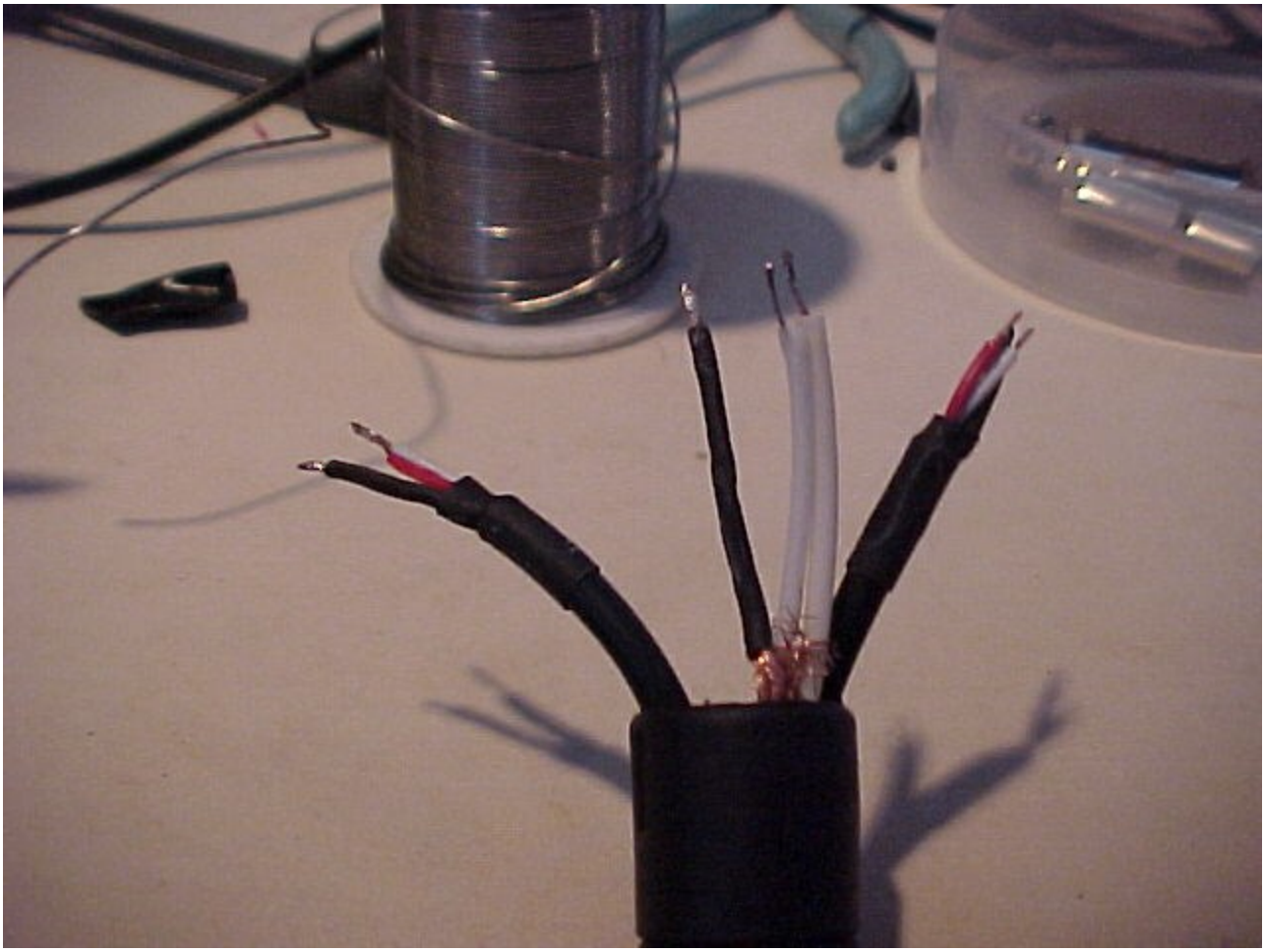


Figure 474 SO2R box DIN connector

From left to right... a shielded 2 conductor cable with the 2 conductors tied together for the mic audio. The two white ones are single conductor shielded cables with their grounds tied together, one for PTT the other for CW keying. Then on the right is another 2 conductor shielded cable for the headset audio(the shield is behind the 2 conductors). The shields of the mic audio, PTT/CW, and headphone audio are separate. The shields are covered with heatshrink to keep them apart inside the shell. Why picture this separately instead of all the rest of the construction?? The rest of the construction went too quick for me to think about taking a picture. The only thing that slowed me down was an error in the documentation for wiring the mic audio that sent me off chasing a ground loop for a while.

Figure 475 SO2R before YCCC box

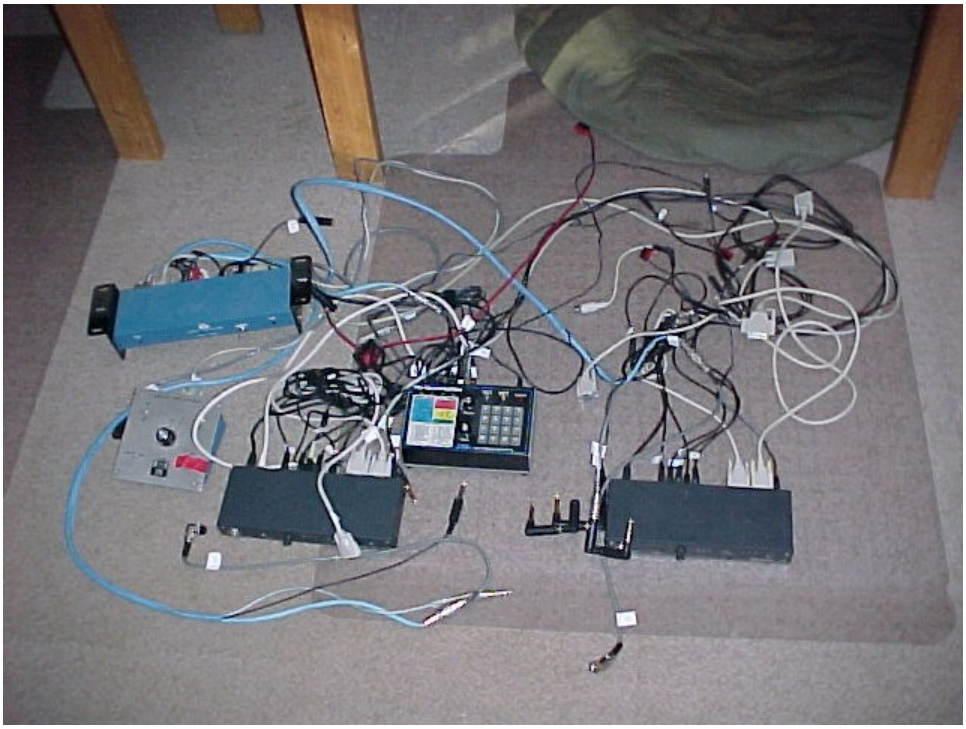


Figure 476 Leftovers from SO2R conversion

In this arrangement there were cables for the following... RS232 from computer to each Rigblaster, then from there to the radios. All sorts of audio to and from the radios through the rigblasters and SO2R box. CW and PTT cables to and from the SO2R box. CW and paddle cables between the keyer and SO2R box. Cables from the SO2R relay box to the control head that sat on the desk taking up space. A parallel cable from the computer to the SO2R box for CW and radio selection. 4 power cables for each of the

separately powered boxes.

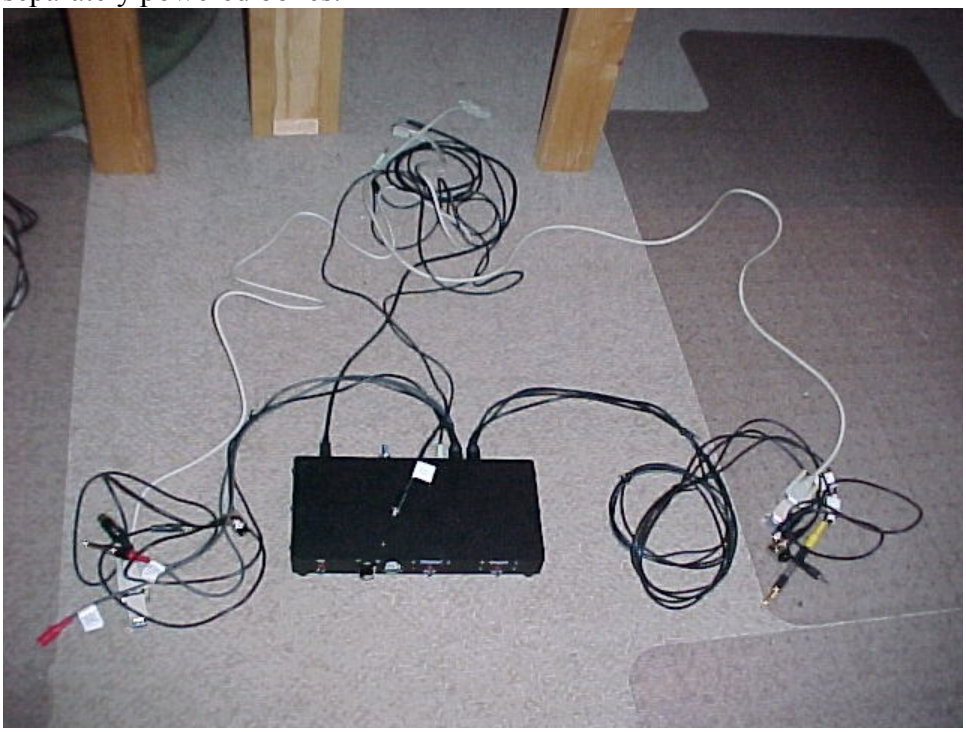


Figure 477 Replacement hardware

One DIN plug going to each radio. Mic audio to and from computer. USB to computer. RS232 directly from computer to each radio. Not shown in either one was RX Line level audio from the back of the FT-1000mp's to the computer Line-In for RTTY RX. Missing in the picture is a power cable for the SO2R Box.

Figure 478 SO2R after conversion

Note there is no SO2R control box on the desktop and all those other boxes that had been stacked up are

gone. The white box on top of the SO2R box is the Beverage selector, since the left radio is used for 40m in M/M contests is makes more sense to have it on top of that radio now that there is room.

12/29 Installed updated Wiki software and did some more cleanup of server.

12/31 Set up for SCC HNY RTTY and ARRL RTTY RU contests for K1SFA M/S. Built the 4 radio version of the SO2R box as a spare and for use on the VHF station in the future. This one took about 3 hours from start to finish in one sitting.

2010 – Electrical work, house work, station improvements!

1/1 Starting out better than last year... everything is working!

1/2-3 While K1SFA/K1MK were running RTTY RU I cleaned up a whole pile of cables and adapters that had been piling up.

Generator!

1/7 Electrical part of generator installation was pretty well done today.

Figure 479 Generator setup

The generator after getting it off the truck and kind of leveled with some pea gravel from the bucket and trash can. The generator is a Kohler 18kw air cooled unit, it has an 80a 240v output breaker.

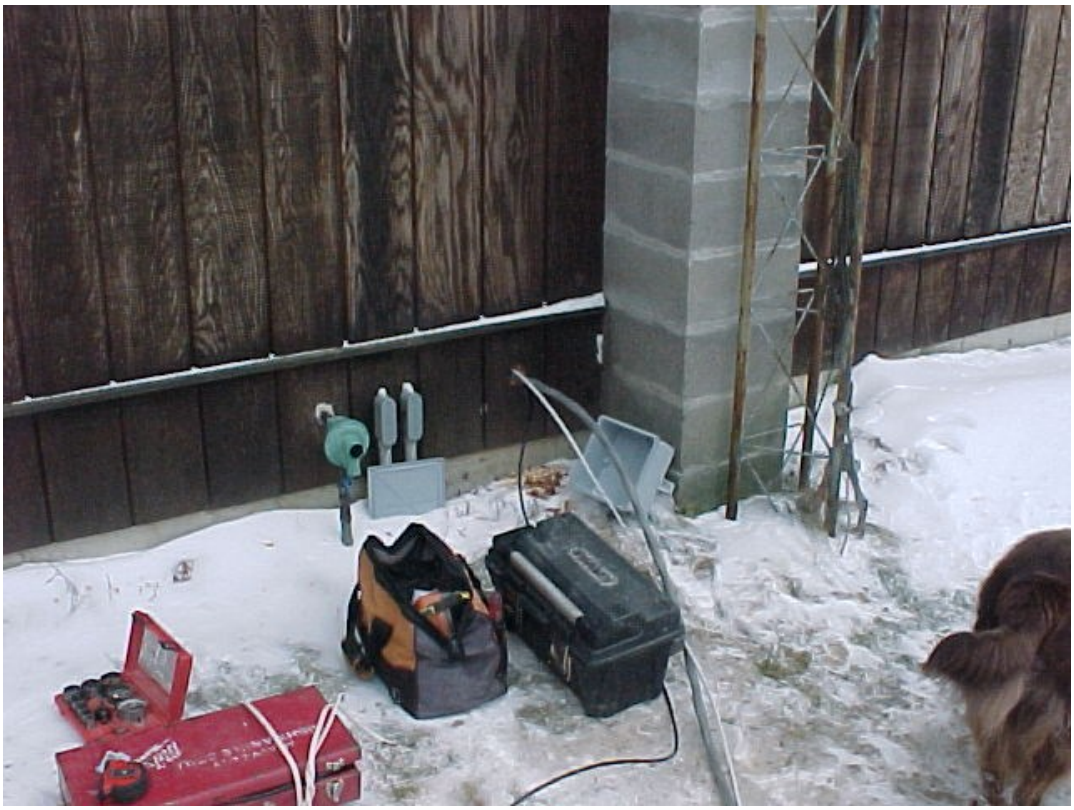


Figure 480 Where the wires are going in.

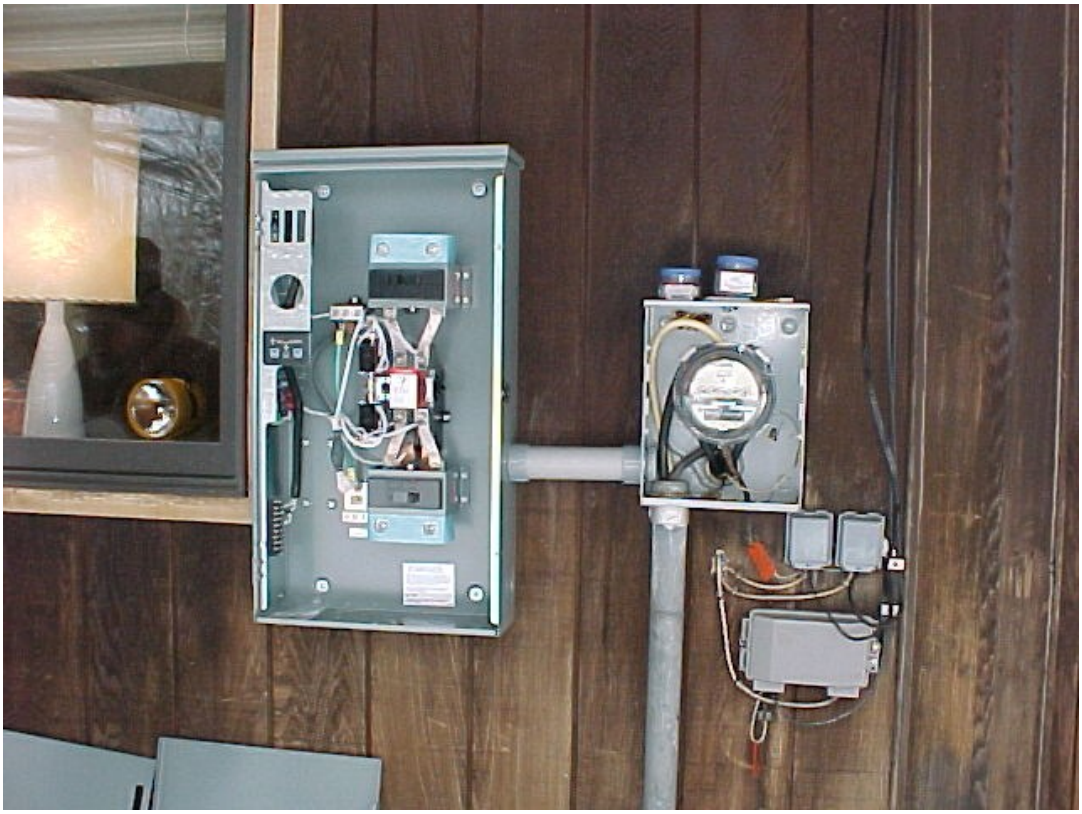


Figure 481 The automatic transfer panel before connecting it in to the meter or generator.

Figure 482 The main panel before wiring in the generator.

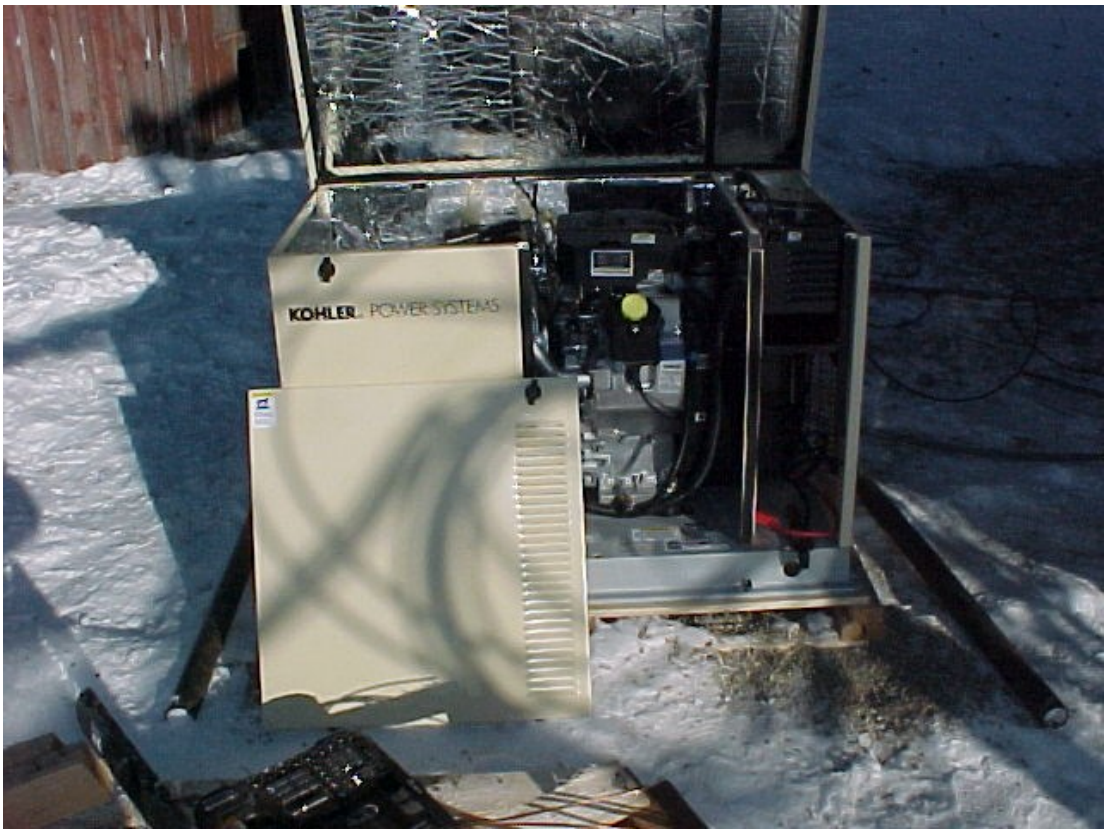


Figure 483 Generator with side panel off.

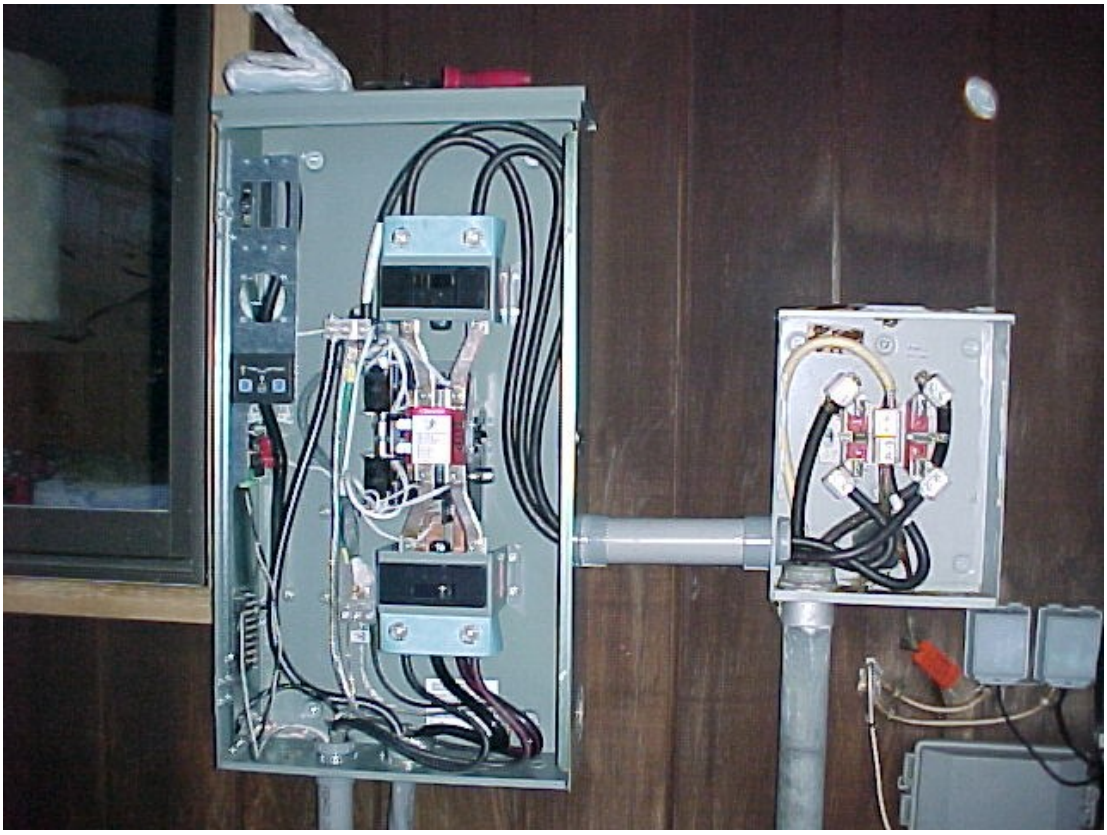


Figure 484Transfer panel all wired in.

The line service comes in the pipe from the meter on the right. The generator comes in the pipe from the bottom. The switched line to the inside panel is the cable going out the bottom. The meter box is a bit tight because the input is on the top and the load is on the bottom going out the pipe. to the left.

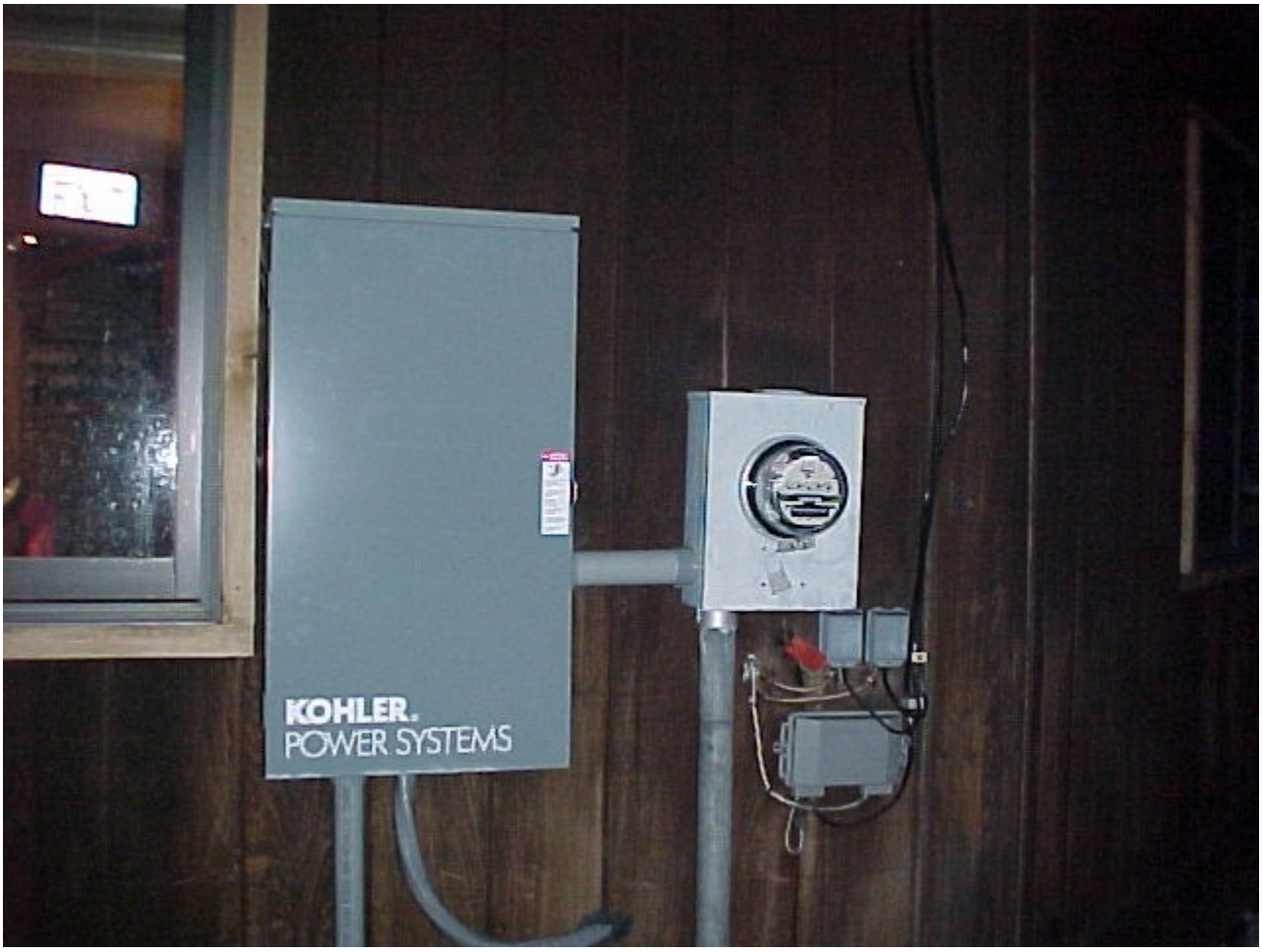


Figure 485It looks better with the covers on.

In between the electrical work I also got a load of wood to finish up my bedroom walls and a long backordered shipment of ferrite toroids from Amidon.

1/8 Another busy day around the house. Rinnai service tech showed up at 8am, even though I had tried to move him to next week. Fortunately he was gone by the time the propane tech showed up to connect up the generator, that took a couple hours. Then the DirectTV tech showed up after lunch and spent an hour or so putting in a new dish and receiver. Finally around dinner time the electrician came back and we fired up the generator for a test run. It has no problem with the well pump, electric oven, dryer, or at least one amp. Will have to test with more amps later.

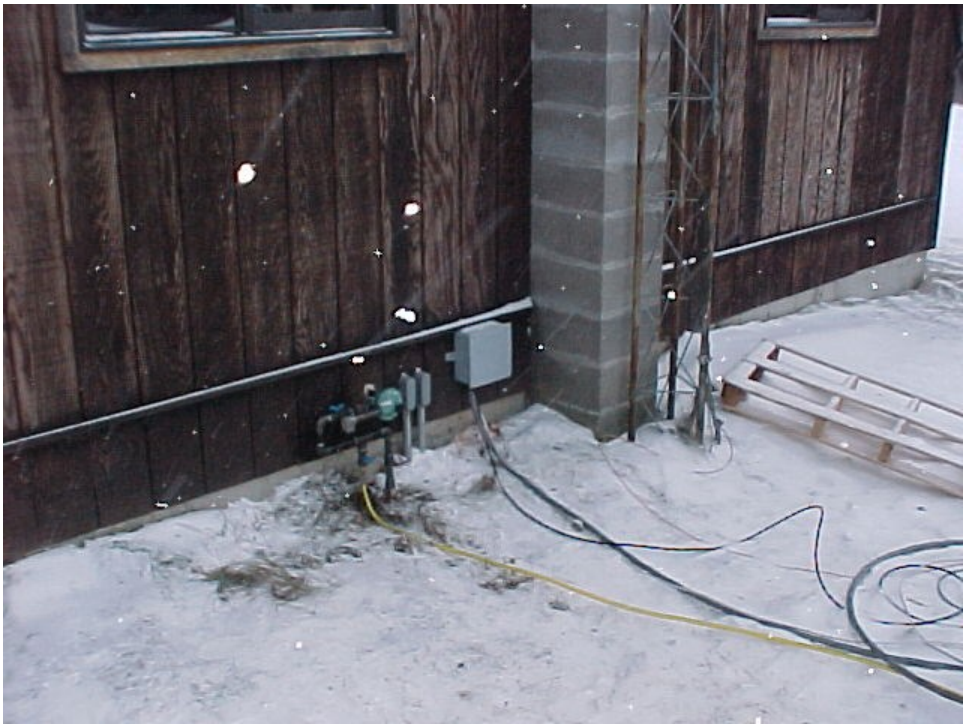


Figure 486 Temporary wiring

A little fancy plumbing to get a tap off the high pressure side of the house reducer for the generator. Wires and pipe will be buried in the spring, they are protected by some big boards and pallets for now. There are 3 cables to the generator, the big gray one for power to the panel, a small power line that runs the battery charger and carburetor heater, and a control cable from the transfer switch.

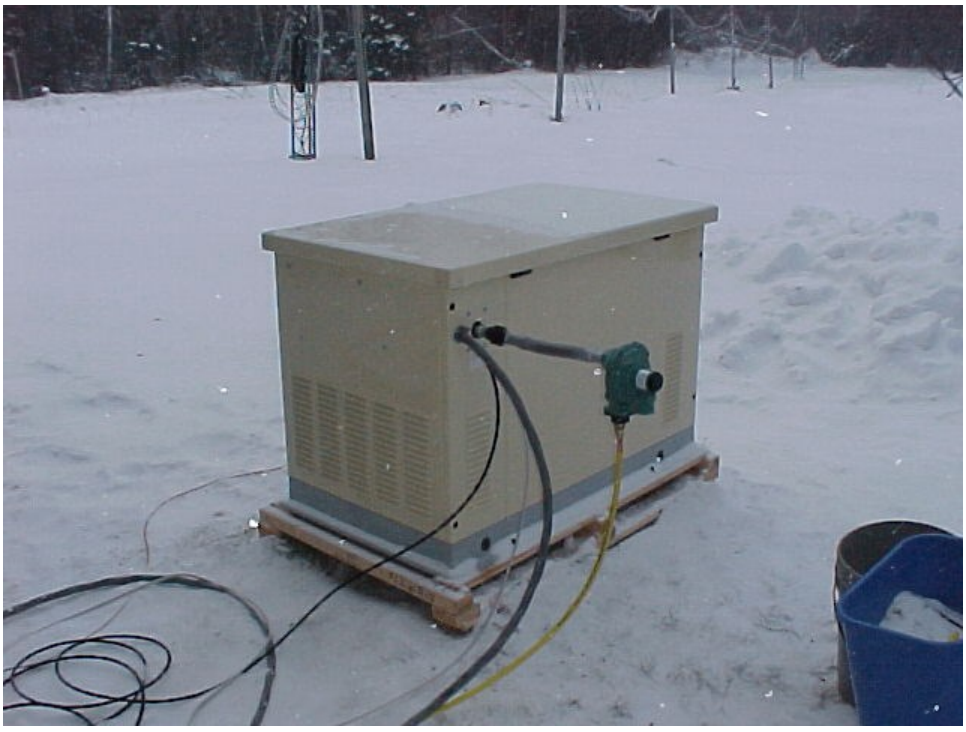


Figure 487 Temporary plumbing

The electrician and propane plumber will be back in the spring to bury wires and create a gravel bed for the permanent placement. With the shack windows shut you can barely hear it even though its only 10' the other side of the wall. It shouldn't even be a problem if the windows were open, though mics would probably pick it up.

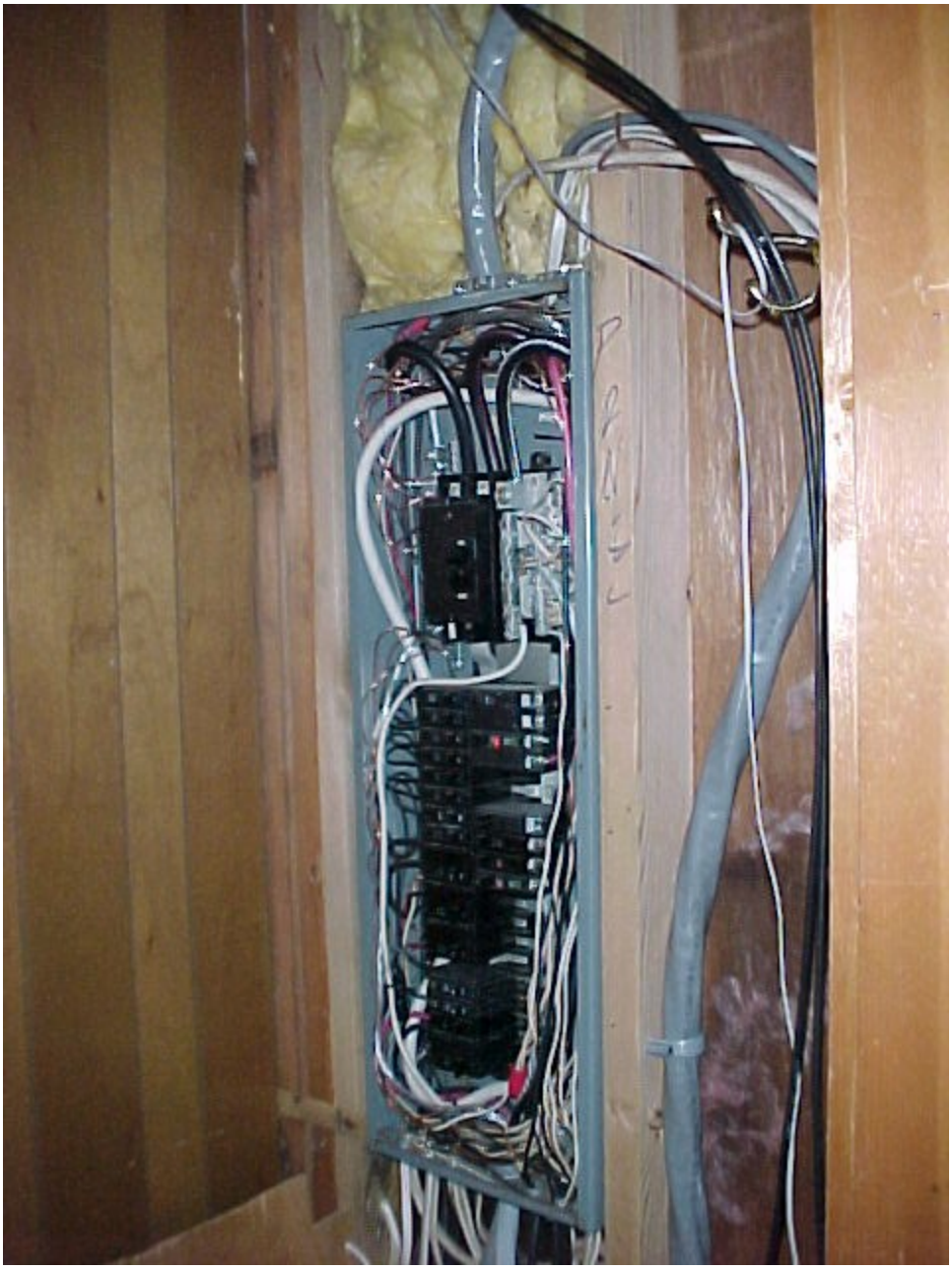


Figure 488 The after view of the main house panel.

The big gray cable in the stud bay on the right is what comes in from the transfer box. In order to do this properly the transfer panel is now the 'main' panel. It has the neutral and ground tied together. The panel in the house is now a branch panel, so the electrician had to spend a couple hours putting in a separate ground bar and moving all the bare grounds from the old shared neutral/ground bus to the new separate ground bus. Now I have to clean up all the phone lines and close the wall back up. Fortunately I'll have some spare paneling as I just got the wood to finish putting tongue and groove on the last 2 walls of my

bedroom, so one of the sheets I pull out of there will replace the pieces in the closet.

1/9 Put the closet back together around the electrical panel. Also cleaned up the old phone cables and connections. Set up for K1MK to do NAQP CW. Now its time to do the walls in my bedroom.

1/10 Did tongue and groove on the last 2 walls of my bedroom. About 8 hours from taking down molding to putting it back up.

1/14 Ok, so this isn't exactly about radio... yet. Just wait for the first high power contest and it might be. It all started with a desire to get the local TV channels from DirectTV. After I gave up on doing it on the web site and 3 different customer service people poked at it the result was that my box couldn't handle it. So to change to a new package with the local channels they gave me a whole new system, HD-DVR and dish delivered and installed free. Plus after removing the networks I was paying for separately and the old Ultimate TV service it comes out to $10/mo less than what I was paying before... what a deal!

But my TV doesn't do HD, and its a 4:3 set, so all the HD channels are letterboxed which makes them smaller than before, and the little lump in the scan is not from the old box, its in the TV. Plus the DVD player doesn't do Blu-Ray and its display has been broken for a while. etc, etc, etc... so off to visit BestBuy today. And after one thing led to another I ended up coming home with a new Blu-Ray player, a receiver box (my old DVD included the receiver, now most of them don't), a new powered sub woofer since the receivers seem to assume that now and my old one is passive, and of course over priced HDMI cables to hook them all up since none of them come with cables. Oh, and the TV I wanted wasn't in stock and will be delivered next week... And they will take away the old monster, this could be fun to watch!

1/16 Set up for NAQP SSB for WB2JSM M/2 operation.

1/21 Exciting week in radio land. Removed Aluminum foil hat from the old TV, the new Samsung HDTV should be delivered tomorrow morning.

1/22 New HDTV installed today. Set up for BARTG RTTY Sprint for tomorrow morning.

1/23 No discernible noise from the new TV setup found on any band yet.

1/25 Setup up 2 radios for 160m cw contest. Setup rest of station in SO2R for later.

1/29 Finish setup for CQWW 160m CW contest. I had been playing with some usb-vga adapters to use extra monitors for grayline maps, but those machines locked up randomly during BARTG RTTY. Pulled them out and put the 19" widescreen monitor I got by mistake (it really isn't very good for normal use since the height is only 768 pixels) on the skimmer server to run DXAtlas on. It works good for that since its best on a wide screen.

1/30 Found that the NW Beverage box output is dead. Ordered a new box and preamp to try out from DX Engineering. That way I can have a spare on hand in the future. Temporarily connected both wires to one input terminal so the SE output is bidirectional for now.

1/31 It was a nice day and NJ1F showed up but couldn't operate until near the end of the 160m contest so we took down and repaired the NW/SE Beverage box. There was a broken wire on one of the transformers, I soldered in a short piece of wire and its working fine again. The replacement box will be kept as a spare when it arrives.

2/4 Setting up for FOC Marathon for N2KW. The first red tape of the winter... the top 40m ring is stuck. Inspection with telescope doesn't show any problems. But motor current is high, with my ear on the tower I can hear it trying. Best guess is that one of the motors is jammed. Have spare motor set to go if WX forecast holds I should have a couple hours in the morning without much wind.

Received DX Engineering spare Beverage box and preamp. The case style has changed a bit on the Beverage box, the top is now plastic but with a , but it still pretty hefty.

2/5 Went up tower at dawn before wind came up. Replaced one of the top ring rotor motors on the 40m tower.

Figure 489What the well dressed tower climber is wearing this season...

Lucky dog doesn't seem to care about the temperature. It was a relative heat wave at 16f with winds slowly rising to 5-10mph by the time I was coming down. I'm glad I didn't opt to tie up the hood before going up, it would have been too warm. I did take up 3 pairs of gloves, I only used the mid weight pair.

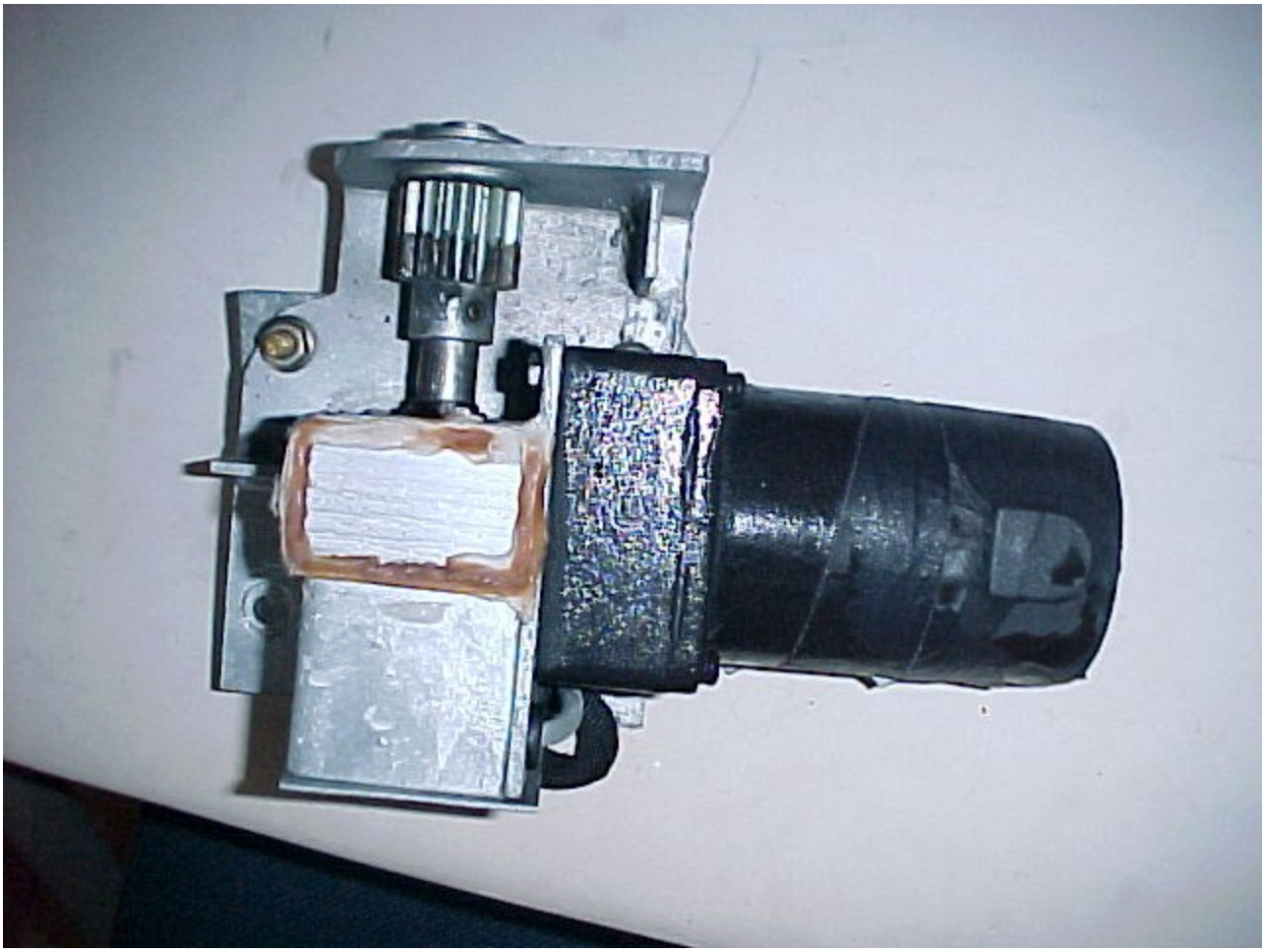


Figure 490 The motor taken down, autopsy to be performed later.

2/6 Motor taken down from top 40m ring works ok on ground. Sent back to TIC General anyway to have them check it out.

2/7 While N2KW was playing FOC Marathon I cleaned up and swapped tool cabinets so the bigger one is in the shack with the good stuff in it and the smaller one is now in the bedroom with all the little used stuff.

2/10 Setup SO2R RTTY for K1SFA for WPX RTTY.

2/13 Installed DX Engineering RPA-1 preamp and SDR-IQ on 160m Beverage line after the RIP-1. Found one of the annoying birdies at about 1843. It was actually 2 of the MM-3 keyers contributing to it... very stable clocks in those things from the traces on the SpectraVue waterfall. There is some other noise that is raspy and unstable that seems to be related to when the second radio amp is keyed on the SO2R station.

2/15 Started setup for ARRL DX CW.

2/18 more setup for ARRL DX CW.

2/19 finish setup for ARRL DX CW.

2/25 Start setup for CQ 160m SSB for W1EQO S/O and NAQP RTTY for K1SFA M/2. Big snow yesterday, see full story at: BIG Blizzard

2/26 Broke snow blower gearbox trying to clean up big plow pile by mailbox. Set up for CQ 160m SSB. W1EQO gave up on trying to get up RT-9 because of snow/ice. Did a little playing around myself. He may come up Saturday and W2GB may be up then also.

2/27 Setting up for NAQP RTTY. 20m bottom ring rotor indicator pot appears open. Can still turn it by jumpering the indicator and watching position out the window. 10m bottom ring rotor motor appears open, is pointing East, it can just stay there till it warms up a bit.

3/5 Set up for ARRL DX SSB. Went skiing around Beverages, more small branches that have been hung up in the trees since last winter fell down but nothing big enough to do any damage.

3/18 Well, been quiet except for a bit of ice and wind last weekend. The only damage may be a slightly bent reflector on the 120' 20m Yagi. The rope from the 150' 80m inv-v got stuck under the 60' 2m Yagi and had to be untangled but I was able to do that from the ground. In the wind I noticed the bottom 40m beam slowly turning (like 30 degrees an hour), the rotor controllers were off and when I turned it on the display tracked the beam position so it wasn't skipping teeth on the drive gear. TIC says that yes, apparently the newer drive motors that I put on the lower ring will do that. They recommended adding 'dynamic breaking' to the box, basically just shorting out the motor leads when the box is off to prevent the motor from turning. Kitchen remodeling is getting under way, the new appliances are here. The new range and dishwasher are staged in the living room and the new fridge is in the garage. I have started packing up stuff and moved the big glass front cabinet over to the corner of the dining room.

3/19 Set up for Russian DX Contest. Some good news... The 120' 20m Yagi is probably not bent, the wind blew it so hard that one side of the reflector snagged on the top guy wire. So it should be an easy job to go up and tip it a bit to free it.

3/21 Upgraded both Wiki's to latest software.

3/27 Set up for WPX SSB for NE1C M/M. The spare ring rotor drive motor is back from being repaired. All they found were some bearings that needed to be replaced, maybe there was some ice in them that froze it up.

3/31 Set up SO2R for SP DX contest and others coming up in the next couple months. Kitchen contractor started ripout.

4/2 Walked the Beverages. This is the best time of year for that, no hunters, no bugs, mud just dried up, stream is running a bit high to cross though. The N/S and NE/SW both had dead branches down on them, but were ok otherwise. Lots of dead branches still falling out of the trees from the Dec 2008 storm

4/3 Replaced pot on 60' ring on the 20m tower. The wiper was open on the pot itself. The rebuilt motor for the 1032 ring is much easier to replace the pot than the old ones, this one is right on top. The only special tool needed is a small Allen wrench to put the gear on. It is soldered in, but I changed that by cutting short pigtails and splicing them in the box.

Shed Remodeling

Ripped out the old open shelves in the shed and installed the old kitchen cabinets. Cleaned up a bunch of junk, scrap wood, etc. Hopefully with the enclosed cabinets and drawers I can keep the mice and squirrels out of some of the stuff.

Figure 491 Shed before

Figure 492 More shed before

Figure 493 Shed after new cabinets

Upstair Remodeling

Figure 494 This is what is left of the kitchen and bath:

4/8 Electrician was back to bury the electrical cables to the generator. Unfortunately the plumber couldn't make it to move the propane line at the same time so the ditch will be open till next Tuesday.

4/10 Some problems do take care of themselves... big wind last night and this morning, I see the 120' 20m reflector has blown free of the guy wire. So cross that off the To Do list. Set up for JIDX CW for JA1BPA.

4/13 Propane pipe to generator replaced and buried, now its pretty well done:

Figure 495 Final generator installation

4/16 Set up for Holyland Contest for N2KW.

4/18 Extracted some old junk from back in the woods. An old cast iron wheel from near the Beverage trails:

Figure 496 Cast iron wheel from back in the woods

And a newer(probably) wheel and axle from near the north property line.

Figure 497 Pair of old wheels

4/23 Got the DR mower start and cut some brush around the 150' tower. Set up for FL QSO Party for N0HI.

4/25 Fabricated replacement hardline connector for the 180' 2m vertical in case the commercial one is a pain to repair up the tower again. Cleaned up the shed a bit more. Cut some more brush around the 150' tower. Rolled up the ground screen under the 80m 4-square for the summer. Put the shack wall and drop ceiling back together now that the plumbing and electrical inspections are done on the kitchen job.

5/1 Set up for NEQP. Tested bottom ring on 10m tower, now its working. Went up to check connections in box and they all looked OK. I hate intermittent failures!

5/8 Set up for CQ-M M/S. Started preparing Lucky Dog for his job at the next picnic.

Figure 498 Lucky dog at work

5/9

The kitchen is coming along, starting to look a bit like it might work now.

Figure 499 Kitchen installation

Figure 500 More kitchen work

Nice day for cleaning up some more around the 150' tower perimeter. About 30f, 25-30mph wind, a bit of snow now and then, windchill in the low teens, but NO black flies!

Dayton

5/17 Back from Dayton. Bought just a few things, some tools, a new camera, a couple books, and a mini vna. Below are the first pictures with the new camera...

Figure 501 The best of the Dayton flea market, an F-16 cockpit simulator

Figure 502 The worst of the Dayton flea market, a cadaver storage tank with left over body parts

5/20 Started playing with the miniVNA Pro I picked up at Dayton. First finding is that the 20m stub to

notch the 10m harmonic was way short. Added a longer jumper to get it closer but it needs some more trimming.

5/21 Finally a nice climbing day, got up the 180' tower to fix the 2m packet hardline connector again. Was going to replace it but it was easier to repair this time, probably because it was warmer.

5/22 Stripped the antennas, feedlines, control cables, and rotor off the 60' tower. Lowered the mast down inside the tower to the base. The top vertical (that couldn't be reached without removing the rotor and lowering the mast), and the 2m Yagi needed repairs after the winter... I'm amazed the vertical was working at all, when I got it down within reach the shell of the PL-259 had slid out of the base and the screw holding the radome in place was missing so the whole thing just came apart. I had to tape it into a bundle to keep it from hitting the ground in pieces.

5/23 Took down the 60' tower, took off 3 sections with gin pole and then laid the rest over using the ground rod through the plate as a pivot. Had to use bumper jack to get the bent up ground rod out but otherwise it went pretty smooth. The 2m and 6m Yagis will be cleaned up and probably fixed SW on the 15m or 20m tower where there is spare hardline already in place.

5/28 Set up for WPX CW for k1mk.

5/29 Replaced brown shelves in hall with the short table from the old kitchen for the shack coffee pot. Put the old kitchen microwave on it also for downstairs.

5/30 Added new jumper for the spare hardline on the 15m tower to the VHF station.

Put 5 ele 6m Yagi that was on the 60' tower up at about 70' on the 15m tower pointing SSW. The hardline connector had a bit of corrosion and moisture in it, I cleaned it up as well as well as I could. It must not have penetrated down the foam very far as the resistance and loss readings were ok.

What is the picture below of? (answer in a few days, or when someone reminds me about it)

Figure 503 Whatzit?

Solar Array

6/1 Construction of solar electric system started.

Figure 504 Ground breaking for solar array

Figure 505 Solar ditch

6/2 Solar system construction continues...

Figure 506 Wet Sonotubes don't work very well

Figure 507 New forms out of REAL wood.

Figure 508 Another meter just for the solar system on the other end of the house

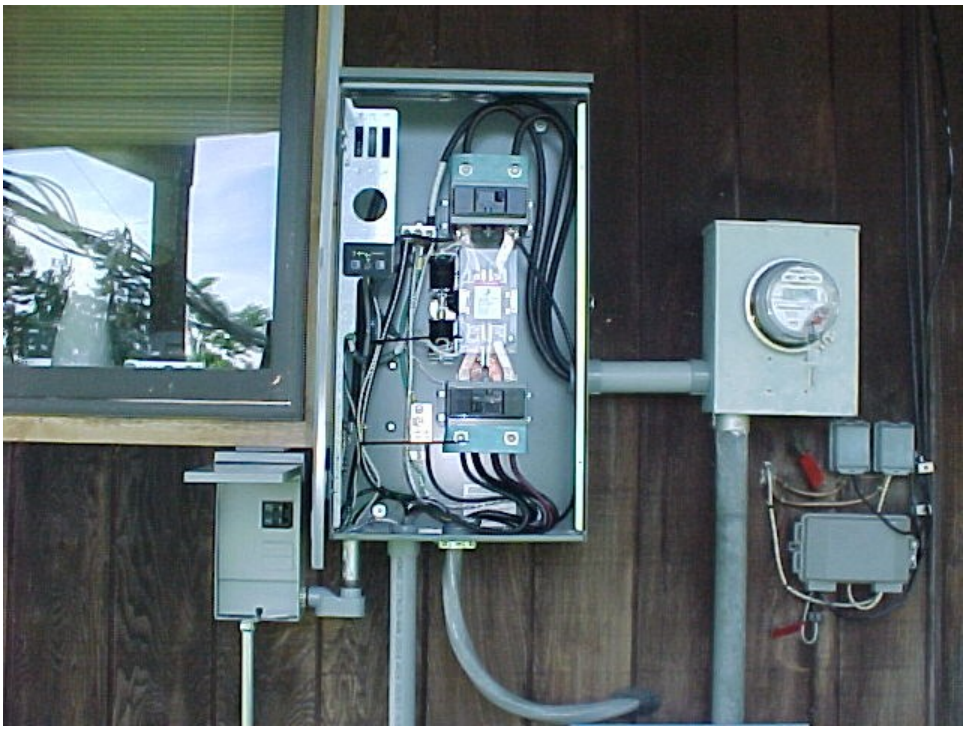


Figure 509 Another box added for the solar system cutoff breaker to the left of the big generator transfer switch

6/3 The foundations for the solar system were poured today.

Figure 510 pouring foundations

The panels will be mounted on the horizontal pipe. There are 4 2'x2'x6' piers with galvanized pipe embedded in them.

6/6 The kitchen and baths upstairs are pretty well done now. The only obvious missing thing in the kitchen are the drawer and cabinet pulls.

Figure 511 New kitchen!

Figure 512 This the the completed mounting frame for the solar system

6/10 Replaced 120' 10m rotor box to fix the indicator again.

6/11 Cut more brush around 150' tower and around 80m 4-square.

6/12 Set up vhf station for June VHF contest... some day I should make up cables for the second SO2R box for the VHF station!

6/18 Set up for AA CW for W1UE.

6/23 Solar panel installation started.

Figure 513 The first panels on the framework.

Figure 514 The full array a couple hours later

Hooking up the wiring between the panels and inverters. Each panel has its own inverter, the 4 rows of inverters are daisy chained together and tomorrow the 4 of them should come together in a box on the closest leg of the frame where the conduit goes back to the house.

Figure 515 Wiring solar array

6/24 Solar system connected and tested ok. Ran the SDR-IQ through the bands while standing next to it and had some hash up around 15MHz, but not sure if that was from the system or conducted from the power line. Will have to run more tests later, but seems relatively quiet.

6/25 Started setup for Field Day. Will run on generator power to see how it handles the amps and other stuff.

6/26 See statistics on my system at: PV System. It probably won't be running full time until later next week, we are just testing and getting the monitoring set up now. The project was designed and built by Pioneer Valley PhotoVoltaics

6/27 Generator ran well after one burp at the start. No problem with 4 amps on ssb. With 3 keying CW simultaneously at full power the voltage sags a bit and ups's start to beep.

6/30 Set up for Canada Day Contest for JA1BPA SO2R.

7/1 Finally got approval to operate the solar array. WMECO was quick, it took almost a week to get an electrical inspector here to sign the form off. Got VPN to W1KM for NU1AW operation up with all the stations.

7/2 Fixed the feed point on the south end 160m inverted L. Its down to its last inch of braid, the next fix will probably require soldering on some more. While testing 160m I found some new strong unstable

birdies. Did better scan of the solar array, while there is some broadband hash when the SDR-IQ antenna was just about touching it, there were no distinct birdies. Used SDR-IQ with short vertical to DF and found it was the LED bulb I picked up at Dayton to try out. It must have a switching regulator in it, very ugly spectrum. It was in a no-name box with part number JB-P50W-A3x1W AC85-265V. Its probably the wide voltage range that required the regulator. It also ran warmer than another one that is marked for AC-110V only.

More on generator noise. When running unloaded for test it has a very regular sweep from about 1815-1845khz and a raspy noise about 1864khz. When loaded the sweep is weaker and less regular, this is probably the voltage or frequency regulator. When it is in standby there is a wider raspy noise, probably a switching supply for the battery charger and control circuit around 1850 which moves up in frequency above 1900khz if the generator mode switch is set to off. If the battery charger breaker is opened the noise goes away. I submitted a query on the kohlerpower.com web site to see if they have modifications to filter those out.

7/3 Made a risky early morning climb to 60' on the 20m tower after only 1/3 of my normal morning caffeine consumption to align the ring indicator. Also adjusted the boom brace and leveled the elements a bit better. There is a worn spot in the coax jumper to the beam down to the braid right at the corner where it goes from the ring truss support to the boom, taped that up.

Full image of mystery picture above...

Figure 516 What it is!

I learned this way of storing long ropes from KC1XX. This way there is no twist to the rope like if you coil it. It is also easy to take out and store, you just put the bin at the bottom of the tower and it pulls right out. You do have to be careful when packing it that the rope isn't wet and that you distribute it in the bin so it doesn't make a big lump in the middle. In this bin I had room for a 600' lifting rope and a shorter tag line also on top.

7/9 Setup for IARU contest as NU1AW. Wireless adapter died on hub computer, fortunately I have empty ports on the new hub I just put in for the solar array communications.

7/12 180' packet antenna off the air again.

7/17 Setup for CQWW VHF and NAQP RTTY. Repaired the Diamond f300 from the tower that was taken down and put it on a mast above the weather station for Packet network.

Picnic

7/24 The annual picnic is today, pics below courtesy WA1ZAM, WA1ZHM, and maybe KA1HSP...

Figure 517 EAT! EAT!

Figure 518 Picnic, while there were some showers the tarps held most of it off, and they did cool it off a bit.

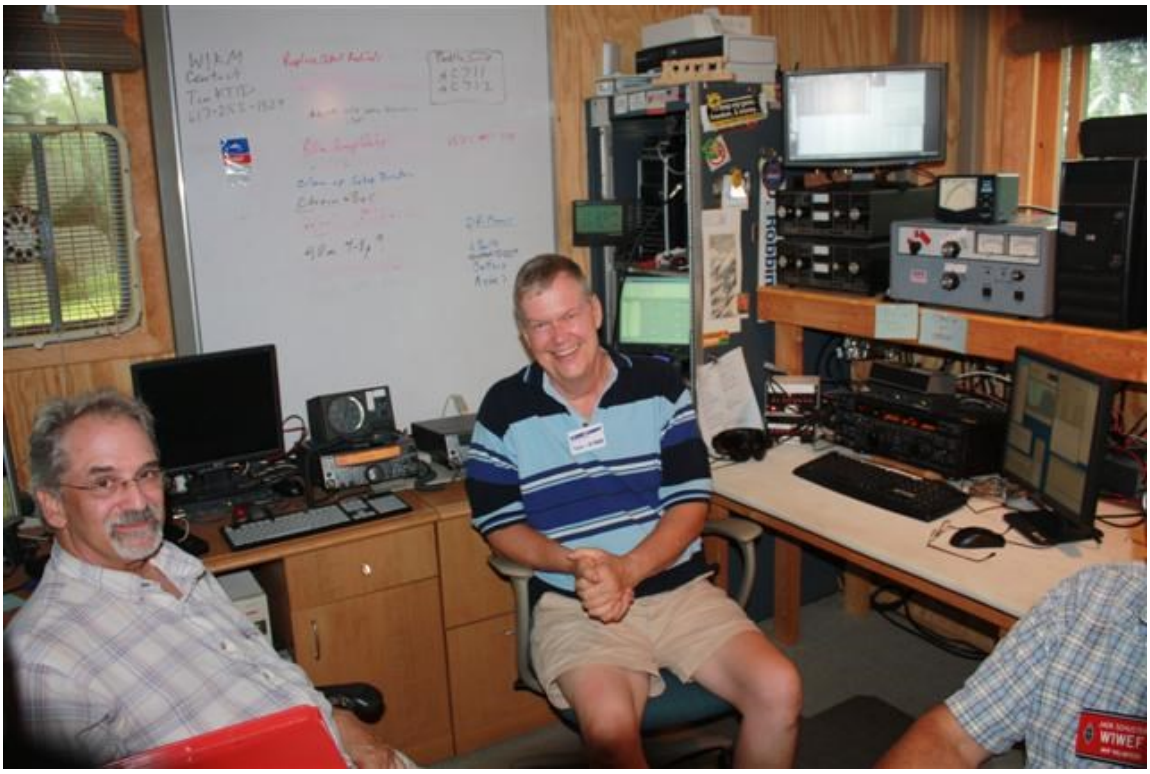


Figure 519 W1RM, N1MM, and W1WEF's nametag in the shack avoiding the showers.

Figure 520 There really is a W1WEF attached to that nametag.

Figure 521 After the showers the Tour de Towers starts off with neck stretches on one of the shorter towers.

Figure 522 It swings around the pond past the 40m 4-square and on towards the 80m 4-square in the background.

Figure 523 The Tour de Towers faces a stiff uphill stretch with Lucky Dog in the lead by a nose.

Figure 524 From the other direction passing the 180' tower and heading toward the 150' tower and solar array.

Figure 525 A quick stop at the Beverages with some beverages in hand.

Figure 526 A look behind the solar array showing the micro inverters.

Figure 527 The always interesting cable entrance, now including the solar array generation meter.

Figure 528 N2KW on 20m operating the IOTA contest.

Figure 529 KK1W on 40m, WA1ZHM on 20m, and someone without much hair on 15m.

7/30 Finally got a nice morning to get up and replace the hardline connector for the packet antenna at 180'.

7/31 Spent all morning and into the afternoon digging up and replacing the perimeter ground. The old one was made up of salvaged pieces of 4/0 braided aluminum lightning rod cable. It was broken by the backhoe when they installed the solar array, and in doing a temporary fix for that I found it had rotted off the rod connection at the NE corner of the house. It has been replaced with solid #4 copper and all new hardware, including the connection to the wx station tower, a connection to the solar array emt, and a cleanup of the service entrance ground.

8/7 Set up for NAQP CW SO2R for K1MK. Mostly been doing stuff around the house recently, changed dining room light, built bigger patio for Lucky Dog to stop his digging under the steps, cleaning out the garage, cut grass, etc. Also set up temporary real time scoreboard since getscores.org hasn't been finished yet.

8/13 Set up for WAE CW. Bottom 20m ring isn't indicating the right direction again.

8/20 Set up for SARTG RTTY.

8/23 A dull and drippy night and interesting question about what I do for QSLing resulted in this reply: I used to send DX 100% via buro from every contest, then that got too expensive. Now my policy is this: 100% to LOTW, and 100% for SASE. As far as filing, in the first year or two of contesting when I was doing paper logs and QSLing by hand I kept a DXCC checklist and sorted cards by country into a big shoebox. Pretty soon I realized that DXCC wasn't for me, I would rather see how many countries I can work in a weekend than track all that stuff for life. So the shoebox is now in the bottom of one of the dozen or so file boxes of unsorted cards sitting in my crawlspace. I figure some day if I break a leg I'll sort the cards into 2 piles, those with naked women on them, and all the others.

8/28 Set up for SCC RTTY. Got up to troubleshoot 60' 20m ring rotor, the motor shaft is bent so on part of each revolution the indicator drive gear disengages making the indicator gradually loose calibration.

9/3 Set up for Russian RTTY contest.

9/10 Finally wired up cables for the YCCC SO2R box for the TS-2000's to do VHF contests properly. Set up for ARRL Sept VHF contest.

9/12 DL9DRA, DL8DYL, and son visited for the night in an RV on the start of a New England tour.

9/18 Started brush mowing around the 80m 4-square. Got about half of it done this morning. Cleaned up some stuff in the garage and shed to make room for parking. Stored away the flea market junk in the shed for now.

9/21 Cut more weeds around 80m 4-square until I bent the mower chassis on a stump. Got about half of what was left done.

9/22 Beat the brush mower back into shape and mowed just enough to get the screens rolled out before it bent more and slipped the belt again. Its about had it this time I think.

9/24 Set up for CQWW RTTY M/M. Cleaned relay on 80m amp.

9/29 Welded on some reinforcement on the DR Mower chassis. Seems to be cutting as good as ever now. Cut rest of weeds around 80m 4-square and started around pond... until I broke the drive chain doing wheelies in reverse to stop the slide down the bank into the mud around the edge of the pond. The pond is very low due to lack of rain this summer so thought I would cut back the brush before it rained.

This is the mod that added plates on each side of the chassis to support the mower deck tilt plate after both of the bent pieces of tubing bent and cracked at the point where they go into the chassis.

DR Mower Modifications

Figure 530DR Mower modifications

Modification from last year that added a piece of rebar to support the back end of the exit chute skid. The skid kept getting caught on stuff while backing up which then would also break the front brush pusher.

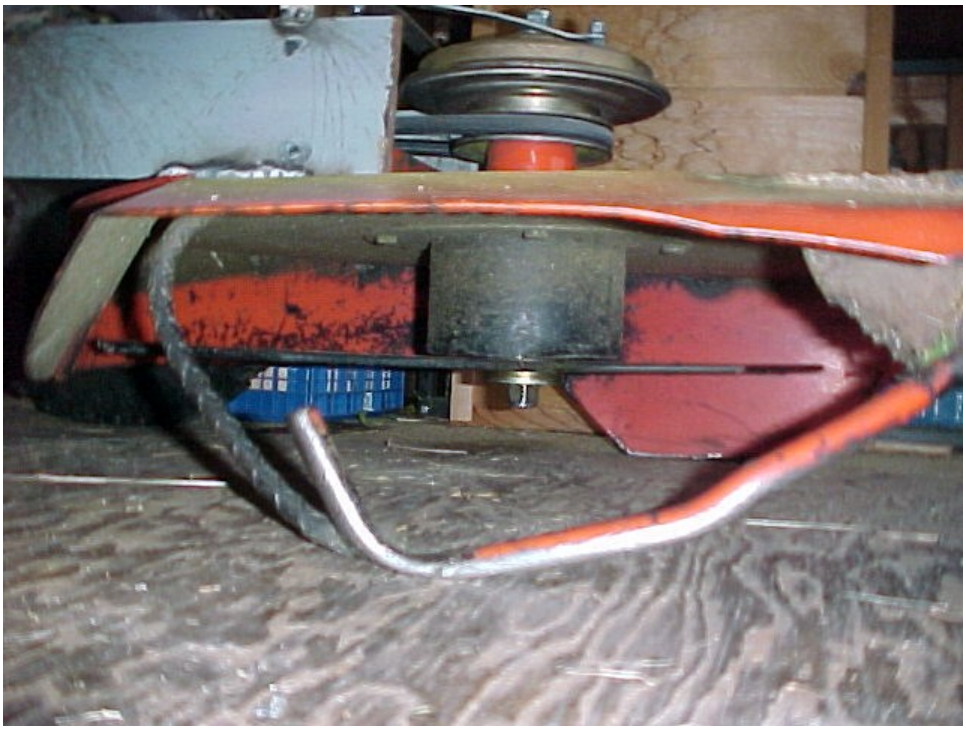


Figure 531 More DR Mower mods.

Modification from last year that added an angle bracket to reinforce the front end of the exit chute skid

and the brush pusher. There just isn't enough metal there to take that force. The big bolts are ends of a cable clamp that was used to pull in the skid bar before welding, now its just a part of the weld mass.

Figure 532 And more DR Mower mods.

9/30 Replaced drive chain with bigger old chain. Of course now that I'm ready to cut its pouring rain! Set up for SO2R for W1UE to do CQP.

10/1 Cleaned tr relay in 80m amp, again. Nothing like 5" of rain in 5 days, 2" just today, to dampen things a bit.

10/2 Started trying to figure out audio problems on vhf SO2R setup. Something is strange with power I think, there is odd feedback that is related to power output but also from computer. Finished brush mowing between 40m tower and pond. Lost idler pulley on mower for a while, found it partially buried where it must have come off, and spring not far away. After repair, cut brush between 15m and 40m towers.

10/3 Finished cleanup of the VHF SO2R station. It is now really SO2R with everything switched through the YCCC SO2R box. I did have to keep the RigBlaster between the computer and mic input on the SO2R box because I was getting some odd feedback, probably something strange with the TS-2000 mic input vs the computer sound card output and the power supply ground. Even though all the grounds are connected there must be something, probably in the computer, that is floating where it shouldn't be.

Also cut the weeds and brush between the 15m and 20m towers and trimmed the entrances to the Beverage trails. Had to get a medium size branch off the NW-SE Beverage and replace a couple insulators. This was yet another of the branches broken almost 2 years ago that is finally coming out of the treetops.

Rolled out the 80m 4-square supplemental ground screens.

10/7 New TIC ring is here to replace the 60' 20m one.

10/8 Did more brush mowing. Got the area behind the PV system cleaned out, the skiing trail, the path back to the north end of the high 80m inverted V, and around the far guy anchor for the 15m tower. The area by the north end of the high 80m inverted V needs some chain saw attention to get branches off a downed pine tree that are blocking mowing.

Set up for M/M for Makrothen RTTY.

10/9 End of brush mowing for this year. Broke another part and wore out my last belt while cleaning up around the 80m and 40m 4-squares, under the 160m inverted L radials and around the pond.

10/14 Installed new Zoom x6 ADSL wireless router. Used current phone line filter and wound extra power cord through 2 of the 1" toroids I use all over for stuff like that. Had new blinds installed upstairs. Got some new relays to replace the open frame ones in the HF-2500 amps. These are Shrack rp710012 spdt sealed units, they are pc mount so I'll have to make up a little board to mount 2 of them on for each amp. They were purchased from Palstar who is using them in their updated version of the HF-2500... they may also be the ones that Pat was using in his high speed switching board or later models.

10/15 Set up station for SO2R for next weekend. Tested Zoom router for susceptibility to RF and generated noise. No problems noted. Even though the NWS dropped the winter storm watch I still put the snow blower on the tractor.

10/16 Added special outlet for Solar Array monitoring box directly off it's meter. PLC signal is much better and it can plug in directly to the router now.

10/17 Sorted out parts for new bottom 20m ring rotor into the order I want to lift them. This is another different design for the ring. There are no adjustable bearings in this one, the whole triangular frame adjusts to clamp the ring in place... interesting idea, will have to see how easy it is to adjust up the tower. Also all 3 bearing plates and 2 of the triangle legs are already welded together so there is only one side piece to install.

Cleaned up and reorganized the shed. This is kind of like one of the little puzzle toys with the sliding tiles where you have to keep sliding them into the one hole to rearrange them... except in this case its a 3d puzzle and none of the blocks are the same size. Still, I ended up with more room to move around than I started with so it wasn't all bad.

Took the chainsaw for a walk in the woods to cut down a couple of trees that had been hanging on the wires of the SW/NE one back at the beaver pond crossing. Dog leashes make nice quick slings for carrying chainsaws without needing your hands... an important thing when crossing a not so solid beaver dam.

10/21 Tried to install new UPS for server rack, but it doesn't work.

10/22 New UPS is going to be replaced, but won't make it till next week.

Modified relay board for HF-2500

Built replacement relay board for the 80m HF-2500. This is made from two sealed Shrack RP710012

SPDT relays I purchased from PalStar. Since they are PC mount type pins I mounted the two of them on a piece of a small Radio Shack project board.

The old relay in place. The relay is mounted on a screw on the back plate of the case between the coax connectors.

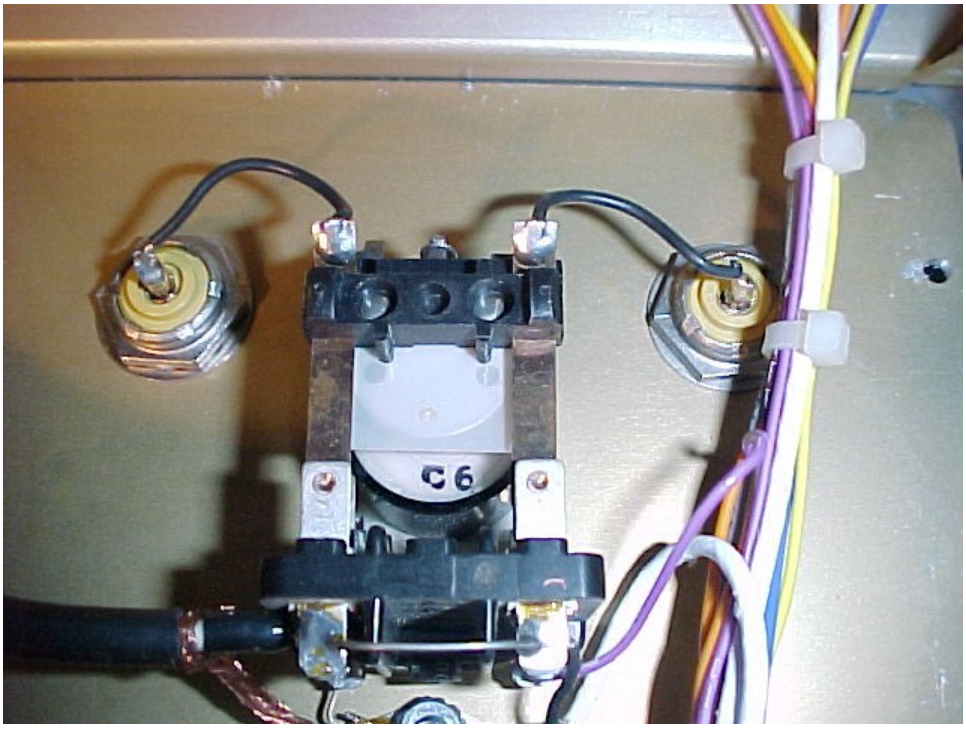


Figure 533 HF2500 old relay

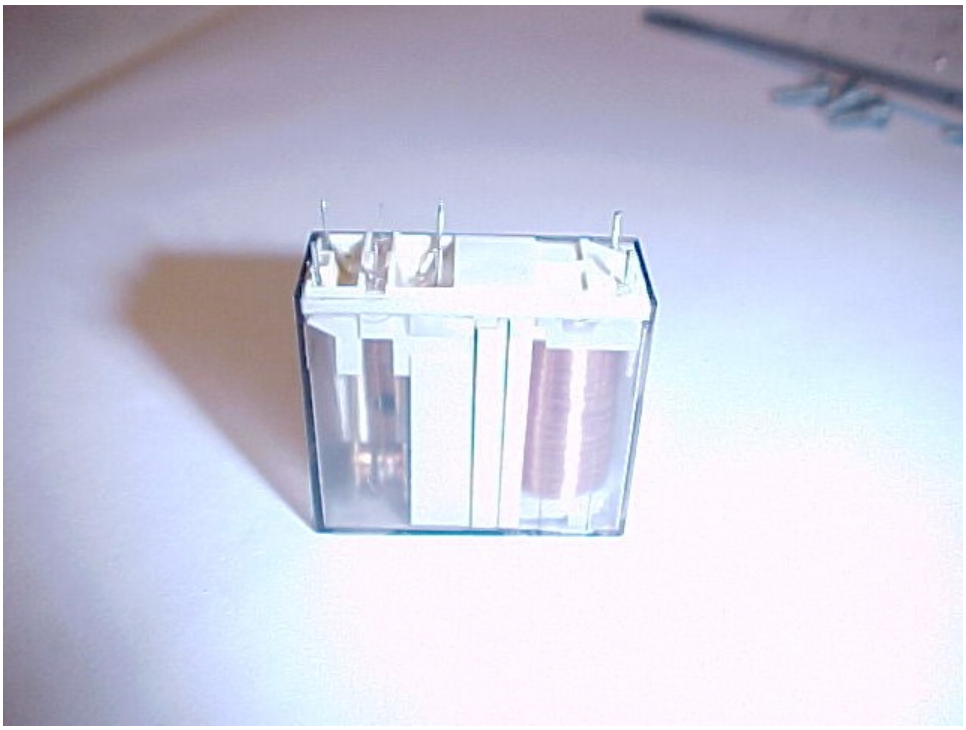


Figure 534 replacement relay

The two relays mounted on the board. The one jumper on top is just to make it cleaner underneath to connect to the two relay coils. The two coils in parallel draw less current (110ma) than the old one did (120ma).

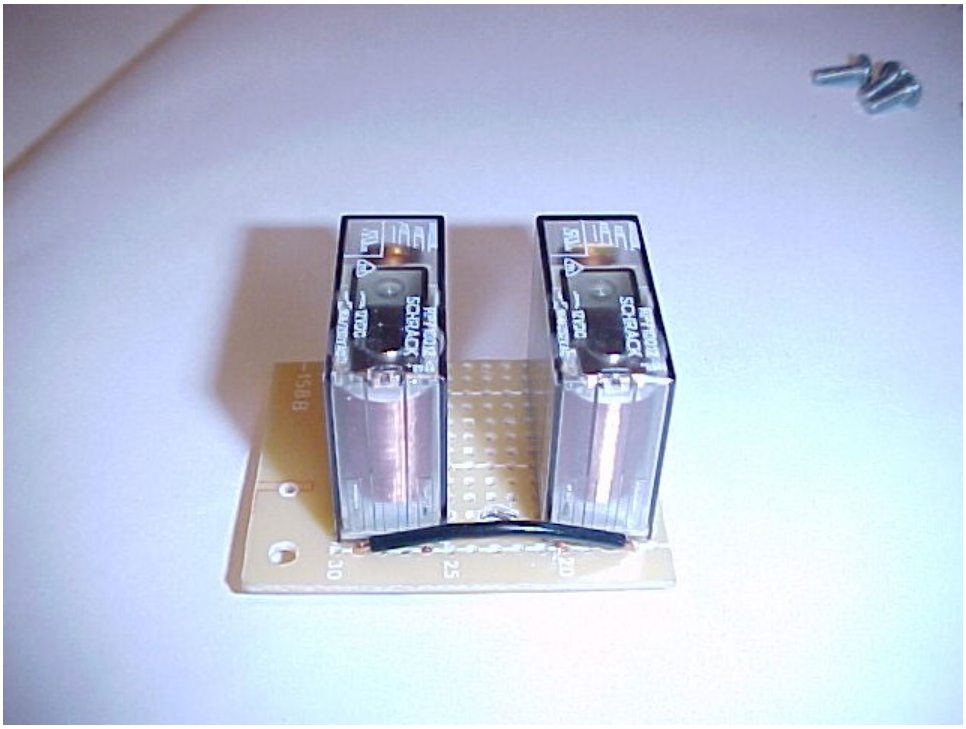


Figure 535 two relays on board

The bottom of the board. The mounting screw is used to ground the center pins by wrapping the lead from the kickback diode around the hole to the other relay and soldering it down. The power to the relays comes in the outside terminal and through the jumper on the top of the board.

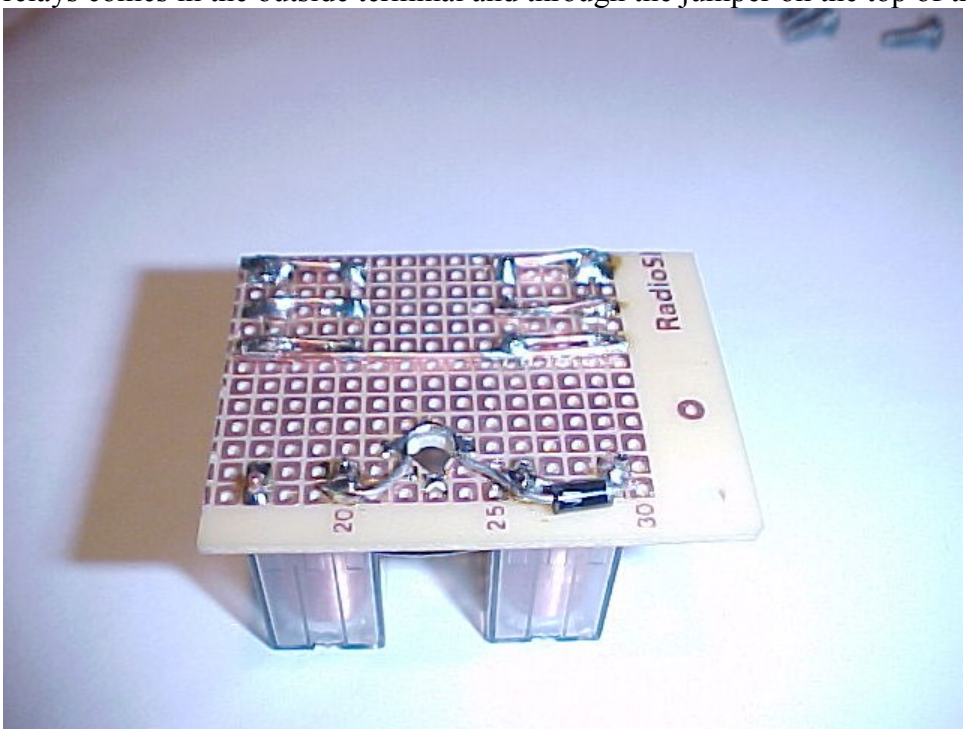


Figure 536 Bottom of new relay board

The new one in place. The small purple wire is the relay power. The RF Out is the big cable on the left side, the RF in is the small white one on the right under the board that disappears into the input network box at the bottom of the picture. I did have to replace the old wires from the connectors because they were a bit too short.

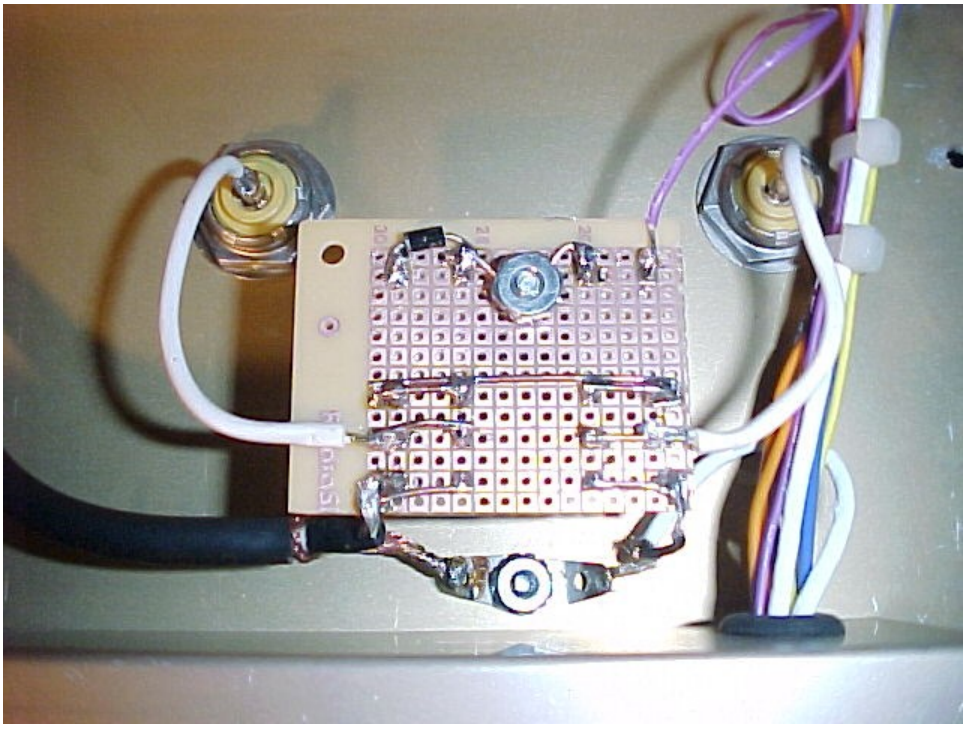


Figure 537 New relay board in place

10/23 Moved new ring to shed and tied it up for lifting. If its not raining in the morning I'll probably start putting it up.

10/24 Started installing the new ring rotor at 60'. Got the frame and ring up but the motor doesn't fit the backing plates that are supposed to clamp it to the frame.

10/27 Installed new UPS for the server rack. Its noisier than I would like with its own fans, but it does replace the other 2 small UPSs, one of which was starting to die. I may move this one to the crawlspace and just run outlets into the shack for it.

10/29 Setting up for CQWW SSB M/M.

11/6 Replacement motor for ring is better, but still not right. There is interference from the welded corner bearing brackets on the backing plates and the gear is too high which allowed the ring to slip under it on first rotation test. Pictures sent to TIC and they have promised a replacement will be sent.

11/12 Set up for WAE RTTY SO2R for NP3D. Cut down 3 pine trees between the house and garage.

180’ Tower Top Pictures

11/13 Nice morning for a climb. Went up the 180' tower to see if I could see why the top ring froze up when it got cold, and also for the fall inspection. Replaced a missing nut on the 70' ring. Took apart the power connectors for the top ring and cleaned them and filled with noalox type gunk then sealed up again. The top ring has some damaged teeth (see picture below) probably from when one motor froze and the other was trying to turn. Took a bunch of pictures, click on the low resolution one to see the full resolution (6MB) version if you want.

Figure 538 L-R 20m tower, solar array, house, BIG, garage.

Figure 539 Damaged teeth on top ring.

Figure 540 One of the top ring motors (note this is an older design.)

Figure 541The old beaver pond in background, top of 15m tower at bottom right.

Figure 542 Neighbors, Cummington regional ATC radar dome on top of hill in background.

Figure 543 More neighbors. 120' 10m Yagi at bottom, 40m 4-square in clearing to left of pond, line just to left of pond is rope for 160m inverted V.

Figure 544 10m tower.

Figure 545 White thing is packet 2m vertical, to the right of the pond is the 80m 4-square.

Figure 546 The only tower in Peru higher than I am.

Figure 547 L-R house, garage, shed, spare aluminum rack, guy wires.

Figure 548 One of the lower ring motors, note they are fully enclosed now.

11/14 Removed the rest of the old 32" ring rotor from the 20m tower.

11/17 Moved the new UPS for the server rack to the crawlspace... ah, the quiet now. Since the rack was only using about 20% of its capacity I also ran a cord over to power my desk computers from it.

11/18 Finished with new UPS installation. My whole desk is now powered from it, as are all the Webcams. So that should cover all the stuff that is used for something other than contests. Note, the VHF radios and accessories are not powered from it, they are still on the normal power... though they could probably get powered from it if needed. That makes 5 separate small UPS's that have been pulled out of the room now and replaced with the one big one.

11/19 Big winds the last couple days brought down lots of dead branches, broke off a 6" ant infested pine near the 150' tower and tipped a 40' tall pine down into the pond. Checked south Beverage that didn't sound too good last night, it is all up ok, sounds better today.

Collected up all the parts of the old 32" TIC ring(click on image for full resolution 6mb image):

Figure 549 Old 32” TIC ring

Figure 550 Old 32” TIC ring

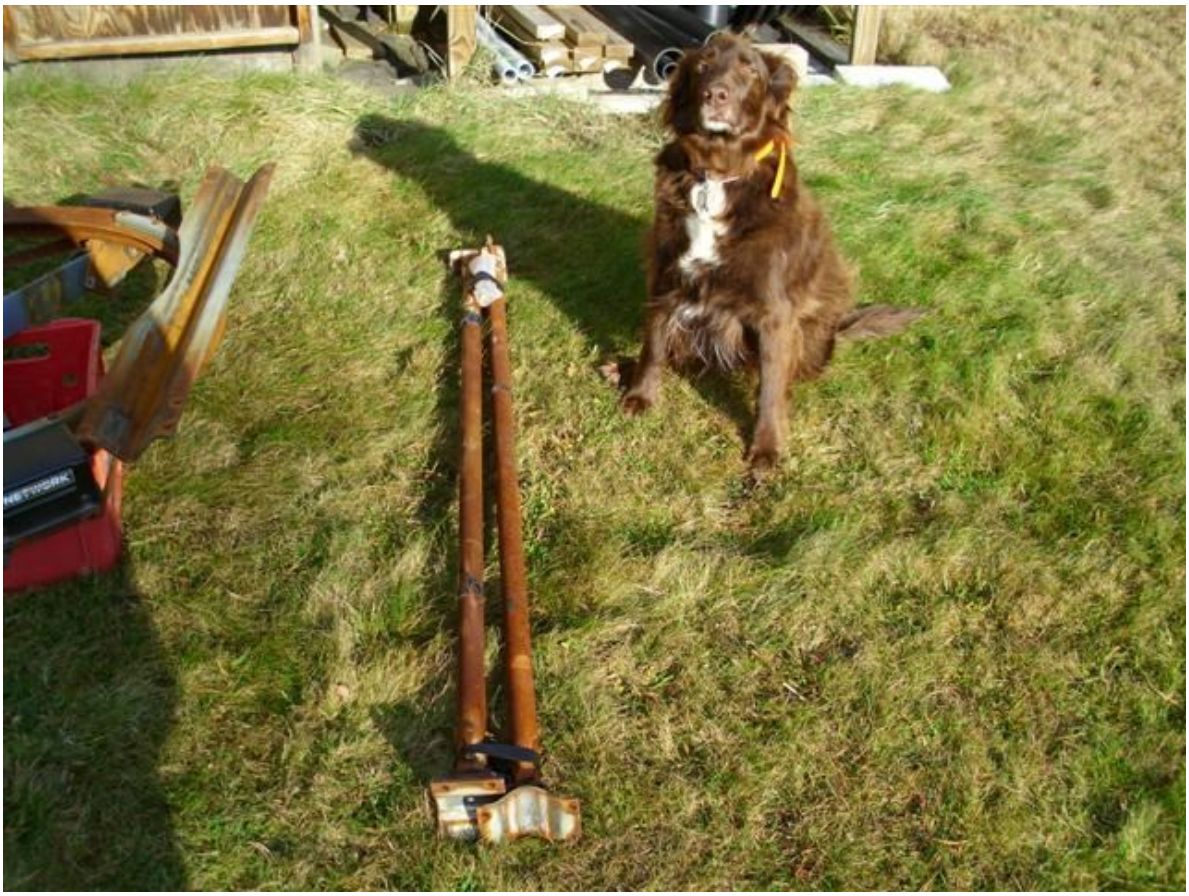


Figure 551 Old TIC ring struts

11/20 Set up for SS SSB M/S. Cut up the pine tree that was blown down into the pond. Walked the Beverages, had to take a good size chunk of rotten pine off the NW/SE one near the end, but otherwise everything looked ok. There were some new blowdowns and lots of branches down though.

11/21 Put on replacement drive motor on the new TIC ring and now it works nicely.

11/25 Walked Beverages again after big winds again the last couple days. The trees must be running out of weak or dead branches now as there were only a few small ones down today.

11/26 A little bit of ice this morning, but not bad. Setup for CQWW CW. The 15m sub-vfo knob seized up, replaced it with the spare radio. Found broken ground on 40m beverage cable on the phone plug going into the filter.

11/27 The top 40m rotor would only turn CCW, went up and moved the south-east leg motor off the ring and swapped the cables so the south-west motor would drive and also run the indicator. Got the 15m sub-vfo pretty well freed up. Removed the main, sub, and rit encoders from W1TO's fried radio.

12/3 Replaced one of the motors on the 180' ring with a refurbished one from TIC. The other one caught on the ring and the ring was too low on that side. So it is running now with only one motor and I'm going to limit rotation range to 90-0-270 degrees.

12/5 Walked Beverages again, no damage found. Shadow from house peak seems to just be nipping the west corner of the solar power array.

12/14 Well, we avoided a threatened ice storm, and I lived through carpal tunnel surgery again, but now the 180' 160m inverted V seems to be dead, and the 180' 10m beam is also gone. Will have to check with the TDR later to see just where the problem is, but I was able to confirm its not at the shack end of either one.

12/18 Walked Beverages, only one section down from a branch in the N/S one. It has warmed up, both the 180' 10m and 180' 160m antennas are reconnected. I'll have to do something with both of those hardline connectors I guess.

12/19 Sunrise over the Solar Array as pretty close to the winter solstice. The big shadow to the left is the peak of the house, it moves down and off the bottom by just about 9am. The shadow on the right side at the start is the pine tree by the shed.

Figure 552 Solar array at solstice 8:30AM Local

Figure 553 Solar array at solstice 8:45AM Local

Figure 554 Solar array at solstice 9:00AM Local

Model 419 Modifications

12/23 When I first built my SO2R setup I bought two Model 419 switchable bandpass filters. When everything was first hooked up and I started testing inter-station interference there seemed to be way too much crosstalk between the stations. I started isolating things and finally figured out that it was going through the power and control lines from the 419 filters. Examining the internals showed that the control wires and power were not well bypassed and the power actually ran parallel to the RF signal path around all the relays. They did attempt to bypass with capacitors at the rotary switch in the front, but the wires from the relays went to the back connector first then to the front switch, and the power was inadequately bypassed at either end. If you have my book there is a description and pictures in there of that modification.

Now I have started to have problems with dirty relays on one of the old Model 419's. Since the relays are in plastic covers that are attached to the circuit board I'll have to cut them apart to clean them. But I had a 419B that I had picked up for using on a spotting station but never used. So I pulled it out and checked it, and sure enough it doesn't look well enough bypassed either. But now I have one of those nifty little miniVNA Pro network analyzers, so I figured I might as well try to measure the isolation and see just how bad it is. The test setup below is measuring the transmission between the radio input port and the power and control wire connectors.

Pictures of the modification. All the green capacitors are the ones I added, they are all .1uF. (click on images for full resolution version ~6MB!)

Unmodified. On the back panel from left to right are the fuse holder, the power jack, and the din jack for the control inputs. The RF input is behind the relay on the left and the output is on the right. The 80m relay is the one closest to the output jack on the right side.

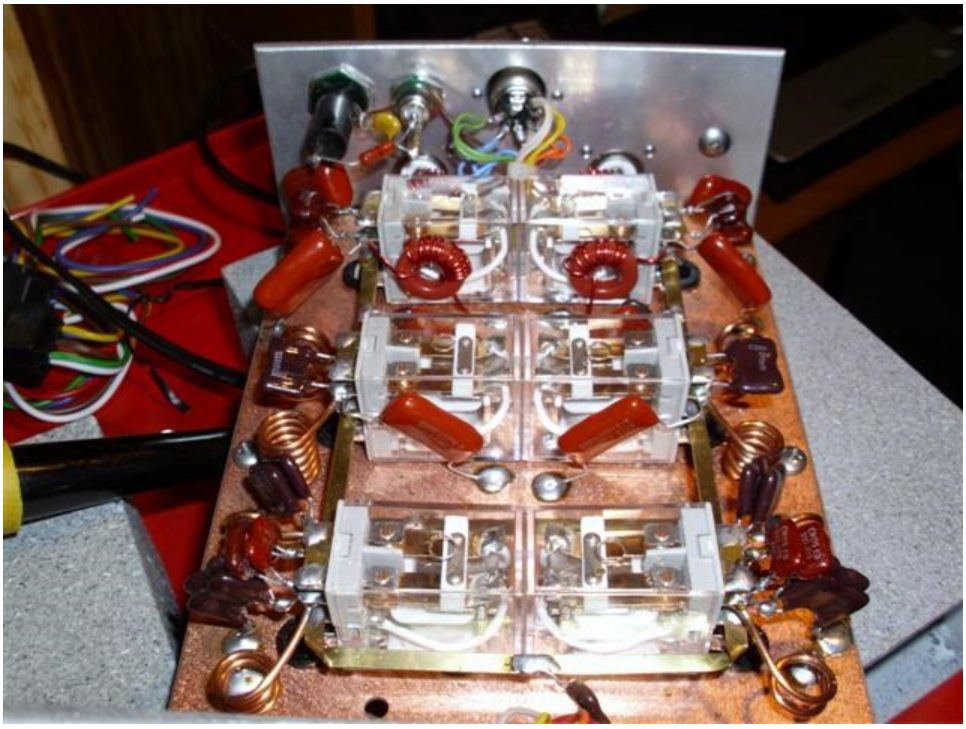


Figure 555 Model 419 bandpass filters

Closeup of the back of the din jack... not much room to work in there.

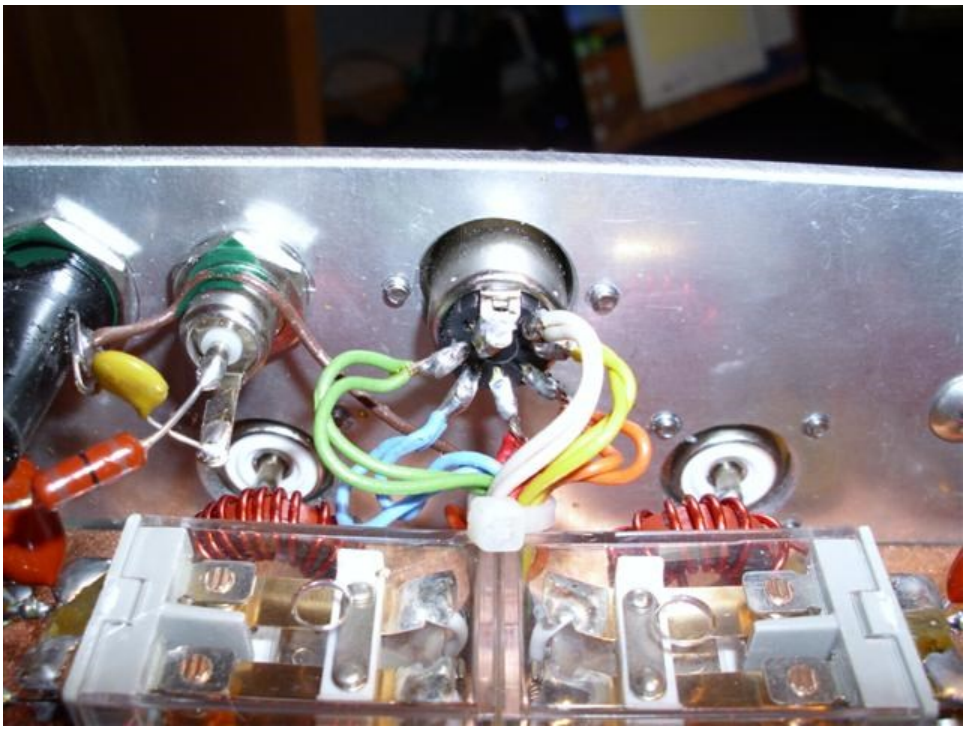


Figure 556 Model 419 DIN jack

First, from the radio input to the center pin of the power connector. This doesn't seem too bad. There is a new inductor in this box in place of the diode that was in the older one. That probably helps it a bit.

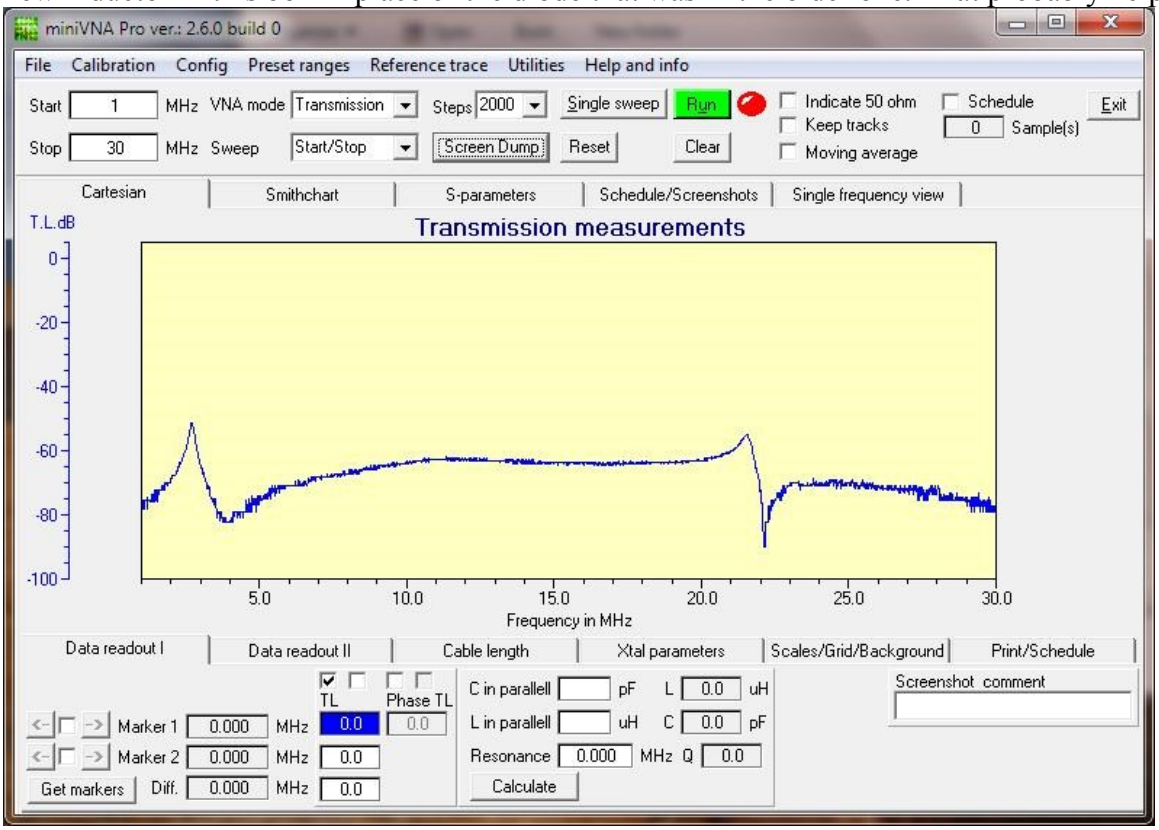


Figure 557 Model 419 crosstalk measurement

This is from the radio input to the 80m control input which seemed to be about the worst one. This is more like what I was expecting, only 23db isolation around 15m. So if you are transmitting 100w on 15m, about .5w of that would be going out on that 80m control wire, back to the relay driver which is probably a transistor, and probably back into power supplies and other places you don't want rf... and if two of these boxes share power supplies and other control circuits that is not a good thing.

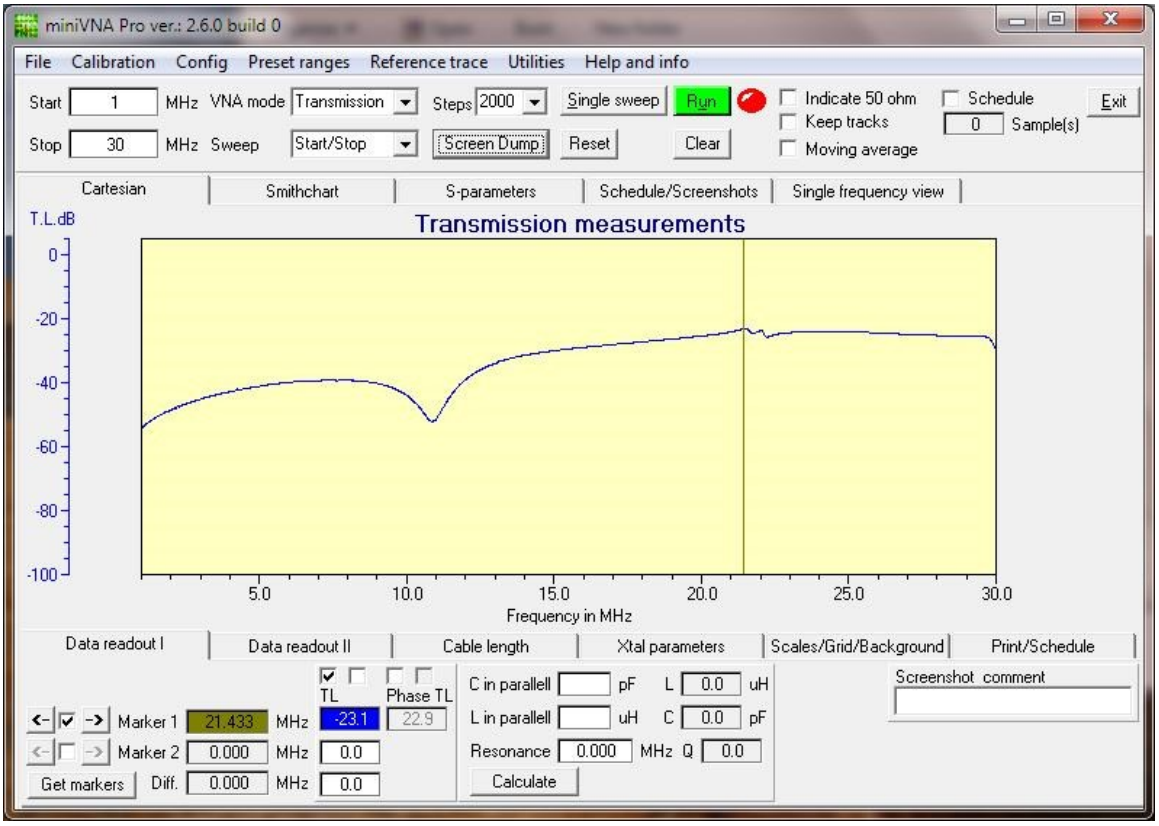


Figure 558 Model 419 crosstalk measurement

This image just overlays the traces from the 6 input pins. It is interesting that there seems to be some kind of resonances around 10MHz, 20MHz, and 21.4MHz. I never could totally get rid of those, especially the one at 21.4MHz, there must be some coupling between the power and RF busses that just isn't broken up by adding capacitors.

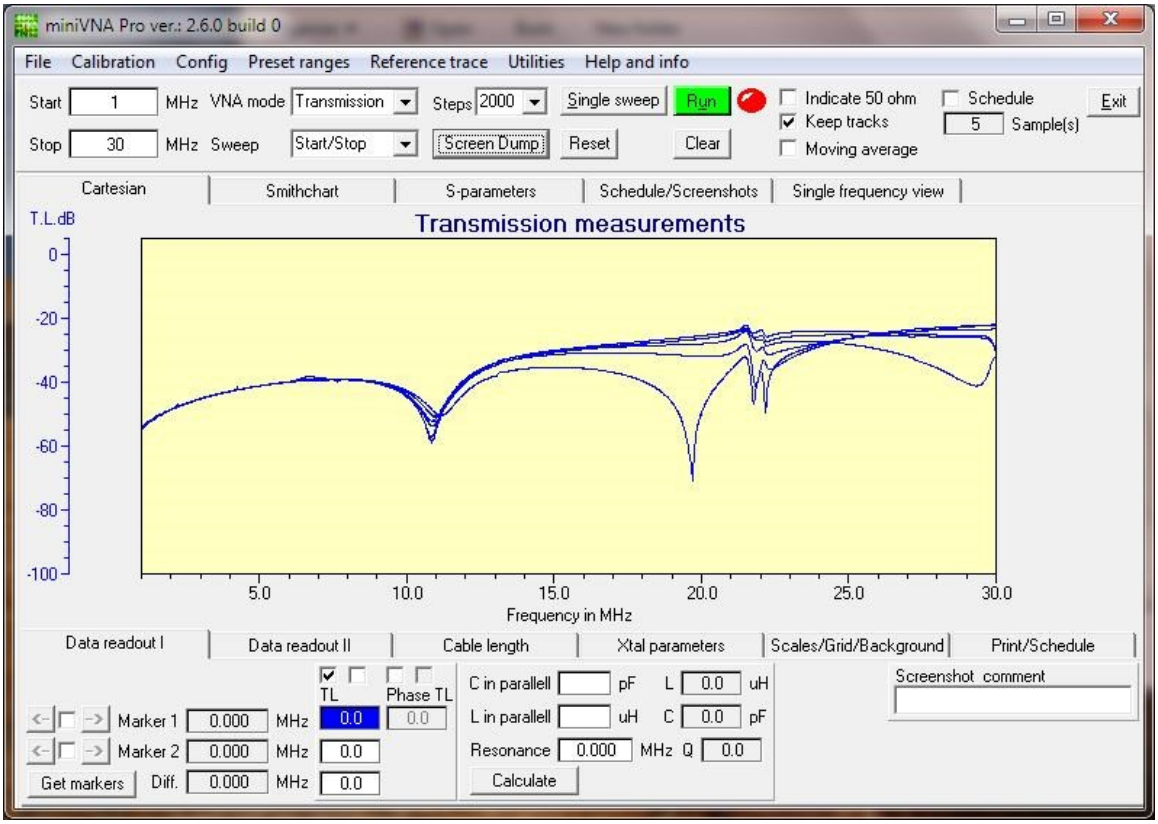


Figure 559 Model 419 crosstalk measurements

The 6 capacitors in place. in doing that I also connected the ground lug of the power jack directly to the din jack ground instead of letting it go through the case.

Figure 560 Modified model 419

This one compares the unmodified response with the response after adding capacitors to the 6 control

line inputs only. Its interesting how this seems to make the 21.4MHz coupling stand out, but that at the 10MHz point there is very little improvement.

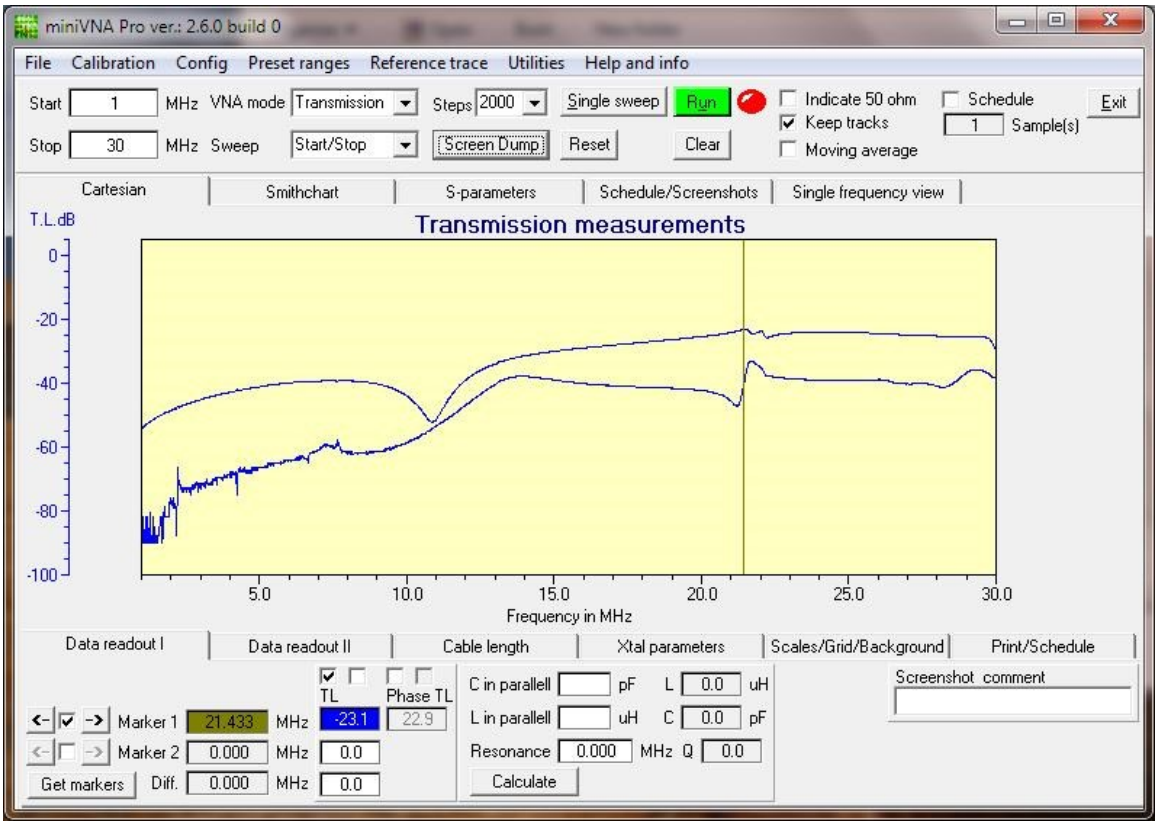


Figure 561 Model 419 crosstalk measurements

Side view of the capacitors from each relay control line connection to the circuit board. Note that the control lines come up through the grommet from under the chassis, but the +12v is on the copper strap running just below the copper strap that connects the RF from relay to relay. At the Right end i also connected from the +12v strap to ground. And just visible behind the 10m capacitors is one from the common +12v bus to ground where it goes to the relays on the other side. The far side has the same 4 capacitors on it's relays and at the back end of the bus.

Figure 562 More Model 419 modifications

This is the final response with the capacitors added to each of the relay ends and to the power bus on top of the chassis. Now that 21.4MHz peak really shows up, but its at least 44db down. This result is similar to what the modified 419 came out as, it's peak was 43db down at about 22.5MHz.

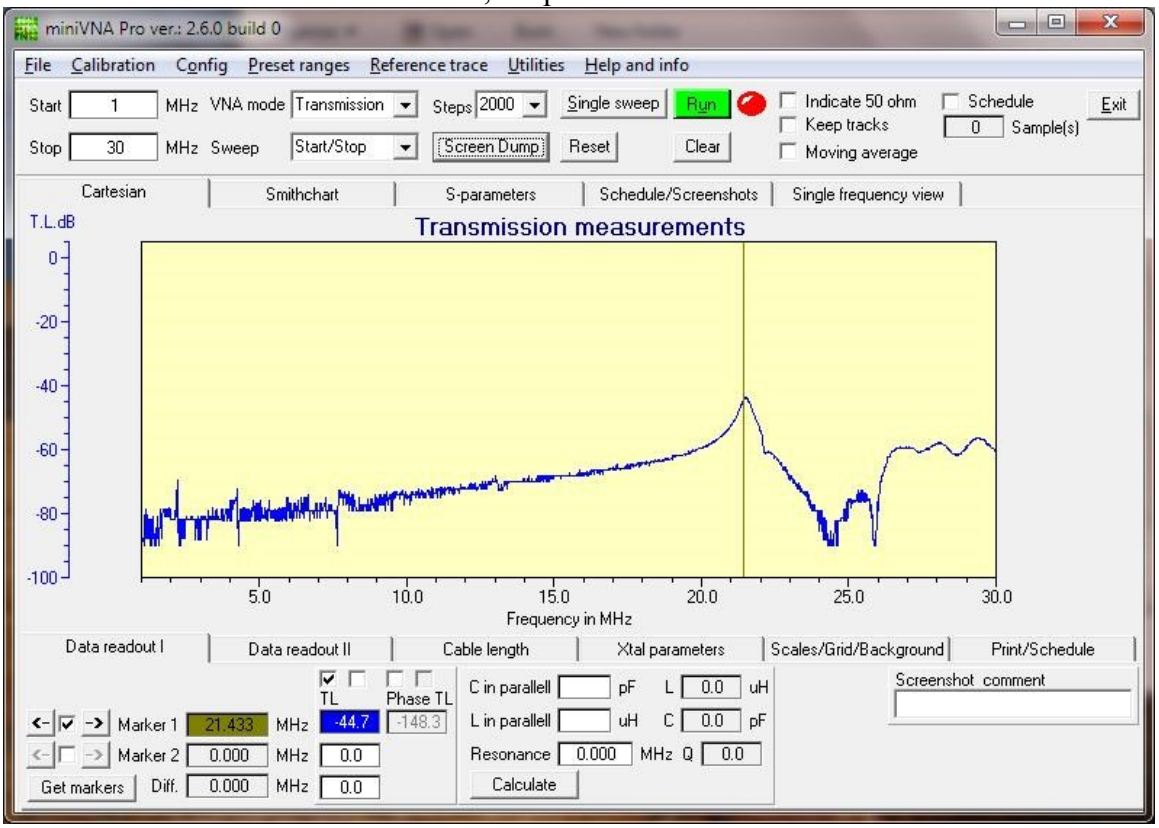


Figure 563 Model 419 crosstalk measurements

12/24 Installed modified 419b on the SO2R station. Did some cleanup and indexing of old maintenance blogs.

12/27 EPRI is closed this week, and last night into this morning we are having a blizzard. Time to do some work around the shack. Defrosted the shack fridge yesterday. Cut the top off of the 40m relay that needed cleaning in the older Model 419 filter. Cleaning seems to have fixed its intermittent attenuation problem, I'll monitor it for a while then put it in storage as a spare.

12/31 Retuned the bandpass filters on the Beverages. They all needed a bit of adjustment, they were all a bit high in frequency so the loss at the bottom of the cw band was as much as 6db. Now all of them are better on cw with loss around 2db at the bottoms of the bands. Took quick climb up 15m tower to replace a rope that broke on the 60' European beam that let it blow to the South East. Also adjusted the 90' ropes so they are both pointing a bit more into central rather than southern Europe.

It was such a nice afternoon that I went cross country skiing around the Beverages. There was another big dead branch down at the 80m 4-square laying on one of the radials that needed moving, otherwise it was pretty clear.

2011 – Changing of the guard

1/2 Cleaned up all the logging computer hard drives and defragged them for the first time in years.

Snow!

1/12 Global warming my a$$... 28" snow in about 12 hours. Nice day in Peru.

During the heavy snow in the morning, only about 18" at this point.

Figure 564 Snow

This is what happens when the flash goes off during a snowstorm. This is about 4pm after most of the snow was over. There was another 2" or so that night.

Figure 565 More Snow

View out the front window over the deck.

Figure 566 Even more snow

View out towards BIG!.

Figure 567 Yep, even more snow

Ice!

1/19 More global warming last night. Looks like about 3/4" of ice on the antennas as of 9am, but not all the way around, just on top. For those of you who wonder why I keep a telescope in the living room, this is what I use it for. (Click on these for high resolution version, 6mb each!)

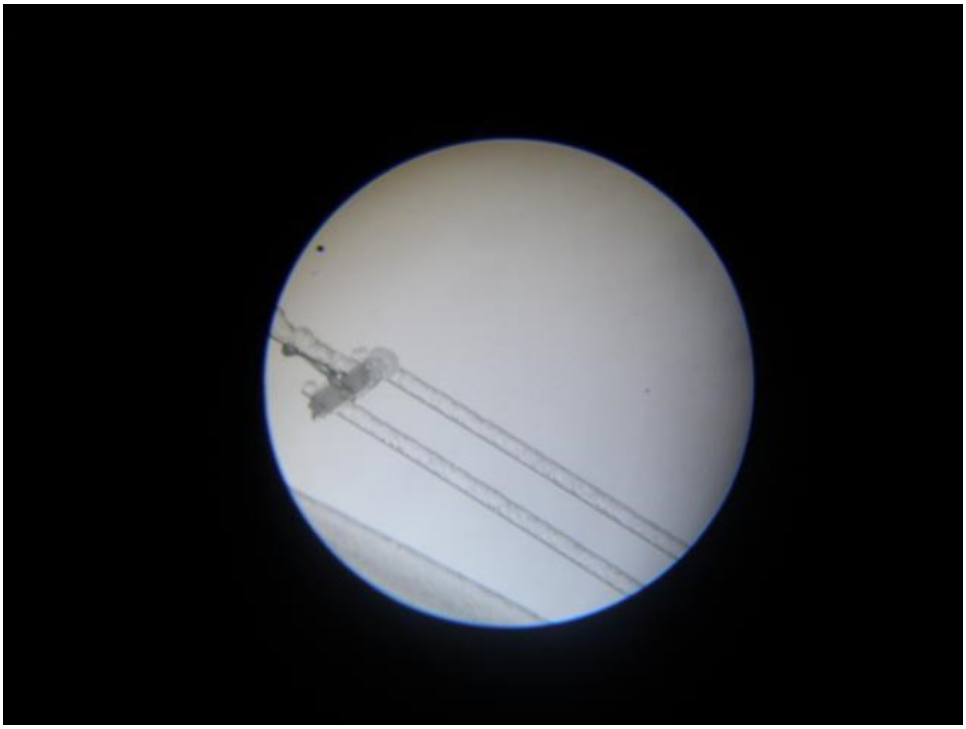


Figure 568 Ice on one of the 70' 40m4lldd element loading lines.

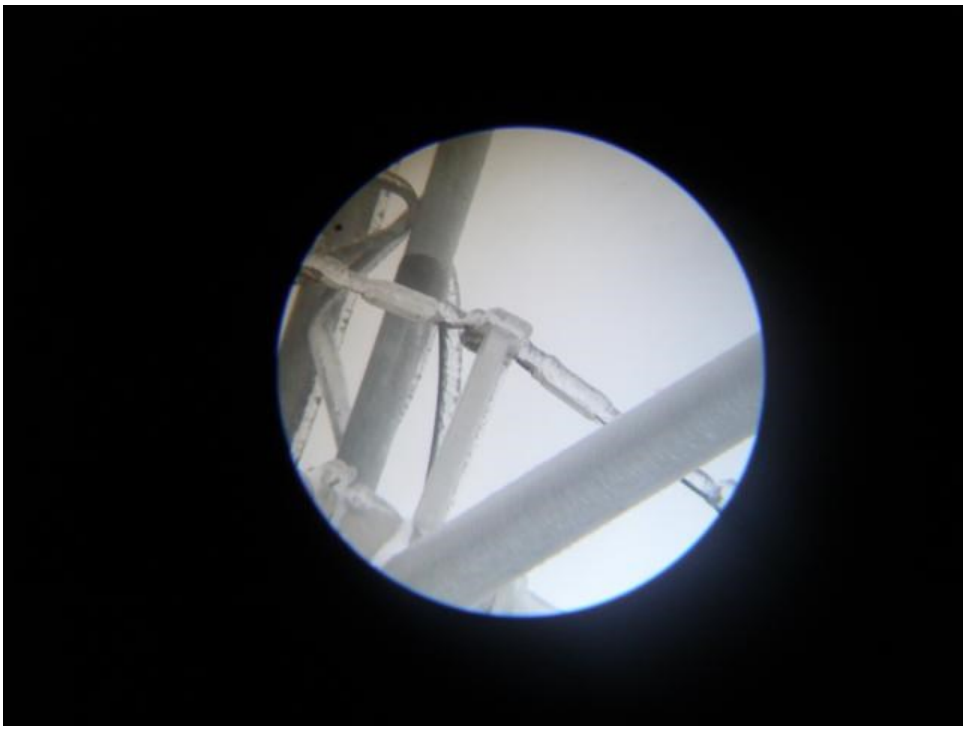


Figure 569 Ice on the 70' 40m4lldd element truss support.

Figure 570 Ice on the 180' 40m4lldd feedpoint.

Figure 571 The 70' 40m4lldd.

Figure 572 The 150' 20m4dx and the VHF/UHF antennas

1/23 Looks like the top 40m Yagi is stuck pointing at Europe now, or at least its not tracking the control box display. I'll leave it where it is and hope it isn't windmilling for now.

2/5 Snow after snow after snow with layers of ice in between, no January thaw either, we haven't been above freezing since 1/2. For probably only the second or third time in 27 years up here I have been shoveling off snow from the roof of the house, the first time for the shed and garage. There was at least

2' of snow layered with ice on all of them. I got about half of it off the house but more off the shed and garage. I'll have to borrow a roof rake to get the peak of the house if this stuff doesn't start melting soon. I have also shoveled off the sides of the deck around the house twice now. The south end is now drifted up to the railings, i don't worry about that as much since it has support all the way around.

2/10 Gusty winds combined with ice still on antennas has tilted the 30' 15m Yagi about 30 degrees. The 60' 20m one is also tilted but only 10-15 degrees. The top 40m one may also be tilted slightly, but there is still ice on it so it may just be sagging more on one side than the other. All 3 of them are in TIC ring rotors.

2/13 A 'relatively' nice day today, snow flurries, 25f, winds only 10-20mph, so decided to go ski the Beverages. Even after all the ice and wind there was no damage on any of them, and the 80m 4-square radials were ok also. Ordered memory upgrade for 6 logging computers from 128+512M to 2x1G. Had 3 of them running ok with full RBN spot feed and last year's CQWW CW log and they seemed ok, but this can't hurt in the long run. Memory is a lot cheaper now than it was when I bought those machines.

3/27 Snow crusted over hard enough to walk back in the woods now. Toured the Beverages and only had one branch down on the far end of the N/S one that broke an insulator.

4/3 New snow Friday now frozen over. Found a white birch and a branch down on a couple of the 160m L radials on the north end.

RIP Lucky Dog

4/11 After a short illness Lucky Dog's luck finally ran out early this morning. RIP Lucky Dog.

Figure 573 RIP Lucky Dog

Welcome Pablo

4/30 Well, the snow finally melted and the ground dried out a bit so I rolled up the 80m 4-square ground fencing today. Had a bit of help from a 2 year old Lab/Hound/Great Dane? mix named Pablo that is on trial period for adoption.

Figure 574 Welcome Pablo

5/1 More spring cleaning. Moved flea market pile into the garage to get more room in the shed for when the new ring for 40m arrives, hopefully this week. This is the first real nice day for climbing, 55f at 10am but no wind and sunny. Went up the 15m tower and leveled out the bottom Yagi that had slipped in the ring rotor cradle. Did the same with the 60' one on the 20m tower.

K0XG Ring

5/6 K0XG ring rotor arrived. 500# box had to be unloaded at the end of the road because the trucking company sent a 45' box rig to deliver it.

5/7 Got new chainsaw running and cut down the ugly birch that was starting to lean over the parking area. Welded up the DR Mower, replaced the blade drive belt, and cut a bit of the stuff I didn't get to last fall.

5/8 Unpacked the K0XG ring hardware and started to prepare it for transport up the tower. The hardware is definitely impressive, but the manual leaves a bit to be desired. It has schematics for several versions of the hardware, but doesn't label them for applicability. It also doesn't have specs for weights, windloads, or the motor current and voltage.

Figure 575 K0XG Ring power supply and GreenHeron control box

The Green Heron control box and remote motor power supply and relay box. The motor runs on full wave rectified 110vdc.

Figure 576 K0XG power supply

Closeup of the remote box. Two big contactors up top are the reversing relays, the smaller ones on the

bottom right are controlled by the 24v from the Green Heron box. The one standing up on the bottom left is the power-on relay for the box.

Figure 577The motor and gear reduction unit.

Figure 578 K0XG Ring top section

Top view of the top of the ring. The brackets with the blue rollers flip over and ride under the ring gear to hold the top part down on the gear. They are flipped over hear to allow removal of the top from the bottom.

Figure 579 The boom clamp and truss assembly.

Figure 580 K0XG Ring gear

The ring gear. In the K0XG design the gear is clamped to the tower and the motor rotates around the tower with the antenna.

Figure 581 K0XG Bottom view of the moving part of the ring

The 3 sideways rollers roll op top of the ring, there are 2 vertical rollers that keep it centered and provide something for the drive gear to push against. At each of the 3 sideways rollers there is one of the blue rollers that will hold the ring down.

Figure 582 One to get the feeling for the size of it.

5/12 Started disassembling the ring to transport up the tower. This is the bottom part almost ready to go.

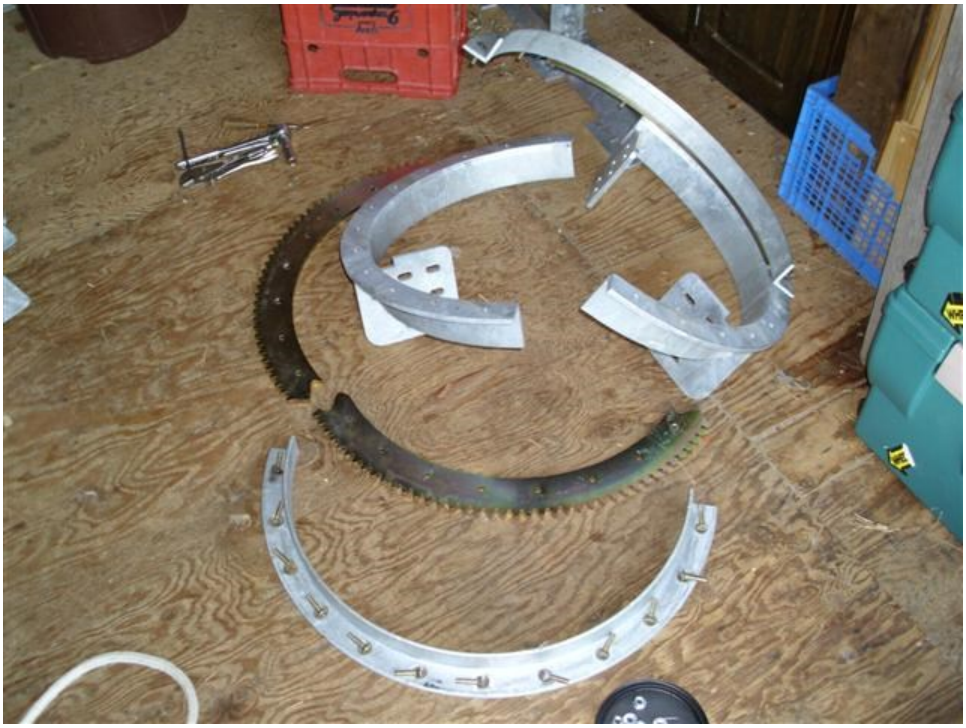


Figure 583 Ring prep for lifting

5/20 Finished disassembling the ring and getting it rigged to lift. Also had to make a list of wrenches for each section since it uses a variety of nuts, most bigger than the normal 1/2" or 9/16" wrenches. Will need 11/16", 3/4", and 7/8" for various parts of this one. Here it is pretty well ready to lift.

Figure 584 Prep for lifting

5/21 Took big branch off N-S Beverage just past the 80m 4-square. Wired up the K0XG power box and Green Heron controller on the shack end of the 180' cable.

5/22 George came up to help after the fog lifted and we got the lifting rope up the 180' tower. I also took up the pot assembly and power cord for the motor and spliced them in to the cable. Found two broken welds on the old ring, tied it in place to try to prevent further damage until it can be replaced.

5/25 George, KJ1K, and KB1W came up to help after I got home from work. We got the bottom part of the ring up and assembled. That took about 2.5 hours, hopefully the rest will go a bit quicker.

This is one of the broken welds on the old TIC ring:

Figure 585 Broken top TIC ring

The top view of part of the new ring over the old one. Note the numbered bolt holes to make sure everything got back where it came from. The yellow cable is the power for the motor.

Figure 586 Assembling ring

George stuck around in the bugs until I was down and we put away the ropes.

Figure 587 George on ground

5/27 George came up again and K1MK is here for WPX CW so we put up the top part of the ring and moved the antenna onto it. About 3.5 hours up the tower. I had to improvise a bit to keep the phasing line on the 40m4lldd from shorting on the boom brace bracket on this one... picture below, I'll have to replace that with a better standoff. Right now its just a piece of that Dacron rope folded over 4 thick, then wrapped in tape and taped to the bracket.

Figure 588 Stretching phasing line around boom truss

The tower also gives a good view of the wildlife. The poles on the right are 2x4 posts holding the ends of the 80m 4-square radials.

Figure 589 Pond from 180'

5/29 Had to swap the SO2R HF-2500 amp with the spare, it blew the HV fuse, which I replaced and then it was working ok... but it started making a random popping noise while on RX.
5/31 Weekend was too busy and windy to do anything, but this is what it looks like from the ground with the antenna on the new ring and the old one still under it.

Figure 590 K0XG ring from ground

6/2 Well, the tornadoes missed here, but we did get golf ball size hail and a bit of wind. But lightning took out the primary line fuses on the road, killed the control board on the generator transfer switch (after it got transferred and started), and blew the internal 2a fuse on the QS1R... will have to turn everything else on shortly to see if there is any other damage. Power was off for about 12 hours here.

6/4 George came up and we got the motor in place on the new ring and got it turning. There are a few little things to sort out and maybe adjust but its working now anyway. Its hard to get pictures of it while up there since it is bigger and there is no good place to get an over all view.

Pablo as few have seen him:

Figure 591 Rare quiet from Pablo

The indicator pot is in the white housing on top of the gold plate. The shaft and gear below it are connected via the belt to a small gear under the main drive gear which is behind that galvanized piece. I added the piece of aluminum wire just in case I dropped the belt, and the tape below the pot gear so it couldn't slide off the shaft. I left that in place just in case the plate loosens up before I figure out how to do it right. The instructions say to clamp that gold plate under one of the motor mounting bolts, but when I tried that the belt was too short, so I bolted it to the plate that was meant for the strain relief for the pot cable on the left side of the bolt.

Figure 592 K0XG Ring Pot modification

This is one of three hold down rollers. This one is the one under the antenna. It doesn't seem to be in far enough.

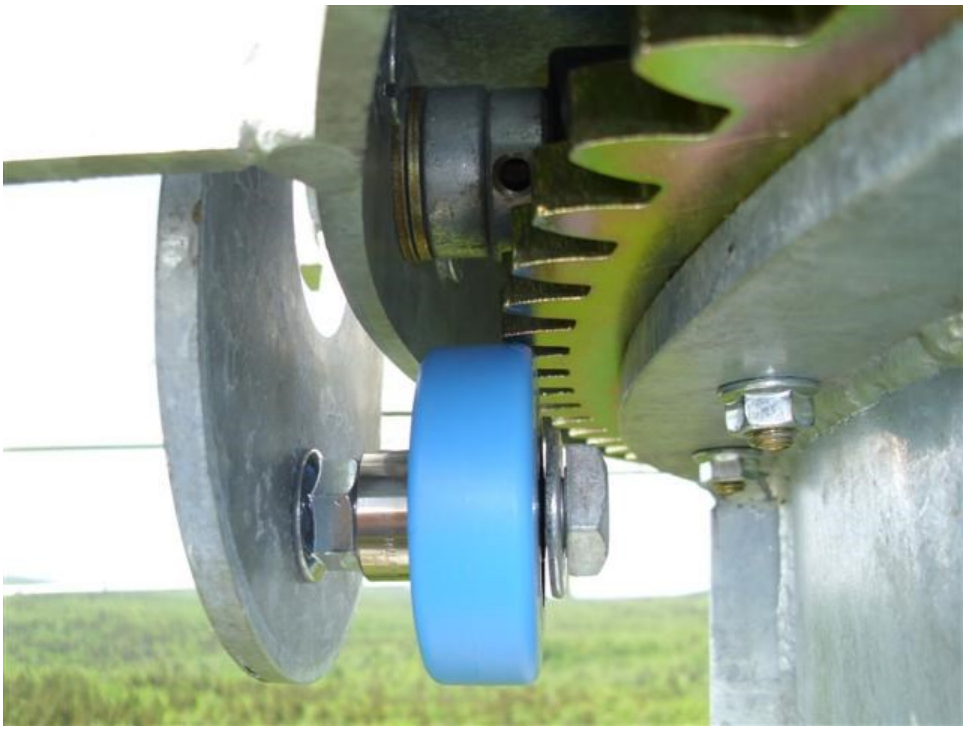


Figure 593 K0XG Ring hold down roller

6/10 N2KW was here so I went up and we took down the remains of the TIC ring from 180'... Film at 11.

Popping HF-2500

6/12 A perfectly dreary day in Peru. Took apart the HF-2500 that had been making popping noises and found this under the RF deck...

Figure 594 Popping HF2500

The popping noise was probably arcing across the equalizing resistors when the voltage got high enough. It looks like it actually blew the end of 4 of them off the board.

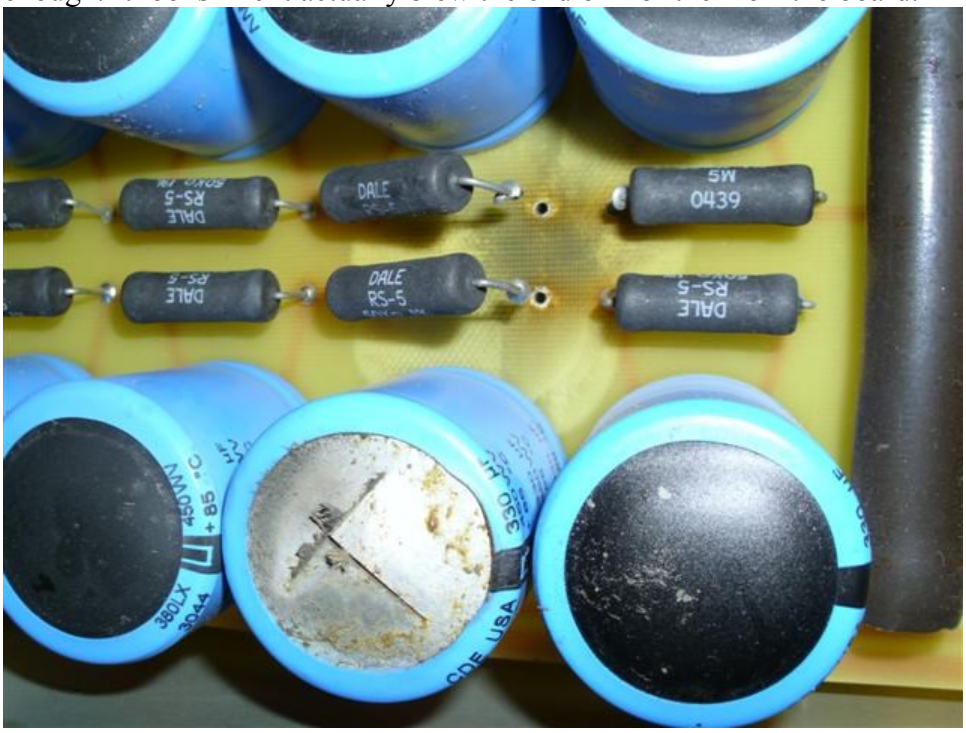


Figure 595 Popping HF2500 power supply

6/18 Put away tools for now, cleaned up the shed, put old TIC ring back together for sale. Started cleaning up and moving stuff to garage for town-wide tag sale next Saturday.

6/20 New capacitors showed up from Digikey. Took out the one bad one and put in a new one. Then started looking at it some more and started wondering about the domed tops on the other 7 caps... the new one had a nice flat top. I cut an X in one of them and it looked ok underneath, but then started pressing and feeling the others and got some fluid from one of them so I cut that top also and it had leaked. So I pulled off the other 7 and will replace those also. Now that the board only has one cap its easier to see the internal damage.

Here is an X-Ray(well, kinda) of the bad part of the board:

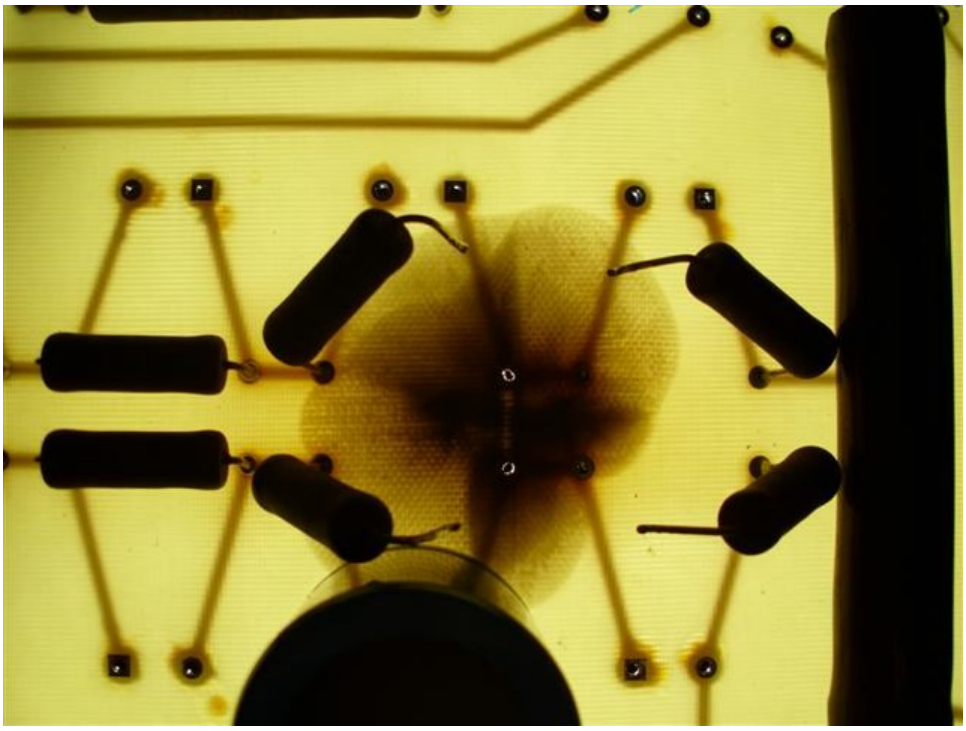


Figure 596 Popping HF2500 power supply board damage

And in normal light:

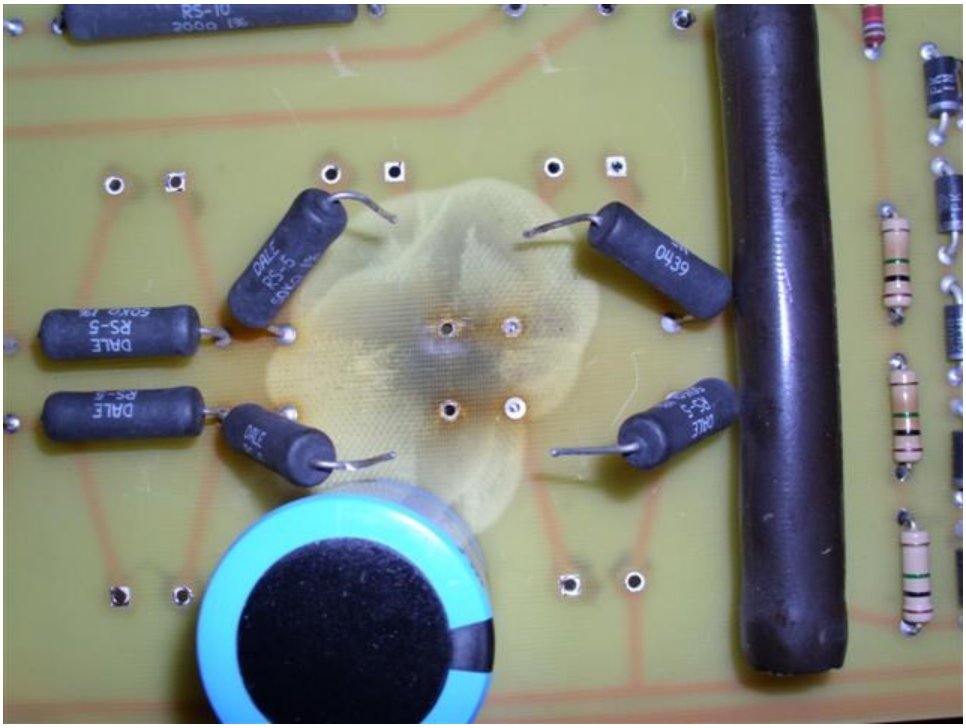


Figure 597 Power supply from top

6/22 Now I know how a dentist feels when drilling out a cavity. I used the high speed cutter and burr to remove all the carbonized stuff I could see, hoping to prevent any future arcing through the damaged board.

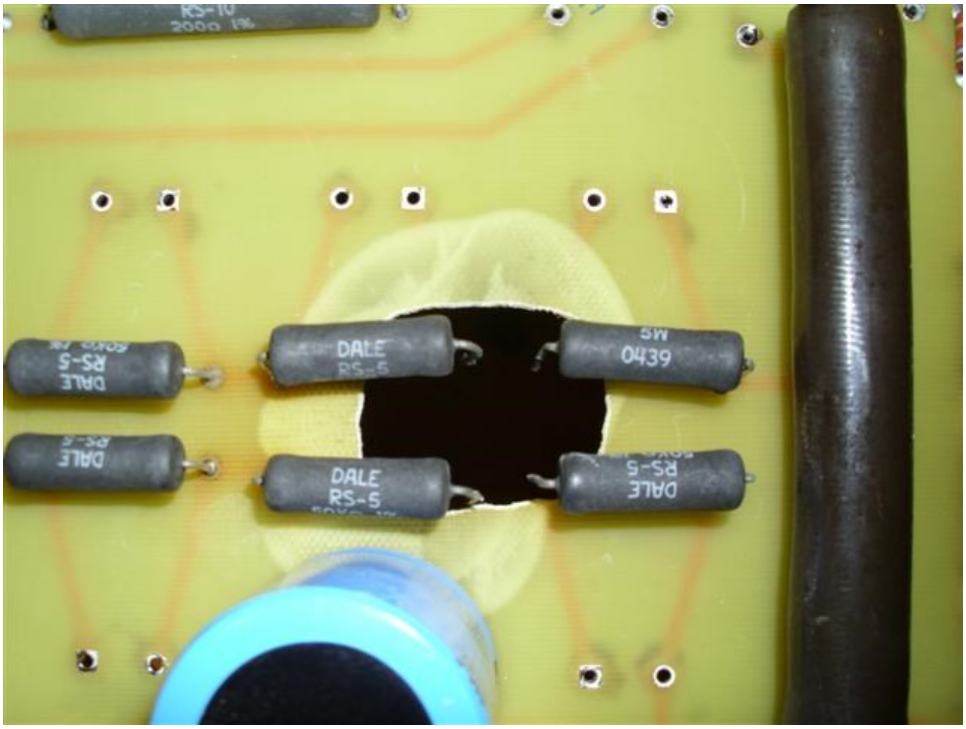


Figure 598 Damage pretty well removed

6/23 Stuffed the board and bridged the gaps with solid copper. Boy its nice to work on a board where

you don't need a magnifier and can use the Weller gun without fear of vaporizing a track.

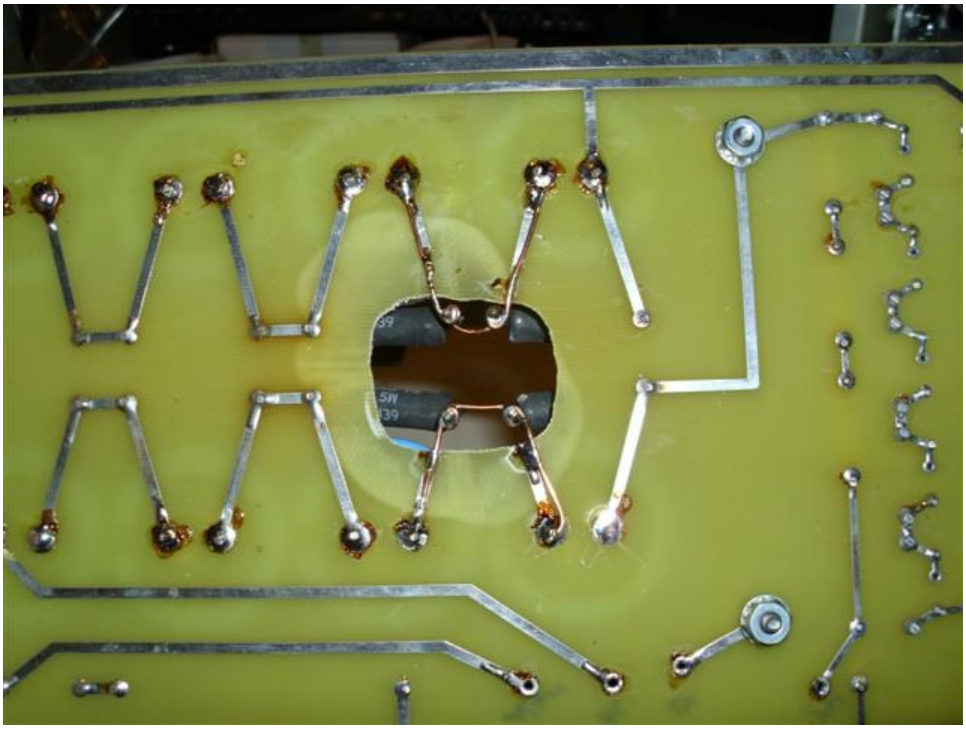


Figure 599 Board repairs

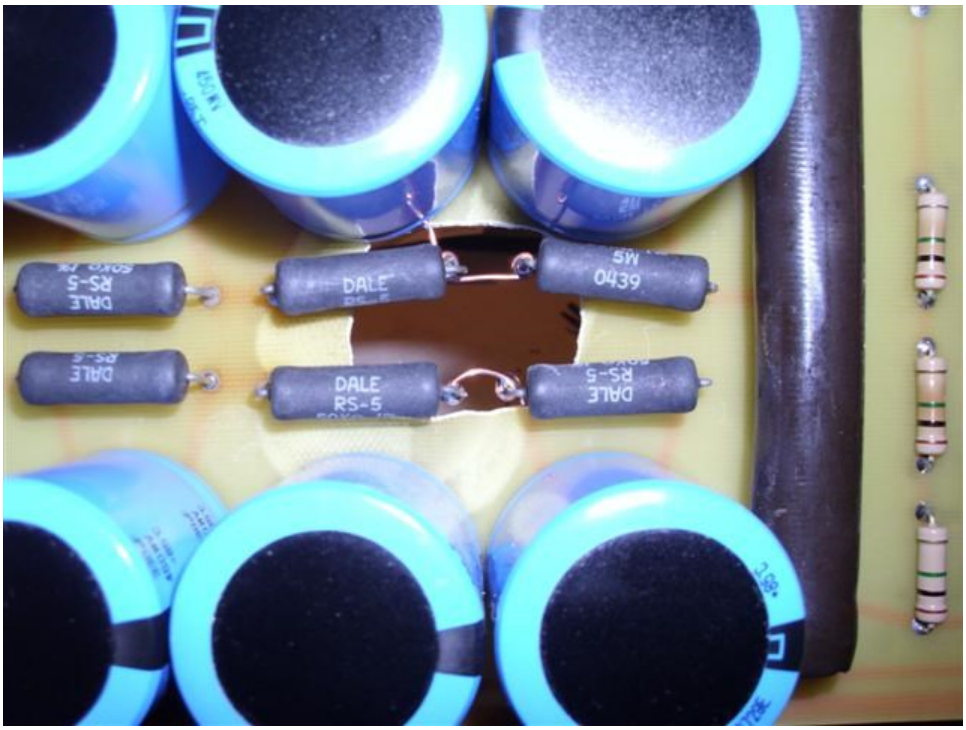


Figure 600 Board repairs

I temporarily hooked it back up, lifted the tube cap connections, and applied power. It came right up to voltage and self discharged properly. Now I have to think about what to do with the partially melted low band inductor form... do I just leave it in place, or rework it into a mono-band amp, or try to maybe make it 40m-10m and see if that keeps it from melting completely.

6/24 While waiting for the hoards of eager shoppers from the town-wide tag sale to take away all my junk I fixed the webcam pages for cameras 1-3 and the outside one to work with Firefox and IE9. They are just a bit pickier on their Java Script.

Just to make sure the motors were ok I froze the newer motors from the 180' TIC ring. I may put one of them up on the 150' ring since it had trouble when it got cold last winter.

6/26 Took the low band coil out of the HF-2500 with the repaired power supply. It was pretty well melted. Took off the 80m and 160m coils, replaced the end piece that was about half gone with one from the spares box, and put it back in. Now that amp is good for 40m through 10m... but should be ok on 40m RTTY now that it won't have the shorted coils.

The 419b filter on the left SO2R radio is not passing 10m very well, looks like about 20db down. Its also not very good on 20m.

7/2 Determined that several of the silver mica capacitors in the 419b have shifted value so the 10m and 20m filters weren't working properly. There is also an intermittent bad relay contact on 80m. Capacitors are on order to fix the bad bands.

7/9 Replaced the capacitors in the 419b filter and now its working fine again.

8/7 Mostly been working out in the yard and on the house. I did make up a power line filter for the K0XG ring rotor, haven't had time to install it yet. Its just a simple low pass filter enclosed in an exterior electrical box. I'll also take up a couple more cores and wind some of the extra cable through them as a common mode choke.

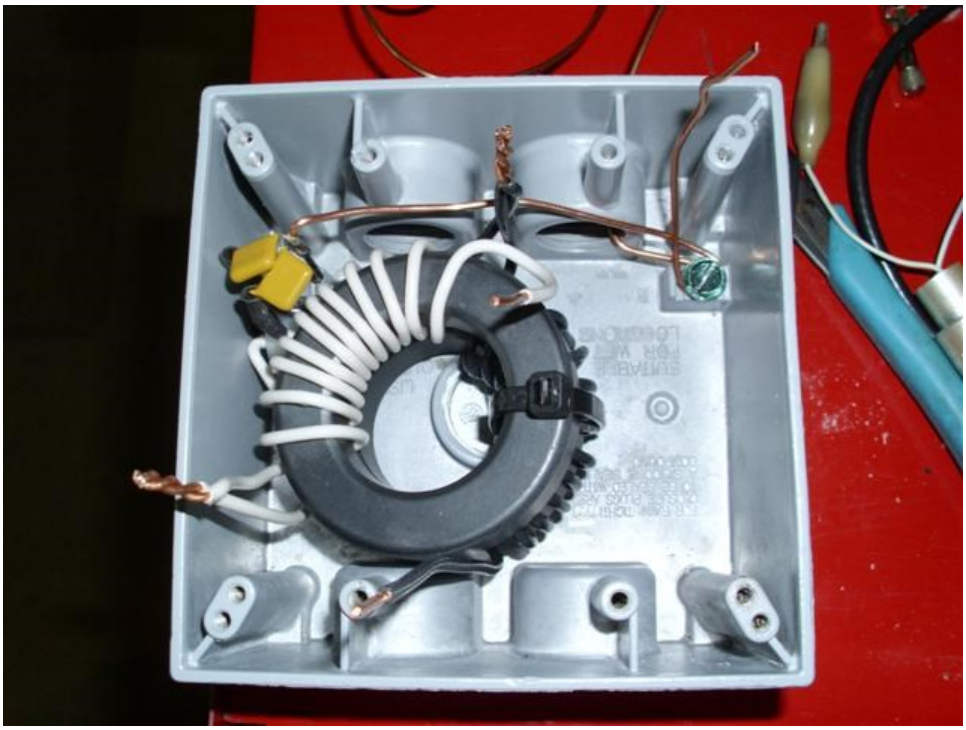


Figure 601 Filter for K0XG ring power

We have had some nice rainbow weather recently also.

Figure 602 Double rainbow over 10m

8/12 First part of heavy construction here got done today. The removal of the rock wall from the field between the 40m and 15m towers should make mowing lots easier. He also removed other rock piles and some stumps. Had to remove the N-S Beverage wires for access.

Removing Stone Wall

Figure 603 Removing stone wall

8/19 Conduit for phone line buried today, and rock wall area graded... got everything seeded then we had big thunderstorm that washed it all away. Reconnected the N-S Beverage.

8/27 Batten down the hatches for Irene... guess its about time to finish cleaning up the down trees from the ice storm almost 3 years ago.

8/28 Noon and the rain started to let up after 4.5" since 8pm. For the first time in 27 years my pond is over its outlet culvert. Pics of the pond below:

Figure 604 Pond full of Irene

Figure 605 Close up of Irene

8/29 Nice breezy autumn morning. Took Pablo for his first tour of the Beverages. Had to cut off branches or whole trees from all 3 of them and one of the radials on the 80m 4-square. The phone wire trench needed some more fill in a couple spots that must not have been compacted enough.

9/3 Bottom 40m beam wouldn't turn past North to the East. Went up and found one of the hold down

rollers had come off and wedged in the outside of the ring and would jam when it got to the motor.

9/10 Finished mowing the brush around the 80m 4-square, broke the DR Mower deck swivel again.

9/11 Ah, the things you see when you don't have a camera... the stream finally went down enough to get to the far end of the NE/SW Beverage. Several of the beaver dams have washed out so the water level was down quite a bit, but still had to walk across a couple downed trees to reach some of the branches on the wires to cut them and get across. There was one big broken up tree down near the end, fortunately the wires were under just the ends of the bigger pieces so I was able to easily get them out from under one part, but they refused to budge from another one. After digging out the end of the log it looked like the wires were grown right into the middle of it. This would have been impossible since they hadn't been there that long and the point where they were would have been about 20' up in the air. What must have happened was that as the piece broke off and came down it had a crack that caught both wires then closed up and stabbed them into the ground under it. I was just about ready to walk back and get the chain saw but was able to roll it enough using a couple branches to cut away a partially rotted side of it with the pole saw and then break them out of it.

9/16 Replacement part for DR Mower arrived, back to work mowing now. Verizon tech showed up to pull cables underground, except he didn't know he needed cable and a helper to pull, so he'll be back Monday. Plumber came and replaced the toilet in the downstairs bathroom.

9/17 Started pulling the stumps of the trees that fell over by the pond in the ice storm almost 3 years ago.

9/18 Finished pulling the stumps. Put a new vertical behind the garage for the QS1R/Skimmer.

9/19 Different Verizon tech here today, still no cable and no helper so rescheduled for tomorrow.

9/20 Third try is the charm... Verizon got two techs AND a roll of 6 pair underground cable here to replace the 2 overhead lines! Replaced the worn out chair mats in the shack.

9/23 80m section of Beverage switch box has a bad relay or two. Switched 80m over to the 160m section for this weekend. 10m antenna selector is acting flakey, release circuit seems to not work all the time.

9/24 10m amp would not go into operate in the morning, swapped in spare amp. In the evening the 15m amp smoked, swapped it with 160m amp. Cut some brush in the RX 4-Square area.

9/25 15m smoked amp still turns on, but crackles and transformer smokes... anyone need a big stinking door stop? 10m amp that wouldn't go into operate has an intermittent switch. Stood up the other 3 verticals in the RX 4-Square... Spacing is 40' on a side, write that down somewhere for the records!

9/29 Fixed 80m Beverage switch by swapping the relay with a bad section with the relay that is only half used.

9/30 Ordered a 7806 regulator and a spare for repairing one of the Yaesu rotor controlers and some spare relays for the Beverage switch box. Cleared out a few trees and cut up some downed stuff around the RX 4-Square area.

10/1 Another perfectly dreary day in the Berkshires, rain started last night and still going. Almost 3" so far from this storm. But a good day to fix inside stuff, repaired the 10m antenna switch controller. There

were 2 pins from the main board to the switch board that carried the 12v to the power switch, they were never soldered properly. I removed the solder and tried to clean them but they refused to take solder. As a fix I just ran a jumper between the boards for the power. Now it switches reliably again.

10/5 New carpet upstairs... Looks kind of empty though.

Figure 606 New carpet

10/7 I love it when a plan comes together... Over a month ago I arranged for new carpet installation and ordered some furniture from LLBean. Then I told the neighbor across the street he could have the old couches if he wanted them, which he did to put in his basement for visiting grandkids rec-room. Last week the carpet installer called and arrange for installation Wednesday this week. So I told the neighbor the furniture had to be out by Tuesday, so he said he would be over Sunday. I then got an email notice that the furniture had been shipped, but they couldn't say when it would show up as that was up to the trucker. The neighbor kept putting off moving stuff till Tuesday night when his helper had to back out so it was just the two of us using his tractor bucket to get the stuff down from the deck... Not a good thing, he dropped the sleeper couch, but didn't really damage it much, so we carried the long one down the steps. Then he asked if he could get a piece of the old carpet for the basement also... Well, Wednesday the installer shows up and is happy he doesn't have to move the couches so is fine with cutting him out a piece as that is less trash for him to dispose of anyway. After they rip out the old stuff I tried to patch a few squeeky spots in the floor, there is no plywood on that floor, it is tongue and groove on the wide spaced beams. I glued a couple spots with construction adhesive squeezed into small holes drilled in the joints, and added a bunch of short deck screws as wedges in the joints. They finished up installation

about 2pm. About noon I got a call from the truck dispatcher who said they could deliver between 10am-2pm Thursday... Thursday about 11am the driver himself called and said the dispatcher didn't know what he was doing and it would definitely be after 2pm. I had another neighbor waiting to help since the truck was going to be a full size tractor trailer, which just doesn't work on my road. So I borrowed the neighbor's(the one who got the sofas) old pickup bed trailer, and a ball that wasn't the right size from the other neighbor, and hitched it up to the JD mower and had that waiting to drag the stuff up the road from the corner where there is room to turn the truck around and unload. 4:30pm the driver finally calls and says he is leaving Pittsfield and will meet us in about 20 minutes. Right on time the neighbor(the one with the hitch ball) and I meet him at the end of the road and we unload all 7 boxes into the trailer. The neighbor and his wife walk up the road next to the trailer to make sure nothing falls off and then helped unload and get the stuff upstairs and into the house. The sofa neighbor comes over and helps a bit, then loads the carpet onto the trailer which I drag across the road and unhitch for him. Then the other neighbor helps attach legs and arrange the furniture... So a bit after 6pm we are done and break down the cardboard for going to the recycle bin at the dump Saturday... Just in time for contests the next 2 weekends and a visit from the local IEEE section members who wanted to come see the solar array after I gave them a presentation on the construction back in the spring.

Figure 607 New furniture

Pablo isn't sure about these changes yet.

Figure 608 Claiming his spot

10/9 Beverages aren't working right so take a walk around them. The N/S one had one wire on the reflection transformer pulled off. The NW/SE one had the ground on the reflection transformer off. Cleaned up the RX 4-Square area some more.

10/10 Hooked up the RX 4-Square. Had to replace another F connector on the box end of the cable and had to check the splices in the power cable.

Lightning damage to Beverage

10/16 Wind is getting cold, and there is snow in the forecast... well, not for here, but at least in the lower 48. So must be time to really check out the Beverages. They were working a bit better after a quick check of the connections a couple weeks ago, but when I put the TDR on them they still aren't right.

The NE/SW one first: Had bad solder connection on one wire going to the reflection transformer, so I replaced both jumpers. Also replaced the reflection transformer with the spare, just in case... and it did test bad back at the shack... one of the connections from the transformer to the board had lifted off. Repaired and retested the reflection transformer.

Next the NW/SE one: Looked bad at the box when pinging the NW input. Box rattles when taken off the post, this can't be good! Replaced box with spare. Now it looks better, but something wrong at far end.

Hmm, the reflection transformer case is blown out at the top and bottom, and it rattles also. Must have been direct hit or side flash to this Beverage.

Outside of NW/SE Beverage Box:

Figure 609 Lightning arc on outside of Beverage box

Inside of NW/SE Beverage Box, note the lifted traces and the capacitor in the background:

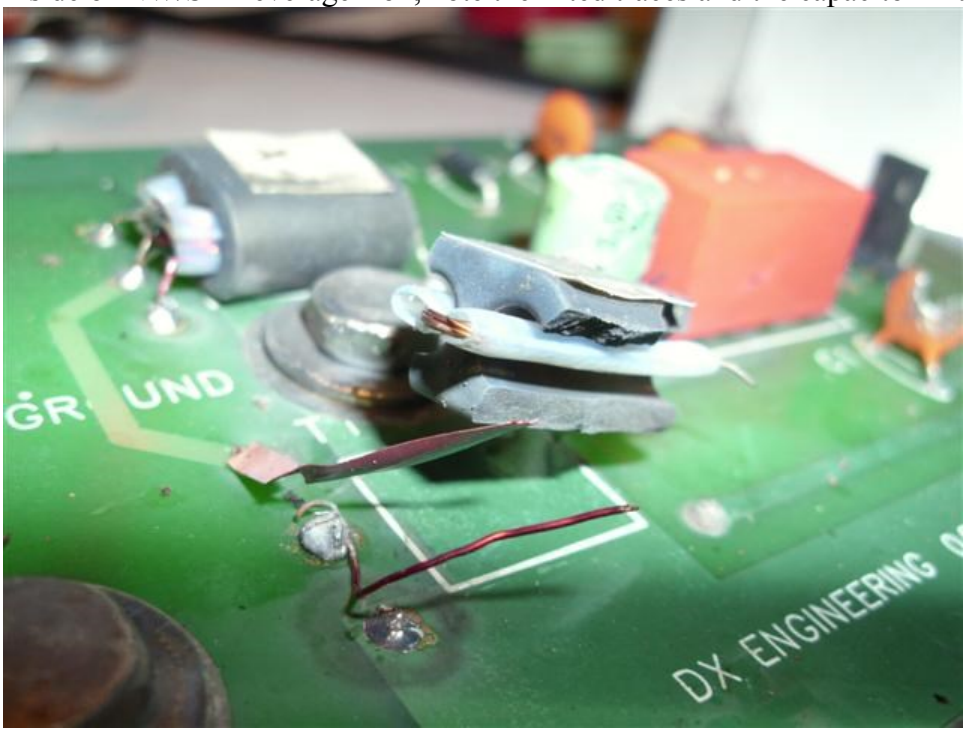


Figure 610 Damage inside Beverage box

The reflection transformer, note the top and bottom are bent outwards:

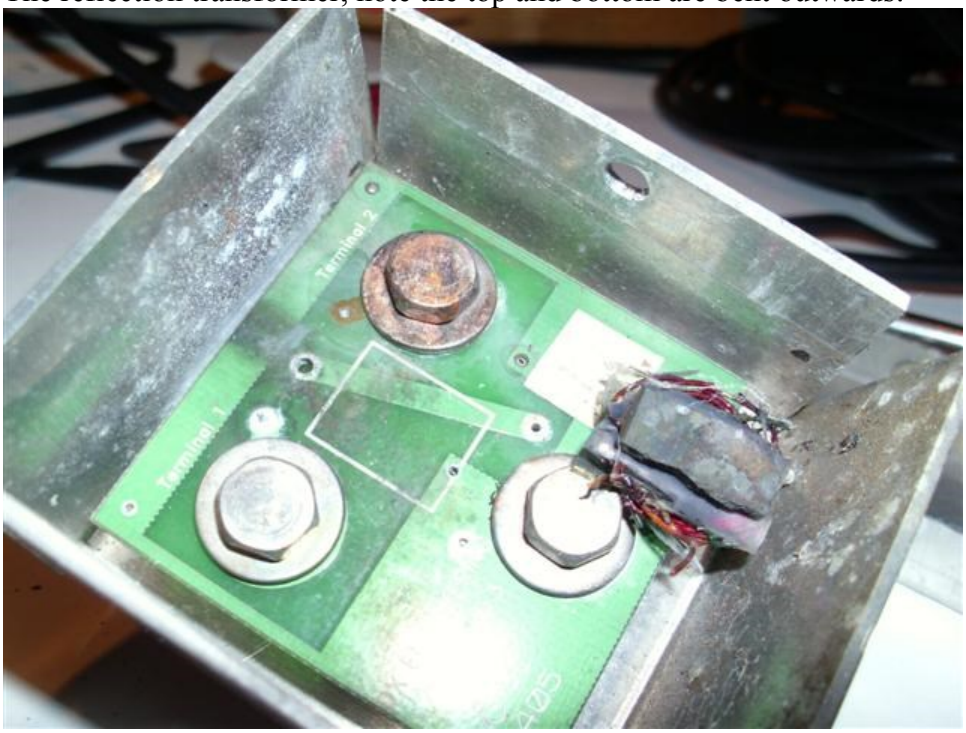


Figure 611 Damaged reflection transformer

Finally the N/S one: This one also looked bad at the box on one input. It didn't rattle, but had some burned off wires on the S direction transformer. On the plus side, the reflection transformer seems intact.

Ordered 2 replacements from DX Engineering and queried about replacement transformer availability.

10/18 Replaced the 30' jumper from the hardline to the relay box on the 40m tower. The hardline connector was pretty corroded between the shell and aluminum jacket, and the pin had pulled back about 1/4". Also swapped relays in the box for the top Yagi as that one seemed to have a slightly burned contact. After replacement the tuning changed a bit, and some cracklies I was hearing on 6m when transmitting on 40m seem to be gone. In a short test I could not get the RX sensitivity drop that I had been seeing Sunday when testing it.

10/19 New Beverage boxes in, installed N/S one. Below is a set of new TDR traces. The top trace is the conventional TDR image of the selected direction. The bottom trace is the return signal on the opposite direction, this should show that the reflection transformer is doing something. Sweep speed is .5usec/div.

A timeline of what you see on the top trace from left to right... The initial step is the start of the pulse. The little smudged part about .1usec long is the 50 ohm jumper from the TDR to the 75 ohm feedline out to the box, plus a little ringing. The first flat part is the 75 ohm line to the box. Then there is a spike probably from the L/C components in the box used to separate control voltage from the RF. Then the long slightly wavy part about 2usec is the wires going through the woods, it slopes down because of the loss into the ground and weak radiation. The discontinuity near the middle is the reflection transformer and should line up with the return signal on the bottom trace.

There is a slight difference in the first 3 vs the last 3 because N/NE/SE are all the 'forward' direction

where the difference signal is generated by the reflection transformer, and the S/SW/NW are the 'backward' direction where the signal is coming in phase down the length of the pair of wires.

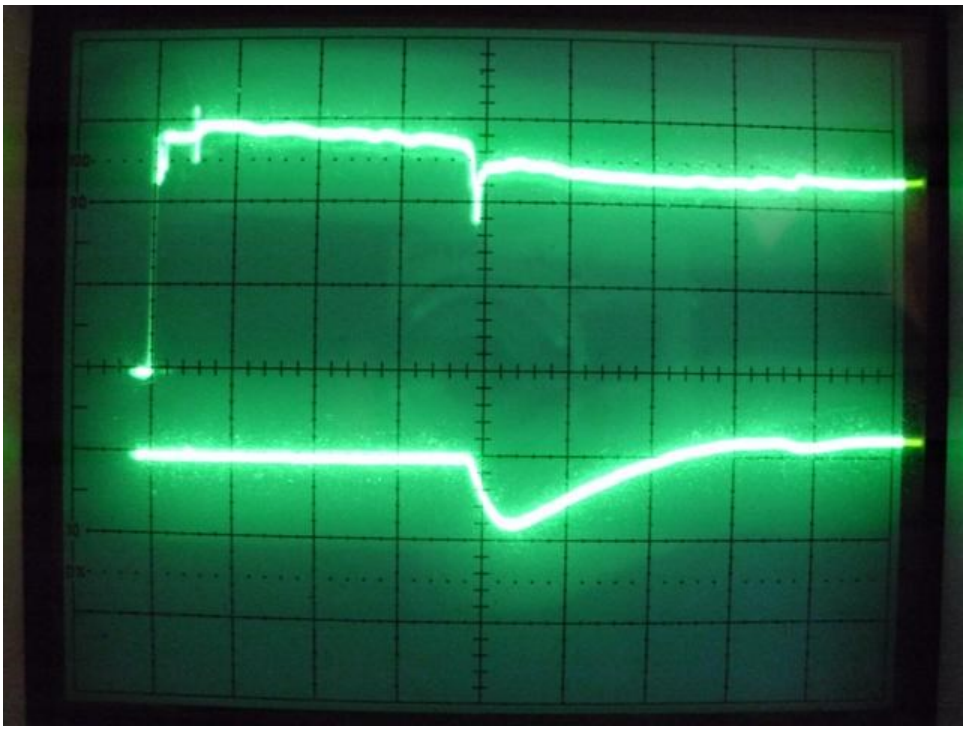


Figure 612 Beverage TDR traces - North

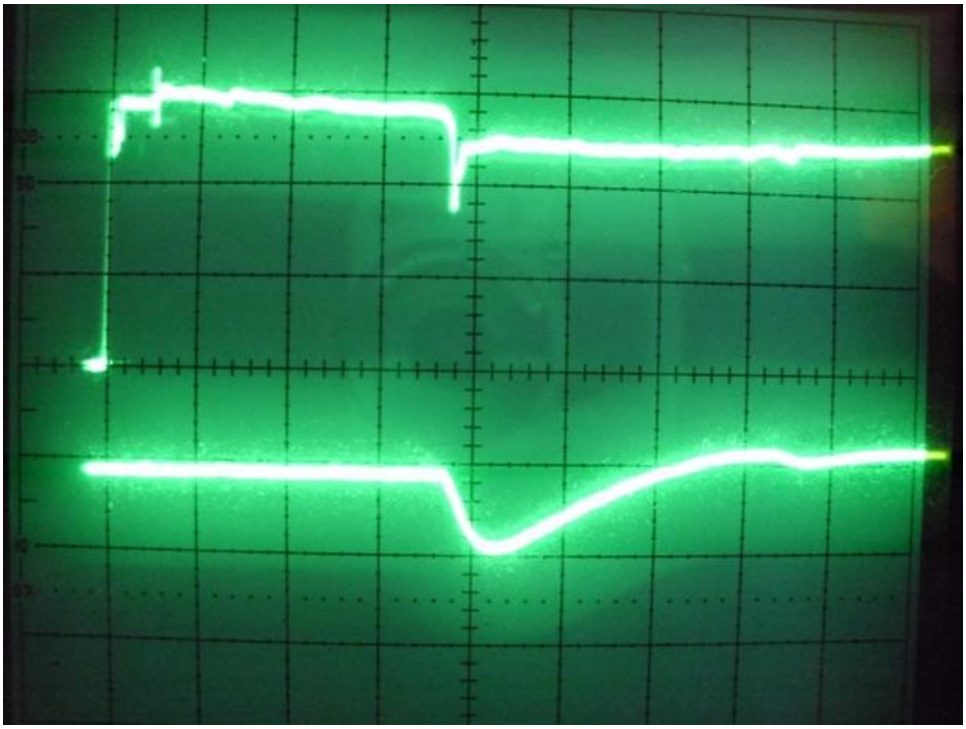


Figure 613 Beverage TDR traces - NorthEast

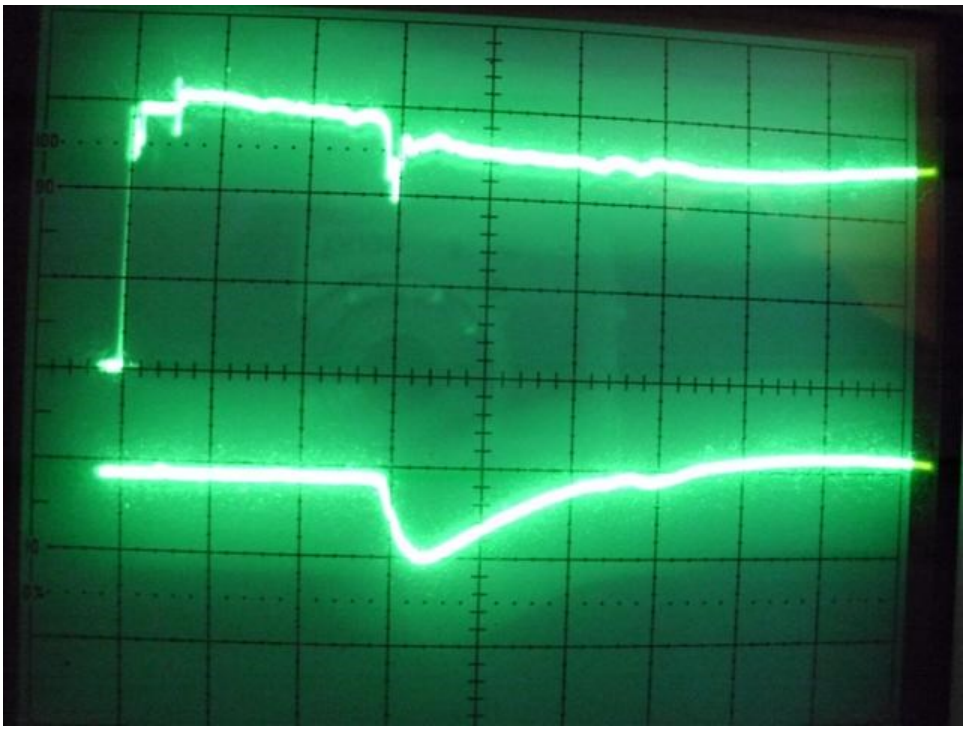


Figure 614 Beverage TDR traces - SouthEast

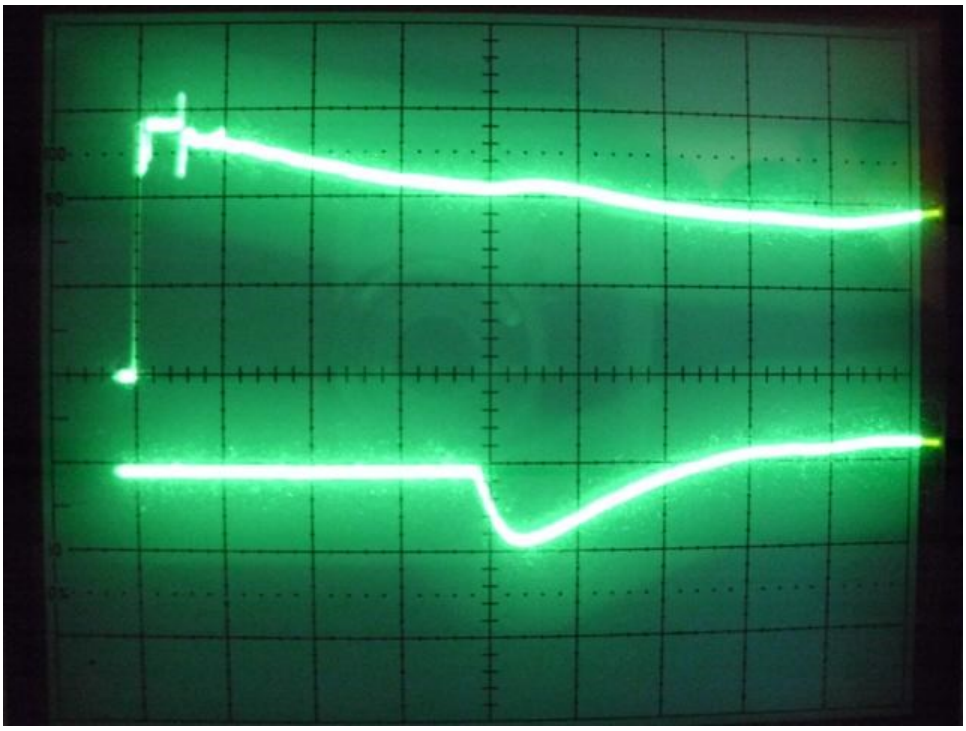


Figure 615 Beverage TDR traces - South

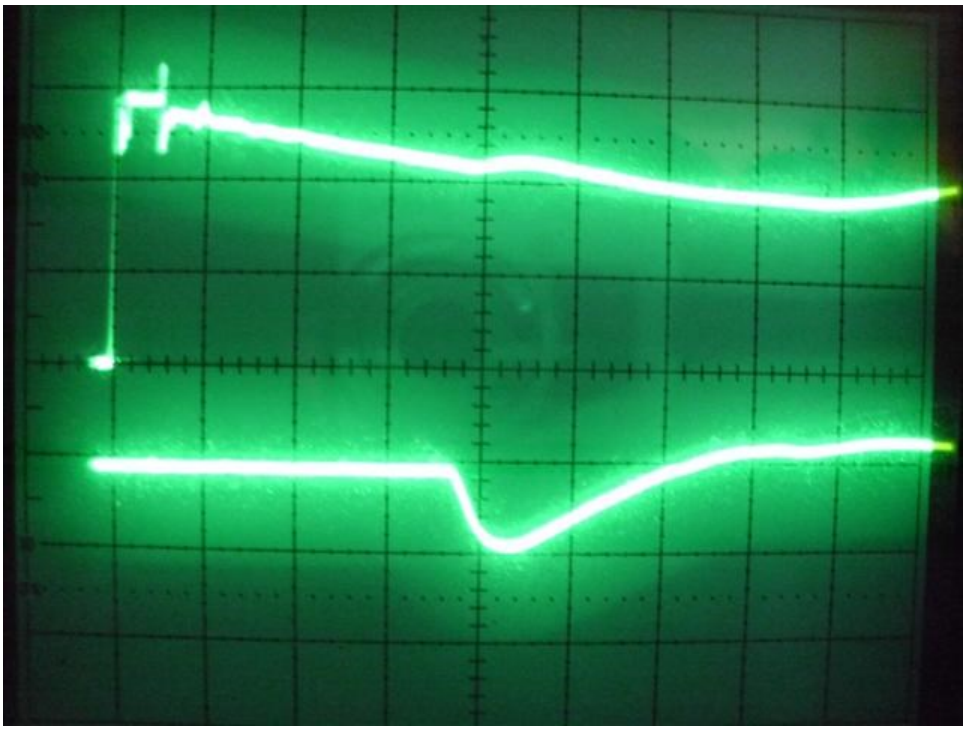


Figure 616 Beverage TDR traces - SouthWest

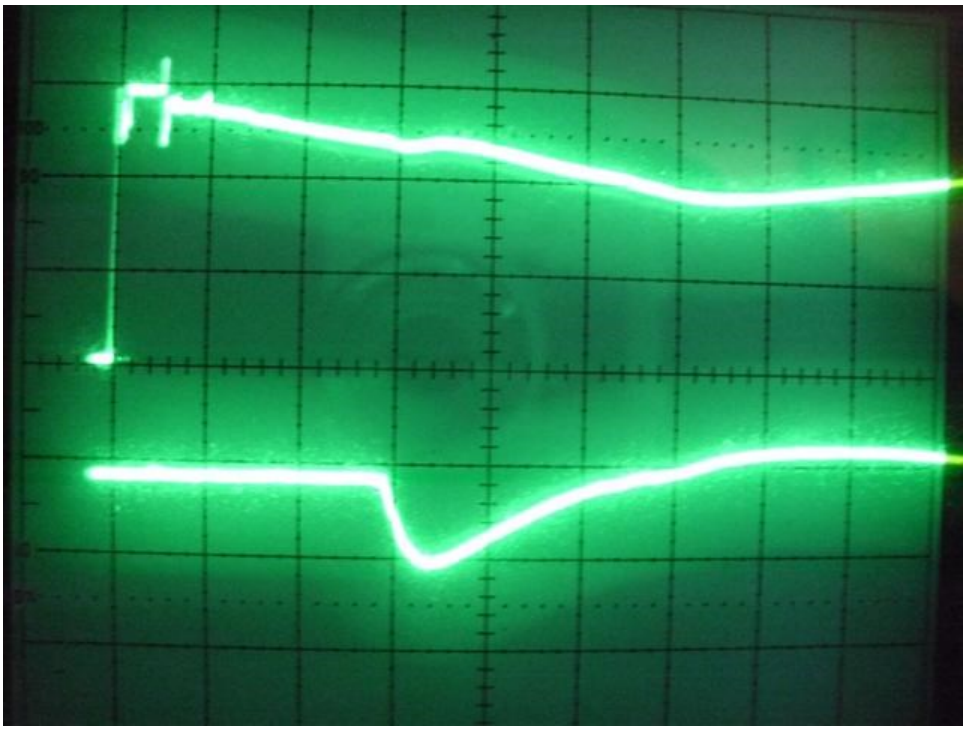


Figure 617 Beverage TDR traces - NorthWest

10/21 Did a bit of clean up and taped some of the feedline runs that were looking ugly. Fixed broken cable support wire where 40m 4-square and RX 4-square feedlines split.

10/22 Berkshire Section IEEE Power Society visited BIG, the PV array, and the station for a lunch meeting. It was mostly centered on the PV array installation and operation.

Figure 618 IEEE tour of BIG!

Figure 619 IEEE tour of BIG!

10/23 Cut brush around North-West guy of the 20m tower. Hooked up a pre-amp for the RX 4-square. Snow in the forecast this week for here, so cleaned up the garage, moved the brush mower and trimmer to the shed, swapped the mower deck for the snow blower on the JD, and put the shovel back by the front door.

10/28 6" of snow last night. 160m UPS dead. 180' 10m hardline connector appears to be open again up on the tower. 150' 20m rotor was frozen for a while until the ice from the wet snow melted a bit this morning. Walked the Beverages, only a few small branches down.

10/29 Cleaned up feed points and radials of 160m Inverted-L's because there was lots of arcing noise from it last night. Had to replace 160m UPS again, guess the spare one wasn't all that good either. Top 20m rotor freezing up again when temperature drops, must be water in the motor. Made new rake for cleaning the solar array.

The old handle on the right, the new broom on the left. The handle and braces are from a roof rake.

Figure 620 New broom for solar array

Detail of the broom head. Braces are attached to broom with just short drywall screws.

Figure 621 New broom for solar array

The handle is attached using a 1/4"-20 bolt, the one needed is a bit longer than the one that came with the handle because the broom head is thicker than the rake head.

Figure 622 New broom for solar array

Stowing the broom under the array. It also fits in the end of the pipe but sticks out farther due to the

braces.

Figure 623 Stowing new broom

Snow!

10/30 20-24" of snow last night measured by the big dog estimation method.

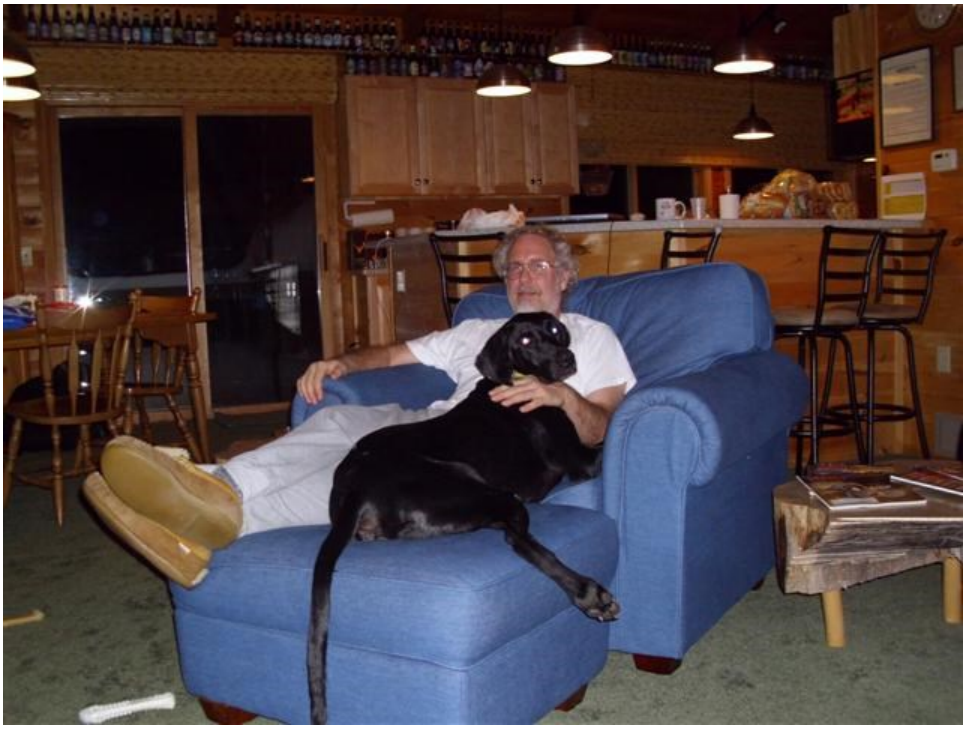


Figure 624 Relaxing during the storm

After the first round of snow blowing.

Figure 625 A bit more snow

The snow must have been afraid of the new rake so it cleared itself off the array this time.

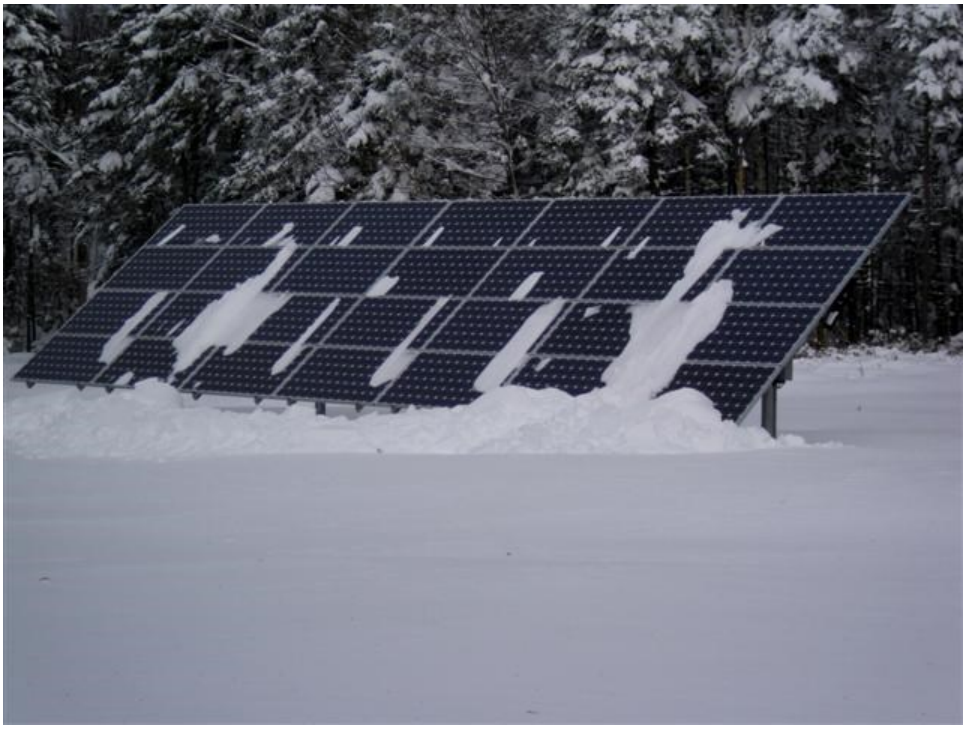


Figure 626 Snow cleaned itself

The big dog snow depth estimation method at work.

Figure 627 Big dog snow depth measurement

You could also use the BBQ to measure the snow. Its a good thing I decided to cook all the sausage for lunch yesterday.

Figure 628 Yes, more snow

11/2 Nice evening for a climb, about 50f and 3-4mph breeze up on tower. Went up 180' and removed the 10m hardline connector after confirming the center conductor had pulled back. Cut off N connector on

RG-213 and just spliced them together. Also checked 160m Inverted-V connector, it was one of my plumbing fitting connectors but suffered almost the same problem. On that the center pin of the barrel connector had pulled back and was just barely making contact. I was able to jam it farther down in and tighten back up so it should be ok for this winter.

11/21 Replace batteries in 2 APC UPS's, one replaced a failed one from 15m, the other is now a fresh spare.

Pablo's best one day shoe collection yet:

Figure 629 Pablo shoe collection

Ice

11/23 Ice!

8am Pictures

150' 20m stack

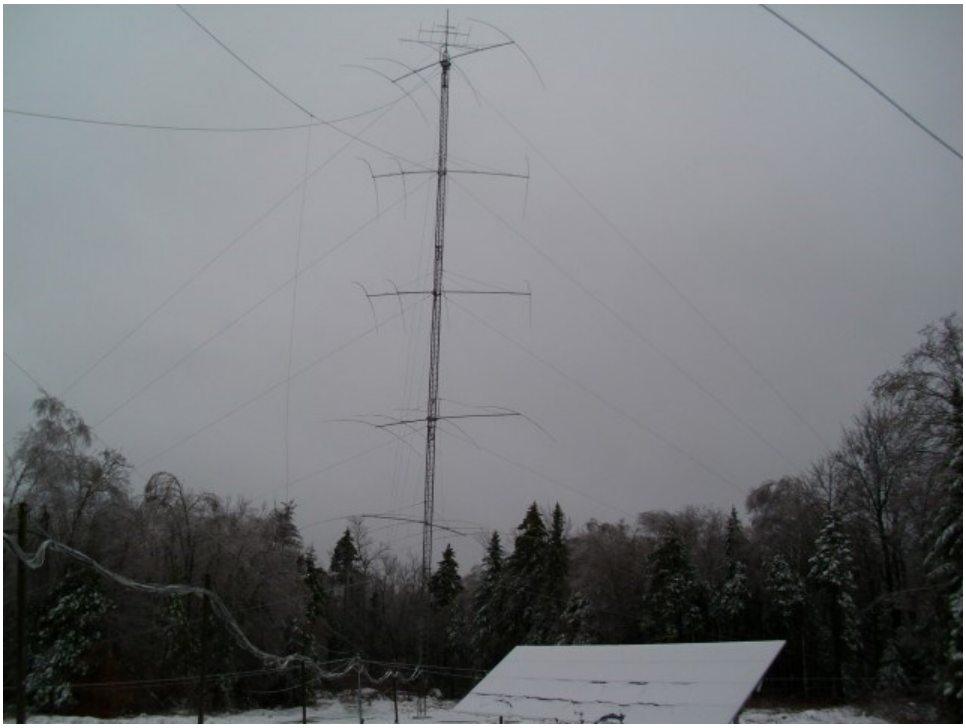


Figure 630 Ice on 20m

Figure 631 Ice on 20m

Figure 632 Ice on 70’ 40m

Figure 633 Ice on 180’ 40m

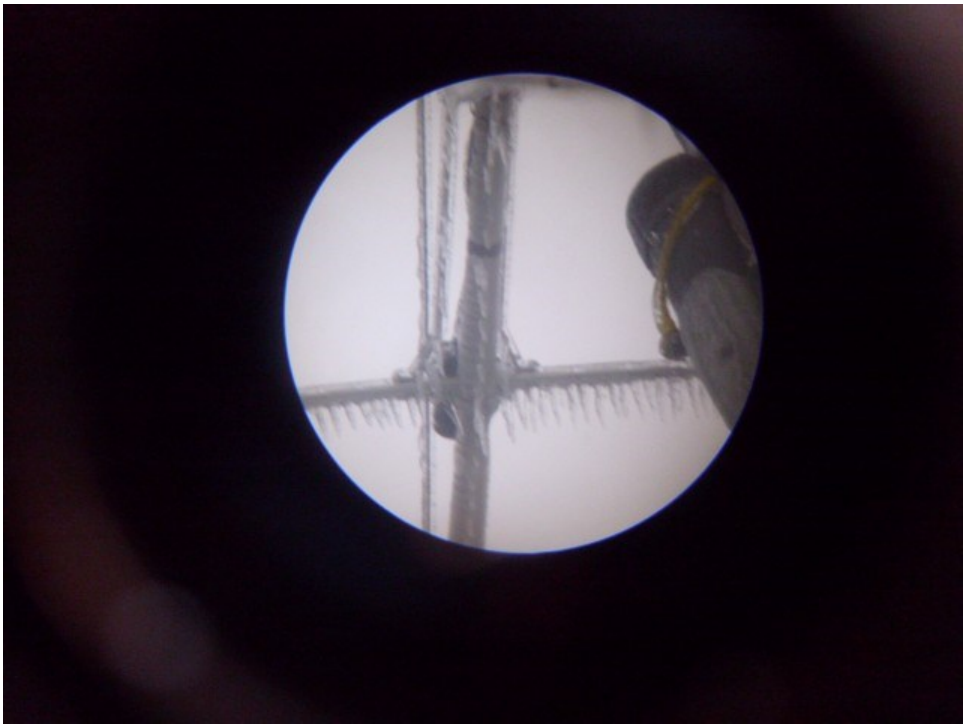


Figure 634 Close-up of ice on 180’ 40m

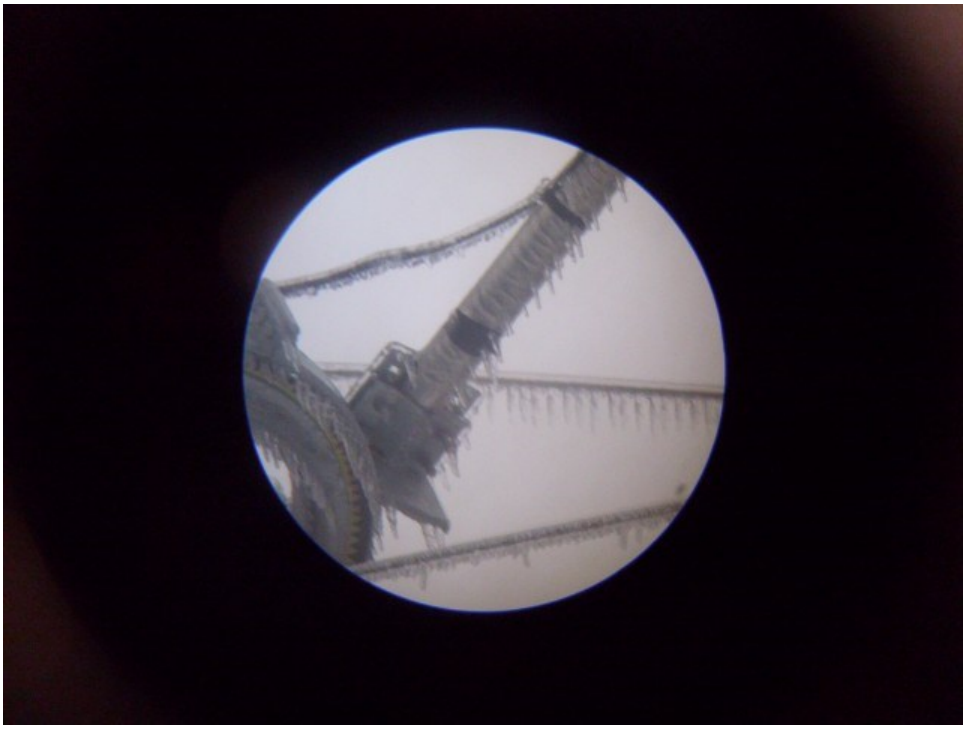


Figure 635 180' 40m Yagi boom bracket and RG-213 jumper for reference.

While waiting for the ice to melt (it never did) I did some adjustments to the HF-2500 that was repaired back in June. The 40m tuning was not quite right on it, the tune capacitor was always at the minimum so there was no real peak/dip. I first took out one turn from the inductor. That helped, but it moved the best spot more on the load capacitor than it did on the tune one, but at least the tune capacitor had a real

peak/dip point. Next I disconnected the extra section of the tune capacitor that gets added in on 40m. This moved the tune peak up near the middle of the range, but I'll have to wait till the ice melts to get a better feeling of the tuning range.

11/24 Ice still mostly hanging on. Wind didn't get too bad, maybe 15-20mph. Chunks of ice that came off confirmed about 1/2" thick coating with icicles on top antennas. More pictures around sunrise:

Figure 636 Ice in sun

Figure 637 Icy trees

Figure 638 Icy 20m

More if you like ice:

- Bottom of 180' tower
- Top of 180' tower
- Top of 120' 15m tower
- Trees and bottom of 150' 20m tower
- Driveway and BIG!
- Closeup of ice separated from element on 15m stack
- Closeup of ice separated from element on 15m stack

If finally warmed up late in the afternoon and stayed above freezing over night so by Friday morning all the ice was gone and everything looked ok.

11/25 Walked the Beverages, only some small branches down around them.

11/30 Deer knocked down part of NE/SW Beverage when Pablo stampeded them when we went for our evening walk. A branch was down on the near end of the NW/SE Beverage. Both were fixed with the insulators found on the ground.

12/3 Nice morning for climbing towers... 27f and no wind at 8am, so went up 150' tower. Top ring motor is frozen, confirmed that the output gear didn't even try to move. Replaced it with a newer motor and it turns fine. Taped up some loose cables and adjusted the 120' 20m boom brace on the way down.

Water that came out of the first gear box. I had already removed the plug on the second gear box and didn't see any water in it, that one is pretty well packed with grease. But the first reduction box wasn't

packed with grease.

Figure 639 Water from TIC Ring motor

Peeling the motor. It had something like Gorilla tape on the outside, then foil tape, then electrical tape holding the filter board in place and wrapping it.

Figure 640 TIC ring motor

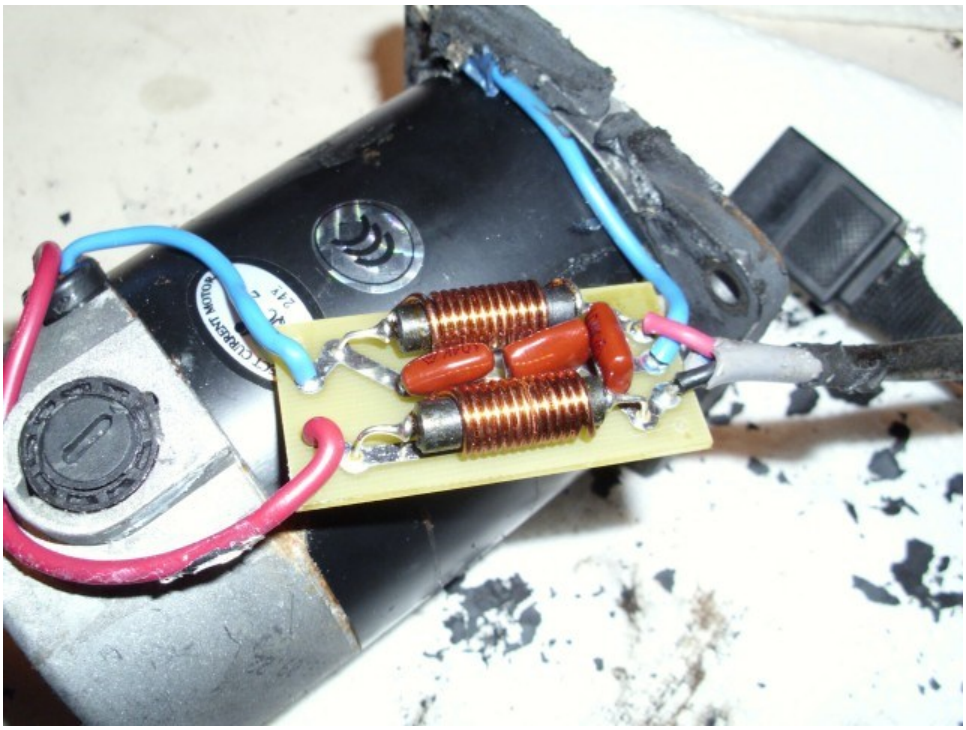


Figure 641 TIC Ring motor filter board

I couldn't get the back end screws out of the motor. I did take out the brushes and it looked nice and clean inside. I also did a freeze test on just the motor and it spun up just fine after several hours in the freezer.

12/9 Found more damage inside Beverage relay box. At least 2 relays are shorted and another one isn't switching. Would give weird effect of paralleling multiple Beverages depending on combinations of station selections. Ordered parts to build new relay system, going to try three Ameritron RCS-10 boxes, one for each band. This will also give 2 more positions since they are 8 input boxes, I'll just have to change the coding on the 3 wires to do the full 3 bit count.

New RX Antenna Switching

12/13 Received the 3 RCS-10 switches from HRO. Modified the 3 Beverage controllers to send the full 0-7 binary code to enable all 8 ports on the switches. Hooked up one of them with the Beverages and RX 4-Square to try the isolation and switching from the SO2R position. Seems to be fine, may need aluminum foil on the plastic cover, but isn't bad at all on a quiet night.

Building new 8x3 RX Antenna switch from off the shelf components.

This is a single RCS-10 switch hooked up to the already modified Beverage controller.

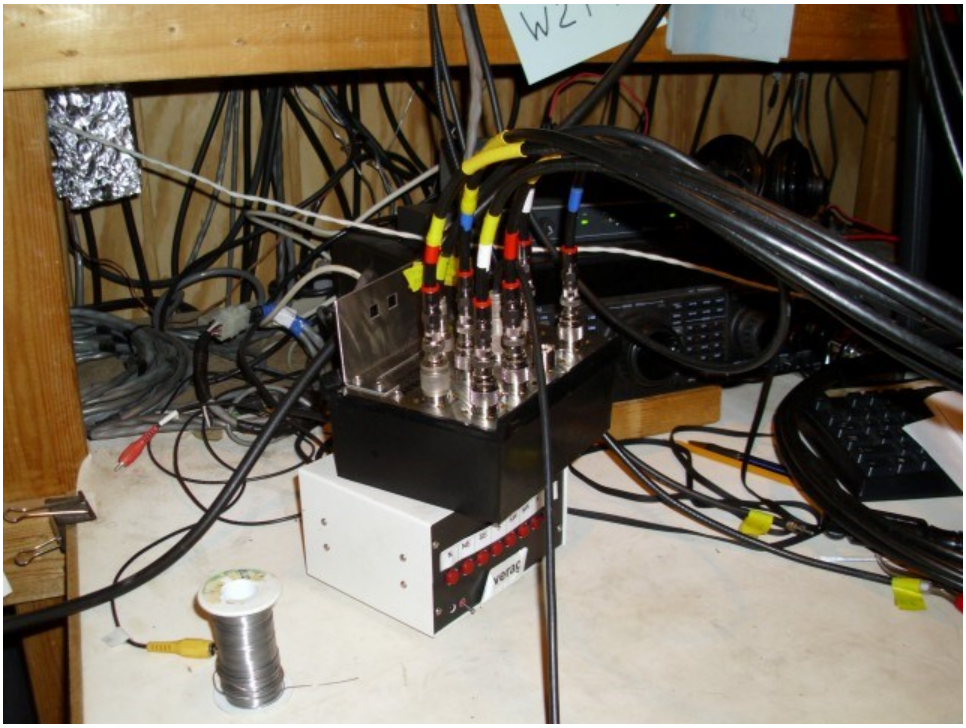


Figure 642 Start of new RX antenna switching

I thought I had enough jumpers and adapters to hook all 3 of them up, but the input connectors are too close together so the T's and cables wouldn't fit. So I had to rethink and order up a few more adapters and cables. Here are 2 of them amost hooked up. The 3 boxes wrapped in heavy duty foil on top of the MT-3000 are the RCS-10 boxes. The Beverages and RX 4-Square come in to the jumble of connectors hanging down in front and are split 3 ways. The preamps for the 4-Square and Beverages are stuck between the tuners and amp.

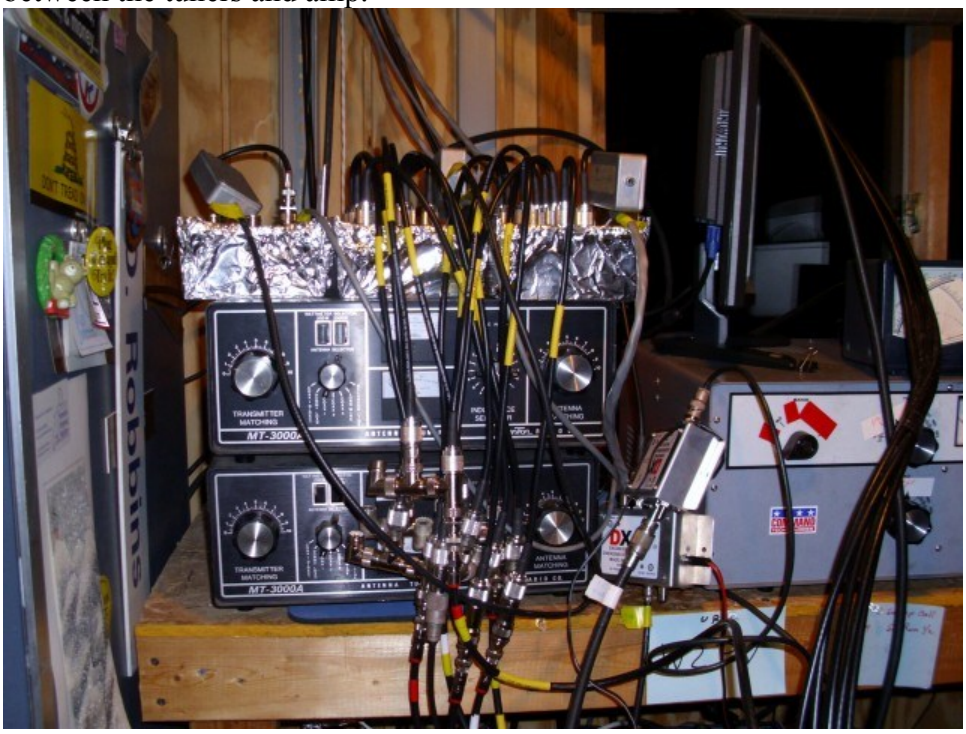


Figure 643 Progress on new RX switching

12/16 Got more cables in and finished the basic hookup.

The 3 RCS-10 switches are mounted on a piece of 1x3 that has 5/16" bolts through it. The cables still need to be dressed up a bit. The left preamp is for the RX 4-Square. The right one is for 160m or the SO2R position. The bandpass filters are in the boxes on top of the switches, the 40m one is bypassed through the preamp now because the station is in SO2R configuration for the Stew Perry 160m contest.

Figure 644 New rx switching installed.

12/18 Finished zipping up and renaming lots of old contest data. Combined contest data with dx spot databases and book stuff into new download data site. Looking to set up mirrors on fatter pipes as even just the first announcement clogged the dsl line.

12/22 Finished dressing up cables for new RX antenna switches. Added RigRunner to power pre-amps.

12/23 Got first two mirrors up for the download site.

http://dxc.wc2l.com/k1ttt/
http://www.wc4j.net
anonymous ftp ftp://wc4j.net

12/27 New dining room table is here... chairs are still being finished so won't be here for another week or two.

12/28 Replaced GFI breaker that was shutting off the kitchen lights when the low 80m dipole was used. Also replaced some other odd breakers with regular QO single pole breakers.

2012 – Cutting Trees and Chasing noise

1/7 First trip up the 180' tower today to fix a sticking indicator on the K0XG ring rotor. The shaft was binding in the bushing coming out the bottom of the pot housing so I wicked some 3-in-1 oil up the shaft and worked it around until it was moving freely again.

1/8 Top 20m rotor still freezes up... could it be that this one has water in it also? I tried freezing it before it went up, but maybe in a position that would not have affected the low torque gear?

1/22 Nice January day, 15f and a couple inches of new snow on top of the ice. I took Pablo for his first cross country ski trip around the Beverages. He did pretty good, he quickly learned not to chase the tips, and only tried walking on the tails for a short distance. He did end up taking a chunk out of one pad on something, but it didn't slow him down. There were some more small branches down on the 80m 4-square radials and on the Beverages and trails, but nothing too big and no other damage.

1/27 A bit icy this morning:

Figure 645 More ice

Fortunately about 3pm the temperature shot up to 36f and it rained so most of the ice came off the top antennas just before the wind started.

1/28 Winds over night gusted around 45-50mph probably, the anemometer was frozen so there is no record. Some of the 160m Inverted-L radials are down. One tree came down on one of them, others just broke from the weight and/or falling ice. Ice was a good 1/2" thick on the top antennas. There is still some ice left on the lower antennas and Beverages.

Put back up a couple radials on each of the 160m Inverted-L radials and reconnected the North one. Guess it really is time to replace them with new wire.

1/29 Tested 3 more of the same vintage ring rotor motors as the one on the top 20m ring in the freezer. One of the 3 froze up, the other 2 seem ok.

2/4 Walked the Beverages. Only some small branches down on them this time, even after all the ice and wind last week.

2/11 Pulled a couple broken little trees off the 40m 4-Square radials.

2/24 Another ice storm followed by high winds. Only about 1/4" of ice on stuff so there don't seem to be any problems.

3/3 Typical of this winter.. more ice.

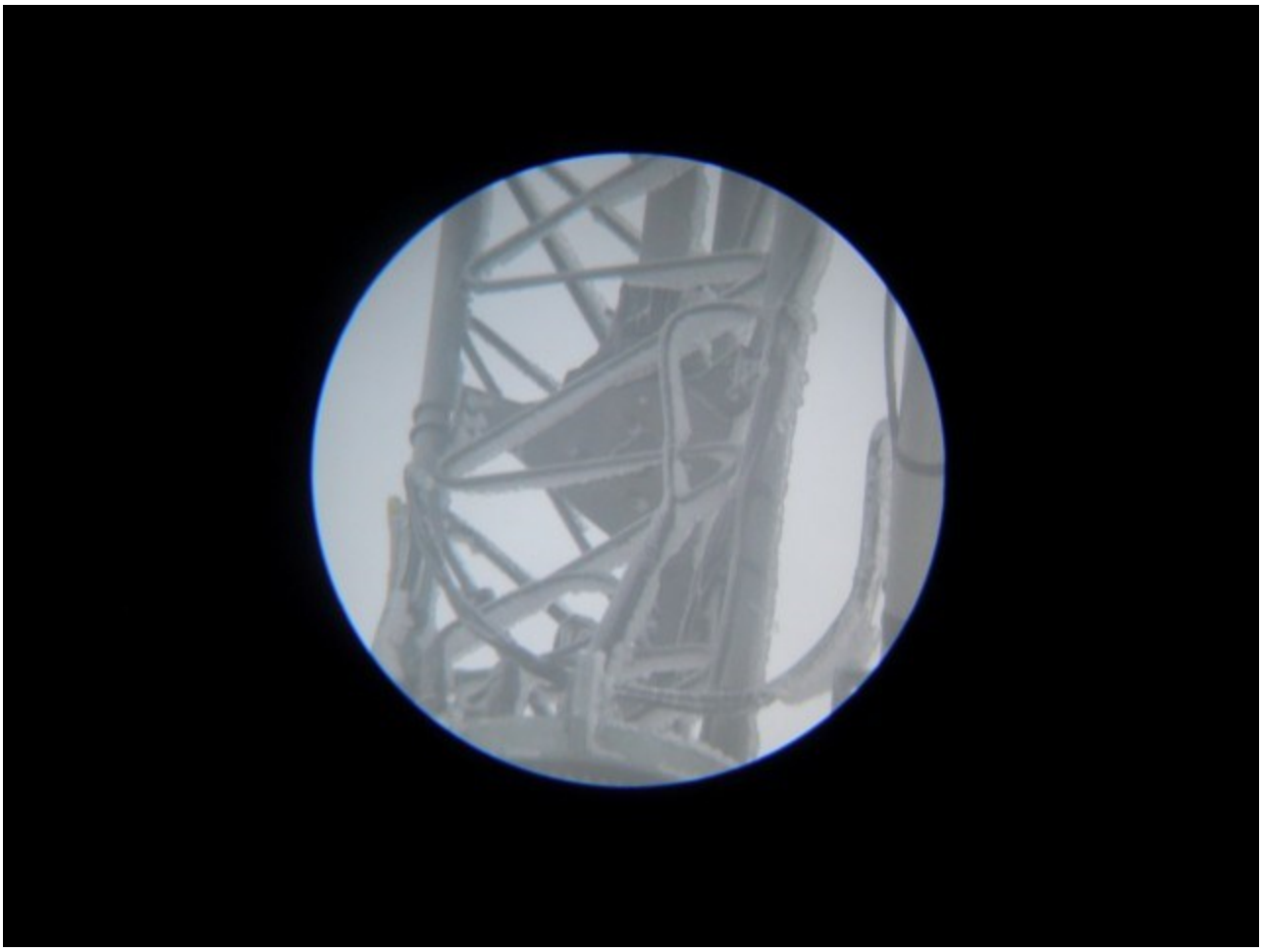


Figure 646 And even more ice

3/17 Finally got up to replace the top 20m rotor motor. Also had to realign the bottom 20m ring as it was about 30 degrees off. The top 40m ring was about 30 degrees off also, that was realigned using the Green Heron controller calibration procedure.

4/12 Been an exciting couple of cold and breezy weeks. Doing the spring rock harvest, digging out the new growth left over from the roots of the stone wall removed last year. I finally bought some better PTT switches, the Heil HS-2 trigger grip style. They sure feel nicer than the little pushbuttons that were starting to get flaky.

4/14 This is one of the fun things that goes on when no one is here playing contest. I have been carefully tending this rock for years until it finally ripened... now it is my trophy rock from the spring harvest.

Figure 647 Rock harvest

Pick the best caption:

- I know I buried that bone around here somewhere!
- You didn't like it when I dug holes in the yard!
- If this is what passes for fun in Peru, I want to go back to the city!
- When do I get to dig?
- I hope you don't expect me to fill this hole in now.
- That steroid shot for my skin problem must have had a few side effects.

- Boy am I going to be in trouble when Dave sees this mess!

More pics if you are curious:1 2 3 4 5 6

4/22 Removed winter ground screens and the plywood that was around the bases of the towers from the 80m 4-square area.

5/7 K0XG ring indicator is stuck again. He is sending me a new one to replace it.

5/18 George came up and I went up the 180' tower with the replacement pot assembly for the K0XG rotor. This one has a brass bushing instead of the phenolic one in the old housing. It took just over an hour to get up, replace it, and come down. I added a brace wire to try to help keep the shaft vertical as the belt wants to pull it at and angle.

The wire loop that goes through the belt is to keep me from dropping it or having it fall off if the pot bracket slipped and made it slack. The wire going up above the plate is the new one to apply some side force to try to keep the shaft vertical.

Figure 648 More modification to K0XG pot

Some more pics from up the tower you are curious:Neighbors and top of 10m tower Ex-AT&T Tower Beaver Pond plus 15m and 20m towers Mt. Greylock Corner of field where stone wall was removed The

place you should never look

More pics from George on the ground: Me inspecting lower ring Me climbing Me sitting on my easy chair Me again Still me Me climbing Me going one way or the other

5/23 Barter does still work... with minor changes, it used to be a case of beer, now its bagels and doughnuts. I had a new brass bushing made to replace the micarta one in the K0XG pot housing at the Pierce Machine company in Dalton for a dozen doughnuts and a dozen bagels.

6/3 When K1MK was doing WPX last weekend he commented on a noise source on 10m to the East or South-East. When I started spinning antennas I found there were 2 sources, one just South of East and one North. The North one is my solar array. It is only really audible when using SSB filters, with IPO off, and FrontEnd=Tuned. I have ordered some clip on ferrites to see if that knocks it down. I can't hear it on 15m or 20m, both of which are closer to the array.

6/4 Replaced the 120' 10m rotor control box with a Green Heron RT-21. Setup was quick and painless, the hardest part was taking out and putting back in the 12 screws in the case.

6/8 Applied snap on ferrites to all the cables in and out of each inverter and knocked the noise down from about s-8 to s-4, so that is a good start.

6/10 The EZ-Eyes keyboards and mice seem to be ok with the RF and computers here so replaced the rest of the old ones.

6/16 The 15m station seems to have problems with its new keyboard or mouse locking up on transmit putting it into a loop of repeating the same function key... put back on old ones and it seems ok. Will test more later.

With the spring rock harvesting season almost over I pulled a half dozen rocks out from around the 150' tower to make mowing easier.

6/24 Pablo's arch nemesis that was hiding under the deck boards and taunting him finally flew the coop... See picture below of the dastardly critters just before they left.

Figure 649 Pablo's nemesis

7/7 Moved Skimmer antenna out of the way of tree cutting that should happen next week.

Clearing Trees

7/10 Friendly Tree Service came today and made quick work of getting rid of a bunch of problem trees around the garage and shed. Now the ice on the driveway should melt faster and I don't have to worry about tree branches laying on the garage roof from the big pine trees.

The biggest tree is down behind the one he is getting rigged up to cut.

Figure 650 Getting rid of dangerous trees

Figure 651 Nice little chipper got rid of whole trees until they filled up the truck

Figure 652 Cleared area by shed that had all the pine trees that were blocking the winter sun

And a clear view from the outside webcam to BIG! The tall pole sticking up on the near side of the garage is the skimmer vertical waiting to be put back behind the garage to the left.

Figure 653 New view of BIG!

7/10 Moved a few pieces of the cut trees out of the way and replanted the skimmer antenna where it came from.

7/15 Straightened up the 6x6 post where the 180' tower and 120' 10m tower feedlines come together. Replaced some old hardware and part of the carrier cable going toward the house that were badly rusted. Adjusted tensions a bit so it isn't being pulled toward the 180' tower as much.

7/22 The old 90' tower foundation was dug out of the field by Carl today. He got rid of a couple of big troublesome rocks at the same time.

Figure 654 Old 90' tower foundation

Figure 655 Carl trying to get it out of the hole

The hole wasn't deep enough to really bury it so he just pushed it down to the edge of the field and over the wall.

Rockzilla!

8/5 Rockzilla is the new guardian of the driveway:

Figure 656 Rockzilla!

9/9 Mostly been doing yard work for the last month. I have widened the second driveway entrance a bit and built the start of a rock wall around the inside of the driveway turnaround. Today started nice and cool so I fired up the DR Brush Mower and cut the SW/NE Beverage path and the start of the NW/SE path. Then went back both of those and replaced some insulators pulled off by some medium size branches that came down over the summer. I also now have a game camera on one of the paths to see what uses them besides me. They always look like there is traffic on them even when I haven't been back there in a while, but haven't caught anything on camera yet. I did get a couple of deer one night up by the pond outlet... film at eleven.

9/15 Well, we have had a good frost and there is a bit of a nip in the air today, must be time to work on the low bands. Today I straightened out the Beverage post that has been slowly leaning over. The process is pretty simple, tie come-a-long to the top and take load off the hole. Use post hole digger on the back side to open the hole up. Pull the pole a bit past vertical with the come-a-long. Then pack dirt back in the hole and release the come-a-long. It sometimes helps to release the tension then pull it back and pack in a bit more dirt, using the force from the post to compact it from the inside. Note, you want to attach the come-a-long before digging the hole or the bottom of the post could kick out making things much worse.

Figure 657 Leaning Beverage pole

Figure 658 Fixed up Beverage pole

I'm also replacing the old bent up ground rod with a new one (already in the ground in the After picture), and will replace the ground wire up to the boxes.

9/16 Cut 12 new 130' radials from the 1/8" aluminum wire that I used for the 80m 4-square radials to

replace the 160m inverted L radials that are getting pretty ratty.

9/17 Added ground wire to new Beverage relay boxes and pre-amps inside... Don't know how I missed that one, but I think something up there was arcing in the last thunderstorm.

Tuning 160m L's and Inv-V

9/23 Removed old 160m inverted L radials. Put up 6 new radials under each L. Check SWR, it sucks... more to follow.

9/24 Made a bunch of measurements...

This is the basic schematic of the system. Two Inverted L's 1/2 wave apart. Each one has 6 radials plus the big feedline bundle under it that are connected to the hardline shield at the feedpoint. The 75 ohm feedline goes back to the relay box where the 1/2 wave phasing line can be switched in and out to shift the pattern. The two lengths of hardline are the same length within a couple inches anyway.

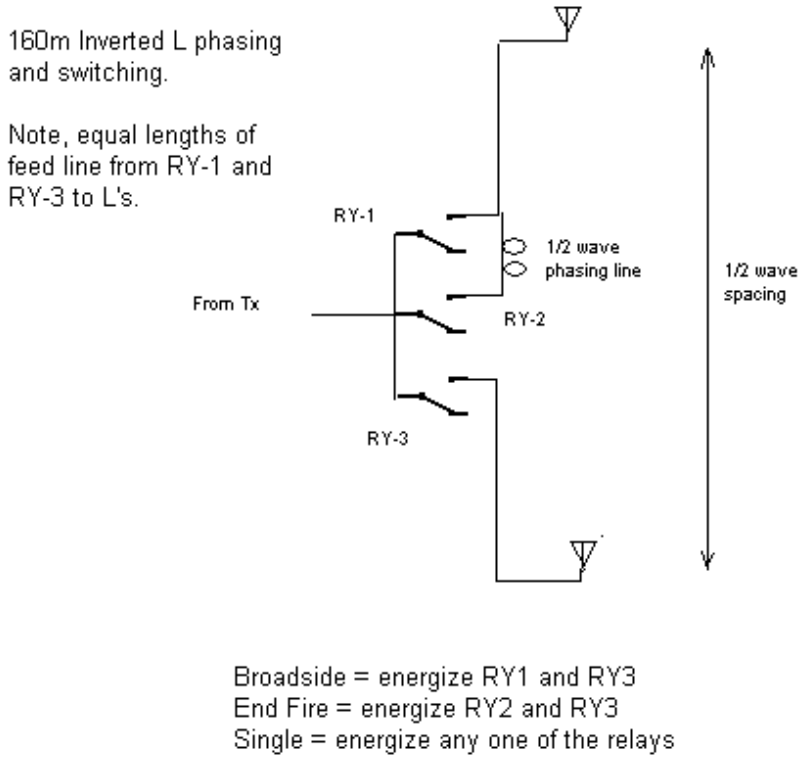


Figure 659 Inverted L phasing

Measurements made with MFJ-269 meter(hence no sign on reactances, just to keep it fun):

South L:

Freq (khz)	Z at feedpoint	Z at relay box	comment
1800	23 j27	440 j0	-
1837	20 j0	185 j0	resonance, more or less
1850	15 j0	120 j65	-
1900	20 j13	34 j39	-
1950	28 j42	18 j7	-
2000	38 j73	10 j0	-

North L:

Freq (khz)	Z at feedpoint	Z at relay box	comment	Z after 1/2 wave line
1800	30 j15	335 j0	-	231 j0
1850	24 j3	117 j0	-	97 j23
1870	22 j0	80 j40	resonance, more or less	74 j31
1900	26 j4	40 j33	-	29 j18
1950	36 j40	21 j3	-	15 j0
2000	49 j67	11 j0	-	24 j10

Now for today's quiz. Design a matching network using nothing but coax to give a 1:1 SWR for this system at 1850khz when relays RY-1 and RY-3 are energized. How does the SWR change when switching from RY-1 to RY-2 to switch the pattern?.. show your work.

Hint: Because the measurements at the end of the 1/2 wave line didn't seem to match up very well with the other end I measured the length of the 1/2 wave line... it was 1 wave long at 3560khz (measured at double the frequency because the length was below the tuning range of the meter)... obviously a bit long, so that should probably be adjusted. For simplicity you may assume that the line is cut for 1/2 wavelength at 1850khz. First bonus... does that length error account for the difference in the measurements from end to end??

Second bonus... how long are the hardline sections in wavelengths?

Super extra bonus... show estimated SWR with designed matching system across the 160m band.

Mega super bonus... show estimated SWR across the band for closing each relay separately.

9/30 New 'bug' in shack... when all 5 stations are CQing on RTTY the 100a breaker feeding the shack overheats and opens. Turning off lights, cutting power to 1kw or so, and putting coffee pot on another circuit keeps it going, but probably just barely.

10/3 Removed 1/2 wave phasing line from 160m switchbox and used the miniVNA-Pro to sweep the lines.

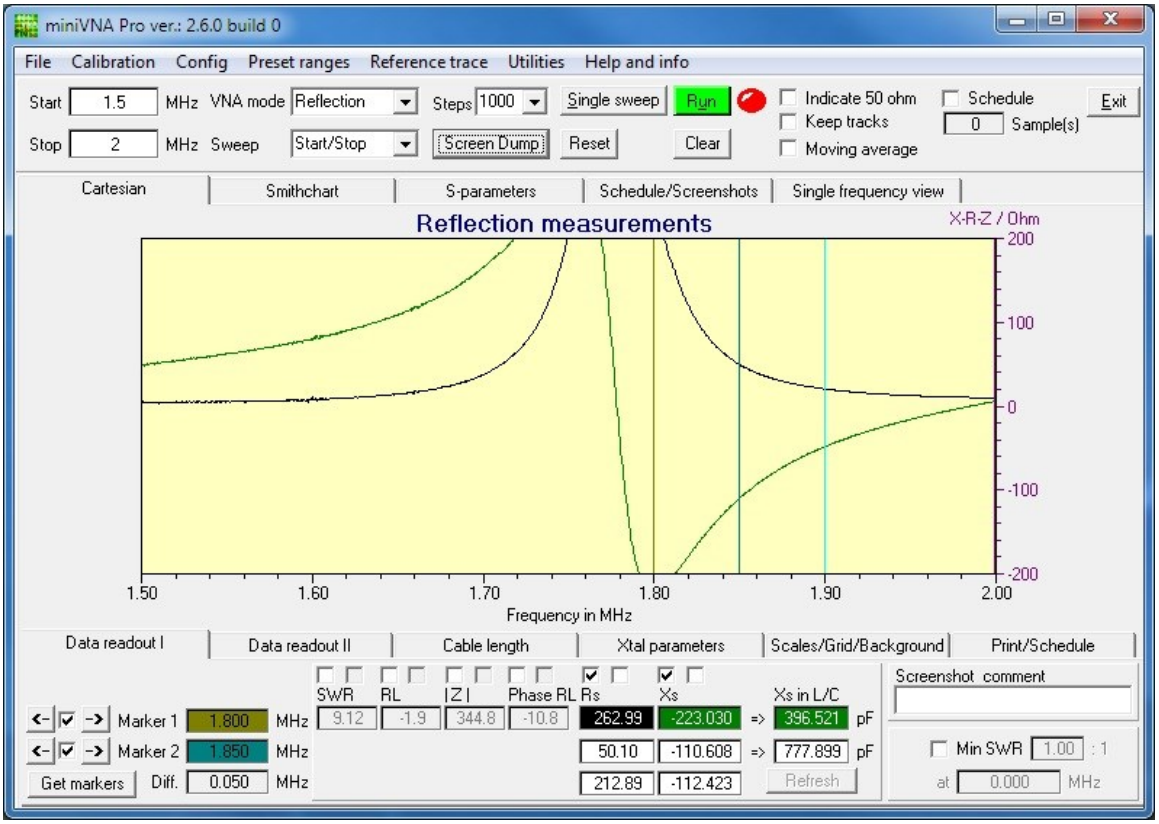


Figure 660 South L alone at feedpoint:

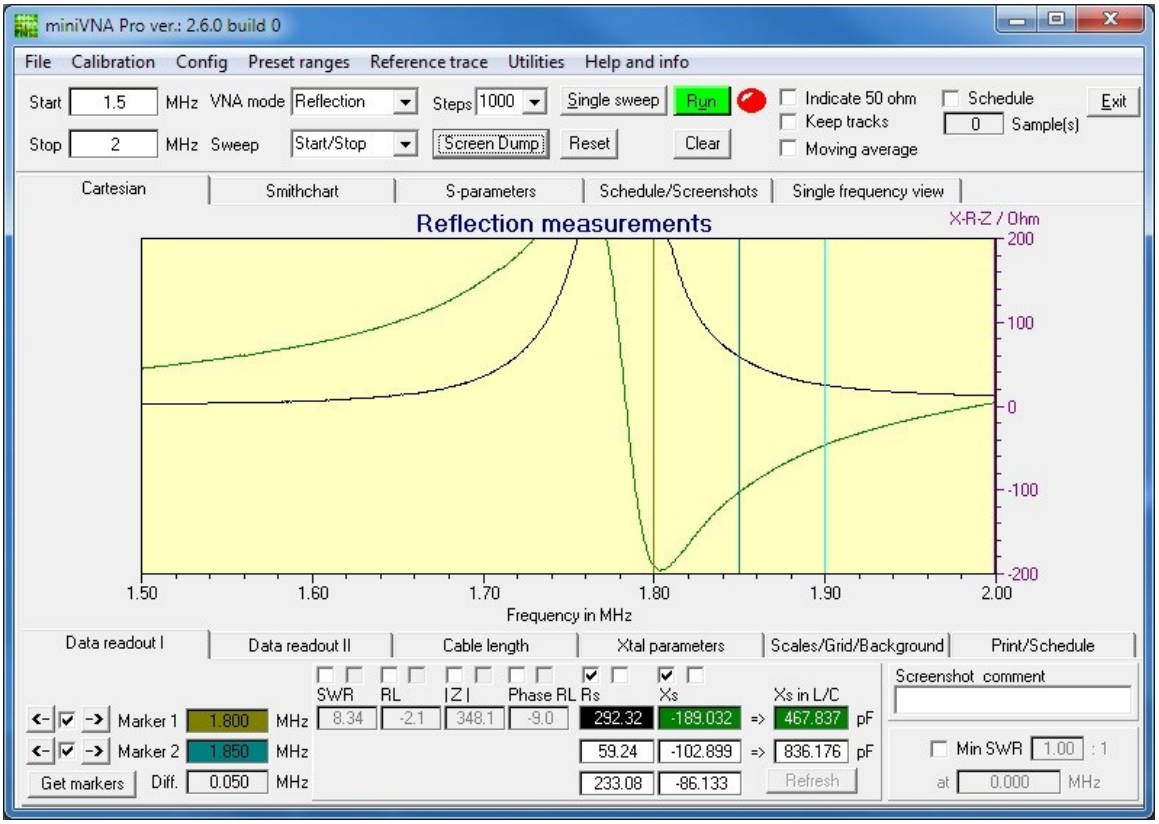


Figure 661 North L alone at feedpoint:

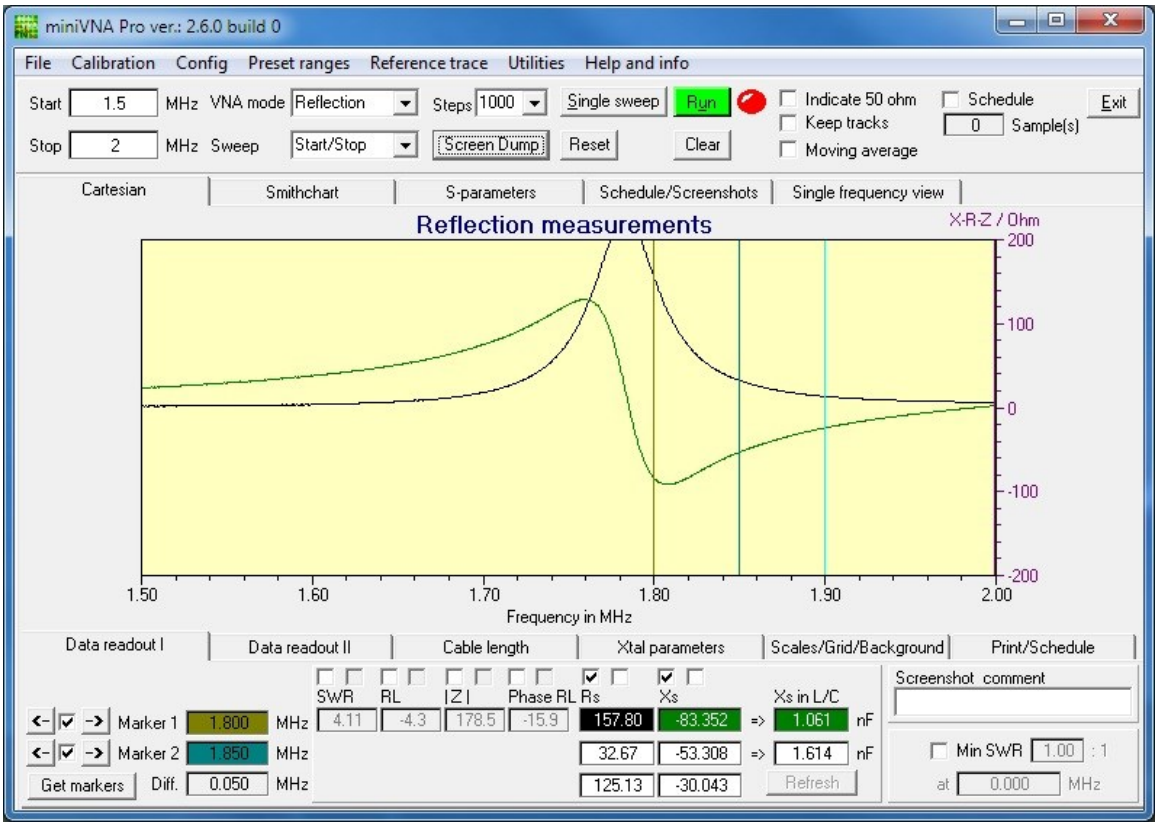


Figure 662 Combined Ls

Does that make the design a bit easier to figure out??

10/5 Finally a nice dry day... cut more brush around 150' tower.

10/6 Cut last big area of brush that needed clearing, around the 15m tower back guy wire. Good thing, because my last weld repair is starting to give up.

Started rebuilding 160m inverted-Ls phasing and matching network. First cut off about 6' of the 1/2 wave phasing line so it is now the right length at 1825khz instead of 1768khz.

The design frequency has changed from my problem statement above. Fearing bandwidth issues I changed it to 1825khz. The design for the matching looks like this:

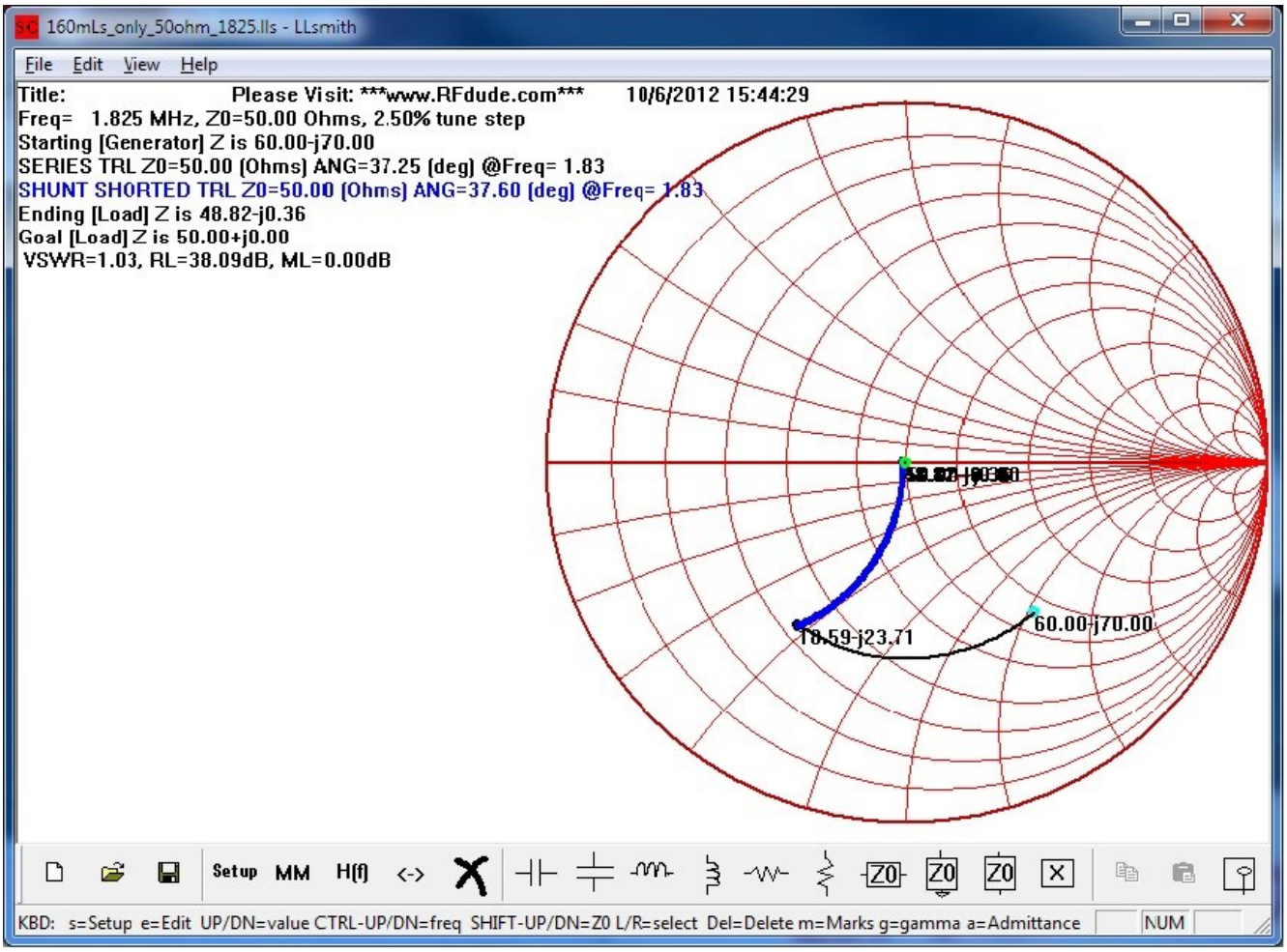


Figure 663 Matching design

What that shows above is that starting from 60-j70 at 1825khz it goes through a 37 degree 50 ohm series transformer to convert it to 18-j23. Then add a shorted stub to bring the impedance back to 50+j0 more or less.

An interesting piece of trivia... at 1825khz using RG-213 with a velocity factor of .66 the length of the lines in feet is almost equal to the length in degrees. So I cut two 40' pieces of RG-213, put connectors on one end of each and started trimming. I ended up cutting 2' off the shorted stub and 6" off the transformer to get this:

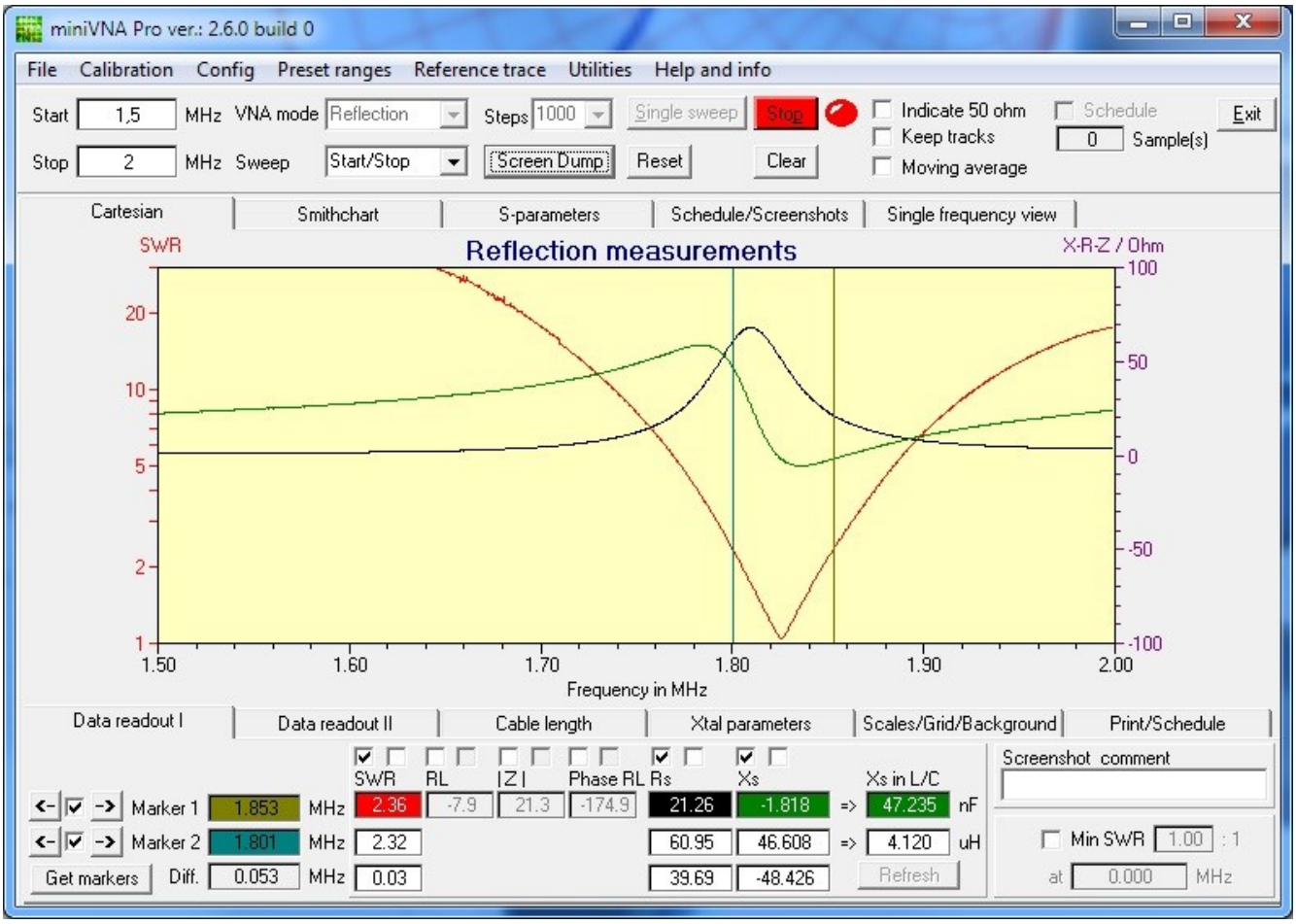


Figure 664 Final matched measurement

I installed the other connectors and put it back outside with the shortened half wave phasing line and it works just fine. About 2:1 SWR width of 50khz, from 1800khz to 1850khz. Now I'll have to add a second switch box to bypass that network for the Inverted V though.

10/7 Wired up 2nd RCS-8V box for selecting 160m antennas. Cleaned up connections, swapped ports so that two of the relays that were scorched in the old box aren't being used... the old inverted-V relay was burnt pretty bad. Then mounted the boxes on a stand off so I can take the tops off without loosening the screws in the wall. And added a strain relief support for the 3 pieces of hardline, plus improved the grounding a bit. This is the final result:

Figure 665 New 160m matching installed

The box on the left is the new selector box. It is only using 2 of the 5 ports, a 3rd one has a control wire but no antenna so it is available for adding a new TX antenna. The big black hardline is the inverted-V, the two unjacketed CATV hardlines are the inverted-Ls going to the phasing and matching box on the right. The older coil of coax is the 1/2 wave phasing line, the newer stuff is the two matching sections.

Also walked the Beverages, had to replace a couple insulators on the SW/NE one even though there weren't any branches or trees down on it... maybe a moose stumbled through it again. Its hard to find missing insulators right now, too many leaves that are the same color on the ground. This is what the well dressed assistant is wearing this season:

Figure 666 Supervisor in his finest outfit

10/13 Another nice fall day without a 160m contest, so might as well see what a matching network can do for the 160m inverted-V.

This is how it starts at the end of the hardline:

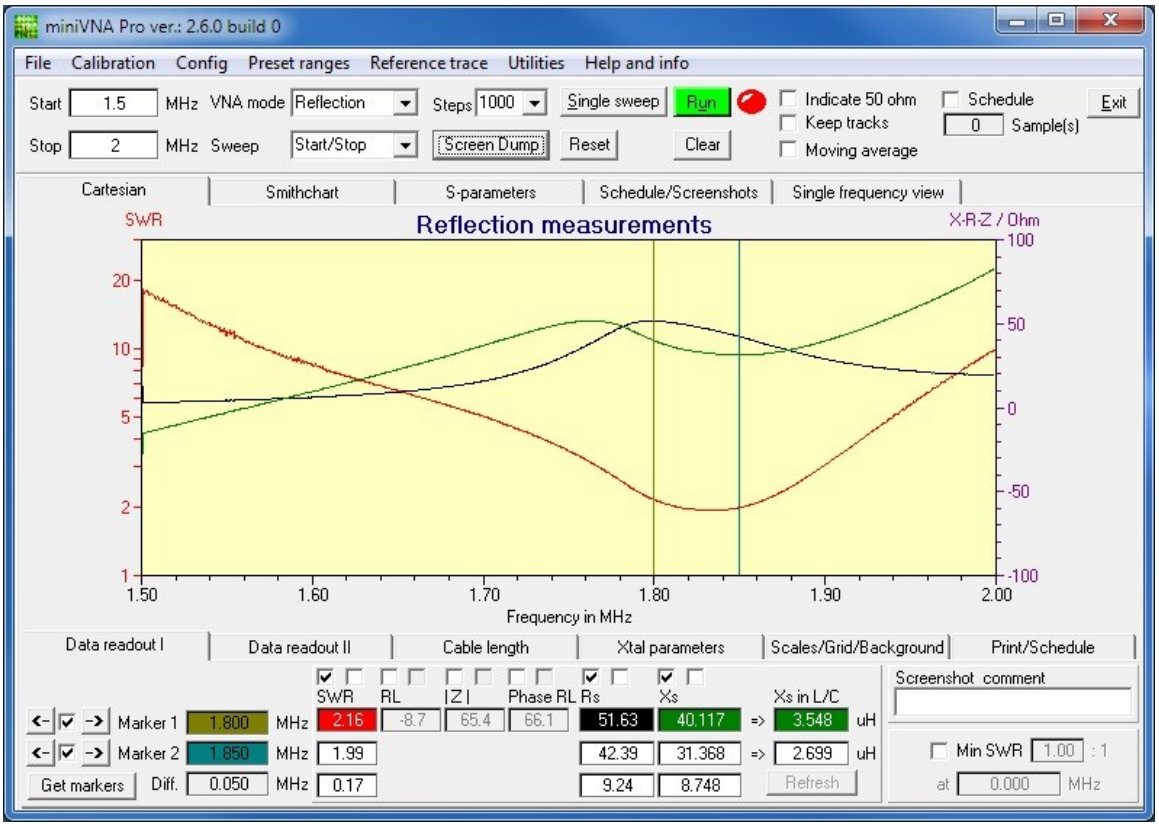


Figure 667Raw 160m Inv-V

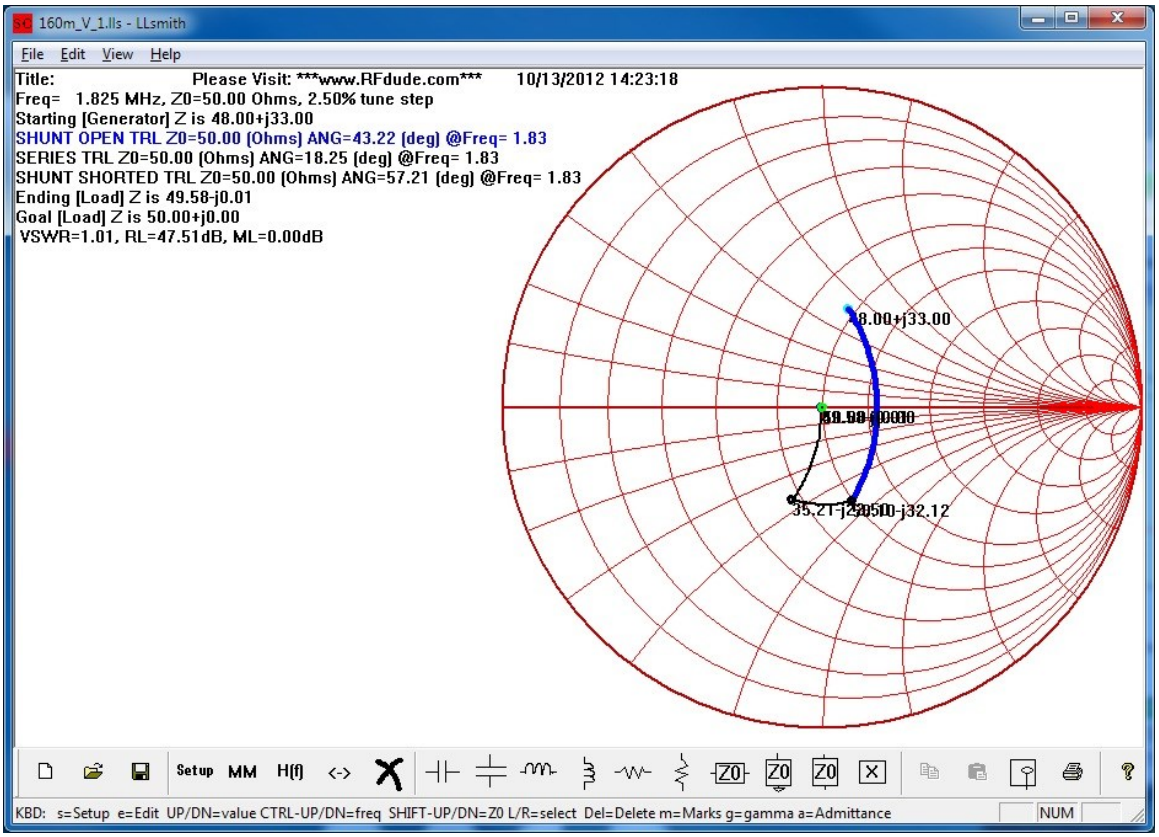


Figure 668 160m Inv-V matching design

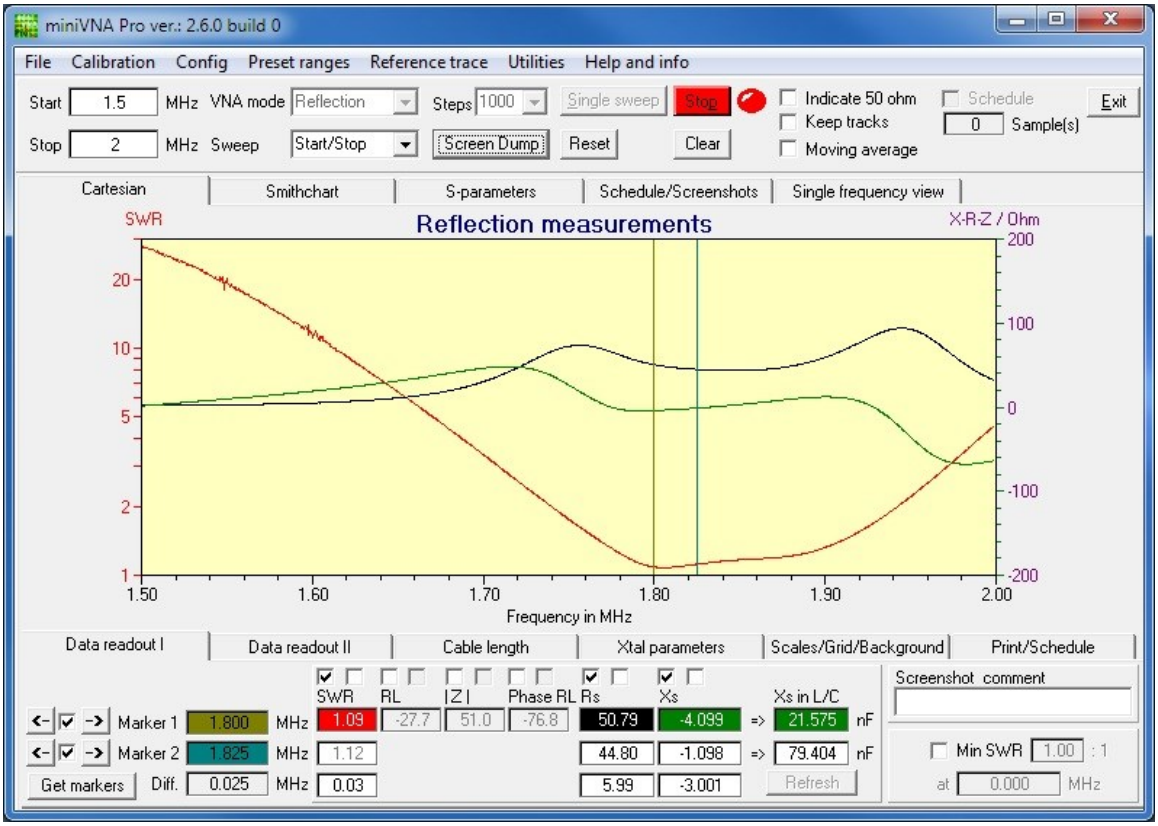


Figure 669 Results of matching network

Simple enough when you have the right tools.

10/21 Put some 3/4" PVC conduit under some of the 160m inverted-L radials to get them a bit further off the ground. Just cut a slot in the flared end for the wire and a 3/8" hole about 18" from the other end to put a rod through to stomp them into the ground. Using a 1" stake makes a better hole than stomping in some places though.

Walked the Beverages again. This time I found more insulators than I used, which is an improvement. Only some stray branches down on the trail between them this time. I did find parts of a LARGE wasp nest that was falling apart, it was way up in a tree over the Beverage connecting trail, from the pieces that were left it was probably nearly as big as a basketball.

10/23 Cleaned up some of the bunk room ceiling high piles of stuff. Moved some junk out to the shed and down to the crawl space.

10/26 Getting ready for cqww ssb and the return of snow-tober... this time hurricane Sandy is coming up the coast and is going to join up with some cold air that was snowing on California last week, so could be a fun weekend. Got chainsaw cleaned up and sharpened and mixed some more 2-cycle fuel... I put the snow blower on the tractor last weekend so that is ready. I added some more supports to the 160m inverted-L radials, this time using 1" PVC conduit. The 1" stuff seems much more appropriate, but of course needs a slightly bigger hole in the ground. Put new roll of RG-213 on the bar in the shed, and evicted the mouse that was living in the old roll.

Rockzilla has been a bad boy...

Figure 670 Rockzilla got hungry

So I put up a sign to keep people away from him.

Figure 671 Beware of Rock!

10/30 Well, after a day of high winds from Super Storm Sandy everything still seems to be up in the air. I only lost power for a couple hours in the evening, probably when they shut us off to fix some other stuff. I took a walk around the Beverages and there is a big pine tree down on the NW/SE one, I left off some insulators to relieve the strain a bit but will have to come back later to cut it off. The NE/SW seems untouched. The N/S one had a couple small branches and needs one insulator replaced that is on a rod in a tree that I can't quite reach.

11/3 Cut out a gap in the pine tree down on the NW/SE Beverage from Sandy and put the wires back up on the posts. Note there is one post on that one that needs a new crossarm. Also one of the trees holding two of the radials on the SE side of the 80m 4-square came down so the two radials that were tied to it need to be readjusted, they are temporarily tied to two other trees but not in good spots.

Went and retied the 80m 4-square radials that had been down and tightened up some others. Put back the N/S Beverage insulator I couldn't reach the other day. Note that there are a couple more trees down around the 80m 4-square, but none that threaten it, they all are down away from it.

11/10 Rebuilt my small DF loop, put TS-2000 in the Jeep with the Hustler mobile antenna, and went hunting for the noise on 160m. I'm pretty sure I found the house about 1/2 mile up East Windsor Rd from here, left a card and am waiting for the owner to call back.

11/11 Ran comparison of Beverage TDR traces to the last installation ones, everything looks ok.

160m Noise

More info on 160m RFI problem. I first noted this about a month ago, it has been there every time I have checked since then. It kind of sounds like a switching supply, but is wider than others I have seen and surprising stable in frequency, others I have seen drift and jump around as line voltage or temperature changes, this always seems to be the same. It cuts off fairly sharply below 1850khz and above 1900khz. Yesterday as I noted above I DF'ed it to a house about 1/2 mile away. Today I still haven't gotten a call back from the owner after leaving a card with a friend who was there. I did go back up there and made some recordings of the band using my SDR-IQ on the 75m Hustler mobile antenna. I also scanned up and down a bit with the SDR-IQ, there are strong identical looking signals above and below the 160m band, up to about 4MHz where they seem to stop... I'm not sure if the other copies of it are real or due to overload of the SDR-IQ though, I would have to spend more time and play with the radio settings to tell for sure.

Screen shots and recordings, click on images for large clearer version, right click and download the SDR-IQ recordings if you want to analyze them directly... just don't do them unless you really need to since they are so big.

On 160m inverted V at home, showing settings for recording audio:

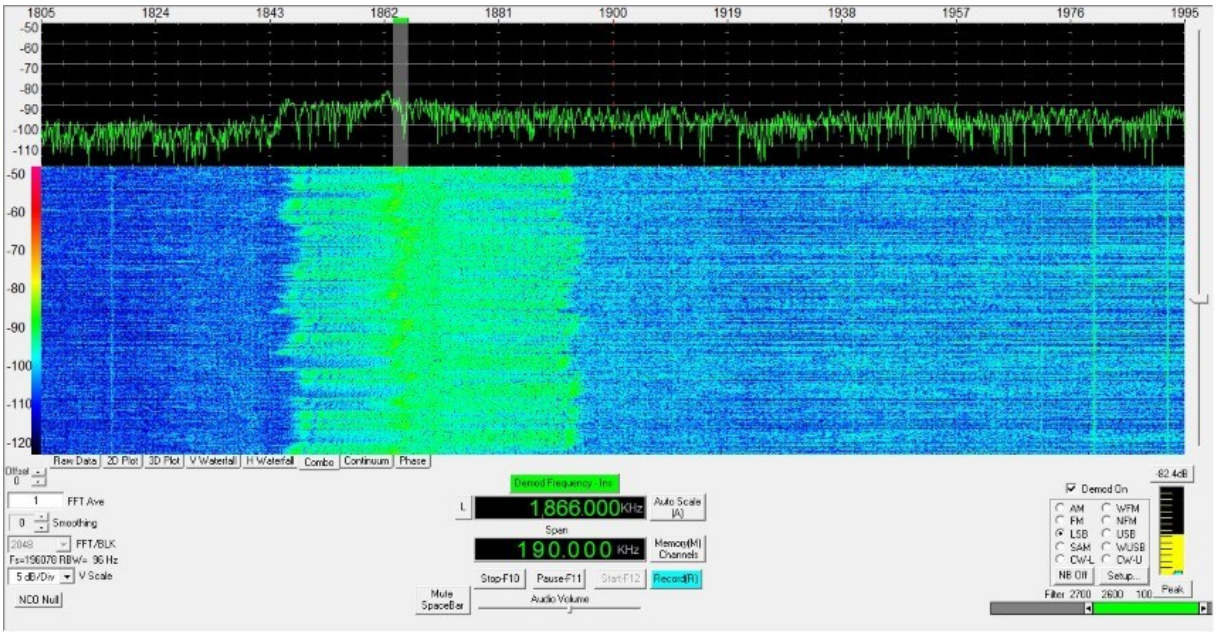


Figure 672 160m noise

[Audio, 1866khz, LSB]

[SDR-IQ recording, center=1900khz, width=190khz, total size 9.1MB]

Mobile, parked with engine off on 75m Hustler:

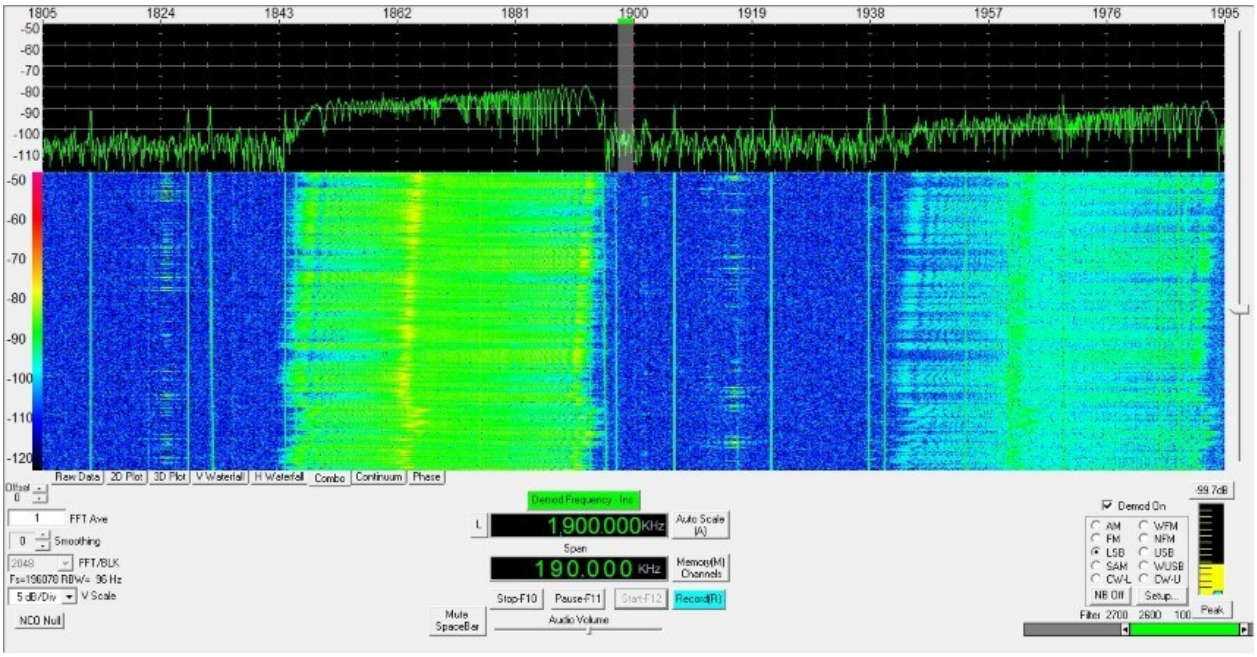


Figure 673 160m noise

SDR-IQ recording, center=1900khz, width=190khz, total size 21.5MB

Same as above but at 1700khz center:

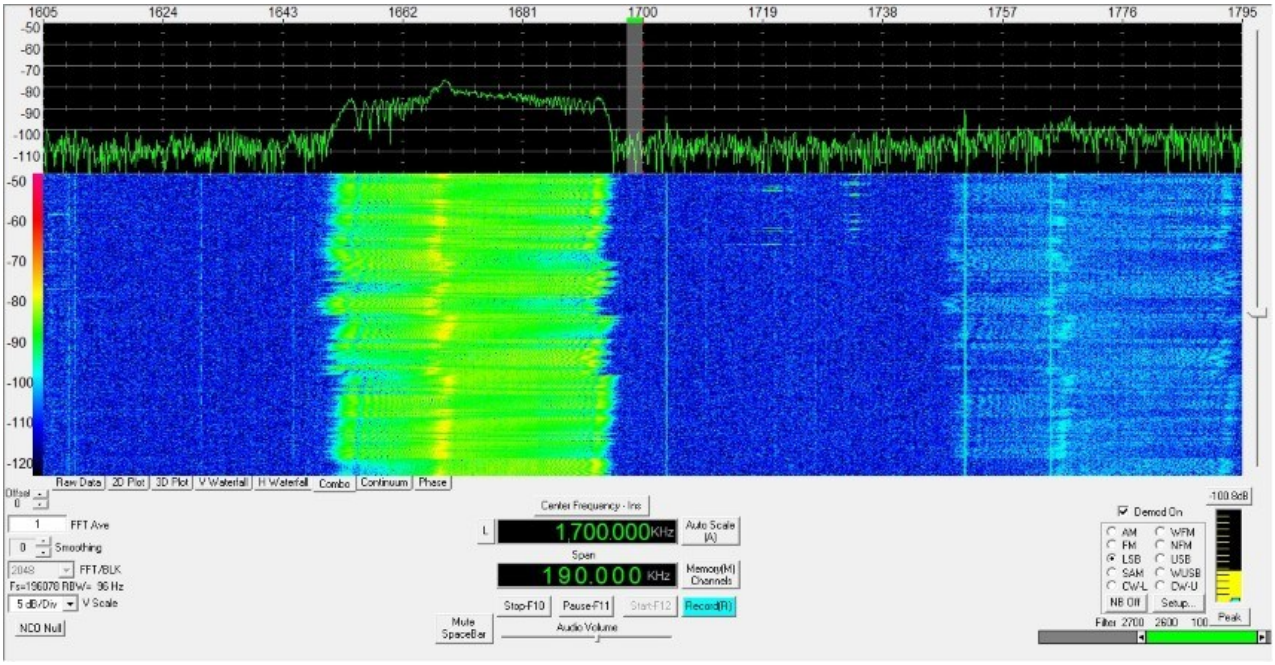


Figure 674 160m noise

Same as above but with 2000khz center:

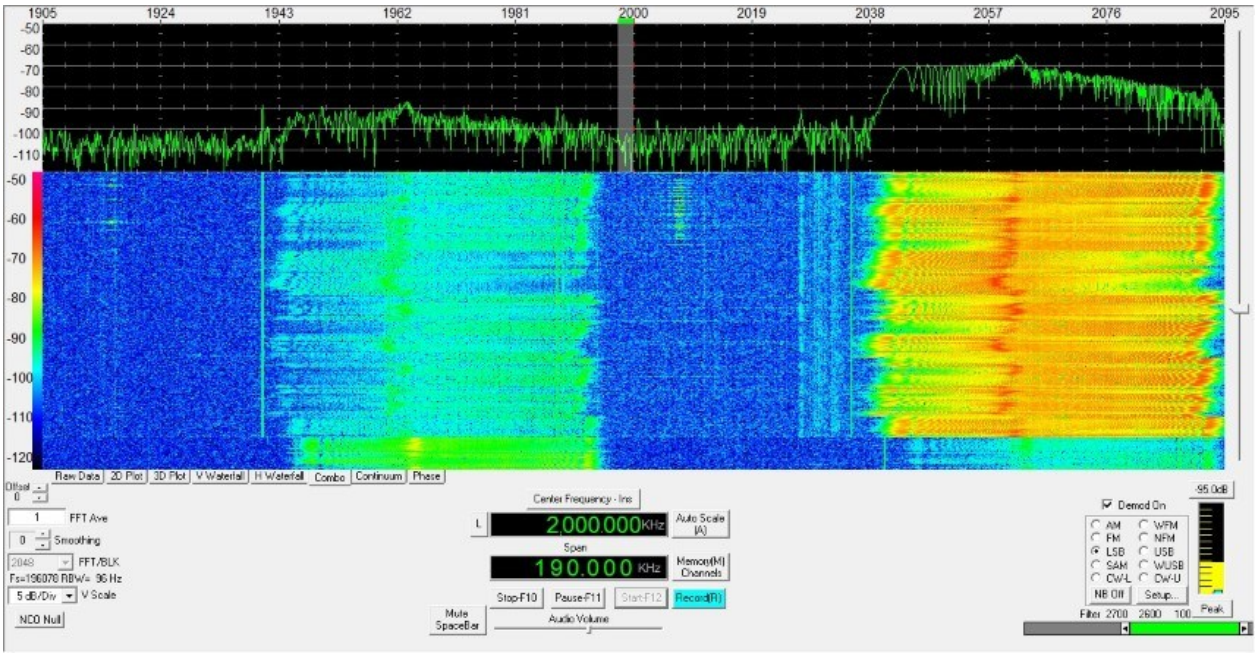


Figure 675 160m noise

11/16 I did some more analysis of it today and left another note for the homeowner... may post screenshots and data on web page later. I put a better antenna on my qs1r and upped the rate and it looks like it is sweeping across that about 50khz frequency range. I also looked in more detail at the screenshots of the harmonics of it I was seeing and did some calculations and came up with an interesting pattern, then went and did some more measurements sitting under their power line with a non-resonant shorter antenna. What I see is the noise repeating over the following (approx.) frequency ranges:

- 97-100khz
- 292-300khz
- 485-500khz
- 680-700khz
- 875-900khz
- 1070-1100khz
- 1265-1300khz
- 1460-1500khz
- 1655-1700khz
- 1850-1900khz

Lots of odd harmonics... might make a nice square wave at 100khz or so.

It would seem that the weaker images I was seeing previously on even harmonics were probably from overload of the sdr-iq as they were clearly not easily visible today... or it could just be that the smaller antenna wasn't sensitive enough to make them easily visible, but as I stepped up the spectrum in 100khz steps it was obviously there every other step... that would mean to me that if there are even harmonics there were probably at least 30-40db down.

I stopped there because what I had seen at home was that the harmonics died out before 3mhz so were no longer interesting... but now that I know the pattern I can hear it on the south and east beams of my 4-square on 80m below 3500, from about 3600-3700 and from about 3800-3900khz.

I'm not so sure now about the sweeping I was seeing on the QS1R/SDRMaxV today. I would think I would hear something sweeping that slowly so I am thinking it may be an artifact of the sampling rates since the noise fundamental frequency appears to be near 100khz and all the sampling rates I tried were probably nearly harmonics of that it opens the possibility of aliasing.

At least I got a callback this time, tomorrow at 10am we will try to figure out what it might be.

11/17 Well, the noise is gone. It was there early this morning, but when 10am came it was gone. A friend visiting the family in the suspect house had just left after a 6 week visit. They didn't know of anything he might have had that could make radio noise. The did turn back on some things that they had turned off that morning, but nothing brought back the noise. So I guess we just hope it was their friend who had something plugged in they didn't know about. I've got their number anyway in case it comes back.

A few hours later the friend and the noise are both back! Waiting for call back from owner again to see if we can find it now.

Just as everyone is getting ready to start their contests the webcam between 20m and 160m falls off its

bracket. The screws holding the base to the plastic case broke off the posts that were holding them, fortunately the power cord kept it from hitting the floor. Tried Gorilla tape, but that only lasted a couple hours. Ended up turning the wall bracket over so the camera is sitting on top of it and then flipped the video. Tomorrow I will update the station selector presets and name settings.

11/19 Sent off two Heil headsets to the hospital for repair. One had a bad cord, the other a broken microphone swivel mount.

11/30 Headsets back from the hospital, as good as new.

12/3 While taking Pablo for his morning constitutional in dim early morning light there was a big crack and bank like a tree falling down near the 80m 4-square. I did a quick check to make sure all 4 elements were still vertical and went to work. In the evening I found the tree that fell, it was another one holding the end of a radial, it fell perpendicular to the radial so it didn't even stretch it. The top of the tree comes out to the pond outlet bridge. I untied the rope and put it around another tree.

12/5 While setting up for ARRL 10m contest I see the 120' 10m Yagi has intermittent jumps in SWR. Probably the gamma match failing as is common on those older Cushcraft Yagis.

12/6 Was going to call the owner of the 160m QRN house, but the noise seems to be gone again tonight.

12/7 Went up the 10m tower and reinforced the gamma match with some heavy aluminum wire and hose clamps at both the shorting strap and the boom connection. The shorting strap was definitely loose, the boom connection was stained with rust from it's mounting screw and seemed to be intermittent also. Inspected the rest of the tower while I was up there, the 120' and 60' Yagi hardware is all pretty well rusted now, the others have stainless so they look ok. Everything else is tight and looks ok.

Must have burned up the 10m bandpass filter while doing the repair work, replaced it with a spare.

12/8 Cut up tree that came down at 80m 4-square and got it out of the way.

12/11 Well, I thought the 160m noise had gone away, but now its back on a different frequency range. The 160m part of it goes from about 1785khz to 1840khz.

These are the cables and relays needed to protect the two transceivers for the ARRL 10m contest.

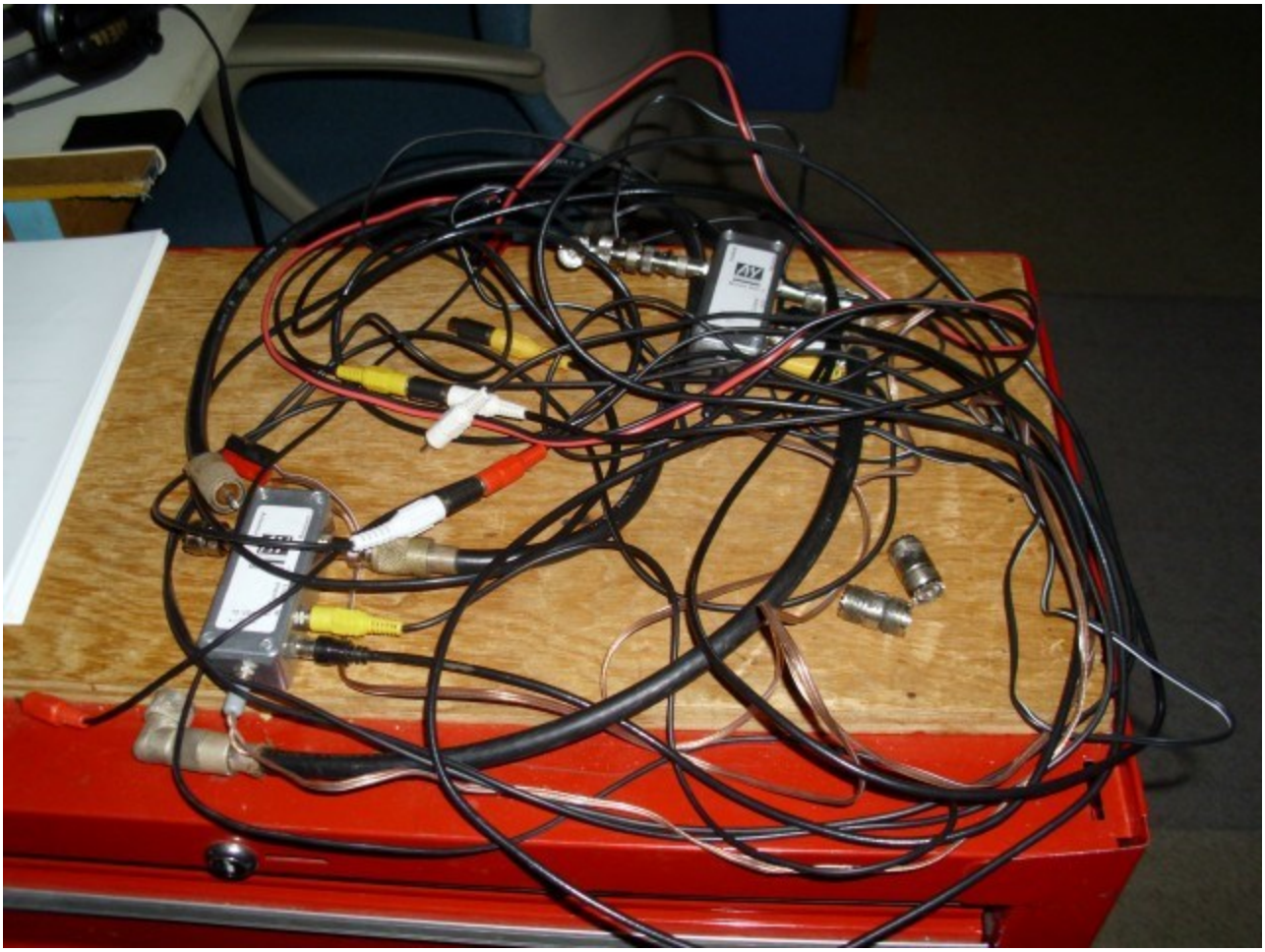


Figure 676 10m contest receiver protection

12/13 The 160m RFI has been coming and going and has changed frequency, but it still seems to be coming from the same house. Today it wasn't there at 7am, but I happened to be monitoring when it turned on just before 11am. At turnon it was sweeping the band very quickly

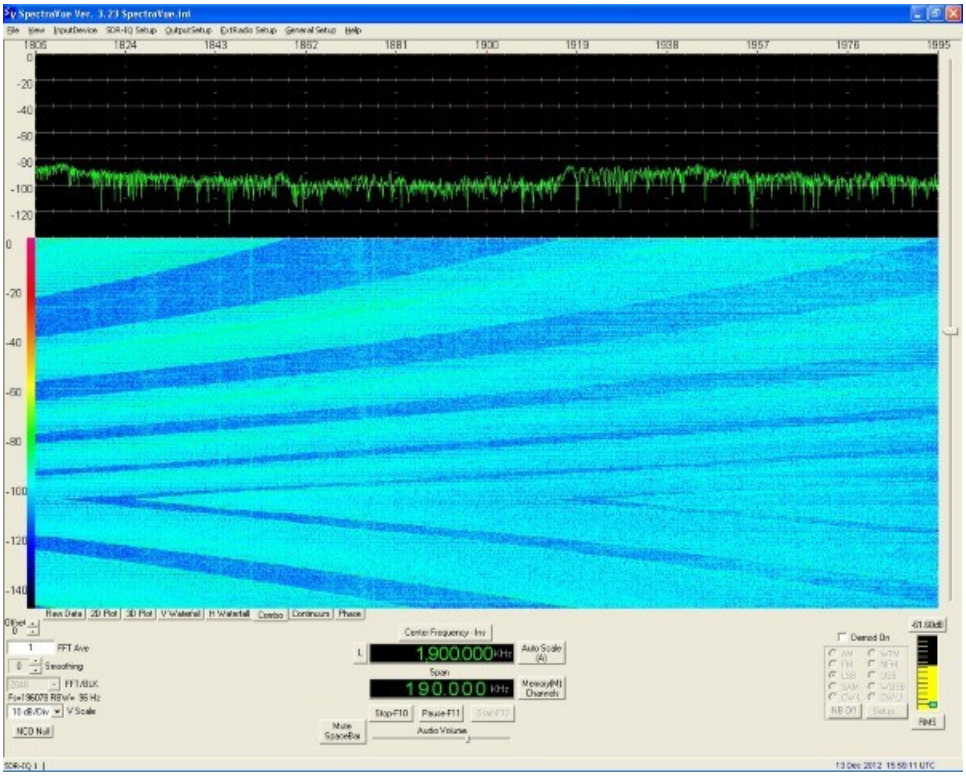


Figure 677 160m noise

It fairly quickly slowed down the sweep

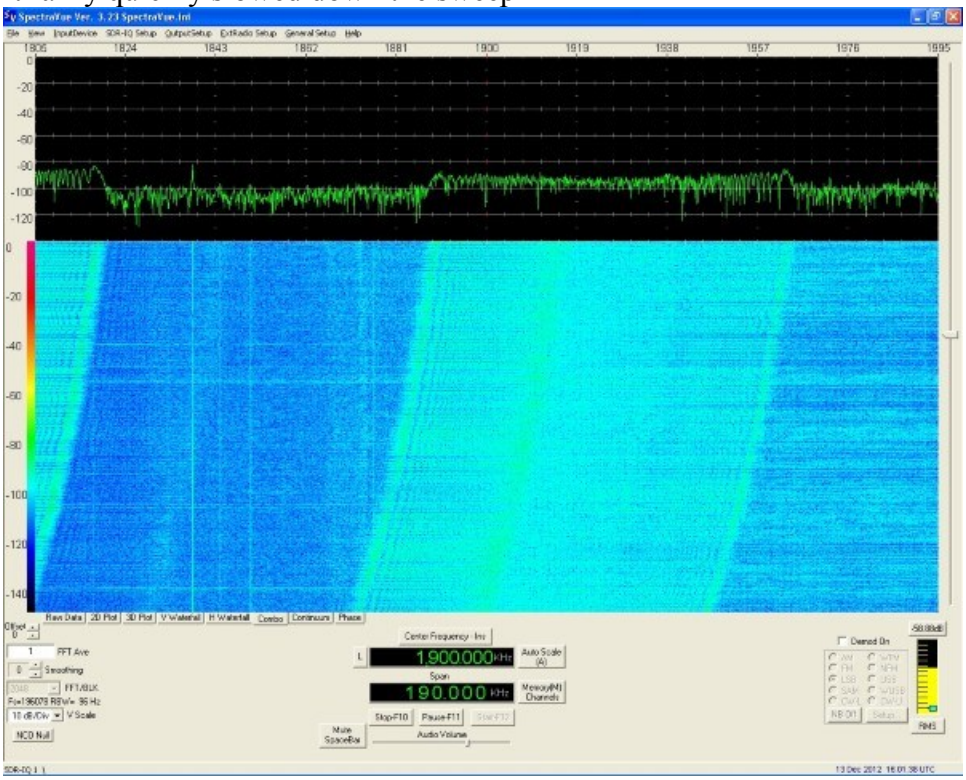


Figure 678 160m noise

And after about 10 minutes was very stable, but wider than before

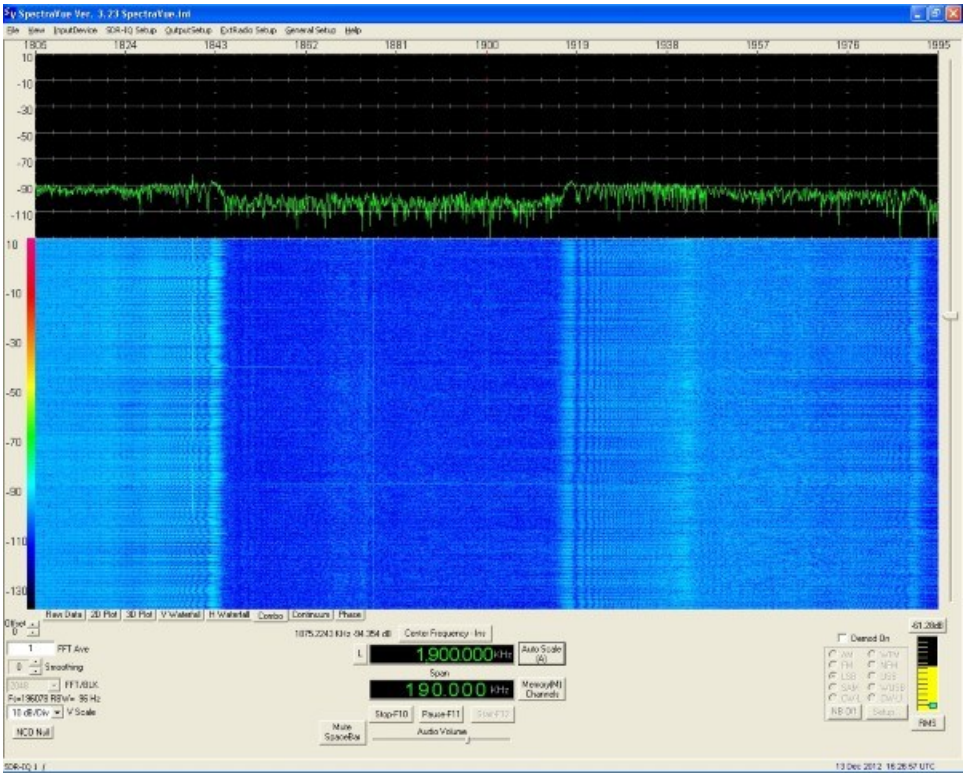


Figure 679 160m noise

I left the SDR-IQ recording when I went to bed and the noise shut off just before 11pm.

12/15 Packed up smoked transformer from HF-2500 to send off to the Transformer Rewind Service in Maine.

Ice!

12/18 It was just going to be a little bit of ice. Only .1-.2" forecast for over night. Yeah, right.

Figure 680 Ice

Fortunately the only damage I could see this evening were a few bent and misaligned elements from falling ice.

12/20 Sick... finally got head clear enough to go walk around yard and take inventory. Looks like bottom 40m beam is toast. Two elements have broken loading elements, probably from falling ice. I am guessing that the big ice falling from the top one hit two of the small linear loading lines and either pulled them out of their end clamps or broke them off. The top one looks ok.

160m Noise Fix

12/22 Well, I guess voice messages weren't specific enough, so today I wrote a letter and taped it to their door, a couple hours later he brought me an electronic ballast and lamp to see if I could clean it up. The ballast is the LK-1000 as pictured in the W0QE article... which I happened to attach to the letter I wrote along with a copy of an FCC letter that points out the legal aspects of the problem and shows that they do take these things seriously. Fortunately I don't have to rush as he says he put back on an older magnetic ballast for now, but would like to get back to this one as it runs much cooler and has nice features for controlling the light (built in dimmer).

12/23 Well enough to walk the Beverages anyway. Only light snow and about 22f, but wind has dropped off a lot. A couple branches down around the 80m 4-square again, these are still some of the ones

damaged 3 years ago that are finally falling out of the trees. Other than that no other damage to the Beverages and a good walk for Pablo after being cooped up for a few days.

Built a filter for the ballast and made some more measurements to characterize the noise. More tomorrow, got holiday baking to do today.

12/24 Ok, lots of info on ballast...

First the offending unit nameplate. On the other end is a switch for selecting 600w, 750w, 1000w, and 'Super Lumens' (kind of like turning it up to 11).

Figure 681 160m noise source

Some examples of how the harmonics multiply. The fundamental frequency is around 100khz (more later) and is about 2-3khz wide, so as the harmonics multiply the width of the noise bands gets wider until it starts to overlap at about the 40th harmonic just above 75m (though this varies depending on setting). The 3 band spectrums below were made at the 600w setting.

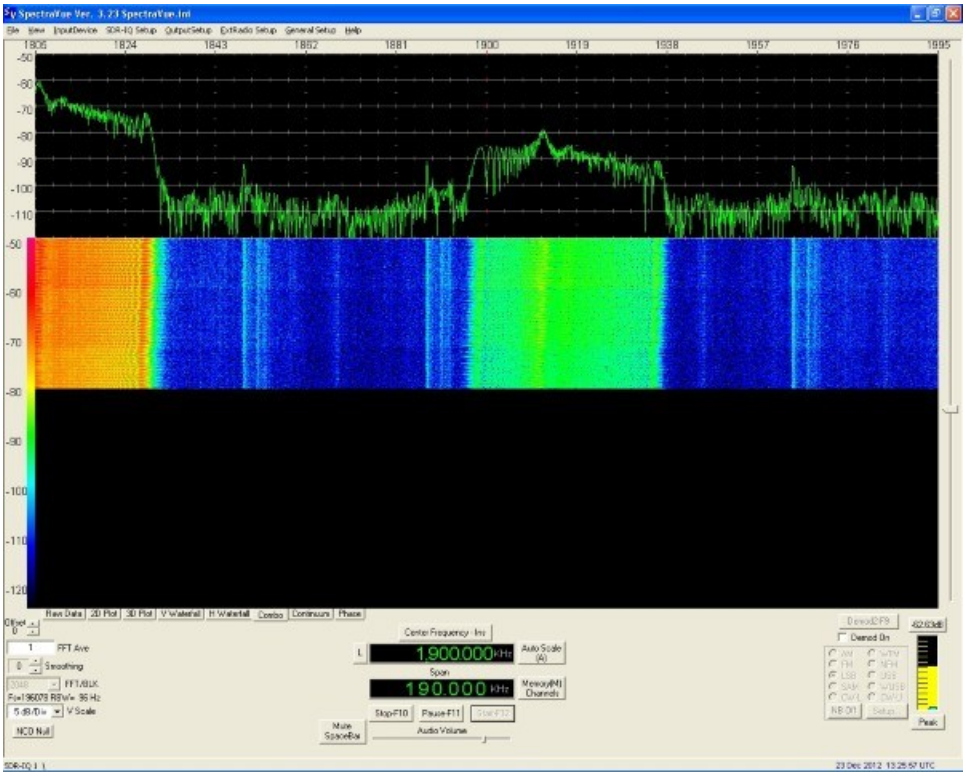


Figure 682 160m noise

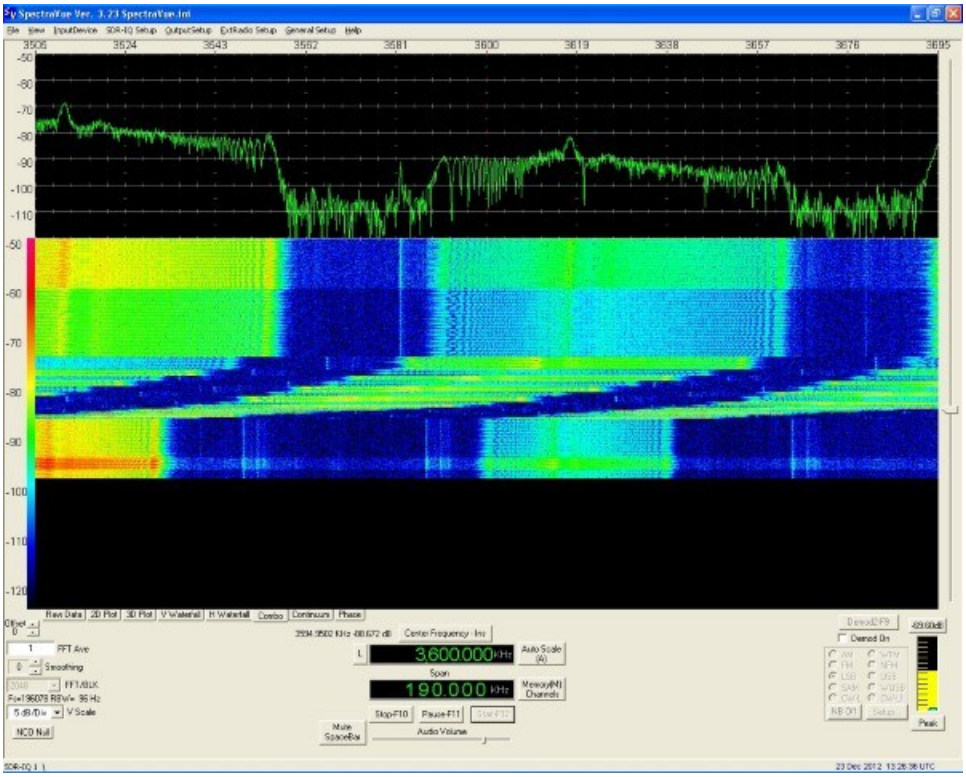


Figure 683 160m noise

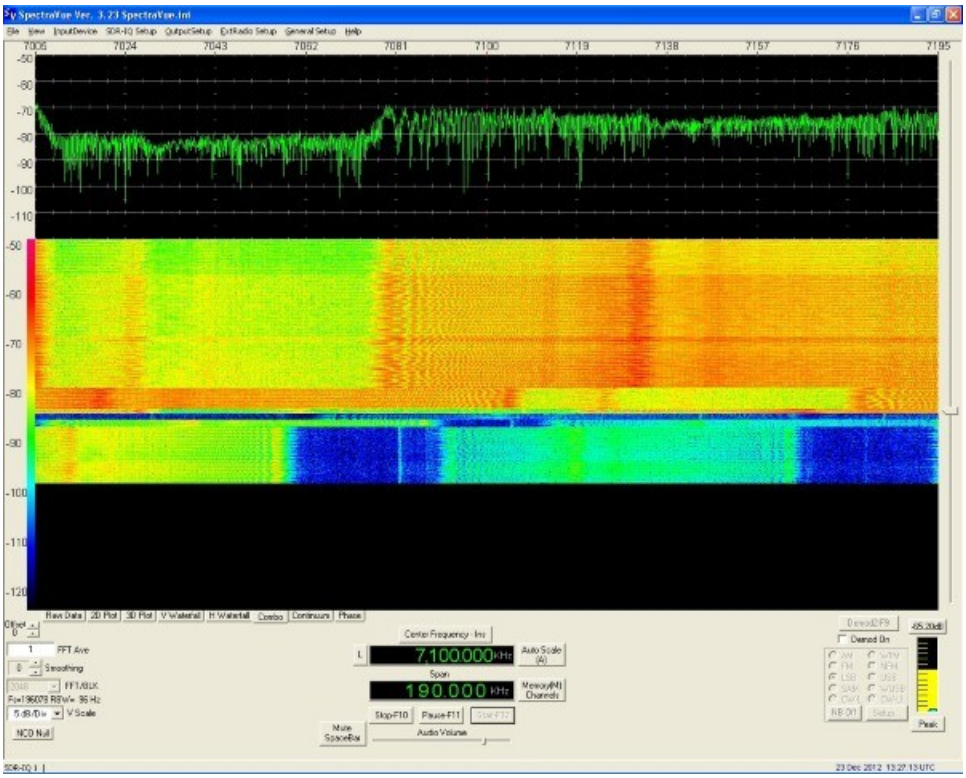


Figure 684 160m noise

The fundamental frequency and width of the noise bands varies depending on the setting of the switch on the unit. And also probably with line voltage, temperature, and type of lamp used. Measurements are approximate, I waited for a while after changing the settings for them to stabilize but there was still some drifting. I am giving the width as measured at a harmonic in the 160m band because measurements at the fundamental were harder. The widths are still an eyeball measurement, but should give you an idea of what to expect from one of these, the higher the power output the wider the noise bands.

- 600W fundamental = 102khz width of harmonic at 160m = 35khz
- 750W fundamental = 88khz width of harmonic at 160m = 50khz
- 1000w fundamental = 72khz width of harmonic at 160m = 75khz
- Super fundamental = 70khz width of harmonic at 160m = 75khz

Another interesting point is that the even harmonics were always down about 20db from the odd harmonics, you can see that on the 160m image above, the odd harmonic on the left side is peaking about -60db and the even one in the middle peaks about -80db. This makes sense based on the measurements from the W0QE article. Since the output is probably a square wave with some distortion the odd harmonics should be the strongest. Another thing to keep in mind is that at the highest settings the whole 160m band is pretty well covered, while at the lowest power only about 1/3 of it is as you can see from the images of the spectrum above. My observation that the frequency moved after initially finding the noise is probably because he changed the power output.

It was very hard trying to do on-air tests of the noise since the ballast was in the same room with and plugged into the same outlets as the radios and test equipment. But I think I did make some progress on it. My initial measurements on the 600w setting had noise on 40m across the band at s9+10db, on 80m in the noise bands at s9+10db, and on 160m at s9+30db. I tried simply coiling the supplied power cord through a couple of FT-240-43 cores, I was able to get 6 turns on each. By itself this brought the noise

down to s9 on 40m and 160m and to s7-8 on 80m... Though I could move it around quite a bit just by rearranging the cords. I tried to keep the cords in the same positions but that can be hard when adding filters and stuff.

Here are some measurements of just the cord, the cord coiled in air, and the cord wound through two FT-240-43 cores with 5 turns each.

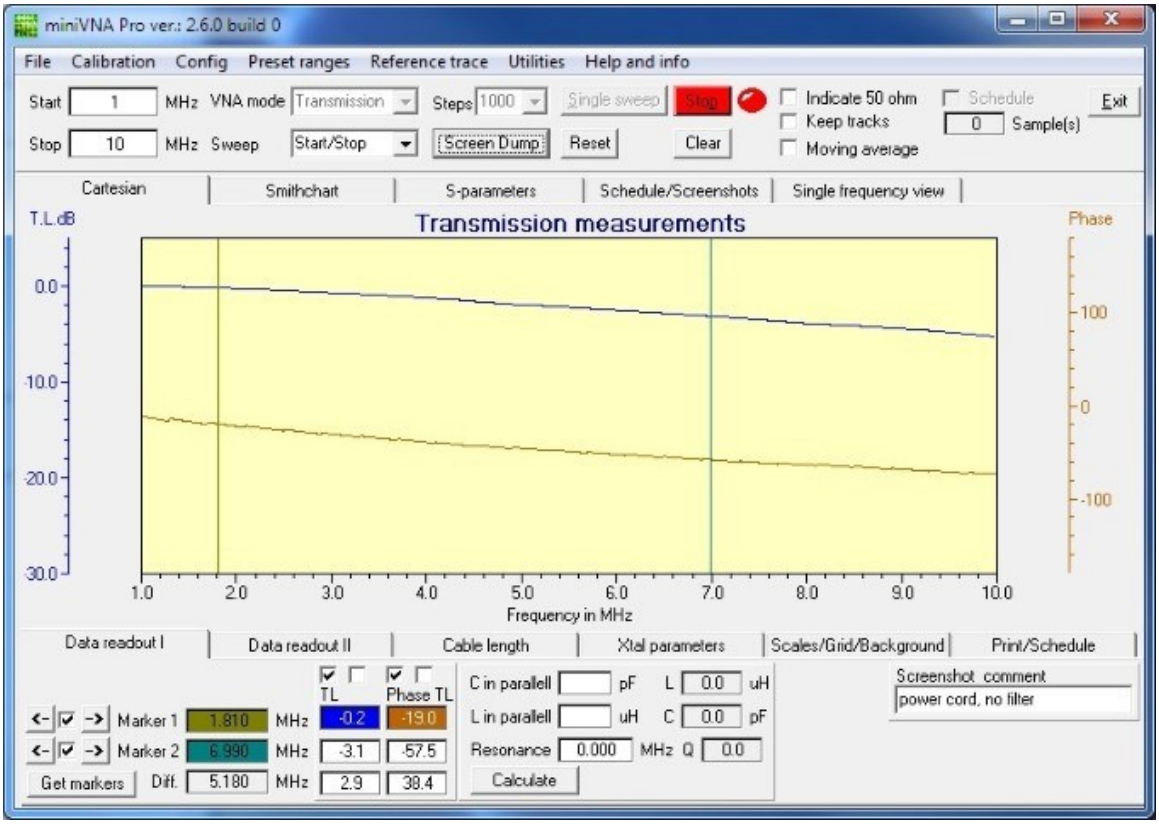


Figure 685 160m noise

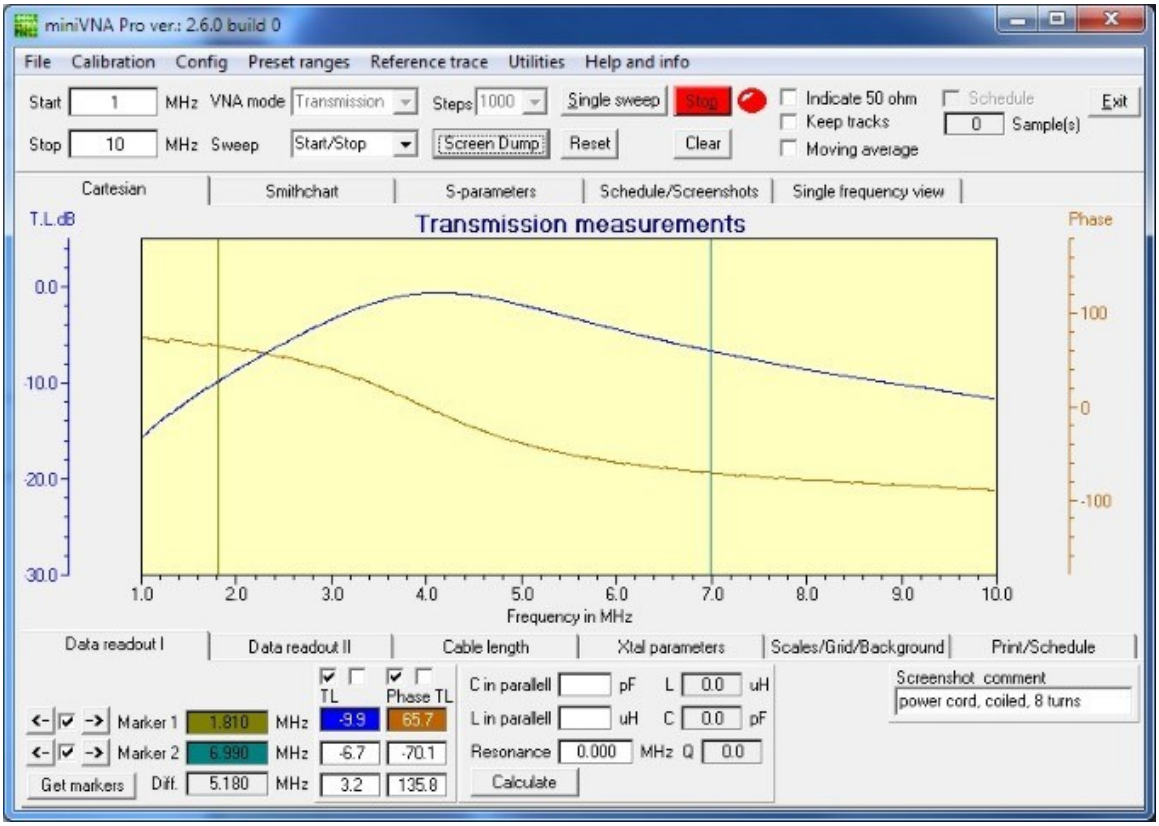


Figure 686 160m noise

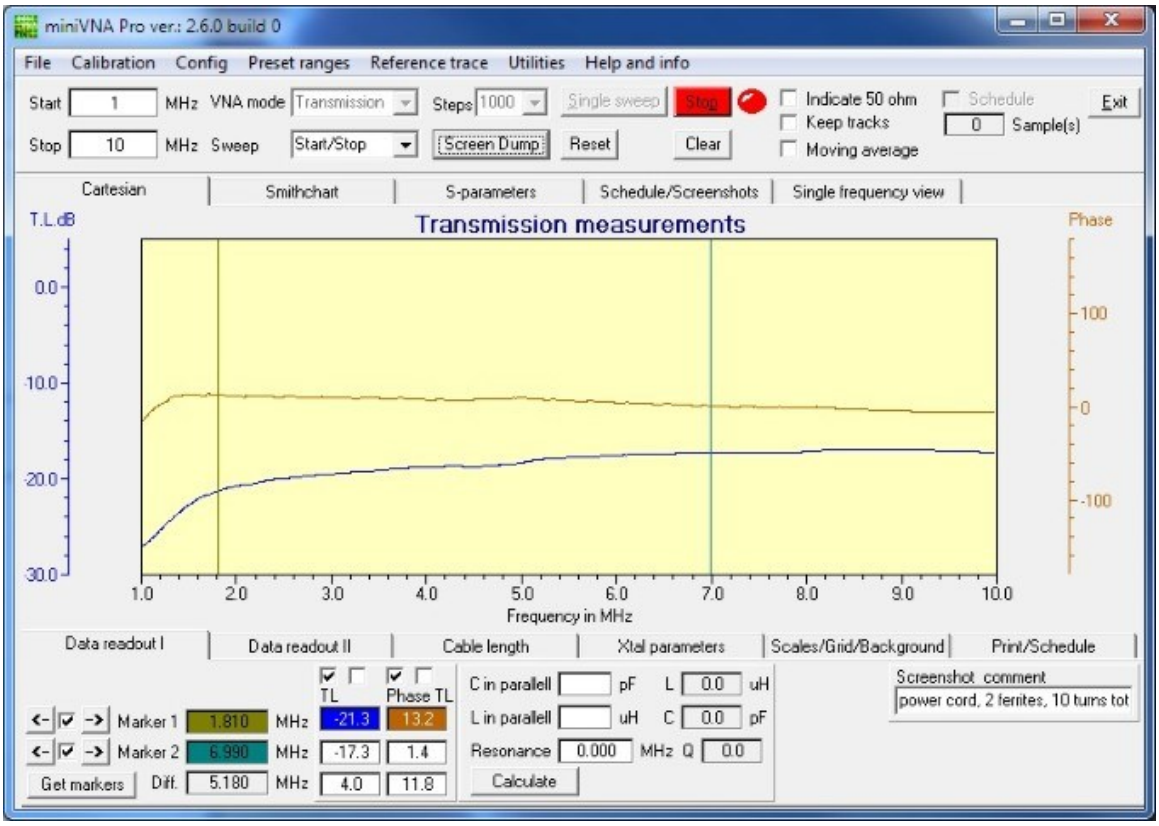


Figure 687 160m noise

Since the W0QE tests ended up requiring a real filter I decided that I had enough junk to build a similar one. So that is what is shown below. It is two FT-240-43 cores with 10 turns of 14ga silver plated teflon insulated wire (left over from winding HF-2500 coils), with .1uf 1kv ceramic caps from the hot and neutral to green on the input side. Just for good measure the cord is shielded power cable, just don't ask where I got that, its been around here for years being used on an extension cord box in the shed, the same box the filter is in.

Figure 688 160m noise filter

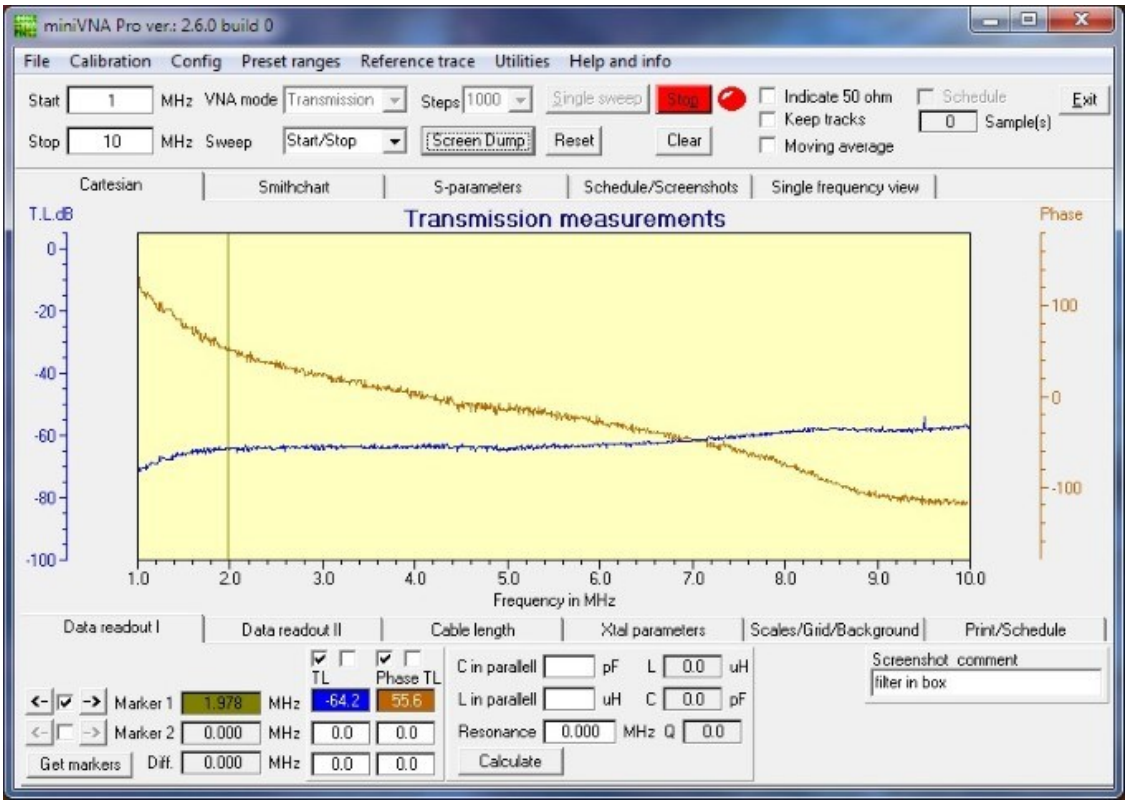


Figure 689 160m noise filter

Then just for good measure I put a dozen of the clamp on cores I bought for the solar panels on the output cable. I did that since the connector on that was too big for winding through a FT-240 core, and I don't know how far the ballast was from the lamp in his setup.

He picked it up on his way home and immediately tried it out in his kitchen. I could tell it was there but only because I recognized the turn-on transient in the waterfall.

12/25 Looks like the ballast is back in use. It is louder than in the kitchen but not nearly as bad as it was.

2013 Minor Fixes, Bigger Improvements

Fixing 40m Again

1/12 These are the two loading lines that were broken by the ice last year.

Figure 690 Broke loading line

Figure 691 Another broke loading line

The basic plan is to take the bottom 40m off the ring, tip it so the elements are vertical, then bring the broken ends of the two elements up to the tower by tilting the boom. To do that I plan to take at least one, maybe two come-a-longs up the tower to latch on to the boom on each side of the ring cradle. We'll use the come-a-longs to do the heavy lifting and tilting, whoever is up there with me will be in charge of them. The biggest worry is that the ends of the elements stay away from the tower so they don't get bent, and we don't want anything to snag on guy wires, the ring, or the tower itself while we are tilting it. I have been looking at the loading rods with the telescope and they don't look broken so I may just be able to put them back in the clamps and tighten them up, but if not I have spare rods. If anything looks weakened I'll have some cable clamps to splice another piece in parallel. Once the two loading rods are fixed then we just set it down and put it back in the ring cradle.

N1TA came and helped and we pretty much did what I described above but without the come-a-longs... though it might have been good to have one of them to help tilt the boom.

Figure 692 Working on bottom 40m4lldd

1/20 Had to free the pond end of the 160m V from a tall tree it got stuck in. Its a good thing the pond was frozen as I had to take the rope across it to get around a pine tree and move the end of it about 20' west to hopefully keep it out of that tree in the future.

1/23 Swapped the 160m FT-1000mp with the spare rig because the RX Antenna Jack is intermittent.

1/24 The North end Inverted-L for 160m broke at the feedpoint and is now blowing around in the 45mph wind gusts. Hopefully I'll be able to lasso it in the morning when the wind is supposed to be lighter so it can be fixed for the CQ 160m contest tomorrow night.

1/25 Fixed 160m Inverted-L... wind chill only -10f to -20f this morning, perfect day for antenna work!

1/26 Put rewound transformer in the broke HF-2500 and put it on 10m, seems ok. Resoldered circuit board connections on FT-1000mp with intermittent RX Antenna jack.

2/18 Bad weekend for amps... Friday night the 160m amp ptt keying became intermittent, or the grid protection is shutting it off. I ran it with no drive for an hour or two and the keying seemed consistent, so I suspect either tubes or the grid protection is doing something funky. I replaced it with the spare which had been the 10m amp before I put the rewound transformer one on there(see above). Then Saturday the 15m amp blew it's main fuse. That one appears to be the HV rectifier/filter as it still blew the fuse without any tubes, but didn't blow it when the HVAC from the transformer was disconnected. I replaced that one with the SO2R right hand station amp. Then later the one now on 160m started sounding like it had dirty relay contacts on receive, which could be a real problem as that one has the high speed relay board which meas the relays are a sealed type.

While I was at it I inventoried the Commander amps....

- 15m s/n 698, grid protection, high speed relays, no 80m/160m, this is the one that had the power supply repaired in 2011.
- 160m s/n 720, grid protection, high speed relays
- 20m s/n 443, no grid protection
- 10m s/n 427, no grid protection, rewound transformer
- 80m s/n 685, grid protection, my modified relay, single band 80m mod
- broken s/n 765, grid protection, intermittent keying or grid fault
- broken s/n 435, no grid protection, power supply blows fuse, needs cleaning

Anatomy of HF-2500

2/20 Took apart HF-2500 s/n 435 that was blowing fuses, don't see anything obvious in the power supply. There is some sign of heating but not the tracking from arcs in the board like what happened to s/n 698 in 2011. The diodes seem to be ok, as do the capacitors and bleeders, at least at ohm meter voltages.

For anyone who has ever wondered what the inside of an HF-2500 is like, here is the grand tour:

I take pictures like this whenever I am disassembling something this complicated just so I can go back when putting it together to make sure all the wires are routed properly and everything else is back where it belongs. Here is where I am starting. The top and bottom covers are off, the transformer is out from where it would be on the left side, and the tubes are out. This removes lots of the weight which makes it easier to handle and reach some of the hardware.

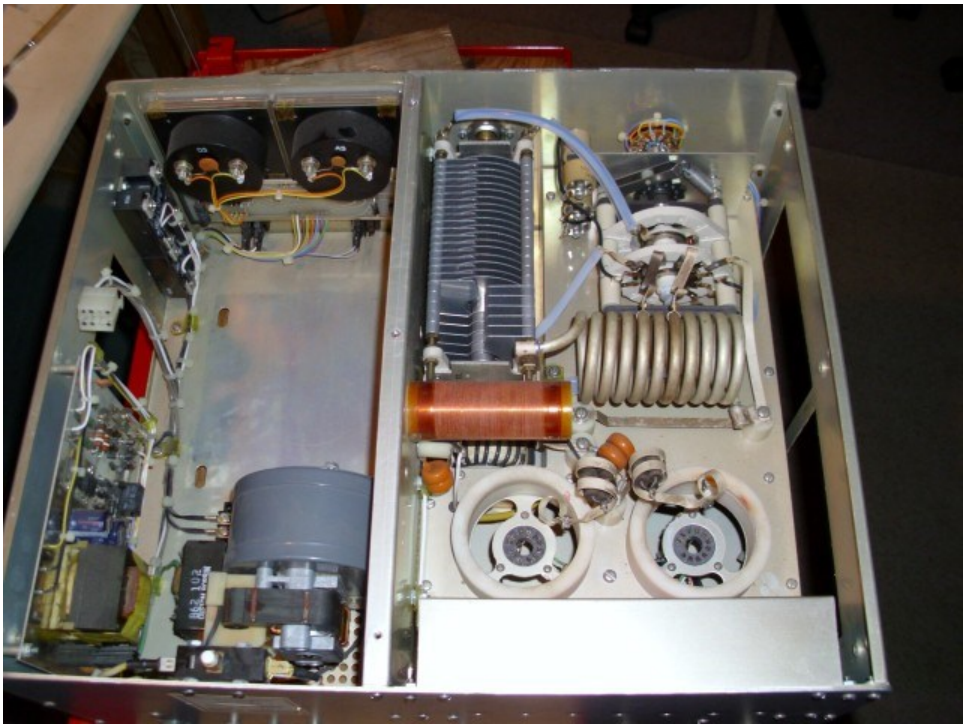


Figure 693 Inside of HF2500 without transformer and tubes

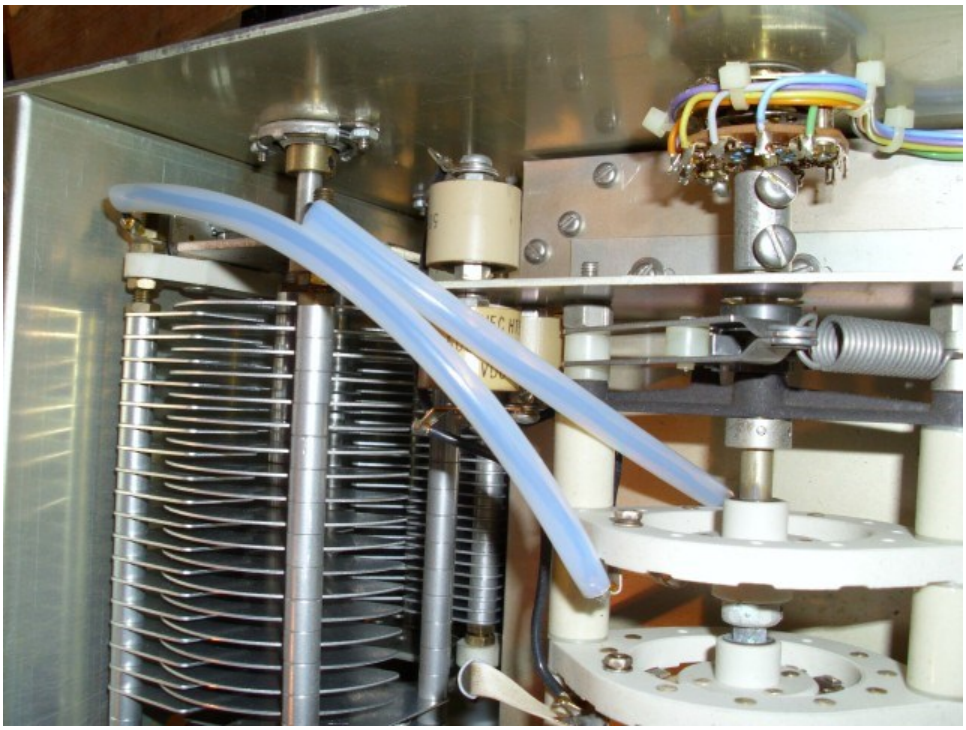


Figure 694 Closeup of the front of the tuning cap and band switch

The back end of the tune cap and the high band coil and plate choke. Note the order of the stacking of the things connected to the closest terminal on the tune cap, if you get those backwards the small strap is too close to the sharp edge on the back support of the tune cap and it can arc.

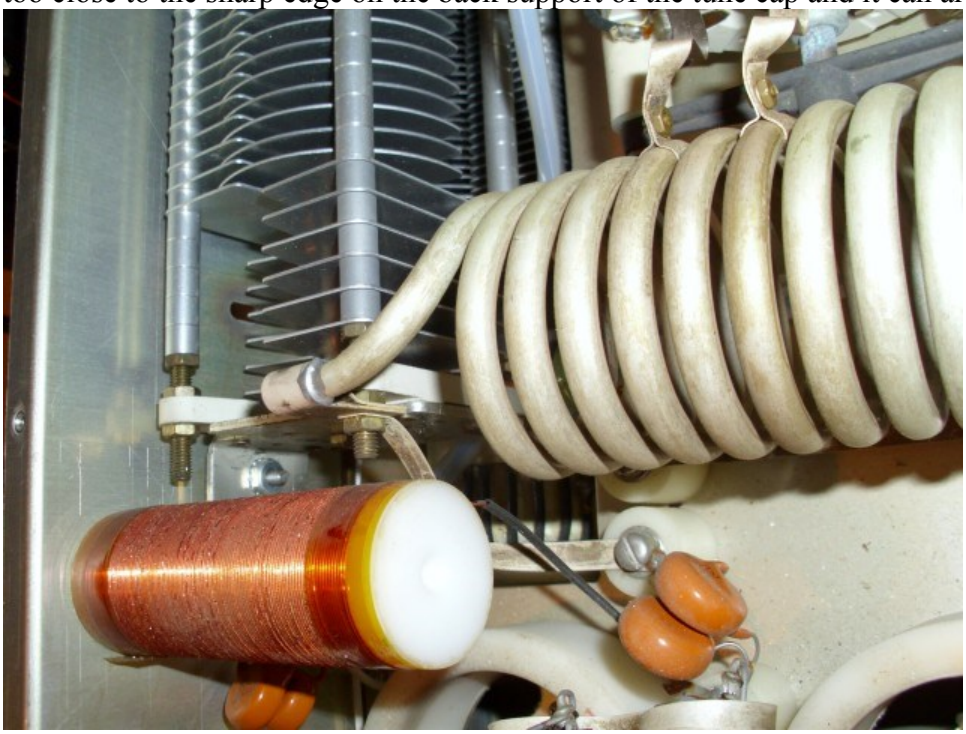


Figure 695 Closeup of back of tune cap and plate choke

View under the plate choke. Older versions only had one capacitor on the HV power supply to ground on that short insulator(the one on the divider under the plate choke), but it was letting too much RF into the supply and metering so Pat supplied pairs of caps to replace the single one.

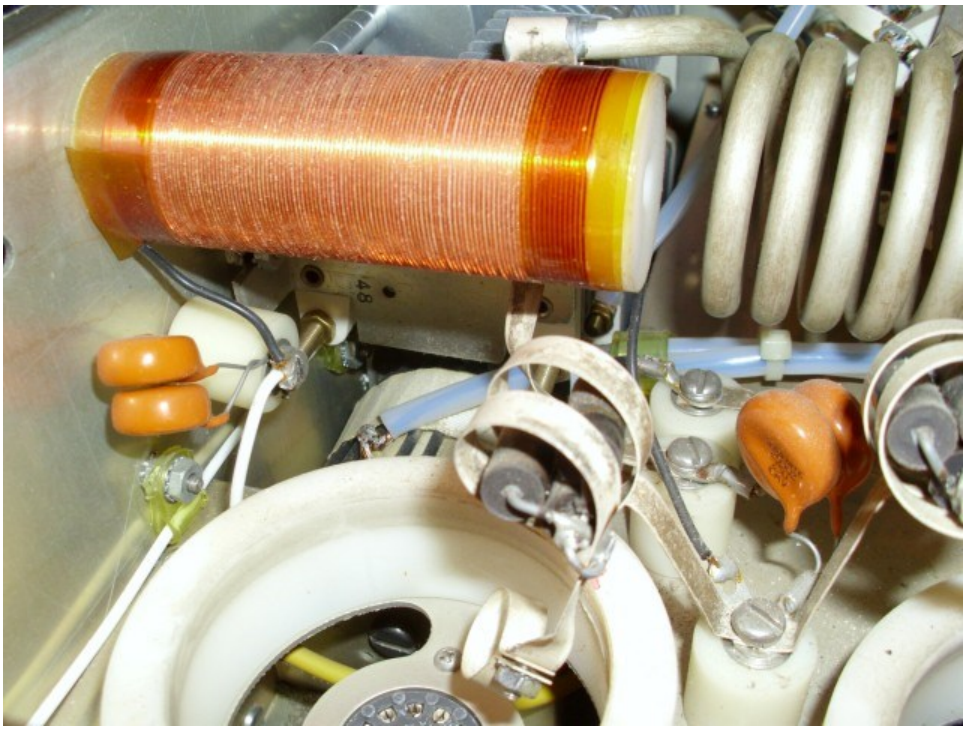


Figure 696 Closeup of under plate choke

Closeup of the back end of the band switch and how the strap from the band switch goes down to the load cap.

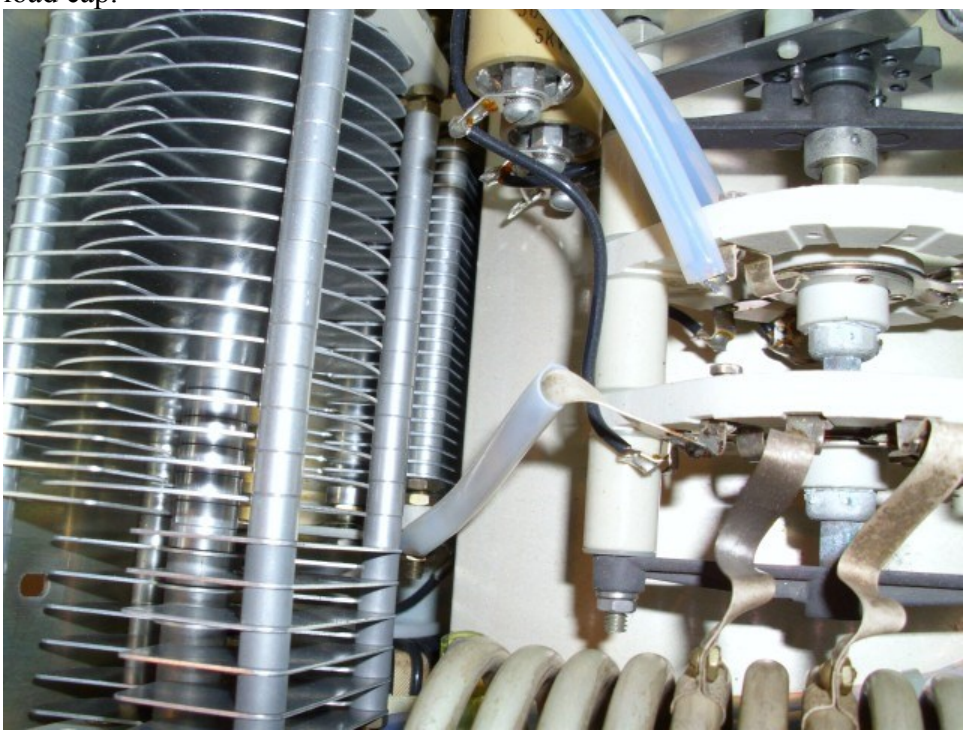


Figure 697 Closeup of back of band switch and connection to load cap

Here the tune cap has been removed. To do that you take off the two wires from the band switch on the front, the high band coil and strap from the tube DC block caps on the back, then mark the shaft and knob alignment and loosen the two set screws in the knob bushing. Then there are two bolts through the center divider that are in slots that let you adjust it's position a bit. It is usually easier to remove the plate choke first, then take the nut off the back slot of the tune cap and back the bolt out of the nut that acts as a spacer so you can just slide the tune cap backwards off the front bolt and out of the knob bushing. The red tape on the RF out from the pi network wire is to remind me to keep it bent away from the back support of the load cap, another place it can arc if you put it together wrong. Note at this point, removing these from the divider is not really necessary just to get to the power supply, it just makes getting to the load cap easier. But it would be necessary to get to the low band toroid that is behind the load cap. Also notice the small black wire on the low band coil, this is an older coil which has had none of the melting problems seen on newer ones that use a larger gauge wire.(See melting pics) There are two possible explanations for this, one that the physically smaller wire leaves more room for air from the fan to move through the coil, the other is the higher resistance of the wire reduces the Q of the coil turns that are shorted when on 40m and 80m thus reducing the circulating current and heating. I must have broken the connection to the plate choke when I put in the new caps on that insulator as the choke is soldered to the HV lead from under the RF deck, I'll unsolder that and put it back on the lug that was there for it.

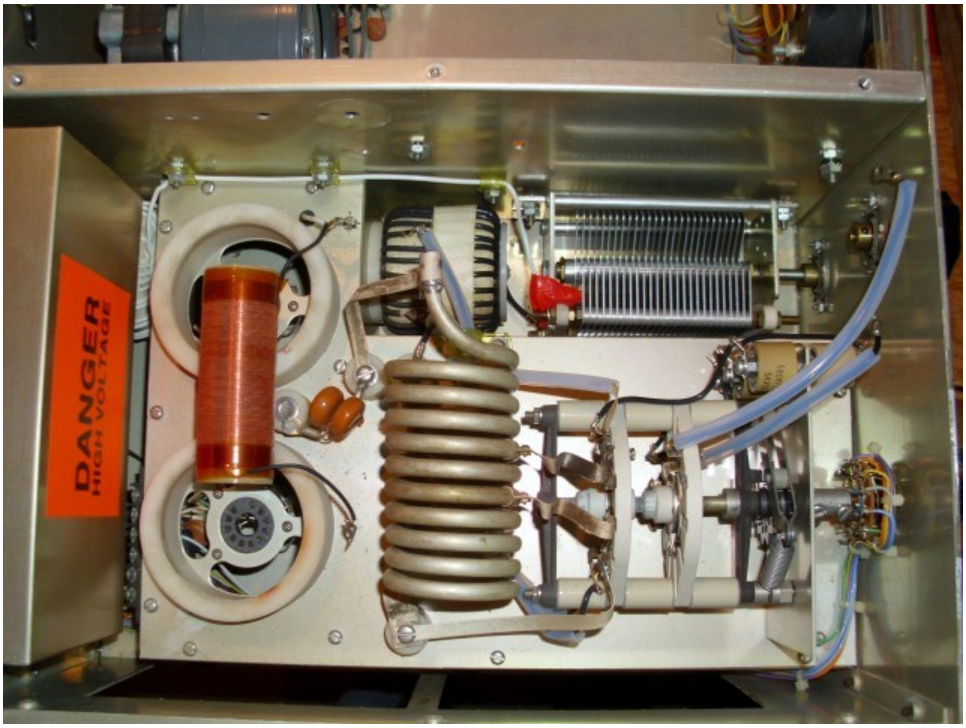


Figure 698 Load cap and plate choke removed from divider

Back view. On the left is an impedance transformer. On the right are the connections going to the power supply and filaments. The cable bundle to the right goes from the input network to the front of the band switch.

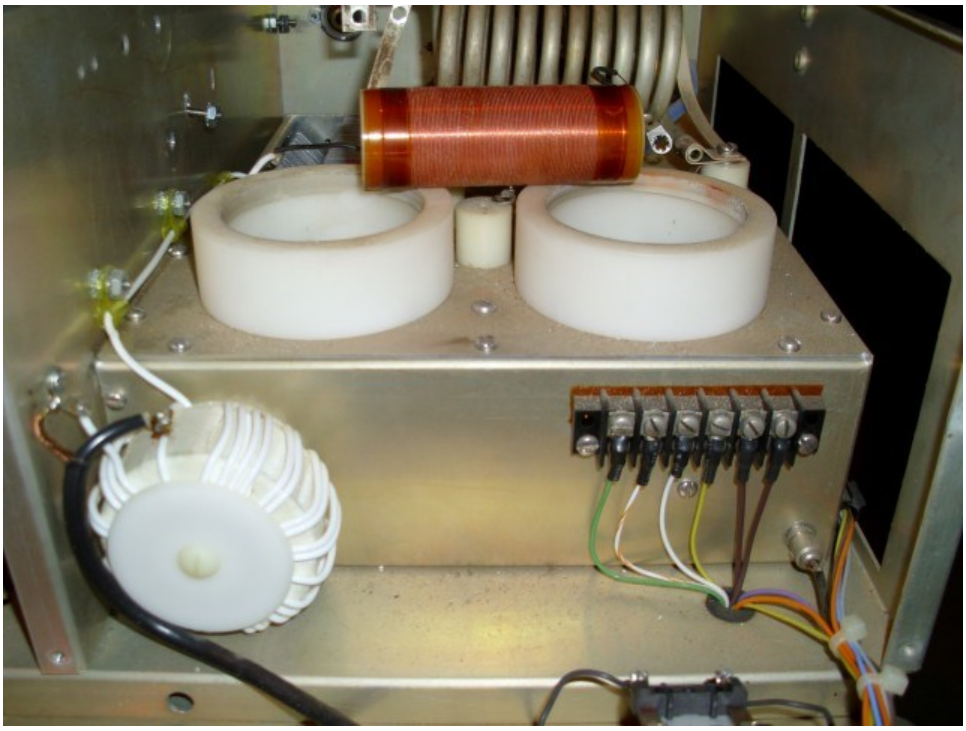


Figure 699 Closeup of back of RF deck

Here I have loosened the set screw on the band switch shaft, I have also marked and loosened the screws on the load cap. Then underneath the chassis I removed the screws holding the RF deck and center divider down, and also the 3 screws holding the divider to the front panel. I then backed it off just enough to get the shafts out of the bushings.

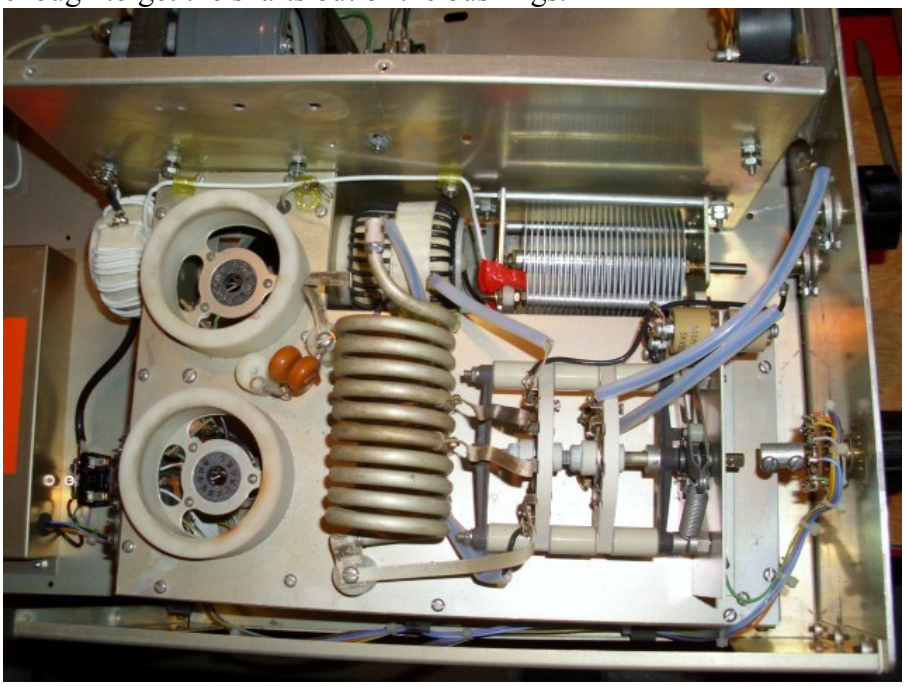


Figure 700 Removing RF deck from front panel

Here I have taped the row of connections together and taken them off the terminal strip and have pulled the RCA plug taking RF into the RF deck. Also I have removed the bundle of wires going alongside the RF deck to the front of the band switch out of their supports. At this point I could take a look under the deck but that is about as far up as it will go at this point.

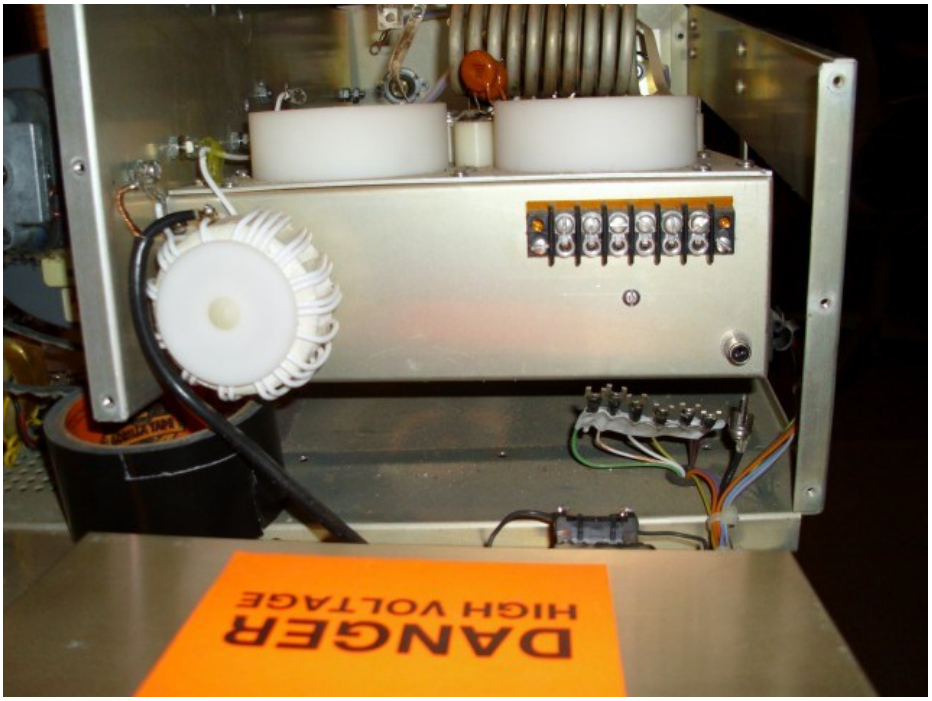


Figure 701 Closeup of back with RF deck loose

The final disconnect of the RF deck looks like this. I removed the white wire from the load cap to the transformer then removed the transformer and it's ground connection from the deck. And also disconnected the two leads for the fan from it's terminal strip. So now the RF deck can be removed and it exposes the power supply.

Figure 702 Underside of RF deck

As I am taking it apart I keep all the screws and other parts in these little plastic containers that electrical tape comes in. If I can't reassemble in a short time I put little notes in each container and put the lids on them so the parts are safely stored away.

Figure 703 Parts dishes

2/21 Dis-assembly was not really required... it was the transformer all along, this time instead of letting stinky smoke out it just shorted from the HV secondary to the primary. It didn't blow the fuse with BOTH of the secondary wires disconnected, but with only one of them disconnected it did... further measurements of resistance between windings proved the problem.

2/22 argh... dirty relay on HF-2500 s/n 720 is really bad. Put tubes from s/n 435 into s/n 765 to see if the tubes were what was causing keying problem, put s/n 765 back on 160m... keep fingers crossed.

2/23 Cleaned contacts on HF-2500 s/n 720 and put it on 15m for test, seems to be ok now. Had to cut off part of the top of the plastic housing to get at the contacts... just wrapping a paperclip around the Weller gun makes a nice hot knife for stuff like that.

2/24 Well, the tubes from HF-2500 s/n 435 ran all the way through the 160m contest in s/n 765, so most likely one of them is bad. Left those tubes in there on 160m. Now s/n 435 is waiting for a transformer and then will test those tubes, but likely one of them is bad when it heats up.

3/3 Well, the tubes from s/n 435 didn't fix s/n 765, it was shutting down last night. Apparently turning down the drive makes it work again. Something must be heating up in the control circuit and making the grid protection too sensitive or something like that. The s/n 435 tubes may be a bit soft also, the power seems to slowly drop as you keep it keyed. Swapped the tubes back again and the s/n 765 tubes don't lose power so that is not a problem with the power supply or something else.

3/9 First nice 'spring' day, only about 18" of snow on the ground, but sunny and only a light breeze. Went up the 10m tower and brought down the TIC 1022B Ring Rotor motor that was showing an open circuit.

3/10 Took apart the ring rotor motor, now its really broke, but is running for now. The problem appeared to be a stuck brush. I got it apart, but couldn't quite get it back together properly because of how the brush circuit board was held to the case. But it seems to be working anyway. I'll have to see if one of the other motors will work on that one or if there are replacements available from TIC.

3/18 Bought Commander HF-2500 s/n 503 from W2ID as another spare.

3/28 Got back transformer for HF-2500 s/n 435. Put in rewound transformer and fired up s/n 435. It didn't get up to full power, it seemed to be topped out at about 1000w on 10m. When not keyed the plate current was about 400ma, so something is wrong with the bias probably.

4/3 Still troubleshooting HF-2500 s/n 435... found 200ohm 10w resistor in series with diode between ground and B- on power supply board is open, but the diode seems ok. Schematic in book is not correct so that isn't helping much.

An easier way to get to the power supply is shown here. First remove the back panel, then disconnect the two capacitors and the bandswitch and the ground wire for the bandswitch from the front panel. Then remove the screws for the center divider from the front and bottom, and the RF deck screws from the bottom. The RF deck should then pull back from the front panel and tilt up from the back. This way you don't have to remove the wires from the rear terminal strip, though I did pull the RCA plug for RF into the deck to keep it from being flexed too much. A small box keeps the RF deck from falling over. In this condition everything except the ground wire that connects to the front of the RF deck under the

bandswitch is still connected, so it should be possible to troubleshoot the power supply and it's connections.

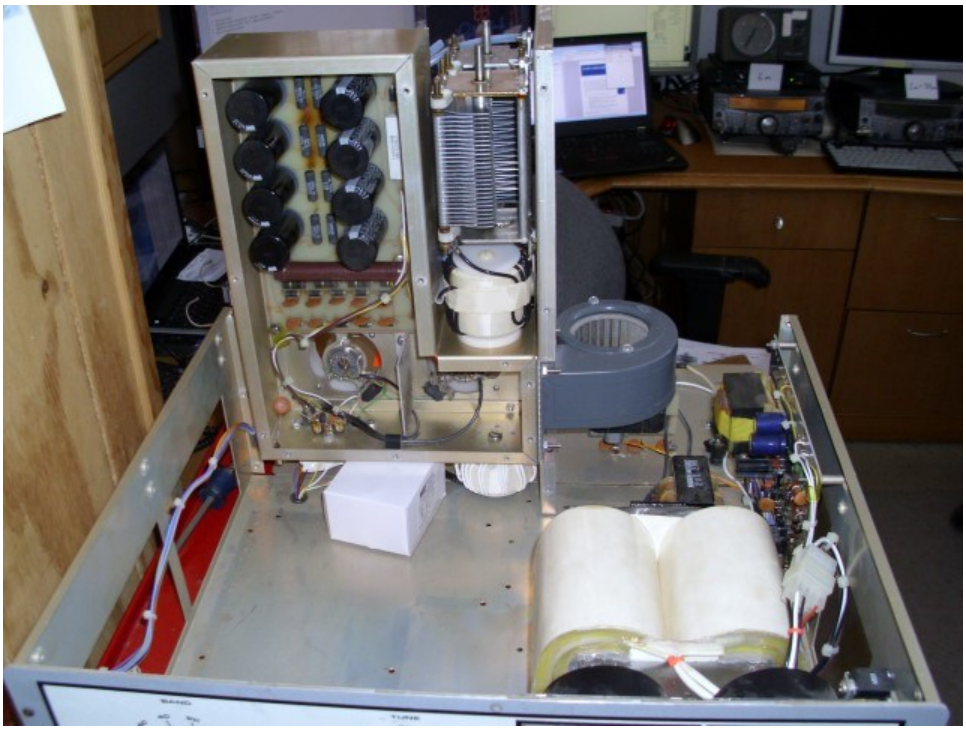


Figure 704 Underside of RF deck with both caps in place

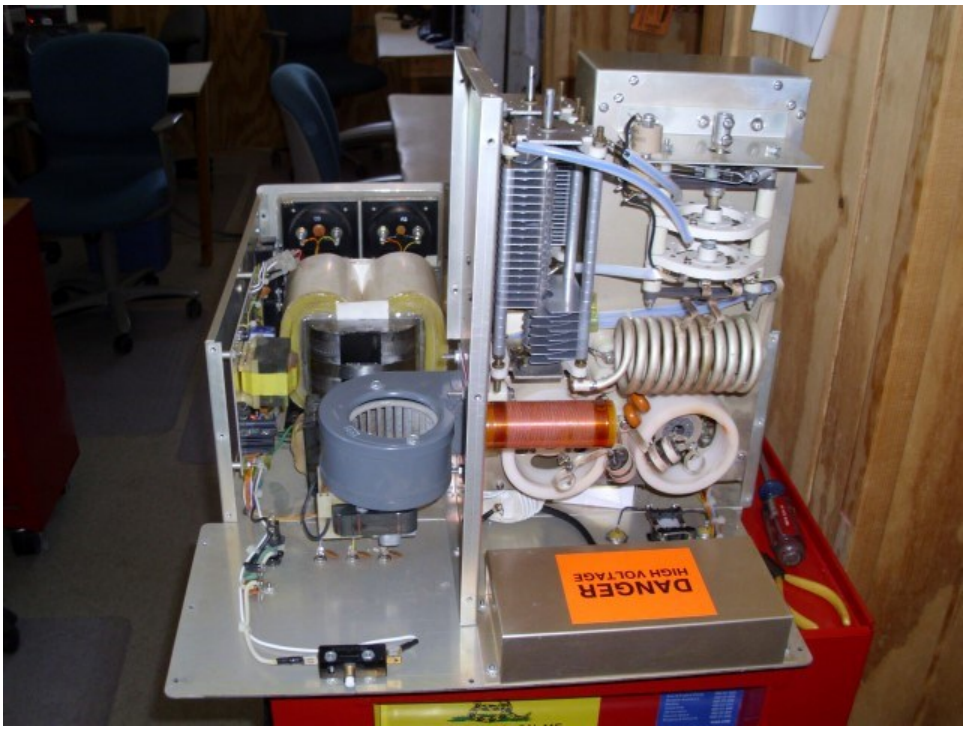


Figure 705 RF deck standing up without removing caps and plate choke

4/5 Found 80m 4-Square SWR high. Trudged down through the 6-12" of snow still on the ground and temporarily fixed the East vertical feed connection. Needs proper lug and re-waterproofing to finish up the job. Should check other feedpoints for fatigue also I guess.

4/7 Ok, now I'm making some progress... thanks for some of the tips from the amps reflector. Yesterday I traced out the circuits for the rf deck, hv power supply, and meter board, and was able to connect up the whole loop from B+ to B-, and it obviously didn't match the schematic that came with that amp... mainly the schematic showed a 8.2v 50w zener doing the biasing during tx and a grid leak resistor during rx that were switched by a relay... well, that relay existed but the terminals that should have switched the bias weren't hooked up. So today I was going to trace out the control and bias board which is up against the side frame of the inner case and partially blocked from view. So last night I dismounted it and got it so I could expose the whole thing so I could take pictures of the top and bottom to make tracing it out easier. This morning after another hint, and in looking at the board I found a label on it "QSK-1"... I don't have QSK in this amp and the old schematic had no reference to that. BUT, the circuit started looking familiar, and since I have several generations of those amps (8 of them in total from s/n 427 to s/n 765) I flipped through a couple of the newer books where I remembered seeing schematics for QSK boards and other variations. It appears that Pat started using newer boards but shipped some of the older amps without updating the schematics. So by s/n 427, bought in 1993, he had changed the control board in non-qsk amps to use the qsk bias and control board that is documented in later manuals. I have found one of the 400 series ones where he stuck in an updated schematic for the control board, but not all of them have that.... and that schematic isn't the same as the one I have, nor the same as is documented in a 700 series book. So this is progress... I went from having one bad schematic yesterday, to at least 4 different schematics this morning, one of which looks like the right one... and also comes with a board layout diagram that looks correct.

I disconnected the HV AC from the transformer to the plate supply, taped over exposed 120v stuff on the control board, shielded the AC on the back panel and powered up the control board. The supply voltages were ok and the startup delay was ok. But the bias and grid current measuring part of the board didn't work. So now I have some parts to order.

Ice!

4/13 This is what 1/4" of ice at ground level can look like at 180'. These are of the ring rotor holding the 180' 40m4lldd showing the cables around the motor and boom brace and on the tower legs.

Figure 706 Ice at 180'

Figure 707 More ice at 180'

4/14 Ok, hit a wall when trying to host video here, upload rate on DSL too slow... so started YouTube channel for stuff. Put up video from drone taking a look at the bottom 40m antenna.

4/20 Replace most of the components in the bias circuit for HF-2500 s/n 435. The plate current at idle just barely moves the needle now and the switching circuit does its job. The cutoff cathode voltage may be a bit low, but everything in the circuit checks out now.

4/21 Another advantage of having more than one of these… besides not being in a rush to fix it, is that I can put another one side by side and compare measurements. Yes, the cutoff bias is too low. A good amp was using about 45v in cutoff and 8.7 on tx. So back to troubleshooting… Found some more discrepancies in the board schematic and ended up tracing it back to the power supply board, which I had just sealed up because everything had tested ok on it. What I am seeing now is that the power supply is loading down the bias supply. The only connections to ground in the power supply are the multi-megohm divider for plate voltage, and a diode/resistor combo that is meant to protect against B- going negative with respect to the chassis… so the only possibility is that the diode is breaking down, even though it passed the standard ohm meter diode test feature. I can at least duplicate the problem by putting 12vdc on the B- wire that goes to the control board with it disconnected from the control board, with 12v it is drawing about 6-8ma which would be more than enough to drag down the bias supply that supplies 60v through 20kohms to supply the bias.

4/22 Well, 5 boxes that should be full of nice shiny 10m antennas got delivered today. Anyone want to help put them together??

4/28 Besides planting 10 dozen day lilies I did get HF-2500 s/n 435 repaired finally. The 1n5408 on the rf deck from B- to ground had turned itself into a 9v zener. So when the cathode bias was trying to shut the tube off it couldn't get the voltage high enough to do the job. I replaced that diode and the two on the meter board just to be safe and now it works just fine again.

Beverage test and repair

5/17 Been busy with yard work, drone, cleaning crawlspace, building brass catcher, and lots of other stuff. Did have one thunderstorm with one lightning stroke, it appears to have taken out the NE/SW Beverage.

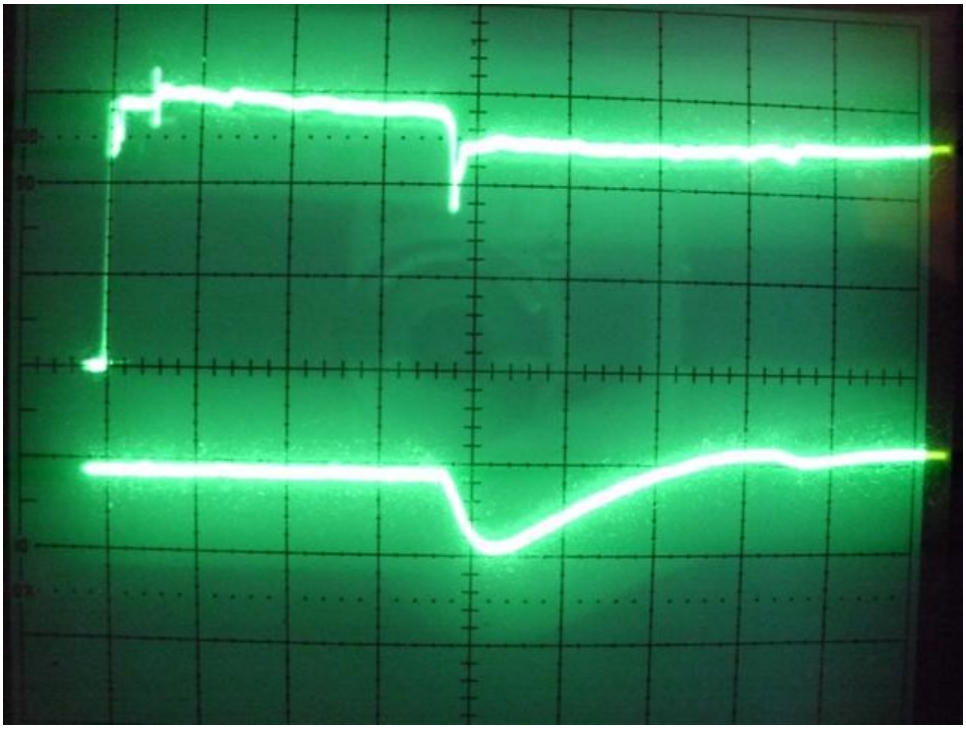


Figure 708 Good NE-SW Beverage TDR Trace

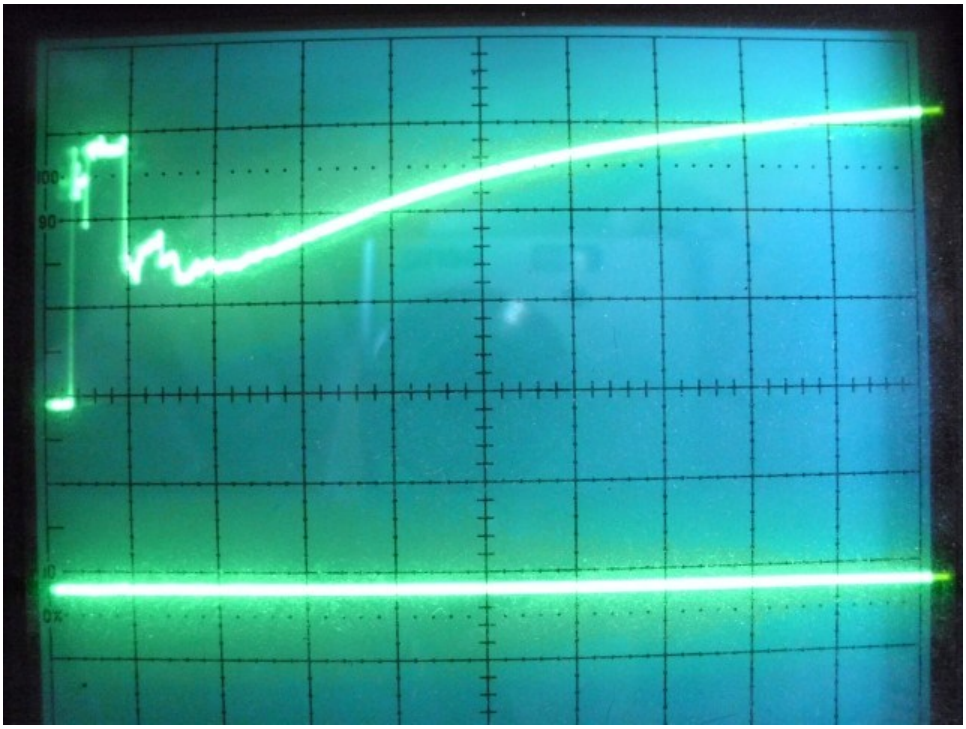


Figure 709 Bad NE-SW Beverage TDR Trace

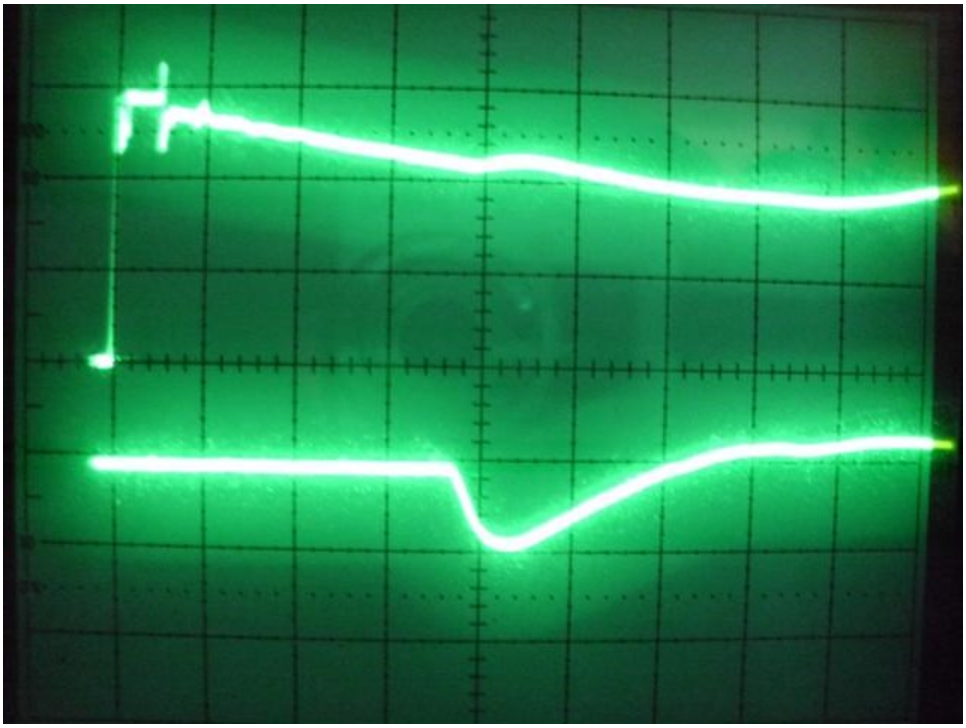


Figure 710 Good SW-NE Beverage TDR Trace

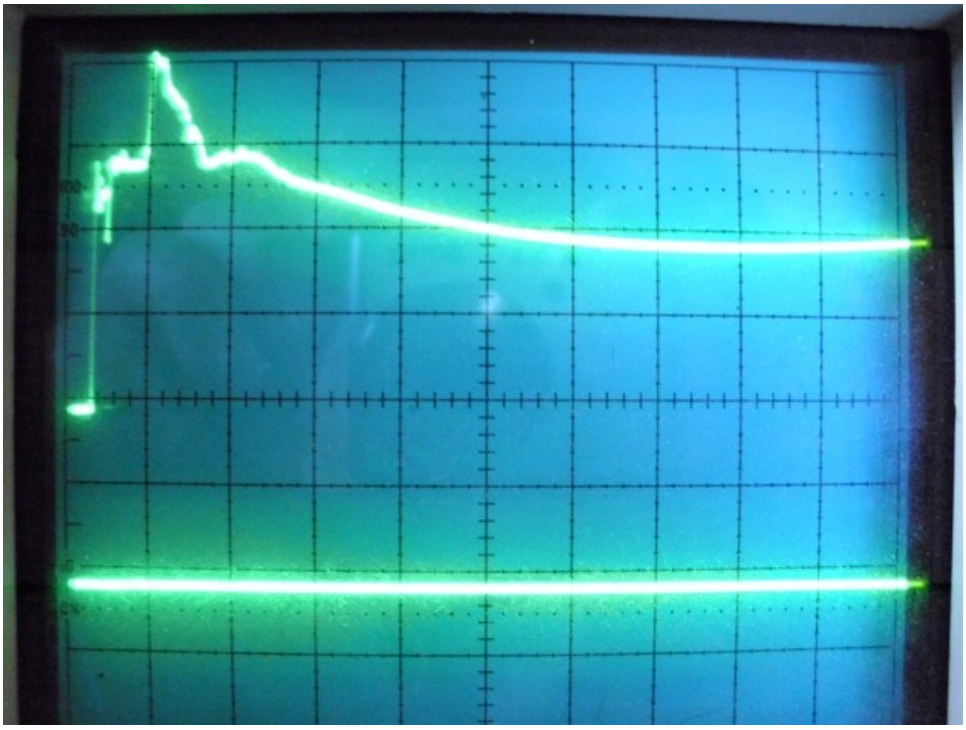


Figure 711 Bad SW-NE Beverage TDR Trace

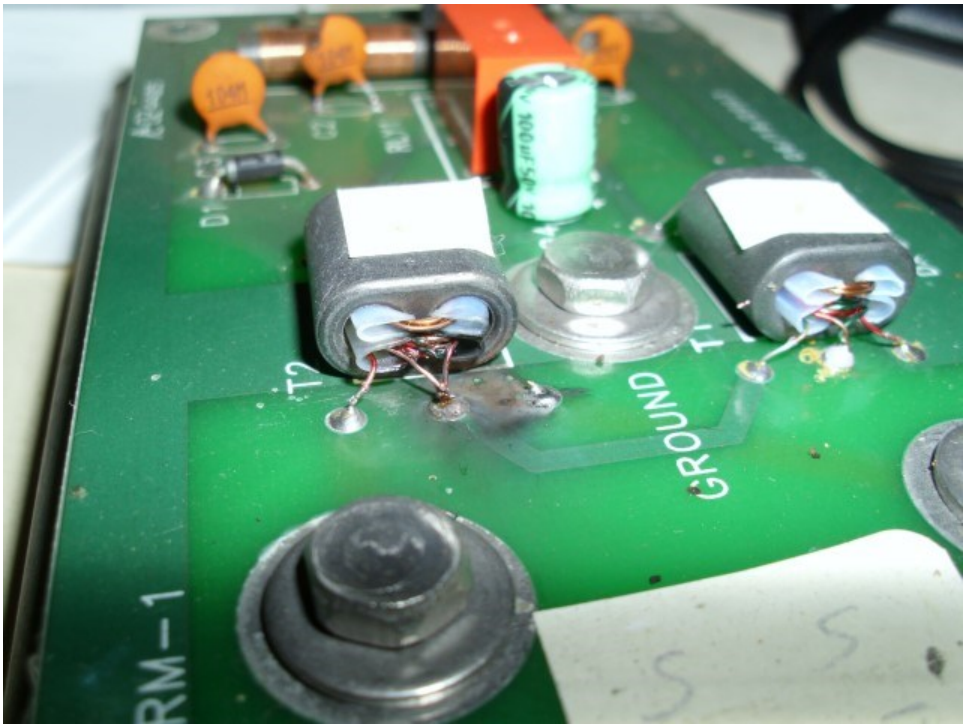


Figure 712 Burnt wire in Beverage box

Halfway there, reflection isn't coming back properly so time to trek through the swamp:

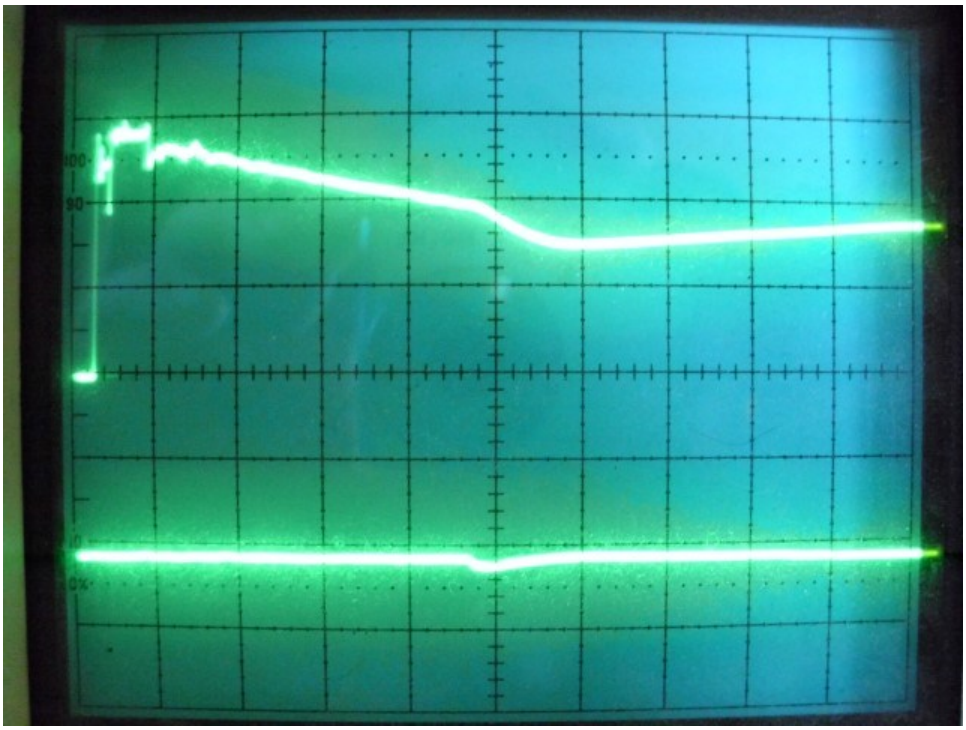


Figure 713 Still not quite right

Can't see anything wrong with the reflection transformer, I'll have to compare resistances to good one later. But for now it is ready to go:

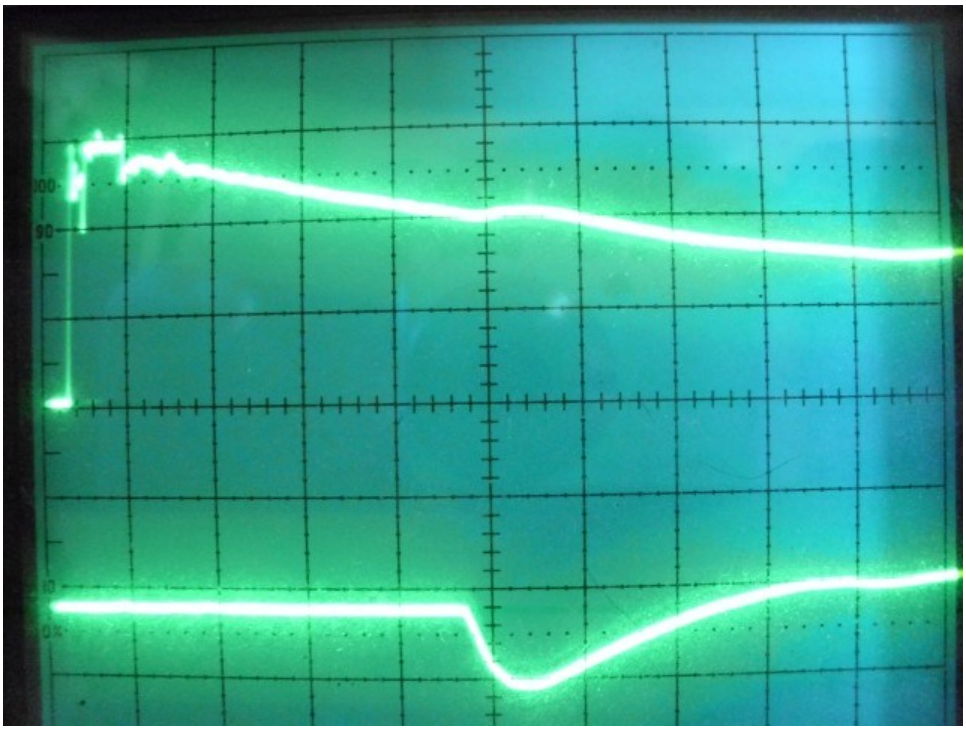


Figure 714 Final repaired trace

5/18

Well, resistance readings on the bad reflection transformer are not definitive. All readings are a few tenths of an ohm, a bit lower than a new one but not that much different. So hook it up to the TDR. Put a pulse into either the + or - terminal and look at the other one. On the traces below the initial part where the top trace goes up is the pulse going into the coax which is about 25' long, after a delay it get reflected and the transformed result also comes out on the bottom trace through an identical length of coax.

Note on the good one pulsing into the + terminal the transitions are sharp and there is lots of ringing.

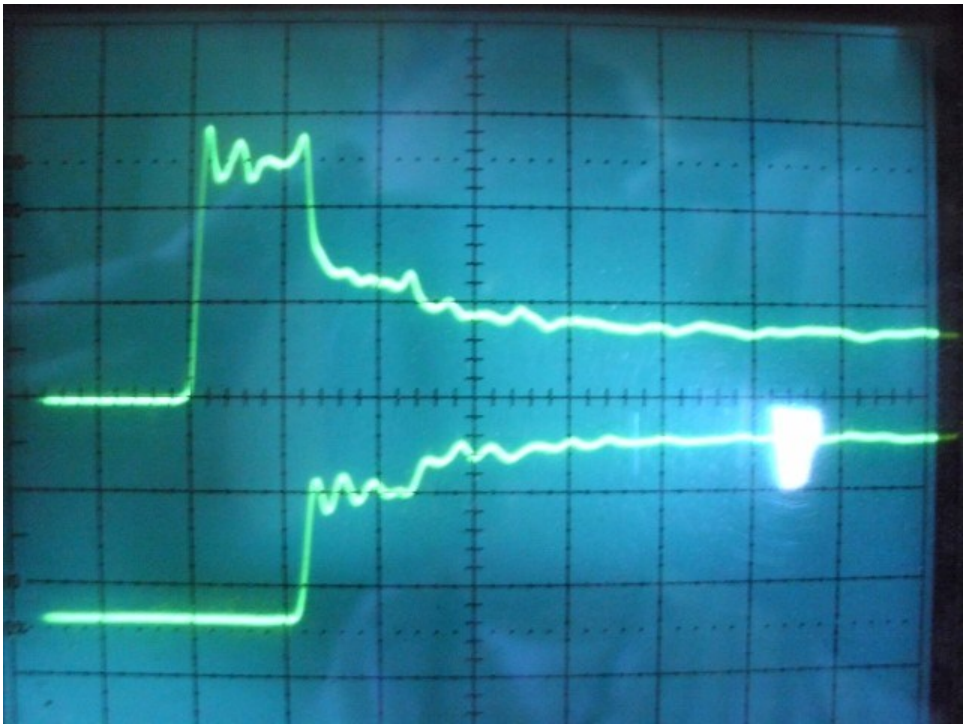


Figure 715 Good reflection transformer

But on the bad one the return on the lower trace is rounded and lower amplitude.

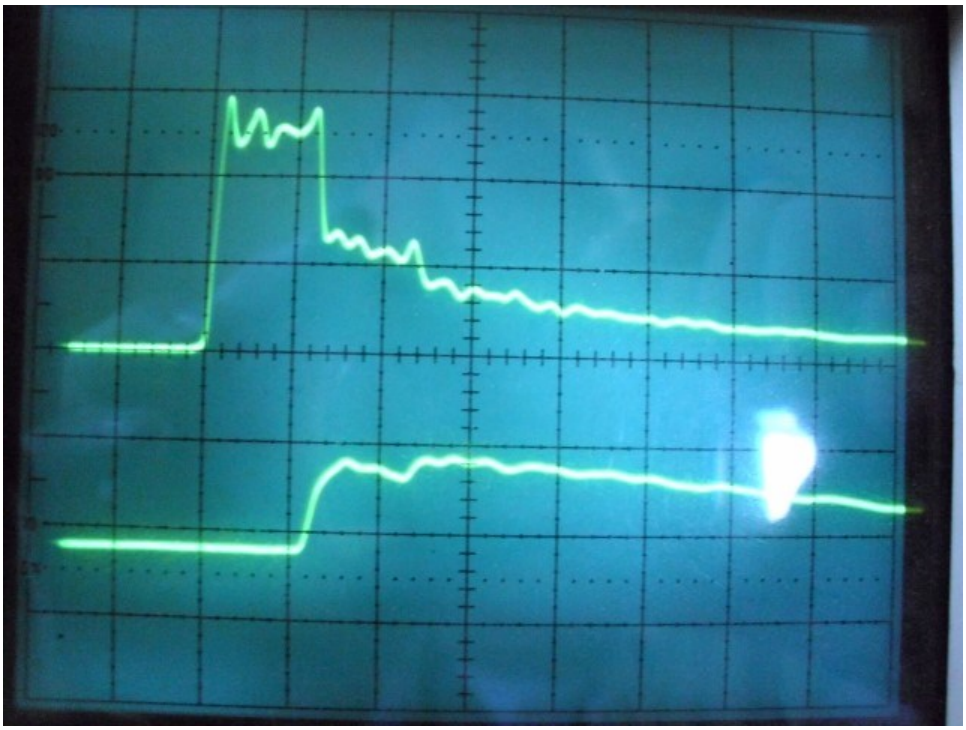


Figure 716 Bad reflection transformer

On the good one pulsing the minus terminal the top trace shows a high impedance with a more rounded return.

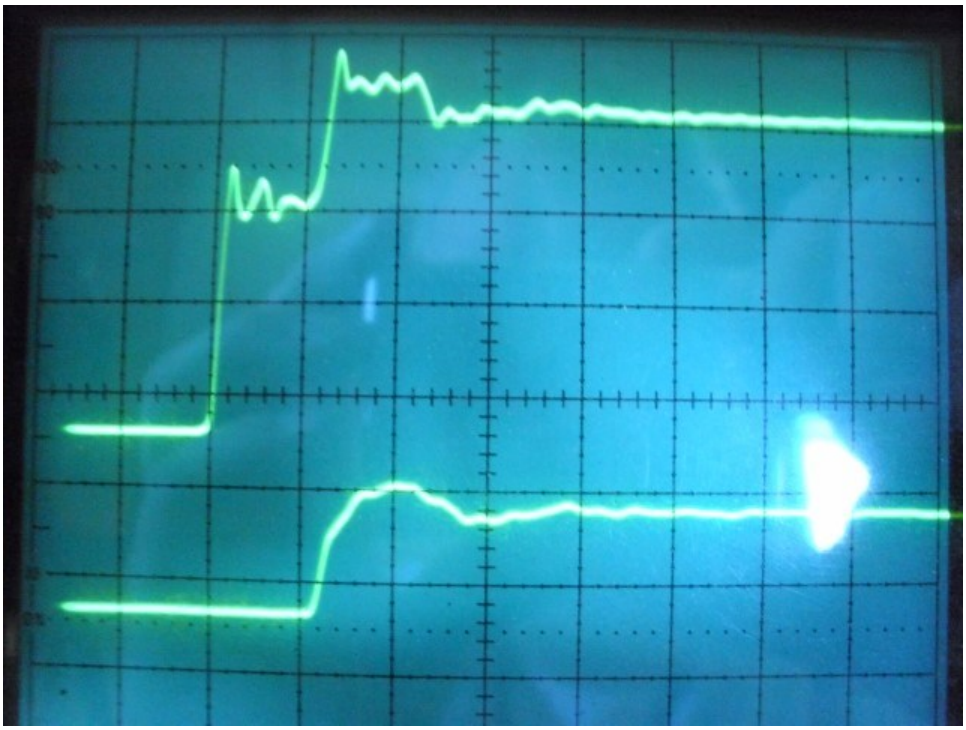


Figure 717 Good reflection transformer

But on the bad one the upper trace shows a smaller impedance and the return on the lower trace is more rounded and lower amplitude.

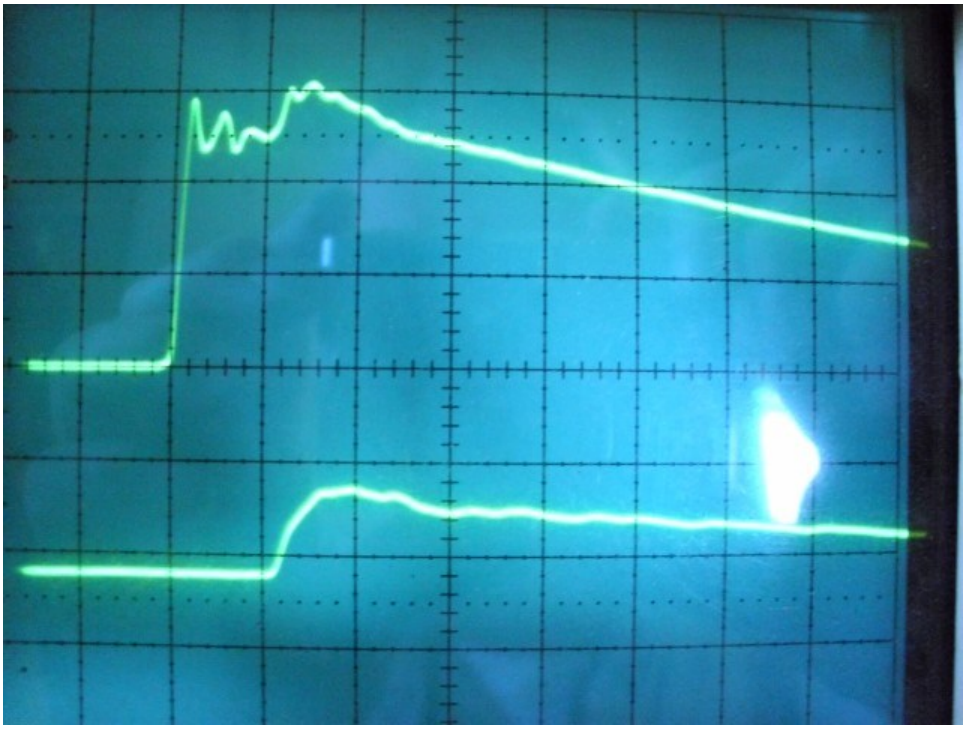


Figure 718 Bad reflection transformer

If you look at the original 'half fixed' traces you can see that the top trace shows a drop in impedance at the reflection transformer and a small return. Where the final fixed one has a rise in the impedance at the reflection and good size return. So most likely there is a short inside the windings of the core reducing it's effectiveness.

New 10m stack

5/24 A mostly rainy and cool Friday. Made the coax for the new 10m stack. Each 70' of Davis RF RG-213 with Amphenol silver-teflon PL-259 on one end and a split end for the antenna feedpoint.

Figure 719 Feedlines for new 10m stack

5/25 This is what I get for starting a long weekend on Wednesday afternoon... Days of rain and cold, and now snow in the forecast for this afternoon! So what better to do than sit around sorting hardware for the new antennas. After looking at the assembly instructions and the single bag of hardware I decided to pre-assemble the boom-element clamps as that would use up about 3/4's of the nuts and bolts so I wouldn't have to sort them. So after assembling 25 boom-element clamps and sorting out the rest of the hardware this is what you end up with. After all that I came up missing the last 1/4-20 square nut for the

last clamp. All the hardware bags looked intact, which is a very good thing, but i'll keep an eye on the boxes in case it got loose.

Figure 720 Parts sorting for 10m Yagi build

Needless to say Pablo was not impressed...

Figure 721 Supervisor doing his job

Then assemble the boom-mast and boom splice clamps:

Figure 722 10m Boom to mast clamps

And put all the clamps on the booms, and you get 5 booms that are too big for the garage!

Figure 723 10m booms

6/1 Thanks to Tom W1TO for coming up to help assemble 10m antennas. With his help we turned 5 boxes of tubing and a pile of hose clamps into 50 element halves then mostly assembled one antenna.

Figure 724 10m Element halves

One antenna, all parts in place except feedline and not all aligned yet:

Figure 725 First new 10m Yagi

6/7 Pablo's new friend.

Figure 726 Pablo's new friend

6/8 I didn't like how the feedpoint connection looked on the first one. Since the clamp ring doesn't go all the way around it looks like it could stretch or crack over time and loosen up. And with it out of reach on an installed antenna any fix later would be a real pain.

Figure 727 10m Stock feedpoint

So I simplified it a bit. Just to be sure the hole through the element didn't weaken it I tripled up the aluminum for the first 6" of the element. The new hardware is #8 ss salvaged from the 40m4LLDD stuff. I went with a longer screw so there would be plenty of room to put on another lock nut with some washers for the coax connection.

Figure 728 10m Simplified feedpoint

6/15 Thanks to George who came over yesterday and today to help out all 5 of the new 10m Yagis are assembled and ready to raise.

6/30 George and W1IM showed up to help take down 4 of the old 10m Yagis, then N1TA showed up to take them apart and eat lunch.

Sure looks empty with only the top one left:

Figure 729 Almost bare 10m tower

One bucket for cold drink and to collect hardware, the other bucket for collecting tape.

Figure 730 Work on 10m tower

Figure 731 Empty ring rotor

Figure 732 Very low 10m stack

7/6 George, W1IM, N1TA, and W1TO were here bright and early to take down the top 10m antenna. It was just too windy by the time that was done to try putting up any of the new ones.

Figure 733 Removing last old Yagi, rigging

Figure 734 Bolts out

Figure 735 Tilt and Twist to get it under the top guy wire

Then down it goes, but the wind and lack of room to the left because of the trees made it easier to just bring it down between the guy wires than to try to pull it out.

Figure 736 Clear of guy wires

On the ground. W1IM taking off the ropes. Notice the fiberglass rod tied/taped to the boom, that was to reinforce it after it was bent in the ice storm a couple years back.

Figure 737 On the ground

An empty tower at sunset...

Figure 738 Real bare tower

7/14 Got top two new 10m antennas up this morning. Had ground crew of N1TA(after being awake 24hrs for IARU contest), W1IM, and W1TO. Here are W1IM and N1TA waiting to rig up the second one to go up.

Figure 739 New Yagi ready to go up

Figure 740 Top one in place

Figure 741 Second one down

7/19 Finished up the 10m stack this morning. Had big crew for a Friday morning... W1IM, W1TO, George, Tom (guest visiting neighbors), and just in time to finish up, N1QOV.

Figure 742 Putting one on ring rotor

Figure 743 Hooking up coax

Figure 744 New 10m stack!

8/11 Did summer inspection tour of 150' tower. Tried to take a bit of the sag out of the top 20m antenna, had hard time because the turnbuckle is rusted too much to turn but think I got an inch or two anyway. Fixed side mount standoff on 120' 20m antenna so it should stay put now. Added or replaced a bunch of tape on cable runs.

8/17 Did inspection tour of 180' tower. Realigned top 40m rotor pot.

9/1 Replaced the 10m 120' and 15m 120' rotor control boxes with GreenHeron RT-21 controllers.

Fall Foliage Pictures

9/28 Went up 10m tower and taped everything down for winter. Took a few pictures from up there of the fall foliage.

Figure 745 Fall foliage from 10m tower

Figure 746 More fall foliage

Figure 747 More foliage and 80m 4-square

Mt Greylock is on the right end of the ridge behind the 150' tower:

Figure 748 Other towers and Mt Greylock in the background

Figure 749 Closeup of 20m and Mt Greylock

More HF-2500 Repairs

Not a good weekend for amps though. S/N 720 let out the magic smoke on first keyup on 15m Friday night. I opened it up and plugged it in Sunday and smoke came out of the top solid state power relay. S/N 443 blew its main fuse Sunday morning on 20m.

10/5 Replaced solid state relays in HF-2500 s/n 720, it seems to be working ok now. Took apart S/N 443, it is another transformer primary to secondary short. I think it also damaged the solid state relays as they are letting power through even when the front switch is off.

The solid state relays that turn on the HF-2500. They are tough to get in and out with the transformer in place but it is possible by removing a couple cable ties and pulling them out through the chassis cutout.

Figure 750 HF2500 Solid state power relays

- 20m s/n 427, no grid protection, rewound transformer
- 15m s/n 435, no grid protection, rewound transformer, repaired bias and switching
- broke s/n 443, no grid protection, bad transformer - out for repair, bad power relays?

- 10m s/n 503, no grid protection, purchased 3/18, no manual
- 80m s/n 685, grid protection, my modified relay, single band 80m mod
- SO2R s/n 698, grid protection, high speed relays, no 80m/160m, this is the one that had the power supply repaired in 2011.
- spare s/n 720, grid protection, high speed relays, replaced power relays
- 160m s/n 765, grid protection, very intermittent keying or grid fault???

10/11 Parts order came in from Digikey so I fixed the 12v 20a Astron supply for the VHF/UHF station so I could get rid of the noisy Kenwood switcher. Also did more troubleshooting on the 40m 4-square. Found a couple of ground connections that were intermittent from corrosion at the verticals. After that it still wasn't working properly so I pulled the box down... It must have taken a good lightning hit as the board was well fried and there was lots of soot blacking out all the relay covers. Ordered new one... starting mystery boxes for next year's NoBARC flea market early I guess.

10/16 Replaced Comtek box for 40m 4-square, now its working properly.

10/19 From odd symptom when testing HF2500 s/n 433 transformer I decided to test the solid state relays. One of them was bad also. This testing used a 240v dummy load made out of two 100w bulbs wired in series. It showed one of the relays was working but the other was always on. Fortunately I had saved the relays out of s/n 720 and the one that hadn't smoked tested out ok so I put that one in s/n 433. I also wired 120v directly to the control circuit power supply to test the fan and control board, everything there looks ok... the timer worked and the bias supply was producing the right voltages.

10/26 Another bad phono-phono cable on the 160m amp keying line???? Replaced it and the amp seemed to go back to keying reliably, again.

10/29 Installed the first 3 of the new Green Heron controllers to replace the TIC Ring controllers. Started with 40m bottom and both 20m rings.

Green Heron Stuff

10/30 Installed 2 more Green Heron controllers to replace the last two TIC Ring controllers.... here is the new look of the SO2R rotor and switch stacks. Note on the Yaesu rotors on the 180' 10m, 120' 10m, and 120' 15m, that I turned the knob 180 degrees so that North is up and South is down on all the boxes. I don't know if I'll leave them that way or not. Also the overlays to hide the dual bearing markings on the knobs are temporary until I get something that is nicely cut out and sticks properly.

Figure 751 Green Heron boxes at SO2R station

Just one more Green Heron box to install on the VHF/UHF station now.

10/31 Installed the VHF/UHF Green Heron box.

11/3 Nice cool autumn day... took chainsaw for a walk back to the SW/NE Beverage stream crossing and cut a bunch of downed stuff in the stream and new growth on the other side of the stream. Cleaned up some other stuff along the trails and around the 80m 4-square.

11/10 Walked around the Beverages and put back up a couple insulators knocked off by a branch coming down on the NW path.

11/13 Transformer for HF-2500 s/n 443 is back. Plug it in, big hum, blow fuse... that's not good. Disconnect stuff, get down to just primary, still does it.

11/14 Take transformer back out and do some tests on it. Putting 15vac on primary through 250 ohm resistor I can get output of 94vac, but only if I energize half the primary at a time. Going across whole primary gives nothing out. Email to TRS asking if I should try reversing one of the primary coils.

11/15 TRS says to try reversing one of the primary coils so I take apart two splices and swap the leads.

Now it produces voltage on the secondary when energizing the whole primary, and the center tap has the proper 1/2 of the driving voltage. Put it in and test in the amp and it is running fine. I am guessing that maybe Commander changed color code on harness which resulted in swapping leads... but at least it is working now.

11/27 Replaced the ALC board in FT-1000mp s/n 9H460125, the VOX Gain pot was broken. Also vacuumed it out while I had it open. It also needed the 10W and 50W power levels adjusted, they were way too high. This one is at the 40m/SO2R-Left position.

11/29 Added a Green Heron wireless remote board to the 10m antenna switch controller. This allows remote control of the antenna selector from a computer using the Green Heron Everywhere wireless base.

Wired up to front panel switches:

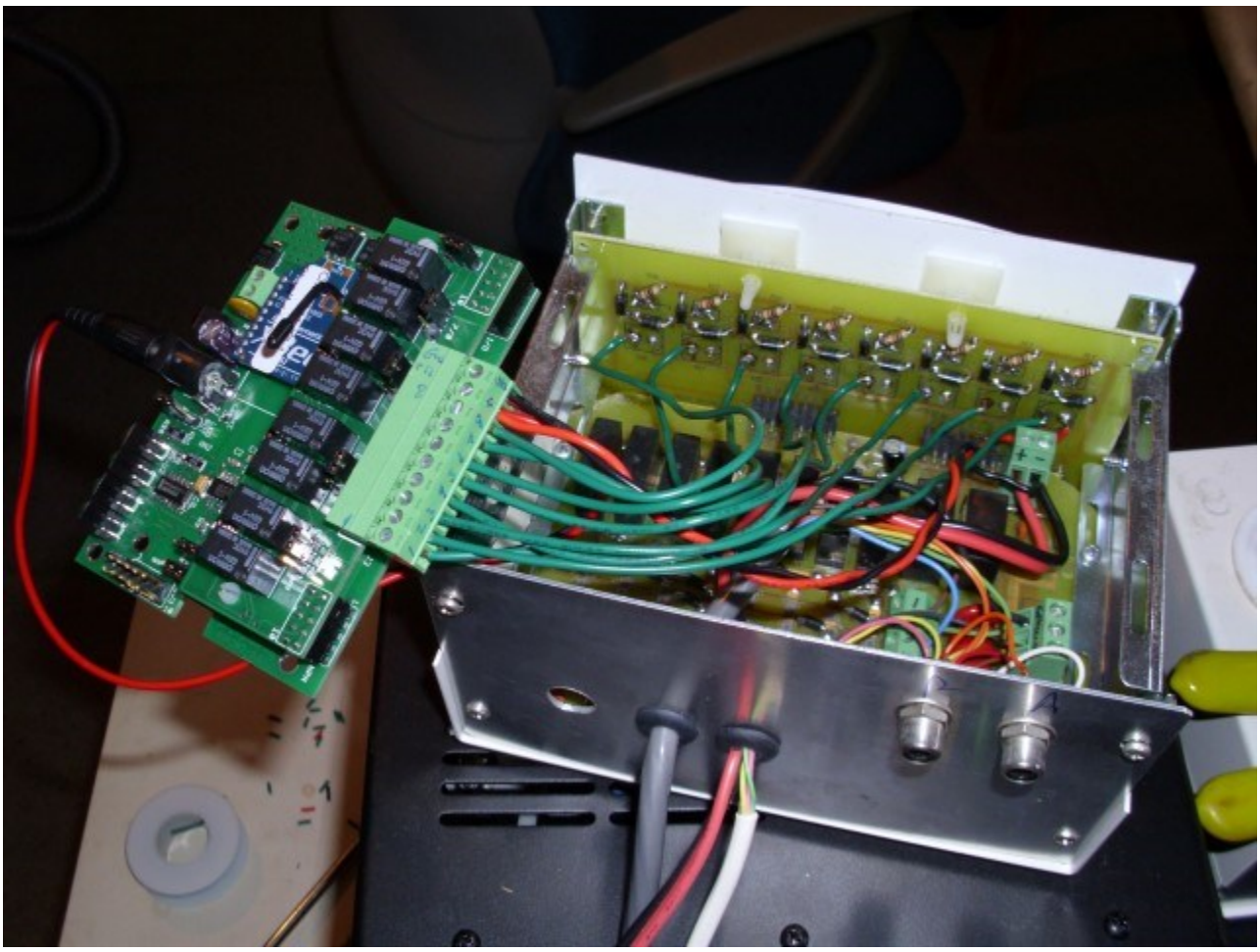


Figure 752 Green Heron remote control board in antenna selector

Stuffed in the box, just held by wires and spaced with cardboard front and back.

Figure 753 Green Heron remote control in box

11/30 Well, there were a few problems with connecting the GHE to the pushbuttons... besides being ugly it would give the possibility of the GHE Client software being out of sync with what the remote box relays were locked into. So I rewired it right into the diode matrix output. This will require a different method of locking out switching while the radio is keyed, but they say it can be done using the Wake line to make it sleep while keyed. It is now also wired into the power switch so the GHE Remote board is on when the pushbuttons are off and vice versa.

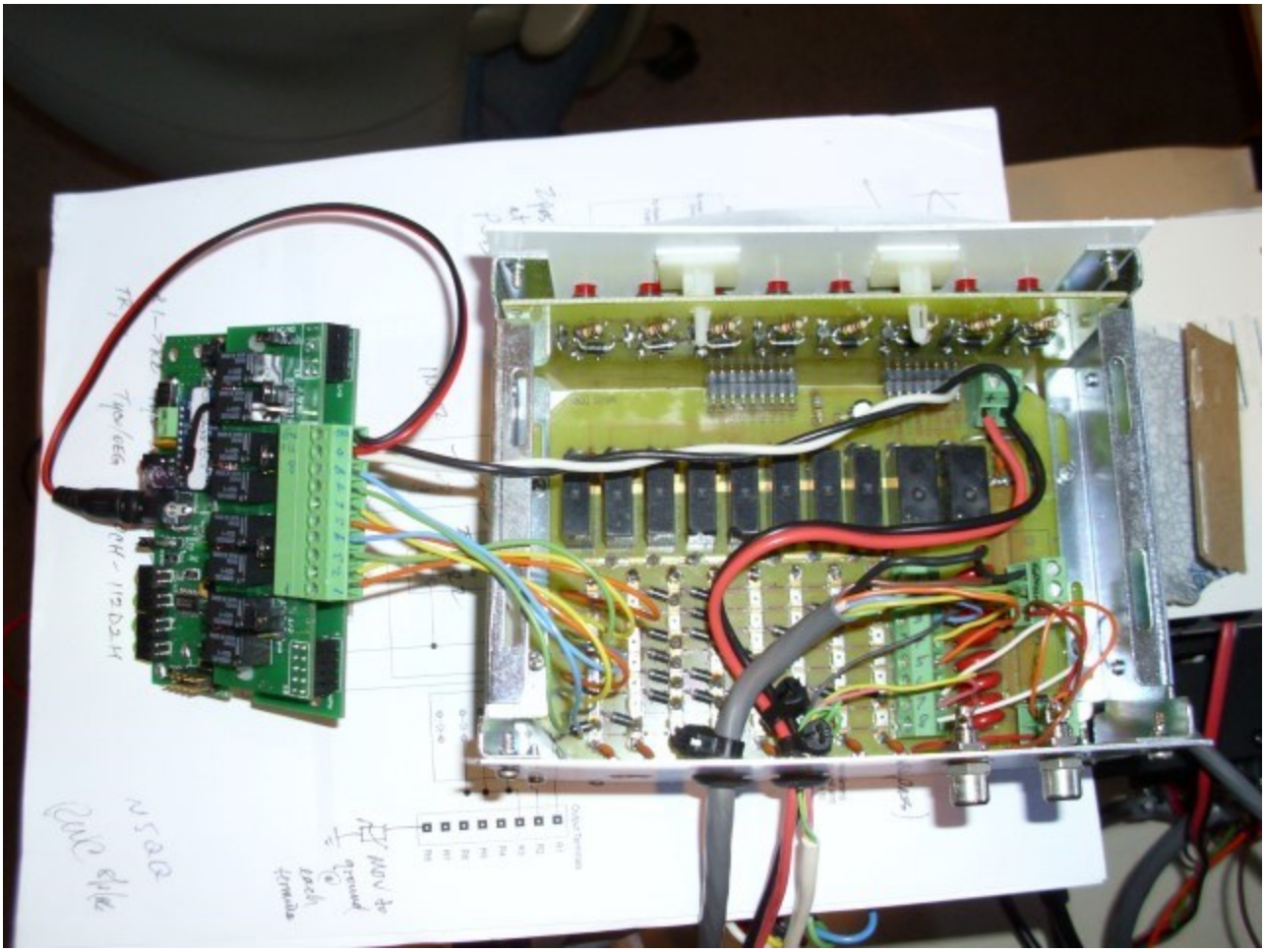


Figure 754 Different way of connecting GHE board

12/13 Have tried 3 computers now, 2 tablets and now a desktop with a touchscreen, for use with the Green Heron Everywhere software. The best by far is an ASUS EEEBox with 21.5" Planar touchscreen monitor. It gives plenty of room for easy to see controls. The computer also mounts on the back of the monitor so it doesn't take up much desk space.

12/14 Wired up cables for audio from TS-2000's Acc-2 jack to the VHF computer for digital use, used a Pyle PHE300 Hum Destroyer to route audio from 2 radios to one stereo line-in jack. Also replaced the Rig Blaster that was breaking a ground loop from the VHF computer to the SO2R Mic In jack with a Pyle PHE300. Now the VHF station should be able to do FSK and PSK or any other digital mode much more easily.

12/21 Replaced RTTY left/right Y combiner on the SO2R computer with one of the Pyle PHE300s. Also put PHE300s in the audio from the computer to the RigBlaster on 10m/15m/20m/80m/160m. I think the 40m/SO2R is ok, but will check that when the contest is done... I had to order 2 more of them and more cables already because of the 2 that went for SO2R RTTY audio routing.

WARC Band Additions

12/23 Made 3 cables to run WARC bands from hardline to SO2R station and stuck them up in the ceiling. Also made 3 coax chokes to feed the planned WARC Inverted Vs.

12/24 Ran 3 new cables outside from the SO2R station and connected to the 3 spare hardlines. Ran TDR and cable loss measurement with MFJ-269. Highest loss was 2.5db for the 350' of cable at 30MHz which was likely one of the two 1/2" lines, the best one was 1.5db which was probably the 5/8" one.

I am now the proud owner of 15000' (6x2500' reels) of IMSA Spec 28-3 insulated 10ga copper-weld wire. Anybody want some?? Only 91# per reel!

12/28 Made replacement hardline connector for the missing one on the 150' tower. Made up 3 center insulators for new Inverted-Vs from bullet proof plastic.

12/29 Rough cut the wires for the new Inverted-Vs.

12/30 Six 250' rolls of 1/4" black dacron showed up today. I also picked up some more split bolts. So now I should have all the parts to assemble and install them.

12/31 Assembled feedpoints for the 3 WARC Inverted V's.

Figure 755 WARC Inverted Vs for ARRL Centenial QSO Party

All 3 of them almost done.

Figure 756 Feedpoints of WARC V's

Closeup of feedpoint insulator. These are made out of bullet proof window material. I rounded the bottom corners to keep the edges from cutting the insulation on the copperweld.

Inventory

For those of you who have lost track of all the changes during the evolution sequence, you aren't alone. So this section is a basic inventory of the current state of the station.

Property

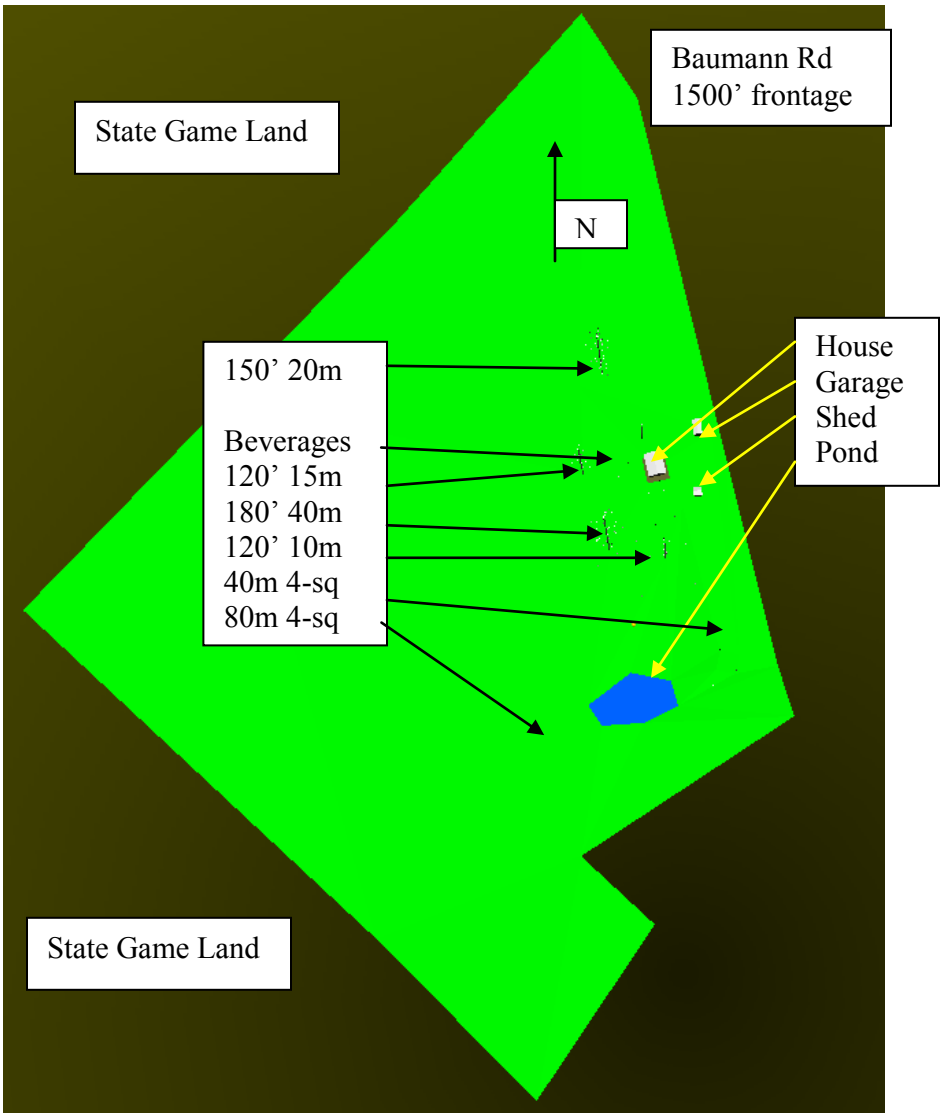


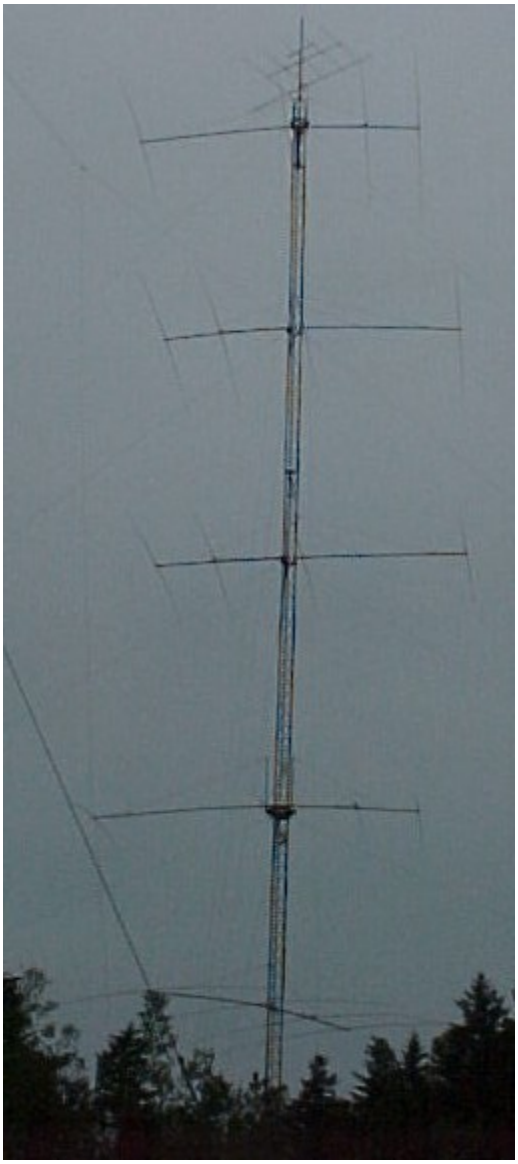
Figure 757 Plot layout

Land area is about 30 acres. I am bordered on two sides by state game lands which they have acquired recently. The odd border on the south east side belongs to a neighbor who likes to SWL, except on contest weekends. And there are about 1500' of frontage on the dirt Baumann Rd. The above image is a screen snapshot of a VRML station tour that is available on my web site (http://www.k1ttt.net).

Tower by tower breakdown, in order of construction… more or less.

Outside

150’ 20m Tower



Specs:
- 150’ Rohn 45
- Tube Top
- 20’ long 2” diameter ¼” wall steel mast
- 2 TB3 Thrust bearings
- ¼” EHS Guys at 5 levels (Replaced 2003)
- Torque arms on all guys
- Anchors with equalizer plates
- Buried short base
- Erected 1985

Antennas from top to bottom:
- 70cm 11eleYagi
- 6m 5ele Cushcraft Yagi
- 2m 12ele Yagi
- 20m 4ele M-Squared Yagi
- 80m Inverted V
- Support rope for 160m Inverted L’s
- 20m 4ele M-Squared Yagi (Europe)
- 20m 4ele M-Squared Yagi (Europe)
- 20m 4ele M-Squared Yagi (TIC 1122 Ring Rotor)
- 20m 4ele M-Squared Yagi (South)

Rotors and stuff
- Yaesu G-2700SDX rotor for top VHF Yagis
- TIC 1122 Ring Rotor for top 20m
- RCS 8V switchbox for 20m stack
- TIC 1122 Ring Rotor for 60’ 20m

Figure 758 150’ 20m Tower

120’ 10m Tower

Specs:
- 120’ Rohn 25
- Tube Top
- 10’ long pipe mast
- TB3 Thrust Bearing
- ¼” EHS Guys at 4 levels
- Torque arms on all guys
- Anchors with equalizer plates
- Buried short base
- Erected 1993

Antennas From top to bottom
- 10m 5ele Hy-Gain Yagi
- Support rope for 160m Inverted L’s
- 10m 5ele Hy-Gain Yagi (Europe)
- 10m 5ele Hy-Gain Yagi (Europe)
- 10m 5ele Hy-Gain Yagi (South)
- 10m 5ele Hy-Gain Yagi (Ring Rotor)

Rotors and Stuff
- Yaesu G-1000SDX rotor on top
- TIC 1022 Ring on bottom
- RCS 8V switch for 10m stack

Figure 759 120’ 10m tower

120’ 15m Tower

Specs:
- 120’ Rohn 25
- Tube Top
- 6’ long pipe mast
- TB3 Thrust Bearing
- ¼” EHS Guys at 4 levels
- Torque arms on all guys
- Anchors with equalizer plates
- Buried short base
- Erected 1995

Antennas From top to bottom
- 15m 4ele M-Squared Yagi
- 15m 4ele M-Squared Yagi (Europe)
- 6m 5ele Cushcraft (South)
- 15m 4ele M-Squared Yagi (Europe)
- 15m 4ele M-Squared Yagi (South)
- 15m 4ele M-Squared Yagi (Ring Rotor)

Rotors and Stuff
- Yaesu G-2800SDX rotor on top
- TIC 1022 Ring on bottom
- RCS 8V switch for 15m stack

Figure 760 120’ 15m tower

180’ 40m Tower

Specs:
- 180’ Rohn 55g
- Flat Top
- 10’ 2” diameter ½” wall aluminum mast
- 2 TB3 Thrust bearings
- ¼” EHS Guys at 5 levels
- Torque arms on bottom 4 guys
- Top guys doubles on star guy mount
- Anchors with equalizer plates
- Buried short base
- Erected 1999

Antennas from top to bottom
- 10m 4 element M-Squared Yagi
- 40M4LLDD-125 (modified)
- 160m Inverted V
- 2m Vertical (for packet users)
- 40M4LLDD-125 (modified)
- 80m Inverted V
- 40m Inverted V

Rotors and stuff
- Yaesu G-2800SDX rotor for top Yagi
- K0XG Ring for top 40M4LLDD
- TIC 1122 Ring for bottom 40M4LLDD
- RCS 8V switchbox for 40m stuff

Figure 761 180’ 40m tower

Other Stuff

Figure 762 Beverage start

There are 3 Beverage paths about 600’ long each. The wire is 10ga insulated Copperweld. The design is a 2 wire arrangement that results in two directions from each pair of wires using a phase reversing reflection transformer at the far end and two transformers at the shack end. See the ON4UN “Low Band DXing” book for details. In 2008 the old home made transformers were replaced by DX Engineering boxes and reflection transformers.

Figure 763 160m Phased Inverted L's

Can't see it, don't worry, its not your eyes. Wire antennas are almost impossible to take good pictures of. In any case there are two inverted L's fed from the tops of 10' posts with 6 radials each. The verticals are made from the 10ga insulated Copperweld wire. The radials are aluminum electric fence wire, random lengths of 100' or more each. The flat top part is about 30' long. The top is supported from a polyester rope between the top of the 10m tower and the 120' level of the 150' tower. The feed points are about ½ wave apart. They can be fed either in phase to beam East-West, or out of phase to beam North-South, or just one of them alone. Phasing is done with an RCS 8V switchbox mounted on the corner of the house.

Figure 764 40m 4-square

The 40m 4-square is built from 4 Rohn pipe towers. The top section was removed and the next section lowered down to tune for the middle of 40m. They are supported on pressure treated 2”x4” wood posts with fiberglass and Plexiglas stand off insulators. They are mounted with 2 bolts, one bolt can be removed to pivot them down for maintenance. There are 4 radials from each one made from aluminum electric fence wire. The phasing box is a ComTek box on a post in the middle.

Figure 765 80m 4-square

- ComTek 4-square box for 80m
- Rohn 25 tower, insulators from K0XG reinforced with fiberglass angle on legs
- Sitting on base plates, no concrete
- Guyed with polyester rope.
- 1/8” Aluminum wire as raised radials
- LDF4-50a hardline back to shack
- Erected in 2007, see history section for more pictures of assembly.

Figure 766 Receiving 4-Square

Vertical elements made of leftover parts of 40M4LLDD that was bent and rebuilt. Bases just a piece of ¾" rebar driven into the ground with a fiberglass tube holding the element above it. Radials are 1/8" aluminum wire on the ground. Switching and phasing box and cables are from DX Engineering.

Inside

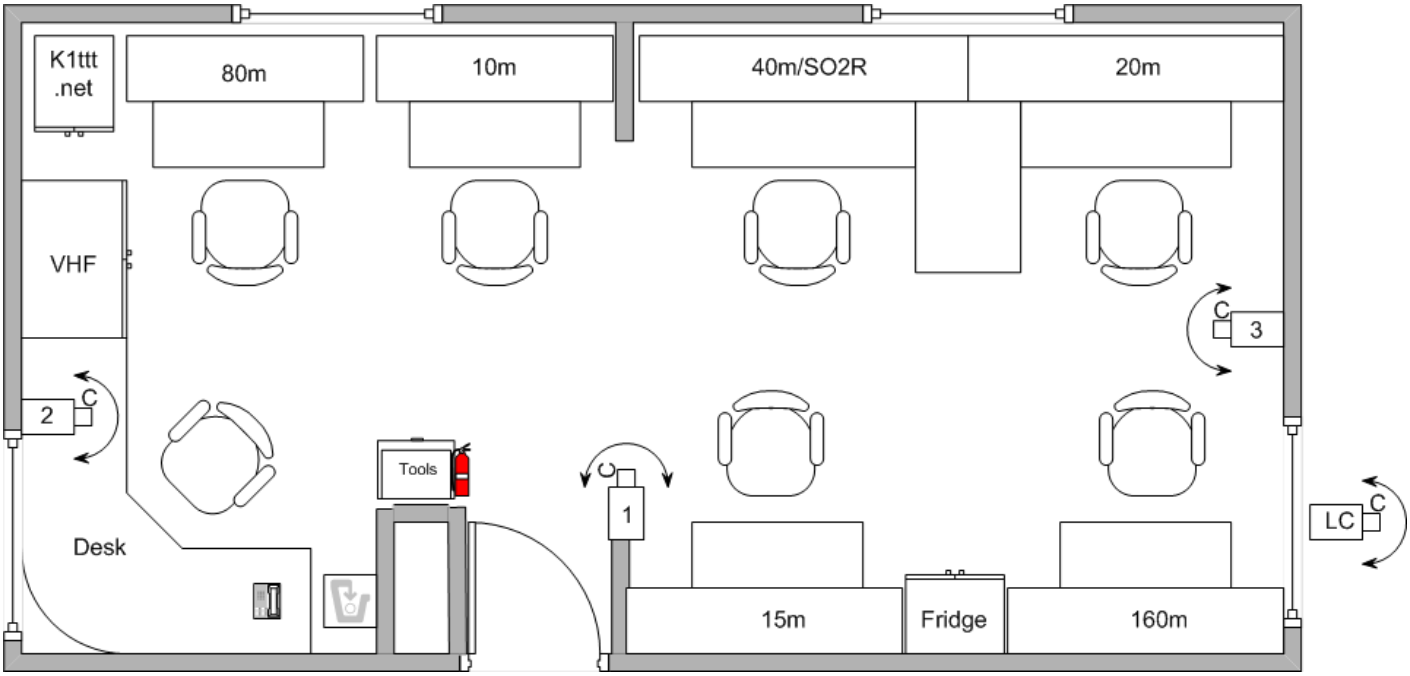


Figure 767 Overall layout of the shack.

The shack contains 7 operating positions. 6 HF positions and one VHF one that doubles as a listening station during HF contests. The 40m station can also be reconfigured to have all the antennas and serve as an SO2R station.

VHF Station

Figure 768 VHF Station, spotting station, and SDR-IQ for CW Skimmer

- Two TS-2000's
- YCCC SO2R box
- Green Heron rotor control for 150' rotor
- Compaq computer under table

Not shown, in rack to right of station

- QS1R for CW Skimmer
- ICE model 119 rf limiter next to model 419B to protect receivers

80m

Figure 769 80m Station

- 2 Dentron MT-3000A tuners, one for each inverted V
- Daiwa CN-801 cross needle power/swr meter
- HF-2500 Amp (modified for 80m single band)
- HP P4 computer
- AEA MM3 Keyer, Bencher Paddles
- RigBlaster Pro
- FT-1000 mp
- Remote control box to select TX antennas
- Remote control box to select Beverage antennas.
- ICE Band pass filter (under table)
- Coax Stub (under table)
- UPS
- Heil ProSet headset
- Front of table is covered with upside down static mat, makes nice non-slip surface for paddles and mouse. This is now on all the other tables following.

10m

Figure 770 10m station

- Daiwa CN-801 cross needle power/swr meter
- HF-2500 Amp
- HP P4 computer
- AEA MM3 Keyer, Bencher Paddles
- RigBlaster Pro
- FT-1000 mp
- Remote control box to pick antennas
- 3Green Heron rotor boxes
- ICE Band pass filter (under table)
- Hard line Stub (behind table)
- UPS
- Heil ProSet headset
- The monitor and keyboard on the top left are for the ‘hub’ computer for the logging network that is under the table.

40m/SO2R

Figure 771 40m and SO2R Station (setup for 40m only)

Figure 772 40m and SO2R Station (setup for SO2R)

- Dentron MT-3000A tuner for 40m
- 2 – Daiwa CN-801 cross needle power/swr meter
- ACOM 2000A Amp
- HF-2500 Amp
- HP P4 computer
- AEA MM3 Keyer, Bencher Paddles
- YCCC SO2R Box
- 2 - FT-1000 mp
- Remote control box to pick TX antenna
- Remote control box to pick Beverage antenna
- Coax Stub (under table)
- UPS
- Heil ProSet headset
- 2 - ICE Model 419A switch able band pass filters
- 2 – Array Solutions IBS-1 band decoder (under table)
- Array Solutions SixPak (under table)
- Array Solutions Level Converter (under table)

20m

Figure 773 20m Station

- Daiwa CN-801 cross needle power/swr meter
- HF-2500 Amp
- HP P4 computer
- AEA MM3 Keyer, Bencher Paddles
- RigBlaster Pro
- FT-1000 mp
- Remote control box to pick antenna
- 2 Green Heron rotor boxes
- ICE Band pass filter (under table)
- Hard line Stub (behind table)
- UPS
- Heil ProSet headset

160m

Figure 774 160m station

- Daiwa CN-801 cross needle power/swr meter
- HF-2500 Amp
- HP P4 computer
- AEA MM3 Keyer, Bencher Paddles
- RigBlaster Pro
- FT-1000 mp
- Remote control box to pick TX antenna
- Remote control box to pick Beverage antenna
- ICE Band pass filter (under table)
- Coax Stub (behind table)
- UPS
- Heil ProSet headset
- Room ventilation fan

15m

Figure 775 15m Station

- Daiwa CN-801 cross needle power/swr meter
- HF-2500 Amp
- HP P4 computer
- AEA MM3 Keyer, Bencher Paddles
- RigBlaster Pro
- FT-1000 mp
- Remote control box to pick antenna
- 2 Green Heron rotor boxes
- ICE Band pass filter (under table)
- Hard line Stub (behind table)
- UPS
- Heil ProSet headset

Also on the pegboard there are 4 spare headsets that plug into the 1/8" headphone jacks on the FT-1000mp's. These are used either for guests to listen in or for me to eavesdrop when trying to find interstation interference or other problems.

Cables

I have been asked many times how much wire I have. The following are rough estimates in most cases, but it should give you an idea of the magnitude of it.

- 4600’ 10ga insulated Copperweld (Beverages, inverted L’s, inverted V’s, 4-square)
- 3300’ of various control wires for switch boxes and 4-square boxes
- 2700’ of various rotor cables
- 8500’ of various hard lines
- 1500’ of RG-213 outside from switchboxes to antennas
- 400’ of RG-8 and misc other coax inside not counting stubs
- 2800’ of 1/8” aluminum wire for 80m 4-square raised radials

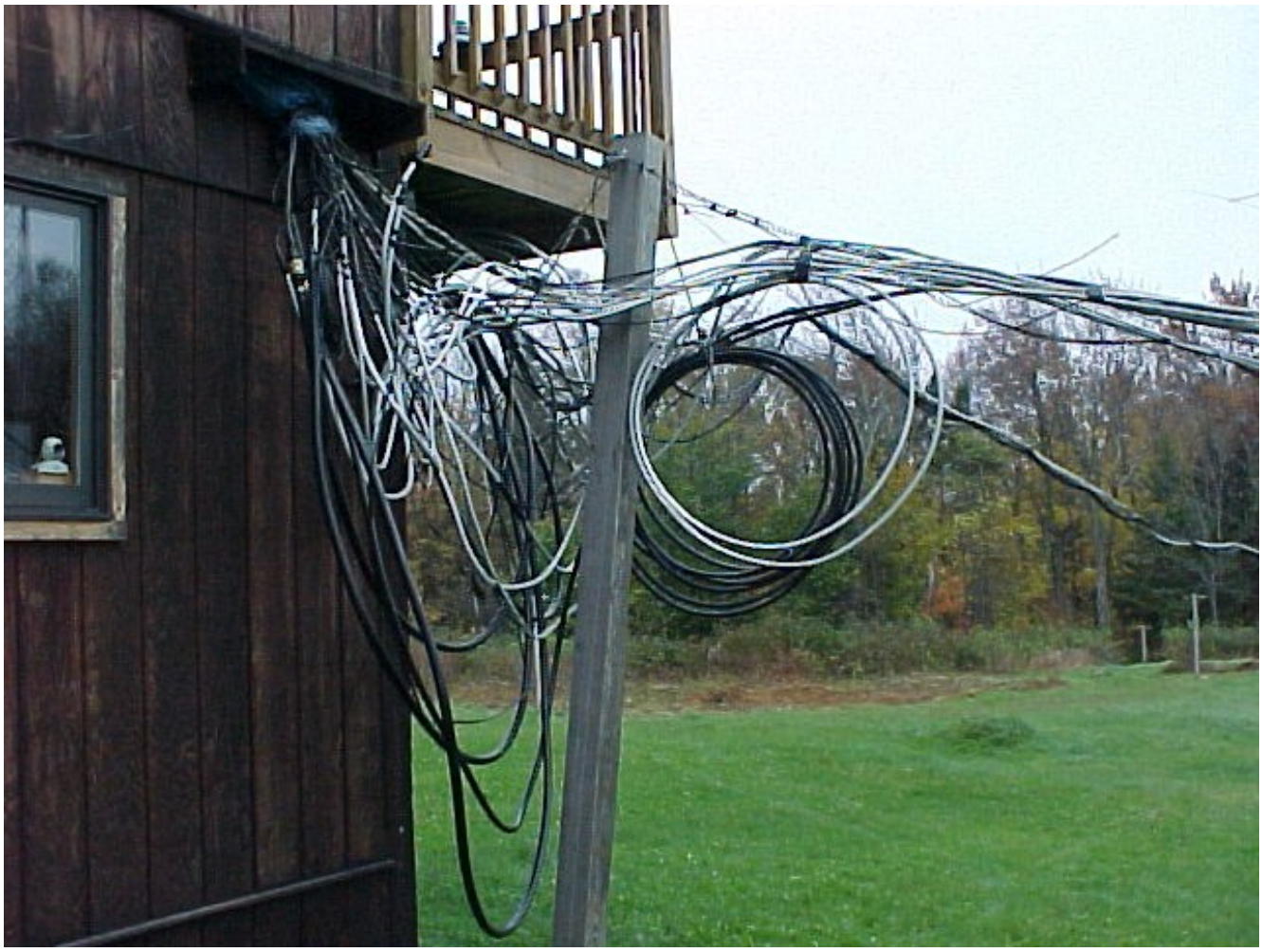


Figure 776 Where all the wires end up

Contest Scores Summary

73Mag 160m — SSB

Year	Call	Power	Class	QSOs	State/Prov	Cty		Score
1985	N3ADQ	Low	SO	184	27	0	0	0
Ops:	N3ADQ							
1986	KY1H	High	SO	0	38	1	0	0
Ops:	KY1H							

73Mag 75m — SSB

Year	Call	Power	Class	QSOs	State/Prov	Cty		Score
1986	KY1H	High	SO	330	51	7	0	98,310
Ops:	KY1H							

AA — CW

Year	Call	Power	Class	QSOs	Px			Score
2008	W1UE	High	SO	376	144	0	0	54,432
Ops:	W1UE							

AA — SSB

Year	Call	Power	Class	QSOs	Px			Score
2002	N2OW	High	SU	306	170	0	0	52,020
Ops:	N2OW							

ARRL 10m — CW

Year	Call	Power	Class	QSOs	State/Prov	Cty		Score
1992	NJ1T	High?	SO	1491	58	73	0	783,380
Ops:	NJ1T							
2000	K1VUT	Low	SO	1571	57	84	0	887,172
Ops:	K1VUT							
2003	N2OW	High	SO	1282	61	62	0	631,482
Ops:	N2OW							

ARRL 10m Mixed

Year	Call	Power	Class	QSOs	State/Prov	Cty		Score
1988	KY1H	High	SO	93	34	39	0	14,892
Ops:	KY1H							
1989	KY1H	High	MS	2293	274	0	0	1,919,644
Ops:	KY1H KB1W NJ1F NS1M NI8L							
1993	KY1H	High	MS	1646	110	101	0	1,010,690
Ops:	KY1H KB1W PACKET							
1994	KY1H	High	MS	870	83	40	0	241,818
Ops:	KY1H PACKET							
1995	KY1H	High	MS	867	70	33	0	252,350
Ops:	KY1H KB1W							
1996	K1TTT	High	MS	797	80	20	0	208,000
Ops:	K1TTT KB1W AA1AS WA1ZAM							
1997	K1TTT	High	MS	1457	105	78	0	753,228
Ops:	K1TTT KB1W WA1ZAM							
1999	K1TTT	High	MS	2693	114	175	0	2,284,256
Ops:	K1TTT KB1W WA1ZAM							
2002	N2OW	High	MS	2536	121	199	0	2,634,880
Ops:	N2OW UR5DEM K1TTT							
2007	K1TTT	High	MS	500	67	0	0	85,358
Ops:	K1TTT							

ARRL 10m SSB

Year	Call	Power	Class	QSOs	State/Prov	Cty		Score
1984	N3ADQ	Low	SO	174	38	15	0	18,232
Ops:	N3ADQ							
1985	KY1H	High	SO	59	16	5	0	2,478
Ops:	KY1H							
1986	KY1H	High	SO	191	35	4	0	14,898
Ops:	KY1H							
1987	KY1H	High	SO	1034	58	36	0	194,392
Ops:	KY1H							
1998	K1TTT	High	SO	2003	57	93	0	600,900
Ops:	WA1ZAM							
2001	N1IC	High	SO	2481	61	88	0	738,444
Ops:	N1IC							
2004	AK2P	High	SO	865	51	51	0	176,460
Ops:	AK2P							
2006	AK2P	High	SO	872	48	26	0	127,908
Ops:	AK2P							

ARRL 160m CW

Year	Call	Power	Class	QSOs	Sections	Cty		Score
1986	KY1H	High	SO	674	67	14	0	115,344
Ops:	KB1W							
1987	KY1H	High	SO	485	61	6	0	66,665
Ops:	N1EMG							
1988	KY1H	High	SO	76	31	0	0	4,716
Ops:	KY1H							
1993	KY1H	High	MS	231	41	3	0	10,164
Ops:	KY1H AA1AS PACKET							
1994	KY1H	High	MS	425	57	10	0	59,161
Ops:	KY1H KB1W							
1995	KY1H	High	MS	521	52	15	0	74,437
Ops:	KY1H KB1W WV1C							
1996	K1TTT	High	MS	1341	78	32	0	337,590
Ops:	K1TTT KB1W WM1K NU1P							
1997	K1TTT	High	MS	665	64	19	0	116,366
Ops:	KB1W K1TTT PACKET							
1999	K1TTT	High	MS	100	32	0	0	6,400
Ops:	K1TTT PACKET							
2001	K1TTT	High	MS	554	57	8	0	73,970
Ops:	K1TTT W2GB							
2004	K1TTT	High	MS	1259	78	23	0	296,037
Ops:	K1TTT KB1W							
2005	K1TTT	High	MS	173	41	6	0	17,108
Ops:	K1TTT							
2006	K1TTT	High	MS	1321	76	25	0	278,962
Ops:	K1TTT W2ID							
2007	N2KW	High	SO	1234	115	0	0	317,630
Ops:	N2KW							
2008	N2KW	High	SO	1293	119	0	0	358,785
Ops:	N2KW							

ARRL DX CW

Year	Call	Power	Class	QSOs	Cty			Score
1986	KY1H	High	M2	1203	232	0	0	837,288
Ops:	KY1H KB1W K1RQ WB1EYL KS1N KB1KE WB2VLM KJ1K WA1ZAM PACKET							
1987	KY1H	High	MS	1512	249	0	0	1,129,464
Ops:	KY1H AK4L NJ2L NT2X							
1988	KY1H	High	M2	2630	358	0	0	2,824,620
Ops:	KY1H KR1R KB1W NT2X KY1K N1EMG							
1989	KY1H	High	MM	5024	423	0	0	6,375,456
Ops:	KY1H KB1W NS1M NB1Y KT1O KM1P KR1R AK4L							
1990	KY1H	High	MM	3522	484	0	0	5,092,164
Ops:	KY1H KA1CI NQ2D N2MG NS1M KB1W KR1R NT2X NJ1F NK1I N1FJ PACKET							
1991	KY1H	High	MM	5300	483	0	0	7,675,353
Ops:	KY1H WB1AUV KY1K NU1P NZ1W KB1W NS1M KR1R NT2X KA1CI NJ1T WA1ZAM							
1992	KR1R	High	MM?	0	0	0	0	0
Ops:	KR1R NT2X N1FJ KB1W N2MG KM1P KJ4KB AK4L NS1M NQ1R							
1993	KY1H	High	MM	3412	499	0	0	5,089,800
Ops:	KY1H AA1AS NQ1R AK4L KM1P KJ4KB NS1M KB1W NU1P NJ1F PACKET							
1994	KY1H	High	MM	3016	459	0	0	4,107,591
Ops:	KY1H KF2MM KJ4KB NJ1F KB1W AK4L NT2X KM1P K1MBO KB2R WA2CJT AA1AS							
1995	KY1H	High	MM	3898	463	0	0	5,400,432
Ops:	KY1H KD1ZA KB1W K1MBO KB1KE NJ1F W1GG KJ4KB WA1ZAM KN1Z NT2X KA1O KF2KT EW1WZ KB2SUT							
1996	KY1H	High	MM	2172	350	0	0	2,277,450
Ops:	KY1H WM1K K1MBO WA1QGC K2WR W1MJ WA1ZAM							
1997	W1VE	High	MM	3746	443	0	0	4,965,144
Ops:	requested?							
1998	W1VE	High	MM	3080	428	0	0	3,950,868
Ops:	requested?							
1999	K1TTT	High	MM	4634	488	0	0	6,776,856
Ops:	K1TTT W1TO WR2I NT2X K1MK N9KAU							
2000	K1TTT	High	MM	5272	524	0	0	8,270,292
Ops:	K1TTT W1TO K1MK K2SIG NT2X KC2FEE W2WB							
2001	K1TTT	High	MM	6735	589	0	0	11,884,842
Ops:	K1TTT K1MK W1TO NT2X NU1P W1MA N1NK K1WD OK1DIX/N1GA W1VE							
2002	K1TTT	High	MM	6612	574	0	0	11,373,810
Ops:	K1TTT NT2X W1TO K1MK KB1W W3SM KC2FEE							
2003	K1TTT	High	MM	5710	575	0	0	9,832,500
Ops:	K1TTT K1WD KB1W K1MK W1TO N2OW K2WR N2KW W1EQO							
2004	K1TTT	High	MM	5692	615	0	0	10,474,065
Ops:	K1TTT K1WD W1TO N2KW K1MK W3SM W1EQO NT2X N2OW W2GB W2AU							
2005	K1TTT	High	MM	5707	547	0	0	9,317,598
Ops:	K1TTT K1MK K2WR N2KW N2OW NT2X NT2Y W1TO W2GB							
2006	K1TTT	High	MM	4624	504	0	0	6,979,392
Ops:	K1MK K1TTT K2WR KB1W N2KW NT2X W1TO							
2007	K1TTT	High	MM	4027	487	0	0	5,842,539
Ops:	K1MK K1TTT K2WR KB1W KB2WJY N1AW N2KW W2AU W2GB							
2008	K1TTT	High	MM	3608	449	0	0	4,815,525
Ops:	K1MK K1SFA K1TTT N1AW N1FJ N2KW NT2X NW2Q W1TO							

ARRL DX SSB

Year	Call	Power	Class	QSOs	Cty			Score
1985	KY1H	Low	10m	43	0	0	0	0
Ops:	KY1H							
1986	KY1H	High	MM	657	194	0	0	382,374
Ops:	KY1H WA1ZAM							
1987	KY1H	High	MS	657	223	0	0	439,533
Ops:	KY1H AK4L KB1W KS1N							
1988	KY1H	High	MS	1334	341	0	0	1,364,682
Ops:	KY1H KR1R N1EMG NT2X							
1989	KY1H	High	MM	3268	489	0	0	4,794,156
Ops:	KY1H KR1R WA1ZAM NS1M KA1RE KM1P NT2X NJ1F							
1990	KY1H	High	MM	4816	592	0	0	8,524,800
Ops:	KY1H KA1CI KB1W KM1P KR1R NJ1F NS1M WA1ZAM KD2RD N2MG NQ2D							
1991	KY1H	High	MM	5294	617	0	0	9,776,982
Ops:	KY1H NS1M WB1AUV KD2RD KA1CI W2SC NQ2D KD2SX WA1ZAM							
1993	KY1H	High	MM	2817	542	0	0	4,539,792
Ops:	KY1H KB2R AK4L KB1W AA1AS NU1P AA2MF PACKET							
1994	KY1H	High	MM	3040	508	0	0	4,570,476
Ops:	KY1H KF2MM NJ1F KB1W KB1KE KM1P WM1K KB1KE NS1M AA1AS WA1ZAM							
1995	KY1H	High	MM	2523	520	0	0	3,909,360
Ops:	KY1H KB1KE NJ1F KB1W WA1ZAM AA1AA K2WR WM1K AK4L WT2Q KB2HUN KA2WEI WA1QGC KD1ZA							
1996	KY1H	High	MM	2088	402	0	0	2,509,686
Ops:	KY1H K1MBO KM1P KE6BER WA1ZAM KZ1O WR2I WT2Q W1GG							
1997	N1TU	High	MM	1684	370	0	0	1,862,580
Ops:	WT2Q KB1W WA1ZAM N1NYD K2WR W1VE NU1P K1TTT AA1OK							
1998	W1VE	High	MM	3631	494	0	0	5,366,322
Ops:	requested?							
1999	K1TTT	High	MM	3363	547	0	0	5,487,504
Ops:	K1TTT WA1ZAM KB1W K2WR KI6EZ W1TO K1MK NJ1F WT2Q							
2000	K1TTT	High	MM	6417	573	0	0	10,991,286
Ops:	K1TTT W1TO K1MK NJ1F NT2X N9KAU JJ4HNN K2SIG							
2001	K1TTT	High	MM	4450	543	0	0	7,218,099
Ops:	K1TTT K1MK W1TO NJ1F K1EP N1SR K2KQ							
2002	K1TTT	High	MM	4665	569	0	0	7,898,289
Ops:	K1TTT W1TO K1MK NJ1F W2GB W2AU VA3PL N1SR							
2003	K1TTT	High	MM	3546	529	0	0	5,587,827
Ops:	K1TTT W2AU W2GB VA3PL K1MK W1TO K1EP W1EQO K2WR							
2004	K1TTT	High	MM	3533	516	0	0	5,459,796
Ops:	K1TTT VA3PL N1SR W1TO W1EQO K1MK K2WR NJ1F W3SM W1MJB K1EP							
2005	K1TTT	High	MM	3354	501	0	0	5,033,547
Ops:	K1TTT K1MK K2WR N1SR N2OW NJ1F NT2X VA3PL W1RZF W1TO W2GB							
2006	K1TTT	High	MM	3530	500	0	0	5,241,000
Ops:	AK2P JG1VGX K1MK K1TTT N1MM NJ1F NP3D W1TO W2GB							
2007	K1TTT	High	MM	3393	425	0	0	4,227,900
Ops:	K1MK K1TTT K2WR N2RRA NE1RD NJ1F NT2X W1RZF W1TO W2WJO WV2ZOW							
2008	K1TTT	High	MM	2347	354	0	0	2,429,856
Ops:	K1EP K1MK K1TTT K2WR N1AW NJ1F W1EQO W1MAW W1TO							

ARRL RTTY RTTY

Year	Call	Power	Class	QSOs	State/Prov	Cty		Score
2006	NC2N	High	SO	1296	53	62	0	148,925
Ops:	NC2N							
2008	NP3D/	High	SO	1317	57	63	0	158,040
Ops:	NP3D							

BALTIC CW

Year	Call	Power	Class	QSOs	Mults			Score
2002	N2OW	High	MS?	42	32	0	0	8,064
Ops:	N2OW							

BARTG Spring RTTY RTTY

Year	Call	Power	Class	QSOs	Cty	Sec		Score
2006	NP3D/	High	SO	953	129	53	0	1,040,676
Ops:	NP3D							
2007	NP3D/	High	SO	420	54	21	6	189,000
Ops:	NP3D/W1							
2008	K1TTT	High	MM	158	49	30	5	62,410
Ops:	K1TTT							

BARTG Sprint RTTY

Year	Call	Power	Class	QSOs	Cty	Sec	Cnt	Score
2008	K1TTT	High	MS	192	40	15	6	63,360
Ops:	K1TTT							

CIS RTTY RTTY

Year	Call	Power	Class	QSOs	Cty	Sec		Score
2007	K1TTT	High	MS	204	70	36	0	65,932
Ops:	K1TTT W1TO							

CQ/RJ RTTY

Year	Call	Power	Class	QSOs	State/Prov	Cty	Zone	Score
1996	KE1FO	Low	MS	637	115	153	69	445,851
Ops:	requested?							
1997	KE1FO	Low	MS	933	146	200	72	761,596
Ops:	requested?							
1998	KE1FO	Low	MS	1028	150	228	89	1,070,831
Ops:	K1TTT KE1FO KT1M WM1K							
1999	KE1FO	Low	MS	1460	184	302	110	1,980,508
Ops:	KE1FO KT1M WM1K N1XS KE1AK W0DC K1TTT							
2000	KE1FO	Low	MS	0	0	0	0	0
Ops:	requested?							
2001	K1TTT	Low	MS	1475	207	307	112	2,031,370
Ops:	K1TTT WM1K WF1B W1TO N1XS							
2002	K1TTT	Low	MS	1733	204	326	110	2,672,937
Ops:	K1TTT W1TO WM1K K1MK KE1FO N1XS KM1P							
2003	K1TTT	Low	MS	1722	200	331	110	2,615,921
Ops:	K1TTT K1MK N1MM N1XS N2AMG W0BR W1TO							
2004	K1TTT	Low	MS	1831	109	452	0	2,510,475
Ops:	K1MK K1TTT N1XS W0BR W1TO WM1K							
2005	K1TTT	Low	MS	2087	347	116	179	3,240,174
Ops:	K1TTT K1MK N2OW W1TO WM1K							
2006	K1TTT	High	M2	2670	297	99	202	3,478,393
Ops:	K1TTT K1MK KB1JZU KM1P N1MGO W1TO							
2007	K1TTT	High	MM	2513	264	97	205	3,042,250
Ops:	K1MK K1SFA K1TTT N2AMG W1EQO W1TO							
2008	K1TTT	High	MM	3454	322	113	214	4,867,500
Ops:	K1MK K1SFA K1TTT K2BB KB1OEV KC2PNE KC2PNN KM1P							

CQM Mixed

Year	Call	Power	Class	QSOs	Cty			Score
2001	N1XS	High	MS	514	135	0	0	184,680
Ops:	K1EBY N1XS K1TTT							
2002	N1XS	High	MS	674	206	0	0	138,844
Ops:	K1TTT K1EBY N1XS							
2003	N1XS	High	MS	0	0	0	0	0
Ops:	K1TTT AA1XJ N1XS							
2004	N1XS	High	MS	869	135	0	0	301,725
Ops:	K1TTT K1EBY N1XS N2OW KL1A							
2008	K1TTT	High	MS	699	125	0	0	241,375
Ops:	NT2X NT2Y NT2Z NW2Q UN9LU							

CQP Mixed

Year	Call	Power	Class	QSOs	Counties			Score
1996	KE1FO	High	SO	583	58	0	0	77,024
Ops:	KE1FO							
1998	KE1FO	High	SO	0	0	0	0	0
Ops:	KE1FO							
1999	KE1FO	High	SO	0	0	0	0	0
Ops:	KE1FO							
2007	W1UE	High	SO	985	58	0	0	136,358
Ops:	W1UE							
2008	W1UE	High	SO	901	58	0	0	123,714
Ops:	W1UE							

CQWW 160m CW

Year	Call	Power	Class	QSOs	State/Prov	Cty		Score
1986	KY1H	High	MS	650	50	27	0	154,385
Ops:	KY1H K1RQ KS1N WB1EYL KB1W W1BS							
1987	KY1H	High	MS	474	53	23	0	101,992
Ops:	KY1H AK4L NT2X							
1988	KY1H	High	MS	704	56	40	0	208,032
Ops:	KY1H KB1W N1EMG							
1989	KY1H	High	MS	607	49	21	0	113,529
Ops:	KY1H KB1W NS1M							
1990	KY1H	High	MS	630	52	27	0	132,246
Ops:	KY1H KB1W NS1M PACKET							
1991	KY1H	High	MS	726	54	32	0	200,724
Ops:	KY1H KB1W NS1M PACKET							
1992	N2KW	High	SO	0	0	0	0	0
Ops:	N2KW							
1993	KY1H	High	MS	876	58	50	0	297,108
Ops:	KY1H KB1W NS1M							
1994	KY1H	High	MS	1041	58	46	0	324,168
Ops:	KY1H KB1W KB1KE AA1AS NJ1F KS1N NS1M KA1NCN							
1995	KY1H	High	MS	1181	58	56	0	430,920
Ops:	KY1H KB1W W1NG WM1K NJ1F							
1996	KY1H	High	MS	1273	58	58	0	551,464
Ops:	KY1H KB1W NS1M WM1K							
1998	WM1K	High	MS	390	49	32	0	101,898
Ops:	WM1K K1TTT PACKET							
1999	K1TTT	High	MS	50	17	4	0	2,793
Ops:	K1TTT PACKET							
2000	K1TTT	High	MS	71	27	2	0	0
Ops:	K1TTT							
2001	K1TTT	High	MS	921	56	44	0	296,700
Ops:	KB1W K1TTT							
2002	K1TTT	High	MS	827	54	36	0	250,110
Ops:	K1TTT KB1W							
2003	K1TTT	High	MS	1031	55	55	0	414,480
Ops:	K1TTT N2OW KB1W							
2004	K1TTT	High	MS	922	54	47	0	324,109
Ops:	K1TTT KB1W W1TO							
2005	K1TTT	High	MS	1486	59	62	0	683,408
Ops:	K1TTT KB1W N2OW NJ1F NT2Y							
2006	K1TTT	High	MS	0	0	0	0	0
Ops:	K1TTT							
2007	K1TTT	High	MS	1148	58	57	0	418,830
Ops:	K1TTT KB1W NJ1F W1TO							
2008	K1TTT	High	MS	1197	56	62	0	537,372
Ops:	K1TTT KB1W NJ1F W1TO							

CQWW 160m SSB

Year	Call	Power	Class	QSOs	State/Prov	Cty		Score
1986	KY1H	High	SO	565	45	15	0	78,873
Ops:	KY1H							
1988	KY1H	High	MS	675	55	14	0	106,605
Ops:	KY1H KR1R N1EMG							
1989	KY1H	High	MS	532	48	9	0	70,281
Ops:	KY1H PACKET							
1990	KY1H	High	MS	574	45	13	0	75,980
Ops:	KY1H NS1M PACKET							
1991	KY1H	High	MS	542	54	12	0	84,612
Ops:	KY1H PACKET							
1993	KY1H	High	MS	382	49	7	0	50,120
Ops:	KY1H PACKET							
1994	KY1H	High	MS	1020	57	13	0	163,450
Ops:	KY1H AA2MF AA1AS							
1995	AA1AA	High	SO	1013	58	26	0	212,688
Ops:	AA1AA							
1997	AA1AA	High	SO	1033	56	33	0	228,463
Ops:	AA1AA							
2000	K1TTT	High	MS	140	25	3	0	0
Ops:	K1TTT							
2006	K1TTT	High	MS	0	0	0	0	0
Ops:	K1TTT							
2007	K1Z	High	SO	984	59	29	0	218,504
Ops:	N5IA							
2008	K1TTT	High	SO	490	52	22	0	98,124
Ops:	W1EQO							

CQWW DX CW

Year	Call	Power	Class	QSOs	Zone	Cty		Score
1985	KY1H	High	MS	1138	89	226	0	1,024,380
Ops:	KY1H KB1W KB1KE K1RQ							
1986	KY1H	High	SO	1052	102	243	0	1,052,250
Ops:	AK4L							
1987	KY1H	High	MS	1860	142	406	0	2,912,620
Ops:	KY1H NB1Y KB1W KY1K NJ1T NT2X N1EMG							
1988	KY1H	High	MM	3671	169	514	0	7,161,938
Ops:	KY1H KB1W NB1Y KS1N NS1M NJ1T NT2X KR1R KT1O W1BS NJ1F							
1989	KY1H	High	MM	5981	181	568	0	12,974,178
Ops:	KY1H AA6RX KB1W KY1K N2KW N2MG NB1Y NQ2D NS1M NV1J							
1990	KY1H	High	MM	5210	173	601	0	11,424,240
Ops:	KY1H WI1W NB1Y KM1P KD2RD KB1W KY1K N2MG NS1M NT2X NU1P							
1991	KY1H	High	MM	2878	159	517	0	5,293,080
Ops:	KY1H NU1P WB1AUV KD1FE NZ1W N1FJ KY1K KB1W KO1O							
1992	KY1H	High	MM	4578	176	638	0	10,529,090
Ops:	KY1H KB1W NQ1R KJ4KB NJ1T KM1P NB1Y NT2X NS1M WA1ZAM KR1R NU1P							
1993	KY1H	High	MM	4185	174	626	0	9,010,400
Ops:	KY1H NS1M KB1W KB1KE WZ1R WM1K NT2X AA2OX KB2R NB1Y AA1AS NJ1F KS1N NU1P WA1ZAM KJ4KB							
1994	KY1H	High	MM	2930	157	545	0	5,458,050
Ops:	KY1H NT2X WZ1R KB1W KM1P AA1AS NY1L WM1K NJ1F WT2Q W1NG RA3AKR							
1995	KY1H	High	MM	4770	168	575	0	9,754,847
Ops:	KY1H WM1K K2WR K1MBO NJ1F AA1ND NT2X KB1W KO0U NS1M WR2I KB2WBQ							
1996	K1TTT	High	MM	3837	160	576	0	7,818,528
Ops:	K1TTT KB1W NT2X AB2AP KB2ZIC WR2I AA1AS UR5LAW							
1997	K1WD	High	MM	4915	182	638	0	11,199,560
Ops:	K1WD N1IWV W1IA W1MJ WO1N W1EA NT2X N1YGW KG2JZ KB1W OK1DIX K1TWF K1MBO							
1998	WO1N	High	MM	5993	180	657	0	14,229,000
Ops:	K1WD N1RHY KB1W WO1N K1TWF KC2CIT KG2JZ NT2X N1GA K1TTT							
1999	K1TTT	High	MM	6929	201	701	0	17,567,352
Ops:	K1TTT K1TWF K1MK WO1N W1ES K1WD KB1W NT2X KC2FEE NT2A W2WB WR2I							
2000	K1TTT	High	MM	7108	180	703	0	17,806,578
Ops:	K1TTT K1TWF KC2FEE/RA9USU N9KAU WO1N W1IA KB1W W1ES NT2X K1WD N2NI NF1D KB1EKJ							
2001	K1TTT	High	MM	5005	170	598	0	10,723,584
Ops:	K1TTT K1MK WO1N W1ES K1WD K1TWF KB1W NT2X W1IA KB1PZ NF1D W1DSW							
2002	K1TTT	High	MM	4762	171	668	0	11,039,562
Ops:	K1TTT K1TWF WO1N W1ES W1DSW KB1PZ W1MJ K1WD NF1D N2OW N1TT K1MK							
2003	K1TTT	High	MM	6589	184	652	0	15,371,532
Ops:	K1TTT NT2X N1IW N2OW NF1D W1DSW WO1N W3SM K1TWF W1ES K1WD							
2004	K1TTT	High	MM	4731	193	656	0	10,669,230
Ops:	K1MK K1TTT K1TWF K1WD KB2WJY N2OW NF1D NT2X NT2Y K3UY W1DSW W1ES W1MJ WO1N							
2005	K1TTT	High	MM	4424	611	159	0	9,296,980
Ops:	K1MK K1TTT K1TWF KB2WJY N1IW NF1D NT2X W1ES W1TO WM1K WO1N							
2006	K1TTT	High	MM	5329	646	169	0	11,852,545
Ops:	K1MK K1TTT K1TWF KB2WJY N1IW NB1B NF1D WO1N							
2007	K1TTT	High	MM	4688	646	163	0	10,100,365
Ops:	K1MK K1SFA K1TTT K1TWF N1IW N2KW NF1D NT2X NW2Q W1UE WO1N							
2008	K1TTT	High	MM	4988	601	160	0	10,399,826
Ops:	AD4EB K1EP K1MK K1SFA K1TTT K1TWF N2KW NF1D W1TO W1UE							

CQWW DX SSB

Year	Call	Power	Class	QSOs	Zone	Cty		Score
1985	KY1H	High	SO	672	76	183	0	455,840
Ops:	KY1H							
1986	KY1H	High	SO	1033	104	268	0	1,049,784
Ops:	KY1H							
1987	KY1H	High	MS	1298	122	392	0	1,839,606
Ops:	KY1H KB1W NT2X WA1ZAM KR1R KA1RE PACKET							
1988	KY1H	High	MM	3862	161	546	0	7,842,851
Ops:	KY1H KA1RE KB1W KR1R NS1M NU0X WA1ZAM NJ1F NT2X							
1989	KY1H	High	MM	4338	153	628	0	9,076,782
Ops:	KY1H WA1ZAM AA2Z NS1M KR1R NT2X KB1W NJ1F VE1RM KT1O KA1RE							
1990	KY1H	High	MM	5058	175	674	0	11,468,292
Ops:	KY1H WA1ZAM KR1R NJ1F N2MG KB1W NT2X NI8L KM1P KA1XN NU1P KA1CI KA1RE							
1991	KY1H	High	MM	3267	161	605	0	6,339,416
Ops:	KY1H WB1AUV N1IBN N2MG NS1M N1FJ NJ1F KY1K KB1W NU1P KR1R WK1O WA1ZAM NT2X AK4L							
1992	KY1H	High	MM	3676	163	639	0	7,801,856
Ops:	KY1H AK4L WA1ZAM AA1AS WT2Q KB1W NJ1T WK1O NU1P KY1K							
1993	KY1H	High	MM	3460	146	574	0	6,192,720
Ops:	KY1H KB1KE NU1P K1MBO KF2MM WM1K AA1AA KB1W AA1AS WA1ZAM PACKET							
1994	KY1H	High	MM	3248	143	530	0	4,678,696
Ops:	KY1H AA1AA WM1K KB1W KB1KE AA2MF N1NQD KM1P N1RFE WB1AUV WA1ZAM							
1995	KY1H	High	MM	5058	153	558	0	9,272,151
Ops:	KY1H KB2HUN WR1X N1NQD KA1NCN AAND KM1P WR2I K1MBO KB2UCV WM1K WK1O RX3QA KA2WEI WB2KDD WA1ZAM NT2X							
1996	AA1AS	High	MM	3511	147	545	0	6,243,224
Ops:	AA1AS KY1H K1MBO WA1ZAM NT2X AA2MF AB2AS WJ1R AA6MC WM1K AB2AP WT2Q							
1997	K1NU	High	MM	3683	152	595	0	7,307,154
Ops:	K1NU K1TTT KB1W NT2X AB2EC KE1FO NO2T WA1ZAM WR2I							
1998	K1NU	High	MM	3808	164	640	0	7,946,736
Ops:	K1NU K1TTT W1SJ KB1W KA1CI NT2X W1IX W1TO KI6EZ K0TF							
1999	K1TTT	High	MM	5050	177	678	0	12,076,875
Ops:	K1TTT K1MK NJ1F KB1W K2WR KC2FEE							
2000	K1TTT	High	MM	5487	179	680	0	12,362,728
Ops:	K1TTT K1MK W1TO KC2FEE KB1W NJ1F N1SR NT2X KC2AIY KE1IR K3TD N9KAU WA1ZAM							
2001	K1TTT	High	MM	4516	169	638	0	9,775,191
Ops:	K1TTT K3TD K1MK NJ1F W1TO W1OHM WM1K N1SR K2WR AA1XJ KB1W							
2002	K1TTT	High	MM	4565	164	655	0	9,735,453
Ops:	K1TTT K1MK W1TO NT2X N1SR AA1TE VA3PL W3SM W2GB W2AU AK2P AA1XJ							
2003	K1TTT	High	MM	5152	156	615	0	10,559,616
Ops:	K1TTT NJ1F KB1KE W1TO K2WR K1MK N1SR W3SM AK2P N2OW							
2004	K1TTT	High	MM	5821	172	678	0	13,752,150
Ops:	AK2P K1MK K1TTT KB1W N1SR N2OW NJ1F NT2Y W1TO W2AU W2GB							
2005	K1TTT	High	MM	5395	577	150	0	10,697,078
Ops:	AK2P K1MK K1TTT K2WR N1SR N2OW NT2X W1EQO W1RZF W1TO W3SM							
2006	K1TTT	High	MM	3528	562	150	0	6,513,376
Ops:	AD4EB AK2P K1MK K1TTT K2BB K2WR KJ1K NJ1F NT2X W1TO W2ID							
2007	K1TTT	High	MM	4946	575	149	0	8,815,424
Ops:	AK2P K1MK K1SFA K1TTT N1BAA N1SR NJ1F NP3D W1EQO W1TO W1UE							
2008	K1TTT	High	MM	4155	536	145	0	7,226,091
Ops:	K1KAA K1MK K1SFA K1TTT KB1OEV N1FJ NJ1F W1EQO W1TO WA1ZAM							

DLDX RTTY

Year	Call	Power	Class	QSOs	Sections	Cty		Score
2004	K1TTT	Low	MS	112	9	37	0	72,220
Ops:	K1TTT W1TO N1XS							
2006	NP3D/	High	SO	532	93	33	0	878,850
Ops:	NP3D/W1							

FLA QSO PARTY Mixed

Year	Call	Power	Class	QSOs	Cty			Score
2008	K1TTT	High	SO	167	42	0	0	7,014
Ops:	K1TTT							

IARU CW

Year	Call	Power	Class	QSOs	Zone	HQ		Score
2003	N1UR	High	SO	1693	89	111	0	1,061,000
Ops:	N1UR							
2004	K1TTT	High	SO	1883	129	122	0	1,674,923
Ops:	N2OW							

IARU Mixed

Year	Call	Power	Class	QSOs	Zone	HQ		Score
1994	AA1AS	High	MS	1570	102	35	0	854,058
Ops:	AA1AS KY1H WM1K NU1P							
1995	WT2Q	High	MS	1246	92	47	0	602,426
Ops:	WT2Q KY1H WM1K NU1P KB1W							
1996	WT2Q	High	MS	1447	90	58	0	669,700
Ops:	KY1H WT2Q WM1K KE6BER NJ1F KB1W NU1P AA1AS							
1997	K1TTT	High	MS	424	54	49	0	167,684
Ops:	K1TTT WM1K							
1998	N1BB	High	MS	1914	128	83	0	1,706,568
Ops:	N1BB KB1W K1TTT WM1K							
1999	KX1X	High	MS	0	0	0	0	0
Ops:	requested?							
2001	K1TTT	High	MS	1626	99	84	0	1,022,970
Ops:	K1TTT NJ1F W1TO NU1P							
2002	K1TTT	High	MS	1292	103	111	0	1,037,900
Ops:	K1TTT W3SM NU1P W1TO							
2005	K1TTT	High	MS	1781	270	0	0	1,516,050
Ops:	N2OW RX9UL							
2006	K1TTT	High	MS	1667	221	0	0	1,247,103
Ops:	K1TTT K2BB N1ICE N1IW NF1D WA1LY WO1N							
2007	K1TTT	High	MS	1702	190	0	0	892,240
Ops:	K1TTT K1TWF N1IW NF1D WO1N							
2008	K1TTT	High	MS	1159	223	0	0	691,077
Ops:	K1SFA K1TTT W1EQO							

JIDX CW

Year	Call	Power	Class	QSOs	Mults			Score
2003	N2OW	High	SO	182	67	0	0	60,568
Ops:	N2OW							

MASS QSO — Mixed

Year	Call	Power	Class	QSOs	Mults			Score
2000	NJ1F	High	MS	330	84	0	0	27,720
Ops:	NJ1F K1TTT W1TO							

NAQP — CW

Year	Call	Power	Class	QSOs	State/Cty			Score
1993	KY1H	Low	SO	321	130	0	0	41,730
Ops:	WZ1R							
2000	?	Low	SO?	535	182	0	0	97,370
Ops:	?							
2001	WM1K	Low	SO	417	116	0	0	48,372
Ops:	WM1K							
2004	AJ2O	Low	MS	887	222	0	0	196,914
Ops:	N2OW NT2Y							
2006	W1AF	Low	MS	1132	200	0	0	226,400
Ops:	NF1R K2TJ K1TTT							
2006	NF1D	Low	SO	0	0	0	0	0
Ops:	NF1D							
2007	K1MK	Low	SO	602	168	0	0	101,136
Ops:	K1MK							
2008	K1MK	Low	SO	612	172	0	0	105,264
Ops:	K1MK							
2008	K1TTT	Low	M2	26	20	0	0	520
Ops:	K1TTT							

NAQP — RTTY

Year	Call	Power	Class	QSOs	State/Cty			Score
2004	K1TTT	Low	SO	460	160	0	0	73,500
Ops:	W1TO							
2005	W8BAR	Low	SO	397	128	0	0	50,816
Ops:	W1TO							
2007	W8BAR	Low	SO	479	145	0	0	69,455
Ops:	W1TO							
2008	K1TTT	Low	SO	18	0	0	0	49
Ops:	K1TTT							
2008	W8BAR	Low	SO	533	148	0	0	78,884
Ops:	W1TO							

NAQP — SSB

Year	Call	Power	Class	QSOs	State/Cty			Score
1993	KY1H	Low	SO	402	121	0	0	48,642
Ops:	KB2R							
2004	K1TTT	Low	SO	504	141	0	0	71,064
Ops:	K2WR							
2006	WB2JS	Low	MS	240	98	0	0	23,520
Ops:	KC2CBA KC2ILK N2BAL N2YTF							
2007	WB2JS	Low	M2	549	117	0	0	64,233
Ops:	AB2UV KC2CBA KC2MBN KC2QDC N2BAL W2KTU WB2HWW WB2JSM							
2008	WB2JS	Low	M2	893	166	0	0	148,238
Ops:	WB2JSM							

NAS — CW

Year	Call	Power	Class	QSOs	Mults			Score
2002	N1XS	Low	SO	109	39	0	0	4,251
Ops:	N1XS							

NEQP — Mixed

Year	Call	Power	Class	QSOs	States	Cty		Score
2002	K1TTT	High	MS	1249	57	43	0	138,215
Ops:	K1TTT W1TO NJ1F							
2003	K1TTT	High	MS	1495	56	80	0	305,592
Ops:	K1TTT N2OW NJ1F W1TO							
2004	K1TTT	High	MS	1374	57	61	0	241,664
Ops:	K1TTT NJ1F W1TO WM1K							
2005	K1TTT	High	MS	1294	55	46	0	197,354
Ops:	K1TTT W1TO WM1K							
2006	K1TTT	High	MS	1508	57	38	0	212,135
Ops:	K1TTT KJ1K W1TO							
2007	K1TTT	High	MS	1531	118	0	0	249,688
Ops:	K1TTT W1TO							
2008	K1TTT	High	MS	2030	115	0	0	303,945
Ops:	K1TTT K1SFA K1KAA W1TO							

OQP — Mixed

Year	Call	Power	Class	QSOs	Sections			Score
2004	K1TTT	High	MS	102	48	0	0	8,112
Ops:	K1TTT W1TO W3SM							
2005	K1TTT	Low	MM	51	42	0	0	3,528
Ops:	K1TTT N1IW N1MM W1CTN W1TO WA1LY WO1N							

RAEM — CW

Year	Call	Power	Class	QSOs				Score
2004	K1TTT	High	MS	78	0	0	0	12,408
Ops:	N2OW NT2Y							

Russian DX — CW

Year	Call	Power	Class	QSOs	Zone	Cty		Score
2003	N2OW	High	SU	1213	369	0	0	1,662,345
Ops:	N2OW							
2004	N2OW	High	SO	1277	0	0	0	0
Ops:	N2OW							
2005	N2OW	High	SO	1245	201	112	0	2,406,031
Ops:	N2OW							

Russian DX — Mixed

Year	Call	Power	Class	QSOs	Zone	Cty		Score
2002	N2TA	High	MM?	1843	163	319	0	1,321,644
Ops:	N2OW NT2X KC2FEE UR5DEM							
2007	K1TTT	High	MS	1586	234	100	0	2,981,618
Ops:	K1TTT KB2WJY NT2X NT2Y							
2008	K1TTT	High	M2	1389	193	54	0	1,465,451
Ops:	K1TTT NT2X NT2Y NT2Z NW2Q							

Russian DX — RTTY

Year	Call	Power	Class	QSOs	Zone	Cty		Score
2005	K1TTT	High	MS	164	56	11	0	81,740
Ops:	K1TTT							

Russian RTTY — RTTY

Year	Call	Power	Class	QSOs	Cty	Sec		Score
2008	K1TTT	High	SO	109	42	8	0	46,500
Ops:	K1TTT							

SPDX — Mixed

Year	Call	Power	Class	QSOs	State			Score
2001	W1/VA3	High	SO	622	57	0	0	106,362
Ops:	VA3PL							
2002	W1/VA3	High	SO	1015	82	0	0	84,577
Ops:	VA3PL							
2003	W1/VA3	High	MS	398	60	0	0	23,880
Ops:	VA3PL VE3BDN							
2004	W1/VA3	High	SO	561	59	0	0	98,058
Ops:	VA3PL							
2005	W1/VA3	High	MS	590	68	0	0	119,952
Ops:	K1TTT SP2FF SP2UUU VA3PL							

SS CW

Year	Call	Power	Class	QSOs	Sections			Score
1986	KY1H	High	SO	779	73	0	0	113,734
Ops:	AK4L							
1992	NJ1T	High?	SO	515	74	0	0	76,220
Ops:	NJ1T							
1993	KY1H	Low	SO	883	76	0	0	134,216
Ops:	KB1W							
1994	KY1H	High	MS	1197	77	0	0	184,338
Ops:	KY1H KB1W NJ1T KM1P							
1995	KY1H	High	MS	1217	77	0	0	187,418
Ops:	KY1H KB1W WM1K							
1996	KY1H	High	MS	1193	78	0	0	186,108
Ops:	KY1H KB1W WM1K NJ1T AA1AS							
1998	W1MJ	QRP	SO	665	78	0	0	103,740
Ops:	W1MJ							
2000	K1TTT	High	MS	1062	80	0	0	169,920
Ops:	K1TTT W1MJ K1WD							
2001	K1TTT	Low	SO	950	79	0	0	150,100
Ops:	KB1W							
2003	K1TTT	High	SO	1103	78	0	0	172,068
Ops:	K7BV							
2004	N2OW	High	SO	1093	80	0	0	174,880
Ops:	N2OW							
2005	K1AK	Low	SO	879	80	0	0	140,640
Ops:	W2ID							
2006	K1AK	QRP	SO	694	78	0	0	108,264
Ops:	W2ID							
2007	NF1D	Low	SO	608	79	0	0	96,064
Ops:	NF1D							
2008	NF1D	Low	SO	617	77	0	0	95,018
Ops:	NF1D							

SS SSB

Year	Call	Power	Class	QSOs	Sections			Score
1984	N3ADQ	Low	SO	237	68	0	0	0
Ops:	N3ADQ							
1985	KY1H	High	SO	786	73	0	0	114,756
Ops:	KY1H							
1986	KY1H	High	SO	678	73	0	0	98,988
Ops:	KY1H							
1987	KY1H	High	SO	67	30	0	0	0
Ops:	KY1H							
1992	WA1ZAM	High	SO	1250	77	0	0	192,500
Ops:	WA1ZAM							
1993	KY1H	High	SO	1108	77	0	0	170,632
Ops:	WM1K							
1994	KY1H	Low	SO	71	43	0	0	6,106
Ops:	KY1H							
1995	KY1H	High	MS	1648	77	0	0	253,792
Ops:	KY1H WM1K KB1W							
1996	K1TTT	High	MS	276	77	0	0	42,504
Ops:	K1TTT PACKET							
1998	WM1K	?	SO	0	0	0	0	0
Ops:	WM1K							
2000	K1TTT	High	MS	1646	80	0	0	263,360
Ops:	K1TTT NJ1F							
2002	K1TTT	High	SO	111	55	0	0	12,210
Ops:	K1TTT							
2003	W1VE	High	SO	1637	79	0	0	258,646
Ops:	W1VE							
2004	K1TTT	High	SO	121	38	0	0	9,196
Ops:	K1TTT							
2005	NJ1F	High	SO	1332	80	0	0	213,120
Ops:	NJ1F							
2006	NJ1F	High	MS	533	80	0	0	85,280
Ops:	NJ1F K1TTT							
2007	NJ1F	High	SOA	1385	80	0	0	221,600
Ops:	NJ1F							
2008	W2PV	High	MS	1686	80	0	0	269,760
Ops:	K1TTT NJ1F W1VE							

STEW PERRY CW

Year	Call	Power	Class	QSOs				Score
2007	N2KW/1	Low	SO	265	0	0	0	0
Ops:	N2KW							
2008	N2KW/1	High	SO	427	0	0	0	2,403
Ops:	N2KW							

WAE CW

Year	Call	Power	Class	QSOs	Cty			Score
2003	K1TTT	High	SO	1489	176	0	0	1,355,688
Ops:	N2OW							
2004	N2OW	Low	SO	484	140	0	0	67,760
Ops:	N2OW							
2005	K1TTT	High	MS	1617	418	0	0	1,350,140
Ops:	K1TTT N2OW RX9UL							
2007	K1XM	Low	SO	1071	390	0	0	826,800
Ops:	K1XM							
2008	W1UE	High	SO	1618	495	0	0	1,601,820
Ops:	W1UE							

WAE RTTY

Year	Call	Power	Class	QSOs	Cty			Score
2007	NP3D/	High	SO	1257	656	0	0	1,538,976
Ops:	NP3D							
2008	NP3D/	High	SO	1381	681	0	0	1,662,321
Ops:	NP3D							

WAE SSB

Year	Call	Power	Class	QSOs	Cty			Score
1995	KY1H	High	SO?	0	0	0	0	0
Ops:	KY1H							
2003	K1TTT	High	SO	1966	164	0	0	1,648,636
Ops:	N2OW							
2004	K1TTT	High	SO	589	74	0	0	43,586
Ops:	K1TTT							
2007	K1TTT	High	SO	1395	387	0	0	1,003,878
Ops:	N7ZG							
2008	W1UE	High	SO	1994	404	0	0	1,596,088
Ops:	W1UE							

WPX CW

Year	Call	Power	Class	QSOs	Px			Score
1989	NJ1Q	High	SO	1632	500	0	0	2,271,000
Ops:	WB9JKI							
1990	KY1H?	High	SO	0	0	0	0	0
Ops:	KQ2M							
1991	KD2SX	High	20m	1117	556	0	0	1,361,644
Ops:	KD2SX							
1992	WZ1R	High	MM	2937	898	0	0	6,824,800
Ops:	WZ1R NS1M NU1P AA1AS KY1H N2DU NZ1Z N2MG WT1T							
1993	WZ1R	High	MM	3536	928	0	0	8,334,368
Ops:	KY1H WZ1R KB1W N1MM NJ1F NU1P KB2R K1MBO AA1AS KB1KE KF2MM							
1994	WZ1R	High	MM	3208	897	0	0	6,840,522
Ops:	WZ1R KY1H KB1W WM1K AA1AS K1MBO N1RFE KA1NCN KA2CIW KB2R							
1995	WZ1R	High	MM	3128	880	0	0	7,121,840
Ops:	WZ1R KY1H KB1W W1MJ NU1P WM1K K2ONP							
1996	WZ1R	High	MM	2444	841	0	0	5,735,620
Ops:	KY1H WZ1R WM1K K1MBO W1MJ							
1997	KQ2M	High	SO	2757	784	0	0	7,085,792
Ops:	KQ2M							
1998	WT2Q	High	MM	3155	865	0	0	7,517,715
Ops:	KB1W N1BB N1GA NJ3K K0TB W1IX K1TTT WT2Q							
1999	KQ2M	High	SO	3010	822	0	0	7,386,492
Ops:	KQ2M							
2000	K1MK	High	MM	2506	790	0	0	5,458,110
Ops:	K1MK K1TTT KB1W W1VE							
2001	K1VUT	Low	SO	1824	647	0	0	3,354,048
Ops:	K1VUT							
2002	NU1P	High	SO	2012	675	0	0	3,759,750
Ops:	K1MK							
2003	NU1P	High	SO	2021	677	0	0	3,756,673
Ops:	K1MK							
2004	NU1P	High	SO	1627	681	0	0	3,011,382
Ops:	K1MK							
2005	WK1Q	High	SO	1920	729	0	0	3,998,565
Ops:	K1MK							
2006	WK1Q	High	SO	2281	786	0	0	5,308,644
Ops:	K1MK							
2007	WK1Q	High	SO	2171	779	0	0	4,902,247
Ops:	K1MK							
2008	WK1Q	High	SO	1850	777	0	0	4,459,203
Ops:	K1MK							

WPX RTTY

Year	Call	Power	Class	QSOs	Px			Score
2007	NP3D/	High	SO	1273	538	0	0	1,966,390
Ops:	NP3D							
2008	AJ1I	High	SO	2070	725	0	0	4,423,950
Ops:	W1UE							

WPX SSB

Year	Call	Power	Class	QSOs	Px			Score
1985	KY1H	Low	SO	122	0	0	0	0
Ops:	KY1H							
1990	NU1P	High	MS	1842	776	0	0	3,243,680
Ops:	KY1H NJ1F NU1P KB1W							
1991	NJ1F	High	MS	2041	828	0	0	3,886,632
Ops:	KY1H NJ1F KA1JFP WI1W KR1R N1IBN NU1P							
1992	NS1M	High	MM?	0	0	0	0	0
Ops:	NJ1F KB1W NS1M							
1993	WZ1R	High	MM	4840	1115	0	0	11,076,410
Ops:	KY1H WZ1R NJ1F KB1W WM1K NU1P AA1AS KD1GG KA2CIW							
1994	WZ1R	High	MM	6100	1151	0	0	16,024,222
Ops:	WZ1R KY1H KB1W NJ1F WM1K AA1AA AA1AS K1MBO KA1NCN N1NQD WA1ZAM							
1995	WZ1R	High	MM	4727	1139	0	0	13,462,980
Ops:	WZ1R KY1H AK4L KB1W NJ1F NY1L WM1K K1MBO K1VWL AA1AS WA1ZAM							
1996	WZ1R	High	MM	3911	1062	0	0	11,170,116
Ops:	KY1H WZ1R KM1P NJ1F NE1V WM1K WR2I AA1AA KE6BER WA1ZAM							
1997	N1RR	High	MM	2336	813	0	0	4,733,286
Ops:	WZ1R KY1H WM1K + ?							
1999	KQ2M	High	SO	3781	994	0	0	11,064,214
Ops:	KQ2M							
2000	K1TTT	High	SO	3129	932	0	0	7,883,788
Ops:	N9KAU							
2001	NJ1F	High	SO	2885	959	0	0	6,585,453
Ops:	NJ1F							
2002	NJ1F	High	SO	3380	991	0	0	9,013,145
Ops:	S51TA							
2003	NE1C	High	MM	3379	961	0	0	6,204,216
Ops:	K1TTT KX1X KB1FWN N1SR KB1GHC NX1X KK1W							
2004	NE1C	High	MM	3196	1005	0	0	6,399,840
Ops:	K1TTT Kx1X KB1KQN KB1FWN KB1FVL N1SR KK1W							
2005	NE1C	High	MM	2000	839	0	0	3,819,967
Ops:	K1TTT KB1FVL KB1FWN KB1KQN KX1X W1EQO							
2006	NE1C	High	MM	3115	1007	0	0	6,784,159
Ops:	K1TTT KB1FVL KB1FWN KB1GHC KB1KQN KX1X NJ1F W2NAF							
2007	NE1C	High	MM	2755	923	0	0	5,348,785
Ops:	K1KAA K1SFA K1TTT KB1KQN KB1NSN KB1NWH KB1ODC KI1I KX1X N1SR W2NAF WB1DBY							
2008	NE1C	High	MM	2829	943	0	0	5,414,706
Ops:	K1KAA K1SFA K1TTT KB1KQN KB1NSN KB1ODC KB1OEV KB1PQU KB1PRA KB1PRC KI1I KX1X KI1I, KX1X							

YO DX Mixed

Year	Call	Power	Class	QSOs	Mults			Score
2008	W1UE	High	SO	765	202	0	0	693,448
Ops:	W1UE							

The Land

This starts my rambling stories and other miscellaneous thoughts about how to build a super station. I have tried to organize it from finding a new location through building the station and then doing the operating. At the end are some other technical type of things.

Where to go?

Weather is a nice factor to consider. Warm weather year round, a lack of severe weather like hurricanes or tornadoes, plenty of sunny days, gentle breezes. Yeah, right!

World Geography would be a nice deciding factor also. Lots of QSOs and Multipliers in easy range on HF would be good. Plenty of QSOs in easy VHF range for those contests is a nice thing. Kind of hard to satisfy those all the time though.

Job… Ah yes, something has to pay for all this. Finding a job is often what selects the general area you have to work with.

Local Geography is one thing you can really work with. Things like level ground, avoiding shadowing by hills toward important QSO sources, and staying away from noise sources like power lines and electric arc furnaces, are reasonable things to keep in mind when picking a location.

Finding

When I accepted the job that moved me to this area I was lucky enough to get a 1 week paid trip to find a house. This made the search much easier as it was before I actually started the job and was not rushed. The most important thing I learned was to get a Real Estate agent, but not to rely completely on the agent.

I basically told the agent I wanted a house 'out of town', with 5 or more acres, and 'good views'. The agent picked out about 10 places that fit the description, well kind of, and set up a schedule to go look at them during that week. Well, I got into town a bit early and stopped by the office and they gave me an old MLS book (Multiple Listing Service, I don't know if this even exists any more with all the internet listing sites now, but this was a county wide listing of homes for sale from most realtors in the area). I thumbed through the book to get an idea of what was around the area and the prices and flagged a couple that the agent hadn't… including the one I ended up with.

After visiting several of the ones the agent picked out, including one only feet from a busy highway and another one at the bottom of a steep valley that had the stream literally flowing through its basement we finally headed for this place. We didn't make it though, the agent didn't know the roads, it was December, there had been an ice storm, and we ended up in the ditch out of range of their company radio. Ham radio to the rescue, I had thrown my HT into my bag I took along and pulled that out to call for a tow. The next day we went in the other end of the road and the search was basically over.

The good points…

- It was out of town, but only about 15 miles to work.
- Good elevation
- Relatively flat
- Very sparsely populated town
- Sellers had been trying to sell the place for a while and were ready to deal.

The bad…

- Lots of trees, but this can be easily fixed.
- The town often forgot I was living on the road and had to be reminded to plow the road after the first couple of snow storms.

And the ugly…

- The house needed a major cleaning, including evicting some unwanted residents.

At this time (1984) I didn't know about zoning and planning boards and all those things related to putting up towers. Fortunately for me about 2 miles down the road K1RQ had already taken care of those details by becoming a member of the planning board that wrote the zoning regulations. That's one way to make sure you can put up a station.
I recently continued that work by more or less acting as a consultant to the board during a recent rewrite of the regulations. They were happy to have someone who knew a bit about radios and towers look over the sections they wanted to add on towers and windmills. Fortunately they had already added the PRB-1 exemption required by a relatively new Massachusetts law so Hams were completely free of the new requirements. But boy were there some strange things that had made it into where ever they had copied the new sections from. I cleaned up lots of odd things, made sure they removed a clause that would have put them into the RFI regulating business, and those 2 sections were the only ones accepted at the special town meeting, the rest of the changes were rejected. So at least in Peru Hams are exempted from all the limitations and requirements placed on cell phone towers and the like.

Zoning and Covenants

Check carefully. This is something I didn't know about but just lucked out on. This type of place is getting harder and harder to find these days though. But they are out there if you look and are careful. Don't take the word of a resident ham, they may be grandfathered or not following the law. Check first with the proper authorities.
Beware of covenants. Ask specifically about the property you are looking at and be sure the person you ask knows what to look for. I remember the pile of paper I signed at the closing when I bought this place, there is no way I would ever have found one clause buried in all that stuff that would have prevented building towers. I think a decent lawyer is an absolute necessity to be sure your interests are looked after.

Neighbors

I have been blessed with good neighbors up here. One is an SWL who has helped put up towers and antennas. He keeps thinking he wants to connect a wire from one of my towers to his SWL rig. Another had a backhoe for a few years and dug holes for one of the towers for me. Another one has helped several times with putting up antennas and watches the house when I have had to go on business trips.
The whole time I have been here I think I have had a total of 2 TVI complaints. The first one was from a Ham part time neighbor (who has since sold the place). He was trying to get New York City TV with a deep fringe antenna and preamp, my 220 MHz packet link to Long Island NY was blowing away his preamp. The other was from the neighbor across the road who was trying to get the Super Bowl on rabbit ears inside his trailer, fortunately at that time the 160m contest ended before the Super Bowl started.
If you have any doubts, test the neighbors… put up first tower, don't connect antennas for a week or so and see who complains of TVI. I know, it's a tough thing to not hook it up right away, but if you have any questions of the sensitivity of your neighbors do this!

Start Small

Make sure you like the area, that it is quiet, and that there aren't big problems before investing in big stuff. Unless you are in a big hurry try out a small tower first, maybe with a tribander and a couple wires. This should give you some idea of how good the area is for reception… and what kind of reception your construction may get. Try to think ahead though, you don't want to put up something that will have to be removed later to make room for bigger stuff. So put it in a place where it could be used for a TV antenna, maybe some VHF stuff, or as a second station or for a second radio for SO2R.

Single op to multi-single transition

The transition from single op to multi-single is a hard one. First you have to make sure the station is set up so that someone else can operate it without having to ask you how to do something every 5 minutes. This means that you should hide or remove switches and things that aren't needed for contest operating. Only things that are required to be operated during the contest should be within reach… and they should ALL be within reach! Telling an operator who is there for the first time that he has to go to the other side of the room and flip a switch in the middle of a jumble of other stuff so that he can get the 160m vertical tuned for SSB just won't work, about 2am he will be trying to remember just which switch that was and was it for SSB or CW. The other thing to do after everything is within reach is to label everything. Nice big clear labels with the band, antenna, rotor, etc, in a nice simple format. I like to use white electrical tape for labels, it is easily removed and makes a nice bright background for writing on.
The next step, adding a second operating position is probably the more complicated. The second operating position can make you much more competitive in CQWW DX and can get you into the M/2 class in ARRL DX. There are lots of things to consider when doing this. Not only do you need the room for a whole second radio, amp, and computer, but you need to start thinking about interstation interference, band pass filters, stubs, switching antennas from one station to the other or designating each station to certain bands, and coordinating operators.
An often overlooked problem with multiple stations is noise in the shack during SSB tests. Operators have to be trained to keep the noise down as much as possible to prevent tripping each other's VOX or making it hard for the other operator to hear stations calling. Use of digital voice recording is a big help here, with a bit of practice you can cut out a large percentage of manual talking which makes it easier for the other operator and saves your voice at the same time.
And of course you must learn the politics of recruiting operators and evaluating how good they are. Finding reliable and enthusiastic operators can be one of the hardest jobs. Getting hooked up with a good contest club definitely helps in this aspect. A good club can also help find helpers for tower construction and other big jobs.

Thinking Big

The Vision

A vision is nice, but not necessary. Sure you could have in mind that you want to build a super multi-multi station and start out directly to do that. But it is much easier to start small and build up over a period of time. It took me several years to go from single-op to multi-single and then up to multi-multi. If you do have it in mind that you might some day want to run multi-single or multi-multi in big contests then it does pay to think ahead a little bit. A little bit of planning can prevent you from building yourself into a corner and wasting time and effort. Some examples of 'mistakes' I made were:

- The location of my second real tower. It seemed like a good spot to start with because it was relatively easy to clear the smaller trees where I put it. But over all it was a very poor location, it was in the way of just about any other place I wanted to put another tower. It was also too short. In the end it had to go, but I gave it a grand send off with a free trip to Grenada.
- The expansion to a bigger operating room. Instead of biting the bullet and taking out a wall I put the 3rd and 4th operating positions in a room diagonally across the house from the 1st and 2nd positions already established. Not only did this make both bedrooms next to them noisy, but made it hard to pass multipliers from band to band. This would not be as bad today with computer networks and logging. But at that time we had manual dupe sheets and multiplier lists so someone had to act as a runner to pass frequencies back and forth. Eventually I took out the wall, but then had to patch a hole in the outside wall where the coax came in and fix up some other stuff.

Well, that's not too bad I guess, only 2 mistakes in 21 years. Oh, I'm sure there are others but you get the idea. Thinking ahead a little bit can save time and effort, and even money, in the long run. Oh yeah, one other little thing… the keg in the fridge, that was nice for a while but just had to be replaced with caffeinated soda and coffee creamer in the long run to keep the scores growing.

Keep it simple

If you are going to think big, as in multi op, you have to remember that you will need more operators than just yourself. Because of this you need to keep in mind that not everyone operating the station will know all the intricacies of the fancy switch setup you came up with, or will remember at 2am that there is no stop on the prop pitch rotor, or will remember to swap a coax behind the table to get to 160m… And you must also remember that you probably won't be there for all 48 hours of every big contest to make sure they remember.

Some things that make multi-ops much easier:

- Label every switch with something that makes sense.
- If every operating position is laid out the same way it is easier to switch bands.
- If the operator doesn't need to touch something hide it or put it out of easy reach.
- Using all the same type of radios/amps/accessories on all operating positions makes it easier for operators to switch bands. Nothing is worse than sitting down to relieve someone in the middle of a run and having to find the volume control that's on the wrong end of the radio.
- If something is broke or shouldn't be used for one reason or another I use some red electrical tape over the switch or control so that it is obvious that it shouldn't be used. Don't count on this if it is a safety issue though, disconnect it or disable it some other way.

Radios

Buy good radios, contests are tough environments, multi-station interstation interference and RF running around the shack cause all sorts of other problems. You also must make sure that all the equipment works together.

For years we had been running TS-830's. They were a nice old solid radio as long as you kept a driver and pair of finals handy. Then we used some TS-930's which were pretty reasonable. Then one of the operators who was bringing their radio up got a TS-940… disaster! K1RQ just down the road had a TS-940. We both started a contest with them on 20m and neither one of us could hear anything but the other one's phase noise! We had to coordinate which band they were on from then until he moved to Maine.

The TS-930's and 940's were also known for connector and digital board problems, I got very good at reseating connectors and fixing intermittents in them after a while. They did not like traveling very well either, we also planned on having one or two extras if possible just in case one of them wouldn't work when it got here Friday night. I also got good at modifying the amp keying circuit in the TS-940 so they would key an SB-220.

Don't be an early adopter, the ts-870 story. I bought one of the first TS-870's. It seemed like a nice idea at the time, no filters, DSP, lots of nice features. But it just didn't make it as a contest radio. The front end was too wide which on a busy band caused it to get crunched badly. I think they improved that on later models, but I didn't wait for that. It ended up being relegated to 10m where you could usually find a spot that wasn't too noisy until I finally sold it. Hmm, maybe this story belongs with my other list of mistakes?

An example of RF problems was the IC-765. We had problems with the ALC cutting back the power and traced it down to RF getting back in on the receive antenna jack. Something very hard to track down on Friday night when you are trying to get everything running.

Oh, and just so I don't leave out Yaesu. My first HF rig was an FT-301, a nice mobile rig for the time. One of the first multi-singles we did I had it set up as the multiplier rig with a TS-830 as the running rig. One of the operators, WA1ZAM, sat down at it and started to dial up 15m and work multipliers. After a couple QSOs one of the DX stations asked him why he was out of his band. Well, Ed didn't realize that the FT-301's dial worked backwards, turning it clockwise tuned down the band not up. A good example of why its good to keep all the radios as similar as possible in a multi-op!

Over all I think it is much better to own than to borrow or try to build a station Friday night. Having everything here and ready to run makes it so much easier to get the problems sorted out. I hate to think how much time we wasted tracking down problems Friday nights when we should have been running… it probably cost us millions of points over the years. Now my biggest worry is getting operators into the seats before 00z.

Planning the outside layout

5+ acres, 10 or more is better, if you want to keep beverages on your own property 30 or more is even better. Note that in many rural areas you pay the most for the first 2-3 acres and the house. After that extra land becomes cheaper, especially if it is not on a road.

Aim for the QSOs. Europe is a large source of contacts in most contests. Know what direction it is and try to pick a property that gives you plenty of room to spread towers out so the stacks don't beam through each other to get there. This should help make interstation interference easier to prevent. It can also allow for having antennas for the same band separated enough to have two stations on the same band.

Spread out, but stay close. Say what? There is a delicate balance between getting things spread out too far and having them all too close together. Too far apart and the cost of cables goes up, you need more land, and there is more open land that you have to take care of in between. Too close together and

preventing interference becomes harder. Having towers too close together also makes running inverted V's, inverted L's and other wire antennas more difficult.
If you aren't building everything at once be sure to plan for expansion later. Once you plant a tower it is hard to move it… I know, I've done it a couple times here. Get a copy of your plot plan and try to imagine the biggest station you could ever think of, then double it and see how it would fit.
Beverages. Not beer, though that is good also, but the antennas. Just the opposite of arranging towers on a property, these need to run some distance along the direction toward where you want them to work. And an array of Beverages to cover a variety of directions takes up lots of land. Some people I know have found that neighbors are ok with them running wires either through their trees or across a field after it has been harvested in the fall. These are good things. Bad things are power lines and neighbors with pretty yards that wouldn't like wires wandering across their back yard.
Trees are bad for towers. Let me say that again… Trees are bad for towers. Add to that: Chainsaws are bad for trees. Therefore chainsaws are good for towers. Any tree that I think is big enough to take out a guy wire and that is within falling distance of said guy wires should be labeled 'FIREWOOD'. Come to think of it, with high energy prices that could be a good thing!
Trees are bad for antennas unless they are supporting them. I don't like trees holding up antennas though as they are prone to moving or falling over which tends not to help the antenna. I will use trees to support Beverage antennas since most trees can't move too much at the height were the Beverage is supported.
Grass is only good for preventing mud and feeding hamburger on the hoof. I do nothing to encourage grass, but I would rather have it than mud so I tolerate it.

Keep notes

These are some of the important things you should keep notes about in a safe location.
- Antenna SWR plots
- Feed line lengths
- Wrench sizes for each antenna and rotor
- Cable color codes
- Equipment modifications
- Equipment repairs
- When you put new sets of tubes in amps

Besides keeping lots of notes it is important to put labels on all cables. And make sure they are labels that won't fade or fall off. Trying to sort out which feed line is which in a big bundle is really a pain. When you find a good label system please bring it over and help me do mine.

Planning the Inside layout

Buy vs. build furniture

Furniture is another place where you can either spend lots of money or do it cheap and dirty. Big considerations here are:
- Access to equipment
- Keeping everything within reach
- Strength
- It has to fit the room

I started using whatever tables were at hand. Some old oak work tables, an old desk or two, and some heavy tempered glass to make table tops to bridge the gaps worked for a while. To make more room I

used heavy cardboard tubes from some old copy machines that used roll paper (11" wide) to support some old countertop (thick particle board with Formica, very stiff). This made for serviceable amplifier shelves with enough room underneath for the radio.

Figure 777 Cardboard tubes supporting amp shelf

When going from M/S to M/M I needed more, much more. So I drew up some rough plans and one of my operators volunteered to build 6 of them for me. What I did was to make a 2 part radio table. The back part is basically 2 shelves, one at desktop height, the other just high enough to allow a computer monitor underneath, though now with flat panel displays I would make this lower. Construction was simple, 2x4's and particle board. But they are strong! Operators are often amazed when they see me climbing on top of them to connect or disconnect amps or computers when things go wrong during a contest. Then there is a removable desk section. This part has 2 legs on the front and two bolts that hold it to the back shelves. The two bolts have wing nuts so they can be easily removed to allow you to get closer to the shelves to lift heavy amps. The desk section is made from particle board with a glued on piece of hard fiberboard and 2x4 frame and legs. This is also plenty strong enough for me to climb on. The fiberboard is not so nice to rest your arms on for hours so I have since just stuck a piece of scrap vinyl flooring on each one for comfort. The vinyl just hangs over the front edge to make a soft place to rest your arms at the keyboard.

Figure 778 Custom made operating table for M/M

Lighting

I hate to work in the dark. I also think that a dimly lit room makes for sleepy operators and a brightly lit room helps keep you awake. Available options:

- Desk lamps. Horrible! The light is not where you need it, and can't be directed to the right spots. It is also hard to get enough general light out of them in a decently sized room.
- Ceiling mounted fluorescents. Much better for over all light. Location must be carefully considered so that they don't produce glare on the computer monitors but provide enough front panel light to read markings on dark colored radios and accessories. I found that these were also much harsher on the eyes after long periods and of course are hard to adjust either brightness or location. Then of course there is the risk of noise from ballasts or bulbs.
- Track lights. The ultimate in flexibility in my opinion. A couple tracks with moveable and adjustable fixtures gives you easy control over how many lights are needed and where the light goes. I found that it seems to be best with the tracks running just about over the operator's heads. Then add one or two fixtures with about 60 watt indoor soft flood lights off to the sides pointing back in at the radio. I normally have one fixture for each of the 6 stations when set up for M/M which seems to be plenty for the whole room. But for the SO2R arrangement I point 2 fixtures on the table since the equipment is more spread out and just one light leaves dark areas. It is also easy to tailor the light for specific purposes, i.e. during a single band operation I just unscrew the bulbs over the stations I'm not using to avoid extra heat in the room and focus on the one radio. I use standard 120v tracks that attach to a drop ceiling. For bulbs I use standard incandescent indoor floods, I have tried halogen floods but the light seems too harsh. I have also seen low voltage halogen units used, but again think the light may be too harsh for long term use. While they may not be as efficient, and are not as good for photographers, the warmer light from incandescent bulbs seems to be easier on the eyes than most other bulbs.

Figure 779 Track lights

The lighting above was TOO MUCH! Besides blowing the circuit breaker when both rooms were turned on together it was just too bright. I ended up with just one bulb over each operating position.

Power!

Under each of my 6 stations I have 2 outlets. A standard 120v duplex and a 20a 240v single outlet. They are all fed from a single 100a branch box in the shack. Each of the 240v outlets is on its own breaker, but there are two stations on each of the 120v breakers. On each table there is an outlet strip that is used for all the equipment on that table so there is just one cord to pull to kill everything on a table. This arrangement has worked well for years now.

Baseband noise control

Baseband noise is that component of noise that is at the base frequency before it is applied to a carrier for transmission… in other words, audio noise in the shack. There are several sources of this that must be considered

Common sources:

- Fans.
- Received audio. Use headphones! Nuff said.
- Accessories. Turn off keyer speaker side tones, computer speaker beeps, etc.
- Operators. Teach operators to keep the noise down by limiting side conversations in the shack and to use voice keyers as much as possible.
- Kids, wives, dogs (cats don't seem to be much of a problem)

The problems:

- Background noise in the mic. Use noise canceling microphones if possible, boom headsets kept close to the face, and carefully adjust mic gain and processing.
- Operator annoyance. While good headphone muffs can limit some of the room noise pickup none of them are perfect, and when trying to pick out that weak little guy on a noisy band you really don't need someone having a loud conversation sitting next to you.

At some big stations operators are in different rooms, or even completely different buildings. While this does stop the noise it takes much better operator use of a networked logger to coordinate passing from band to band, finding interstation interference, getting reliefs when needed, etc. It is just so much easier sometimes to be able to see and talk directly to the other operator that I found this to not be really useful.

Computers

Think flexible. Get computers with more speed and memory than you think you will need and they will last for years running logging software. If possible dedicate them to the station, do not use for kids or games or downloading porn or you can expect problems when you want to use them for logging. It is also nice to have identical computers for each station so they can be swapped easily if needed.
Wireless networking is super! 10base2 or 10baseT can have RF problems unless you are careful… cheap hubs are worst source of RF problems. If using twisted pair cable get the good shielded stuff. And what is really bad is that RF can go both ways with wired systems, some of them put out lots of digital hash.
Test everything with lots of RF. There is nothing worse than finding out that a keyboard is sensitive to RF right after a contest starts. Or that the monitor jumps off the desk the first time you key up on 80m. Grounding cases of computers helps, but that isn't always enough. I had one monitor and still have a TV that are completely wrapped in aluminum foil to keep them from radiating.
Make single sheet keyboard and command reminders. Logging programs normally have way more features than any single operator can ever use. CT and the N1MM Logger are no exception. I always make up my own function key labels and a single sheet of the most frequently used commands and

keystrokes. This makes for a quick reference at 2am when you can't remember how to do something, and also makes a handy sheet of notes when you have to teach a new operator how to do at least the basics to get running in the middle of a contest.

Fun things… webcams, streaming audio, real time scoring. Computers and the Internet will be bringing more fun to contests in the future. As of this writing there are several stations running real time webcams where you can peek in on the operation. There have been a couple attempts at building a real time leader board system but nothing has lasted very long yet. Give it a bit of time and those will probably take off. Streaming audio has been done from some places, but takes lots of bandwidth that many places don't have yet.

And don't forget the final backup:

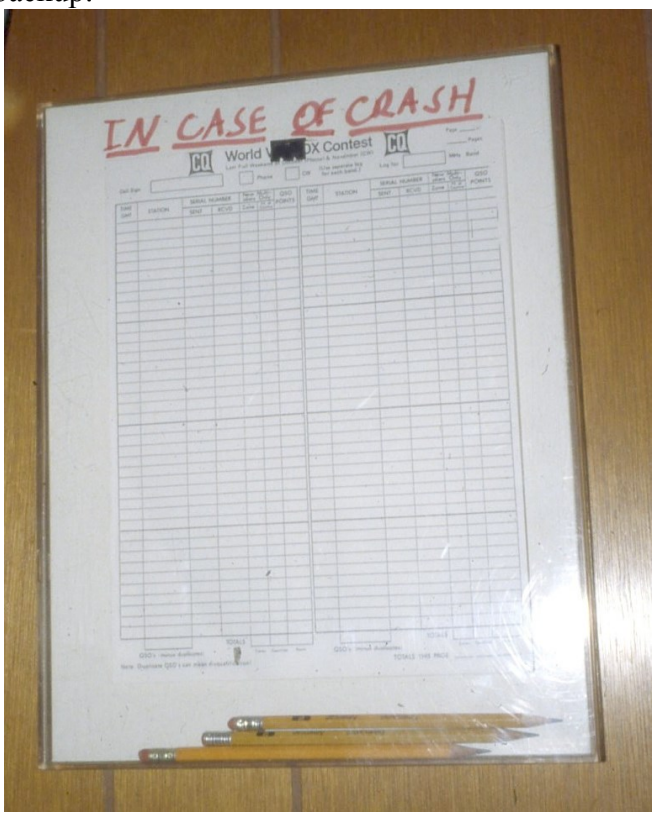


Figure 780 The final computer backup.

There have been many times when something has gone wrong on a logging computer in the middle of a run. The best way I have found to fix it is to give the operator paper and pencil to let him keep operating while I fiddle with the computer. Then when I get it working I type in what he has logged and then turn it back over to him when its all up to date.

One discussion that comes up periodically is about setting of time zone and changes due to Daylight Savings Time. I set all my shack computers to GMT. Not GMT/Monrovia or whatever else is often recommended, just the plain old GMT, and then turn off the daylight savings adjustment. The recommendation for using the other GMT setting comes from an old bug in some Microsoft operating systems, in any recent system this has been corrected and the normal GMT with the daylight savings correction turned off works fine. If you really want to run on local time you should test the transition ahead of time to be sure that your logging software doesn't get confused at the transition times… and now of course that is going to be even more up in the air as the start and/or end date for daylight savings in the states will be changing.

Insurance

I am definitely not an insurance expert, so if you have questions be sure to talk to someone else. But here are a few hints.

Hardware

Check your homeowners policy carefully and ask questions. It turns out that mine has excellent coverage in the default wording, others are apparently not so good. Coverage for damage from wind, ice, and lightning are important. Water damage after a breach of the building is something else that is common. Flood damage is of course a whole different story. For towers ask if they are covered as separate structures, my policy covers them automatically if they are connected by power cables to the house.

Liability

Putting up a tower? Going to have friends help out? Or live in an area with kids?? Get plenty of this. And be sure to check with your company about what precautions you have to take to be sure they don't refuse to pay because you did something dumb.

Adjusters

Long ago, and right in this QTH, I had a 40-2cd at 150' that folded in an ice storm. I contacted the insurance company which told me to get an estimate to get it replaced. So far, so good. I gave the info to a pro who was a friend of NJ1F who was the engineer for some local radio stations who wrote me up a very nice estimate... time estimates, rates for him above and below 100', helpers, removal, new antenna, assembly, feed line, tuning, etc, etc... the insurance adjuster made some calls and came back with a price about 1/10'th of what I had gotten. I asked her who it was and said I would love to have someone who worked that cheap and asked for his phone number.
When I called it the person answering it said it was a grocery store. I asked if John Doe worked there and if he did antennas, they told me he did satellite dishes on the side. I called the adjuster back and said this other guy wasn't qualified to get within 150' of my tower let alone 150' off the ground. After a short discussion of the liability possibilities if they had him do the work she understood and seemed ready to talk. Funny how insurance adjusters understand liability risks like that.
Then I proposed I could probably do most of the work myself for about half what the pro estimated... they gladly paid up which easily repaired the broken 40-2cd, added a new one, and did some other stuff by the time I was done. The whole process did take a while, but in the end it was worth it.

A story I was told about how to deal with lightning damage: A station was hit by lightning which damaged several pieces of equipment. One piece was a radio that looked ok on the outside but didn't work at all. The owner knew that the adjuster wouldn't understand so he opened the case and filled it with soot from a candle. When the adjuster was there he pulled the cover off and showed it to the adjuster who commented "It even smells like lightning".

2008 was of course a year full of insurance dealings. Broke antennas in February, parts of replacement antennas damaged in transit, deer kills car, more broke antennas in December. My antennas, radios, etc are covered under my home owners policy under the 'Other Structures' coverage. This unfortunately defaults to only 10% of the house value, I'm going to look into increasing that. Radios and stuff are covered under 'Personal Belongings' that is 50% of the house value. One thing that I am still trying to figure out is the difference between repair and replace. Under this policy when you replace something they take the initial value and depreciate it, but if you repair they may pay more. They also don't know how long of a period to depreciate antennas over… so watch out for that, if they ask be sure to pick a reasonably long time.

Selecting the type

I am really only experienced with Rohn towers. I have installed Rohn 25/45/55g and helped others with some of the HDBX types. I have had some other no-name used towers but have never been thrilled with them so haven't bothered to follow up on them after I got rid of them.

There is one big option you have to think about on that series of Rohn towers… The top section. There are two different types, the 'Tube' top and the 'Flat' top. I have had both and am still split on which one I prefer. Here are my pro's and con's:

Tube top
Pro
- Provides more side support at top of mast
- Easier to make good rotor loop
- Provides built in clamp mechanism for mast, though I think it is a bit flimsy.

Con
- Harder to reach antennas if you use a long mast
- Mast rotates inside tube which wears off galvanizing or paint leading to rust
- Freezing rain can fill the tube and glue the mast in place
- Requires shelf above rotor for thrust bearing

Flat top
Pro
- Provides natural place for thrust bearing
- Can put guys right on top plate, though I prefer to have them down a bit.
- Provides nice top step if you don't mind belting around the mast.

Con
- Harder to make rotor loop, they can catch under corners or on thrust bearing bolts.
- I like to have a second thrust bearing or at least another method to keep the mast centered if the rotor has to be removed, this gets more important as the length of the mast above the tower increases.

Installation

If you are going to do it, do it right!
Follow manufacturer's specifications. Rohn has fairly good drawings in their catalog. Other manufacturers supply base and anchor drawings. If you don't know what the drawings mean get someone to help. Don't guess, and don't cut corners just because you don't see why they specify it a certain way.
If you can't follow the manufacturer's specifications get a real engineer to design it. This can be expensive of course so should be limited to extraordinary situations. The most common one I have heard of that scares me is the raised anchor point. This is where a pipe or I beam is used to raise the point where the guy wires are connected above the ground. The forces exerted on the guy anchor in this arrangement are WAY different than when a normal anchor rod into a buried block is used. These must be designed by someone who is familiar with not only the requirements of the tower but also with the local soil conditions.
NEVER copy what someone else says works, no matter how long it has been standing. A few corollaries to Murphy's Law apply:

- "Luck Happens" at least as often as "Shit Happens", but usually luck happens to the other guy.
- The more often a lucky 'design' is tried the more likely it is to fail.
- The failed attempts don't get discussed as often as the successful ones.

Bases, anchors

I say again: Do what the manufacturer specifies. The Rohn catalog has the proper drawings for their types of towers, be sure you read and understand what they say. If you don't understand it, hire a good foundation contractor.
If you don't have what is obviously 'normal' soil, hire a proper engineer to evaluate it and give you modified plans.
Raised anchor points. Do I have to say it again? Do what the manufacturer specifies… or hire an engineer, you'll sleep better at night.

EHS vs. Philly vs. Insulators and other guy wire things

Insulators make guy wires much heavier than normal for their size. This makes it hard to properly tension them. All the installations I have seen or worked on with insulator broken up guys were not tight enough to prevent excessive motion on the tower.
I have never used Phillystran or fiberglass guys. I understand they have gotten much easier to use with the introduction of guy grips made for them instead of epoxy potted ends. But other than that I can't really comment on how well they work or hold up.
My preference is plain EHS galvanized steel cable. I use guy grips instead of cable clamps which results in a much cleaner and easier to maintain installation.
I also prefer guy grips, big grips, dead ends, whatever you want to call those Chinese finger trap contraptions that replace cable clamps. If you use cable clamps learn how to properly 'not saddle a dead horse' with them, and how to space them properly on the cable you are using. For best strength they can't go just anywhere, there are specific rules for them. And add them to your annual inspection check list, they must be checked regularly… which of course makes it real hard if you use cable clamps and insulators to break up guy wires. If you use grips be sure to have someone who REALLY knows how to put them on show you, they can be a real pain to get on if you do it wrong. Also remember, use new grips for a permanent tower installation. Yes, they can be reused a couple times, but don't push it, save the old ones for temporary use like attaching the come-a-long to pull the wires tight.
If you are going to be putting a BIG antenna at the top you should also consider a 'star' bracket at the top.

Figure 781 Star guy on 180' Rohn 55 tower

These provide much better torque control at the rotor height to help keep the top of the tower from moving in the wind. Like a ring rotor they are a pain to climb around, but do provide a nice place to sit or stand.

As I mentioned before, an interesting way to prevent ice slides when using plain EHS is to put a cable clamp about half way up each guy span. This causes the sliding ice to peel off before it gets down to the anchor point. These are a pain though if you are going to be working with loops or other wire antennas, they always want to grab the rope or wire if it gets anywhere near them. I have been told that sliding ice can peel off guy grips when it hits the anchor point. I haven't seen that even though I have put a test grip on a 180' guy wire to see for myself.

On the anchor points you should always add a retainer loop to stop the turnbuckles from loosening.

I also add a cable clamp above the dead ends, sometimes including the dead end of the cable, just in case there is something to ice sliding down the wire taking off guy grips.

Grounding

The standard way is one or more 8' ground rods outside the concrete base connected to the tower with heavy cable. I use mechanical connectors. Others like to use CadWeld connections.

The biggest problem here is that there is really no such thing as 'ground' when you are talking about RF. The common uses of the term Ground are as a 'common reference point' or a 'distant reference point'. These are used to define a location from which voltages can be referenced for purposes of calculation or measurement. This is well and good when talking about DC or even very low frequencies where the area being described is a small fraction of a wavelength. But when the area being talked about becomes large or the wavelength becomes small it is much harder to define.

Consider the case where a vertical antenna with a raised feed point and elevated radials is 100m from the shack. If you wanted to measure the voltage at the base of the vertical where do you connect the 'ground' lead of the meter or scope? If you are on 10m the field will have gone through 10 cycles more or less from the shack to the antenna, and there is no reason to think that a ground rod at that spot would have the same voltage as the center of the radials.

Consider another case of the 100m from the shack vertical. Assume the rig it is connected to is powered from a line that comes from the other end of the building away from the vertical. Lightning strikes the vertical with a waveform that goes from 0 A to 10kA in 1 micro-second. Assume a 10 ohm ground resistance at a rod connected to the radials. The voltage referenced to the distant earth will go up to 100kV in that 1 micro-second. But since the current from this stroke travels 300m in a microsecond (a nice number to keep in mind for the speed of light) it takes roughly .33 micro-seconds to get to the other end of the coax in the shack. Of course in the shack the ground wires connected to the transmitter are still at 0v since they haven't seen that stroke yet, and so the rig gets fried if there isn't some other mechanism to equalize the voltage.

When dealing with RF you have to think like RF. And for that there is only one spot that matters, the far end of the coax. At the end of the coax where the antenna is connected the current on the inside of the shield has to balance the current on the center conductor. How this happens depends on the antenna and whatever other conductors may be in the vicinity. If you think of a current going out on the center conductor to an antenna it will couple through whatever conductors are around it in order to get back to the inside of the shield. This can be the ground, a counterpoise/radial system, the outside of the shield of the coax, or any other random conductor (including your body) that has a path back to the inside of the shield of the coax. The objective is the make that current flow on the conductor that you want it to and not some other conductor where it can upset the antenna pattern, or through the ground where it can be lost as heat.

There are 4 different purposes for a ground connection to a radio or any other piece of equipment.

1. Electrical safety. This is the ground required to keep faults in AC powered electrical devices from becoming a hazard to users or causing fires. The basic idea is to keep all device housings at the same potential so that a user touching two devices at once can not get shocked. This ground also must provide a low impedance path back to the electrical service box so the breakers or fuses can operate properly when there is a fault. This only applies if you are connected to a power source that may seek to get to ground through the radio. i.e. a commercial AC main, or a generator that is properly grounded. If you run a charger on the battery while you are in the house you should have a ground connection that ties the rig case back to the same ground as the electrical system for your safety.
2. Lightning safety. The idea of a lightning ground is to keep all electrical devices at a given location at the same potential during a lightning strike. This is to prevent shocking users who may be touching two devices and also to prevent damage to the devices by minimizing potential

differences. Note that this is similar to the Safety ground in definition, but slightly different approaches are needed because of the higher currents, voltages, and frequencies involved. By proper use of lighting arresters on each lead all tied to the same single point ground the voltage difference between various lines is minimized and so should prevent damage to the equipment or operator.

3. Antenna RF return path. If your antenna is not a balanced one like a dipole then some of the return path for RF may be through the ground back to the feed point. Say you run a random short wire just stuck in the antenna jack on the back of the radio with no ground... just like any other current source any power that goes out on the center conductor of the coax connector must come back on the shield. This can be looked at kind of like a big capacitor. if you draw the field lines from one half to the other half of a dipole they are nice and symmetric... however if you do it for the wire stuck in the coax connector all the field lines from the wire end up terminating on the radio case. Ok, so this works fine in free space, but close to the ground lots of those field lines go into the ground along the surface and the capacitively back to the case of the radio... unless of course you get in the path between ground and the radio case, in which case you get RF burns. You can minimize this by providing a counterpoise to act as the other half of the antenna and/or providing a more conductive path than you from the ground to the rig, in this case a ground rod.
4. RFI RF return path. This is similar to the case above, but in this case the RF is the noise that is radiated from nearby devices. Just like your transmitted RF this noise is being transmitted by whatever is around you. If your radio/feed line happen to pick it up that current is going to look for a path back to the source. Now, if you don't have a ground it can't go that way, so it goes up to this big capacitor up above where it finds its way back into the receiver on its way back to the source. If you do provide a ground that MAY be the lower impedance path and 'drain' the noise off the system before it gets to the receiver. Note that the 'MAY' means that it depends on the source, location, orientation, etc of the noise. You may find cases where adding a ground increases the noise because it provides another path to ground through the radio. Making sure everything that can make noise is grounded to a single point ground system helps by making a common point for all radiated junk.

Note that all of these 'types' of grounds work the best when designed basically the same way. The shorter, fatter the conductor the better, and all equipment must connect to the same ground point.

Putting the mast in the tower

I have used a variety of masts. When I was doing the first tower I figured I would have a stack of antennas up there and got a 20’ long ¼” wall high strength steel mast… this monster alone weighed in at 100 pounds! Remember when putting in a mast, you can’t put 18’ above the tower and 2’ inside with the rotor holding it, the side forces will either break the tower or the rotor the first time you get a decent breeze. Watch that lever arm and think about the forces on the tower, bearing, and rotor. I don’t like to have antennas any further above the tower top than the rotor is below the top, that way you always keep a decent lever arm inside the tower.

Also consider the use of more than one thrust bearing. I use TB-3 bearings on all my 2” masts (which is all of them as of this writing). These bearings are meant to support the weight of the mast and antennas. There has been lots of discussion about this being a good or bad thing, some people think that rotors require some of the weight to be on them, others don’t. For the rotors I use I don’t think it is necessary to have any weight on them, so I always use the thrust bearing to hold the mast a quarter inch or so from bottoming out in the rotor clamps. This normally leaves enough room to remove the rotor if needed. On

flat top Rohn towers I like to have 2 thrust bearings above the rotor, this prevents the bottom of the mast from moving sideways if you have to take the rotor out. To prevent problems with alignment of two bearings and a rotor just leave the bolts on the lower thrust bearing loose, just tighten them when removing the rotor.

It is much easier to put the mast in the tower at the bottom then raise it to the top later. If your mast is going to be longer than your gin pole can easily reach above the top section you should put it into the tower at the bottom when you put the first couple sections on the base. This is much easier and safer than trying to handle a long heavy pipe at the very top of a tower. The easiest way I have found to actually do the raising is to get the top section on, add the rotor plate and thrust bearing(s), then put the gin pole as far up as it can go above the top. Run the lifting rope down through the top, bearing(s), rotor plate, etc, all the way to the bottom. Thread the rope through the mast and secure either with a through bolt or tie it to a muffler clamp or something else that will hold the weight of the mast and not catch on rungs as you go up. The pull the mast up inside the tower slowly, I like to climb and follow it up so I can make sure it doesn't snag on bolts or rungs on the way. Use the rope to pull it up until the top is just out of the top of the tower and stop. Secure the thrust bearing and add an extra clamp temporarily above the tower top. Then remove the lifting rope… use the procedure below to jack the mast up as you add antennas or to get it to its final height.

How to raise and lower mast at top of tower. This assumes a Rohn 25/45/55 type tower with at least one thrust bearing. This is a way to raise and lower the mast inside the tower to reach antennas higher than you can reach from the top rung. Note that to get a bit more reach on a tube top section you can add a step to the diagonal part of the leg or to the tube itself with a couple of u-bolts. When doing this process you must also be careful about restraining the bottom of the mast if it could be top heavy or there is any wind. The side forces on antennas in wind could be large enough to tip the mast and damage the tower top if the lever arm above the tower is too large.

1. Keep hands and feet clear of the mast at all times.
2. Make sure thrust bearings are tight, add a muffler clamp or two above one of the thrust bearings just in case they don't hold.
3. Remove rotor
4. Attach come-along to bottom end of mast
5. Make sure wires taped to mast are out of the way and move any beam on the mast up so that it won't jam the mast.
6. Tighten come-along until it removes weight from thrust bearings.
7. Move muffler clamps up a foot or so and retighten.
8. Loosen thrust bearings
9. SLOWLY lower the mast with the come along until the muffler clamps rest on the thrust bearing again. If at any time the mast doesn't move down as you release the come-along immediately pull it back up with the come-along and figure out why it wasn't moving, do not let the come-along have any slackness in its cable!
10. Tighten thrust bearings
11. Re-adjust come-along position if needed to allow next lowering step.
12. Repeat 5 through 11 as many times as needed to lower the mast.

No, this is not a fun process. It is slow and must be done very carefully or you can be easily injured.

Antennas

Buy or build

To build or not to build, that is the question. Yes, building antennas yourself is satisfying. And if you like working with power tools, buying nuts and bolts, fitting tubes in tubes, etc, etc, etc… then build antennas. If you like being able to complain to someone when a part is missing or doesn't fit, or you want to be able to call someone who can send you exactly the one piece of tubing that broke in the storm, buy them. Also remember, building ONE special antenna may be an interesting project. Building 5 copies of an antenna to make a stack is something else.

Wire or aluminum

If you can put up a tower you will want to put aluminum on it. If you can't, then use wire antennas. I have tried the inverted V beams made from wire, and they are ok, but hardly as satisfying as something that rotates.

With wire don't get caught up in all the hype about loops. I have tried all sorts of loops here and have never been happy with them when compared to an inverted V at the same height. In some modeling I did to compare loop arrays with inverted V arrays it appears the lower ends of the loops produce more high angle radiation and have greater ground loss. On the inverted V at the same top height the radiation is from a higher elevation so less ground loss and lower angle radiation is produced.

What about insulated wire vs. bare wire?? I rather like insulated wire, at least if its really well insulated and meant to be outside. It seems to hold up better and is easier to work with. I also think it helps reduce the generation of so called rain noise, though not as much as I would like at times.

Vertical vs. Horizontal

Both is best! While the standard is horizontally polarized Yagis for 40m through 10m and up for best operation, it can help to have both polarizations available for 160m through 40m at least. Over the years here with a variety of antennas on 160m and 80m (and to a lesser extent on 40m) we have noticed that which antenna is best can change in the course of an evening, sometimes even hour by hour. For instance on 80m with an inverted V at 150' and a raised 4-square array you can be running just fine on the inverted V and then the run tapers off, switch to the 4-square and there is a whole different group to work… a bit later switch back to the inverted V and it is better again. The same type of comparison can be done on 160m between an inverted V at 180' and a pair of 120' tall inverted L's. Sometimes the inverted L's are better to Europe, sometimes the inverted V is better.

Refurbishing used antennas

Find good source of stainless screws and bolts. I prefer using local sources but today there are lots of Internet sources that may be reasonable if you need to build a large quantity.

I have never really liked hose clamps for elements joints. They do work but must be carefully tightened. I usually use a nut driver for this, it allows you to exert enough torque to make them reasonably tight and can't slip. A screw driver often slips out of the large slots, and a ratchet makes it too easy to over torque and break them. Make sure hose clamps are 'All Stainless'. Many cheap ones have a plated screw that quickly rusts and makes them worthless. A kind of contradiction can occur when using hose clamps if you also use a joint goop, the goop makes the joint slippery where the hose clamp relies on the friction to grab the inner tube. This can make it almost impossible to tighten a joint enough to stop it from slipping.

How long?

Some people insist on putting up the biggest antennas they can possibly get. There are several problems with this. First you then need bigger towers and rotors to hold and turn them, this of course adds to the expense of the project. Higher gain also means narrower beam width. Here in the North East most of our contacts come out of Europe and Western Russia. This means we need to cover from about 35 degrees down to 75 degrees. Running long boom 6 element or bigger antennas this is around the 3db beam width so while you are getting more power into central Europe you are starting to lose around the edges, and it really makes it harder to hear Africa and central Russia that are farther North. So 4 elements seems to be a good compromise for at least this area. You can get decent gain and f/b and still have enough beam width that the effectiveness of fixed antennas in a stack isn't lost on the fringes. Four element Yagis for 20m and higher frequencies are also reasonable sizes to work with in many installations. And they aren't so heavy that it takes super heavy duty rotors to turn them, or fancy trams or large crews to put them up and take them down. On 40m this gets to be a problem though, and most of us only dream of a full size 3 element Yagi on 40m. The M-Squared 40m4LLDD seems to be a decent compromise. While it is a big antenna it is much lighter than a full sized 3 element Yagi and much easier to handle. I would still not want to put it on any but the heaviest duty rotors though. So far my experience with it is that it has a much better f/b than the old 2 element Cushcraft 40-2cd's, and even though it is much lower it is often better than the 40-2cd that is on top of the tower.

Stacks

I highly recommend the W2PV book when you are thinking about stacks. It gives you the background that shows why stacks help a contest station. Also learn to use one of the terrain analysis packages. However, unless you are in a strange location you won't have much need for the software in my opinion. What I have found is if you put 10m, 15m, or 20m antennas just above Rohn tower guy brackets on 120' to 150' size towers you get plenty of coverage. These are also normally the easiest places to mechanically mount the Yagis as it gives the most clearance possible from guy wires.
Presently I am running 4 high stacks of 4 element Yagis on 10m, 15m, and 20m. On all of these stacks the top and bottom of the stack rotate and the middle two are fixed at Europe. This gives good coverage of the vertical angles for DX contests, and it also provides a low rotate able one for stateside contests and other high angle paths.

When asked recently about a high or low south antenna being better to the Caribbean I replied: "Sometimes the low south antenna works great. Usually during the day when a quick switch is needed to work those Caribbean or South American callers that are weak off the back of the stack at Europe. Sometimes in the evening when pileups are big and the band is changing it is necessary to turn the top antenna south to break the pileups. This is true on all the high bands at various times. It can also be just the opposite of what you expect on other paths. Lots of times on 10m and 15m in the evening we find we get beat by tribanders to the Pacific, turning the bottom antenna on the ring rotor out that way can sometimes break pileups that the top one won't... other times going to the 180' one on 10m is the only thing that works. This can really be seen on the stacks at Europe on 10/15/20... usually the top antenna opens the band, then as it gets later into a good opening the lower antennas get better and better. Often at the peak of a good opening the bottom antennas will be much louder than the top ones.

Summary: yes, there can be a big difference with antennas at different heights... though not always what you expect, and not necessarily the same every day. So the best recommendation is put up both and find a way to turn them."

That is my basic philosophy on selecting and locating antennas. I want to cover as many of the possibilities as possible. This is why on my 10m, 15m, and 20m stacks I can rotate the top and bottom

antennas. The dedicated south antenna is not at any special height, just some place it fit well on the tower.

For many years I ran mismatched stacks. The top antenna was a much longer boom than the lower parts of the stack. I don't recommend this. While it does give a killer pileup busting antenna on top the stack combinations just don't work out properly. Beside the difficulty in evenly dividing power when the antennas aren't identical there can be unwanted nulls in the pattern due to phase differences. On 10m when I was playing one day I was able to null out stations while running the stack and turning the top one. This was a good indication that there were probably other nulls that were affecting the pattern.

Dedicated spot antennas

Here in New England and nearby areas it is useful to have dedicated south antennas for at least 20m, 15m, and 10m. This is because most of the QSOs are from Europe in the major contests. Huh? Why south then? Well, during the time when we are running Europe on the stack we frequently hear these weak little stations calling… A quick switch to the south antenna can bring up that South American or Caribbean station to make working them much easier. These antennas are also useful for stateside contests where they can be combined with the other rotate able antennas to make a stateside 'stack' or shotgun pattern.
Other areas of the world may call for similar arrangements. Check with your local contest club for specific recommendations.

4-squares and other phased verticals

4-square arrays are neat options to get a vertically polarized antenna with some gain. But they are not the best over all antennas. I have had 40m and 80m 4-squares and a pair of phased inverted L's on 160m and compared them with inverted V's, an 80m 2 element wire beam, and Cushcraft 40-2cd's at various heights. Here are some general observations:

- 40m 4-square with raised radials vs. 40-2cd at 120'. 40-2cd usually better to Europe when band well open. 4-square would be best sometimes at European band opening and to deep Asia and for quick switch to south.
- 40m 4-square with raised radials vs. 40-2cd at 180'. 40-2cd almost always better. Only use 4-square for quick direction switch.
- Base loaded 80m 4-square (48' vertical pipes) on ground. Not better than anything except in rare cases.
- Wire 80m 4-square with raised radials and big ground screen vs. Inverted V at 150' or 2 element wire beam at 150'. It's a 50-50 split into Europe which changes quickly during the night. 4-square often better for Asia.
- Tower 80m 4-square with raised radials and ground screen. Best for just about anything except stateside. Sometimes inverted V at 150' better for Europe. Inverted V at 150' best for most stateside, sometimes low one better close in.
- 160m pair of 120' tall inverted L's ½ wave apart, can switch E/W or N/S pattern vs. inverted V at 180'. Another tossup, also like 80m it changes quickly over night.

Inverted V's vs. Loops

I spent many hours modeling loops and inverted V's to figure this out. Some people swear by loops and claim gain over inverted V's, less static, and all sorts of magical properties. I have played with loops, and have never been thrilled with them… probably because I have inverted V's that are high enough. What I did find in modeling is a small advantage in gain for loops if the center of the loop is at the same height as the feed point of the inverted V. This is what you would see if you were modeling a rotate

able quad vs. a Yagi where the boom heights are the same. If you place the top of the loop at the same height as the top of the inverted V the loop loses to the V when they are both fed at the top. This makes sense because in the loop some of the current is going to be in the bottom half of the loop which is closer to the lossy ground and contributes more to high angle radiation. With the inverted V all the current is up at the top.
Also consider the mechanical problems of having twice the wire in the air and also needing at least one extra guy rope to hold the bottom. This can really be a pain if the tower also has side mounted Yagis and other antennas that the loop has to be threaded around.

Beverages

There are all sorts of way to install Beverage antennas. There are disposable ones made from magnet wire rolled down street gutters, insulated wire tacked to trees or tied up with rope, wire on fence posts or other supports across fields, etc, etc. There are also single wire ones with or without reversing relays, two wire versions, and all sorts of different feeding and terminating methods. I recommend reading ON4UN's "Low Band DXing" book for a complete study and for how to calculate matching network parameters and winding of transformers.
I have had 2 sets of Beverages here. The first ones I did were 4 terminated single wires. For these I used galvanized steel electric fence wire which was quickly replaced with aluminum electric fence wire when I saw how fast it was rusting. It was held up mostly with electric fence hook insulators tied around trees with rope. The terminations were single resistors to a short ground rod. This system worked well because I could run them in 4 good directions far enough to be effective… It had to go because one of them went across the town road (up in a big pine tree to cross the road) and the electric company cut the tree down and ran power up the road for a new neighbor.
To replace the original set of Beverages I needed to come up with a way to not run a long wire toward Europe. For this I went to a two wire system out of the "Low Band DXing" book. This system uses two transformers at the feed point to a sum and difference of the currents on the wires. At the far end one wire goes directly to ground and the other is open circuited. A recent improvement adds a reflection transformer at the far end to make a better phase shift at the end which improves the 'back' direction. To do this the wires must be relatively consistently spaced for the length of the run. For this I went to using fiberglass electric fence stakes and the screw on insulators that are used with them. I cut the fiberglass rods in half and either tap them through holes drilled in pressure treated 2x4's or into holes drilled into trees. (Fiberglass in trees is less of a danger to chainsaws than nails and can be easily cut off flush if they break to let the tree grow over them) These rods do have an advantage of bending quite a bit before they break so a big branch or tree coming down on the wires tends to slip the insulator off the end of the rod instead of breaking the wire or rod. This makes repair easy, just take a pocket full of spare insulators along to replace missing ones in the winter, and go pick up the lost ones in the spring when the snow melts.
Another thing I did with the new set of Beverages was to bring all 6 directions coax back into the shack. The old set had a remote switch so if more than one band wanted to use them they had to listen to the same one. With all 6 directions available in the shack it is possible for each of the low bands (40m, 80m, and 160m) to pick different ones.

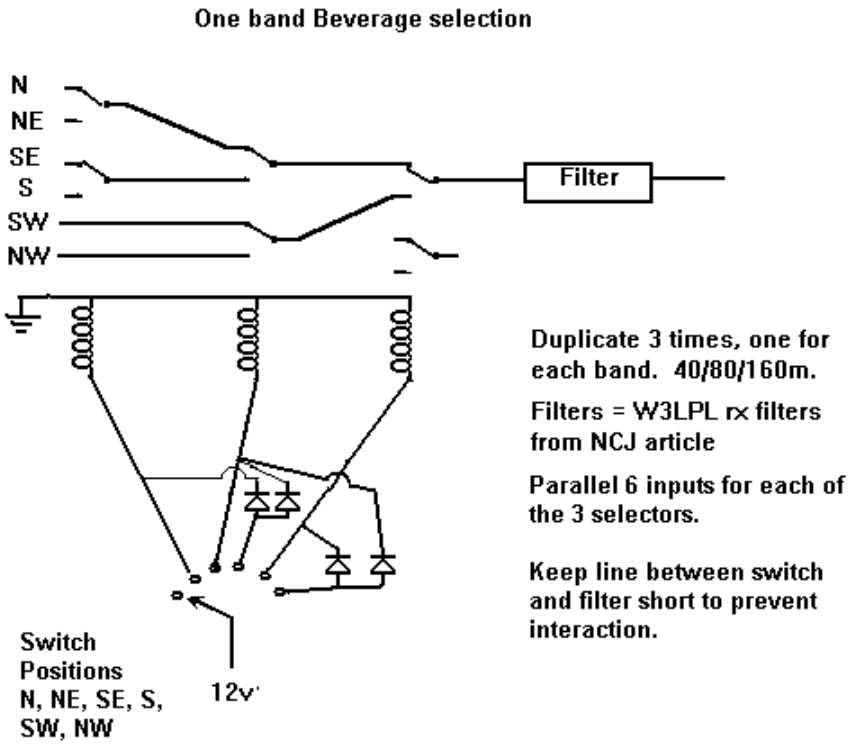


Figure 782 Beverage selection schematic

For 3 bands repeat the above 3 times with the input lines in parallel. It is important that the filter be something similar to the W3LPL band pass filters that have a high impedance outside their pass band. This high impedance effectively cuts off the coax from the other bands. Before I figured out this problem there were problems when more than one band selected the same beverage. The unterminated coax could act as a stub and reduce the signal on the other bands. By using the band pass filters this problem is avoided, and it also adds more isolation between stations.

I also like to use electric fence components for the beverage supports. I used to use electric fence wire for them also but it doesn't hold up well to the long spans up here in the winter. In warmer and safer areas aluminum electric fence wire would be an excellent choice, it is cheap and light and easy to work with.

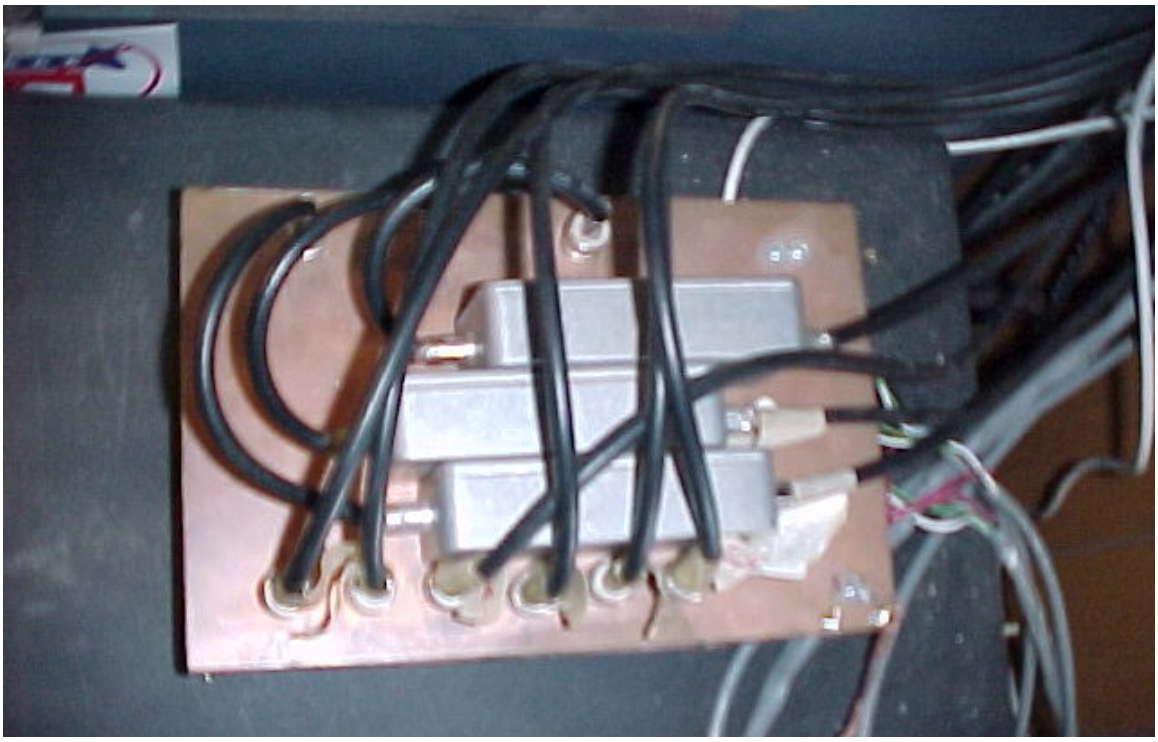


Figure 783 Beverage switch box

The lines between the switch and the filters should be kept short, though with 40m as the highest frequency band these are used on the jumpers could be a bit longer and not affect the performance

Figure 784 Beverage Switch box (bottom)

Not visible here is that each input line goes through a feed through capacitor to isolate the control lines from the RF. Also I have added anti-kickback diodes to prevent impulse noise while switching.

Figure 785 Beverage post with transformers

The shack end transformers are in small cast aluminum boxes. There are some clamp on ferrites around the coax and a ground rod at the base of the pole.

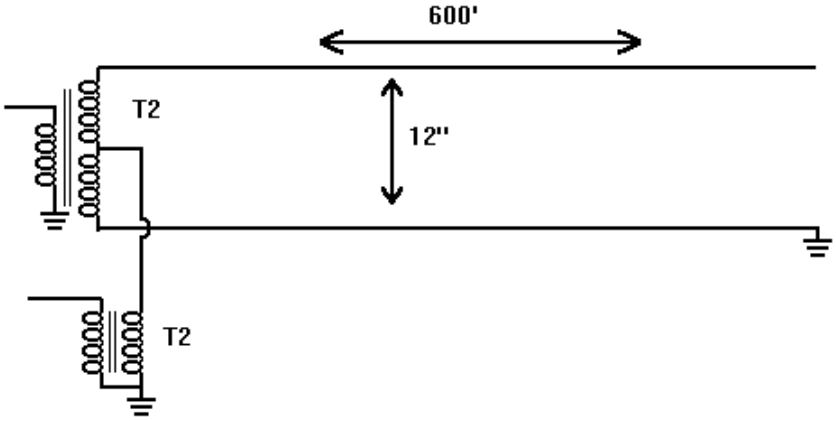


Figure 786 Beverage transformers schematic

For more details on designing the Beverage transformers see ON4UN's "Low Band DXing" book.

Figure 787 Typical Beverage support post

A typical support uses half of an electric fence fiberglass stake stuck through a hole in a pressure treated 2x4 with a pair of screw on insulators. I like to use the insulators even though the wire is insulated since it allows the wire to slide through them. The insulators also will slide off the ends of the fiberglass, usually before the fiberglass breaks, in the event of a tree coming down on the wire… or moose getting caught in the wire, or a bear trying to floss with the wire.
At the far end there is a reflection transformer that improves the performance of the 'back' direction. Plans and calculations for these are in ON4UN's "Low Band DXing" book. At the far end I also drive a ground rod to use as the anchor and slope down to it from the last post. From the ground rod I also run several radials on the ground, I think this helps provide a better ground for the reflection transformer to work against.

Insulated Copperweld vs. other wires.

Love this wire. I was introduced to this stuff by K2TR. It is designed to be rural telephone wire so is tough and well insulated. I use it for Beverages, inverted V's, and inverted L's as well as 4-square wire verticals.
My source is "Clifford of Vt.". (http://www.cliffordvt.com/) The wire is called "Line Wire" IMSA Spec 28-3 Copper-Clad Steel. I use the 10ga version. They do have a minimum order, I usually order more than I need to meet the minimum and sell it off at flea markets. Just be careful when you first untie the end on the roll they ship, it is a very springy wire and can easily get out of hand.

"Improvements"

40-2cd

The Cushcraft 40-2cd is a popular 'shorty forty' Yagi. It is unfortunately a bit lightly built for its size. Common problems are: broken boom braces, elements twisting on the boom, boom splices slipping, the boom slipping in the boom-mast clamps, and elements breaking in the middle. Dave Leeson, W6QHS, published a detailed analysis and recommended modifications for the antenna which I highly recommend. Another modification that is needed is to replace the sheet metal screws on the loading coils with stainless bolts.

Yagi Element Vibration

A well known phenomenon with antennas, wires, buildings, race cars, and other structures exposed to wind is called 'vortex shedding'. Basically a wind that has to go around something speeds up and tries to follow the surface of the object. Around the 'back' of the object the air that went around each side comes back together. Now if the flow is slow enough this all happens very smoothly. As the speed increases the flow starts to cause small vortices behind the structure, but these aren't really stable and get caught in the flow and leave the back of the structure. In doing this they exert small forces on the structure. This is generally no problem, except around certain shaped structures (like tubing), and if the structure can move a bit (like antenna elements), the shedding of the vortex moves the element a bit. If the rate of vortex shedding happens to match the normal vibration frequency of the element a resonance occurs and the element builds up what can be a rather large vibration. With certain antenna elements this vibration can occur with very low wind speeds resulting in long periods of vibration. Aluminum is unfortunately prone to fatigue failure and this vibration over long periods of time can result in elements literally falling apart.

I have seen this happen on Telrex TB5EM, newer Telrex 20, 15, and 10m monobanders, Cushcraft 10m and 6m monobanders, home made 15m monobanders made from various manufacturers elements, and some others.

There are several ways to prevent the vibration, the key is to understand why it happens. There are 3 basic factors that must be taken into account:

1. The vortex shedding frequency. There usually isn't much that you can do about this. For electric power lines there are spiral wraps that go around troublesome wires that break up the vortices. Similar things are used on large smoke stacks, and even on new model car whip antennas.
2. The stiffness of the element. Changing the stiffness of the element changes the resonant frequency, essentially detuning the resonance. There normally isn't much you can do to affect this though as it is basically a property of the type of aluminum and taper schedule used. If you are designing from scratch you can select a taper schedule that results in a less stiff element, M-Squared 20m elements are like this, they sag more but appear to be less prone to vibration.
3. The weight of the element. The weight is the other factor that goes into determining the resonant frequency. This is one thing that can be changed. A common method is to insert a rope or piece of cable into the element. It is difficult to really change the weight enough to change the resonant point a whole lot though.

The rope in the element is the best thing I have found, but to really make it work you have to pick a rope or cable that is as heavy as possible but does not fit tightly in the element. You want a rope in there that has plenty of room to bounce around. This is so that if the vibration does start the rope bouncing around absorbs some of the energy and also gets out of step with the vibrating element. With large elements I have used ¼" Manila or Nylon rope. For small elements like on 10m and 6m I use a piece of aircraft cable. Of course when doing this the ends of the elements must be well capped or some other method must be used to keep the rope inside the element.

Telrex sleeves

Telrex used a rather unique element mounting method. Fortunately no one else has picked up on it as it was a real pain to work with, especially if you had to disassemble the antennas after long use. Basically the design consisted of a 1/8" wall boom, where elements were mounted a ¼" thick sleeve about 4" long went over the boom and was secured with 2 sheet metal screws. Then a hole was bored through both pieces for the element. In the top of the sleeve a large hole was drilled to pass the ¼"x20 screw head, then a ¼" hole was drilled through the element and the bottom of the boom and sleeve. A single ¼" stainless machine screw went through the hole and was secured with a lock washer and nut on the bottom of the sleeve.

There were several problems with this design.

1. The elements would sag after years of use, this would cause the tubing to go out of round and make it almost impossible in some cases to remove the center part of the element from the boom.
2. The elements could of course not be moved along the boom to retune the antenna when modern modeling showed that the designs they used were far from optimum.
3. And now, the long story… In the beginning Telrex built heavy and extremely durable antennas. Then there was a change in management and 'modern' engineering was applied to the old designs. Well, at least some changes were made. The biggest change was to 'upgrade' to modern aluminum alloys. This resulted in lighter and stronger antennas. There were unfortunately two side effects of this. First, the elements were stiffer and lighter which resulted in vibration in light winds. I literally had pieces of elements falling off before I was able to get them down and full of rope. Second, the vibration worked on the sleeve which was still held to the now thinner and stiffer boom with only those 2 sheet metal screws. This vibration caused the sleeve to move and the sheet metal screws to eat out their holes in the boom. As the element vibrated and the sleeve moved more and more the element essentially ate away the boom inside the sleeve. Eventually the boom would break and the element came down. I saw this on a TB5EM and a 20m 3 element monobander. If you are thinking of picking up a used Telrex antenna take a good look at the bottom of the boom near the sleeves, the telltale indication is black areas that look like they have run out of the sleeves. These are due to powdered aluminum getting washed out of the joint by rain and staining the bottom of the boom.

There is however a modification that seems to prevent the boom damage. Actually it takes 2 modifications, first you have to rope the elements to stop most of the vibration. Then drill out the 2 sheet metal screws and replace them with ¼"x20 ½" long bolts with lock washers and nuts inside the boom. Then on the bottom of the sleeve add 2 more. In some cases this can only be done when the element is removed, unless you have very, very long thin tools!

Figure 788 Stock Telrex sleeve attachment

Figure 789 First of the bolts

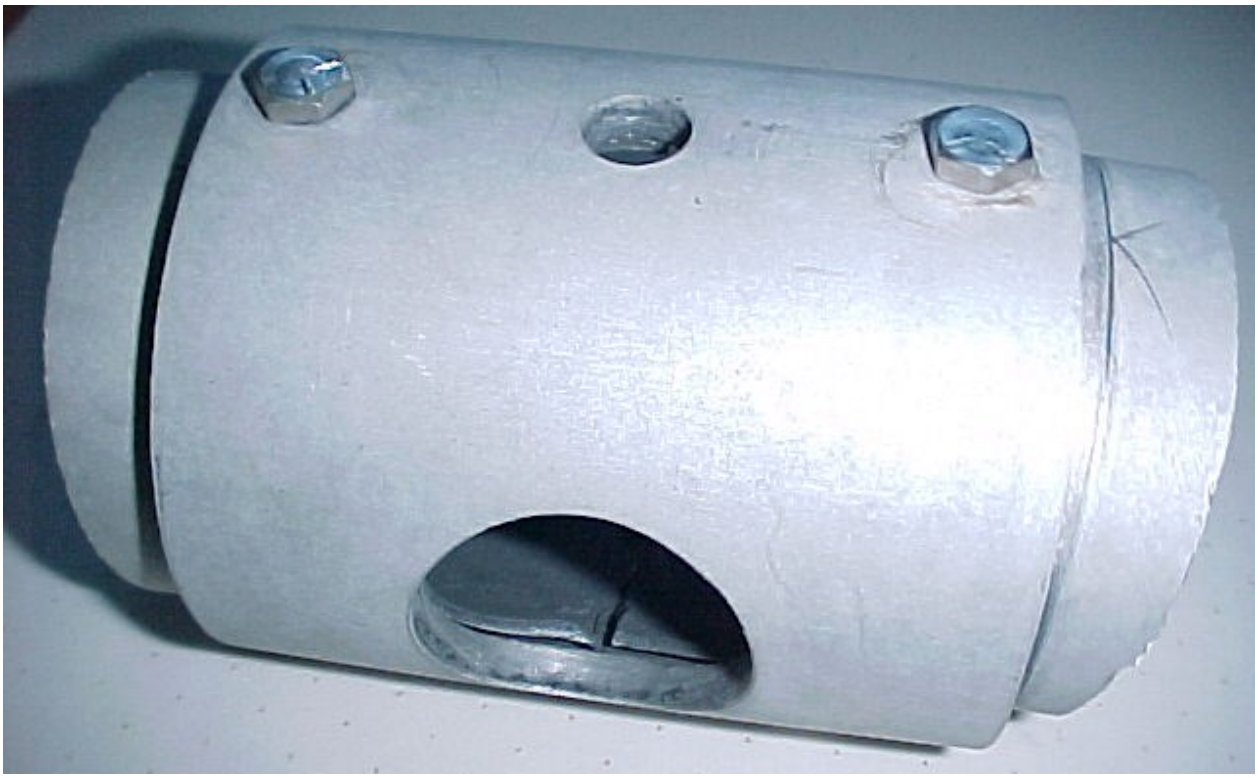


Figure 790 two bolts replacing the screws

The picture above is from the 4 element 20m Telrex that had a broken boom. It was probably wind damage that caused this, you can see the crack in the boom through the element hole, this crack went all the way around the boom. The 2nd director was held on only by the 2 bolts on that side of the break and the boom brace.

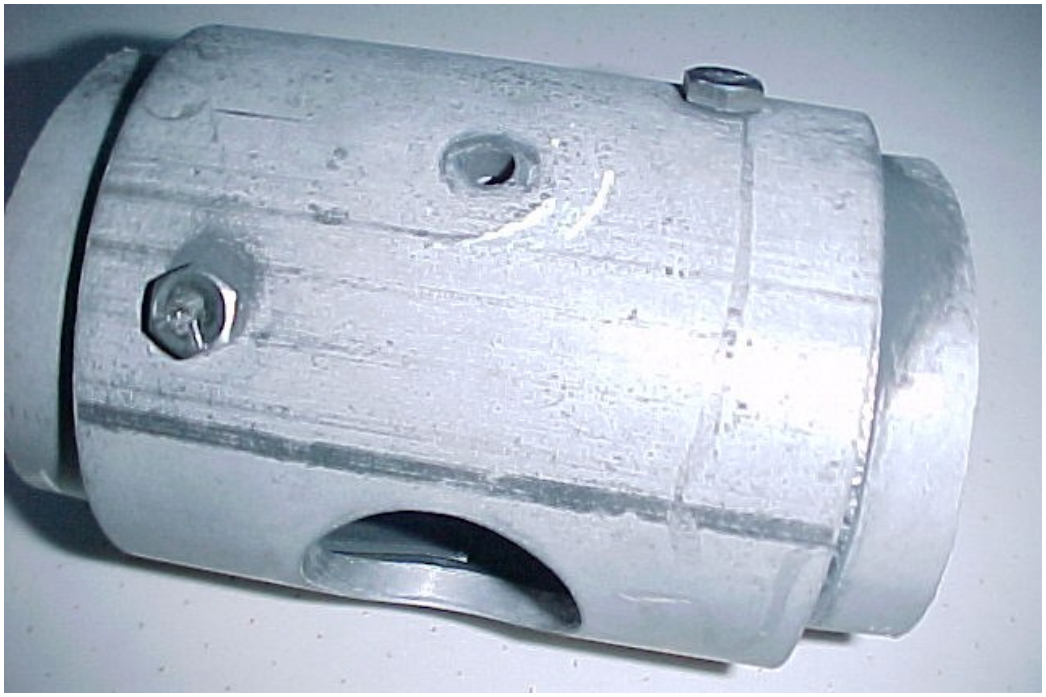


Figure 791 two more bolts on the bottom

This one shows a small amount of the black on the bottom of the boom. In this case the black was caused by the broken part of the boom moving inside the sleeve rather than the element moving in the sleeve, but the effect is the same.

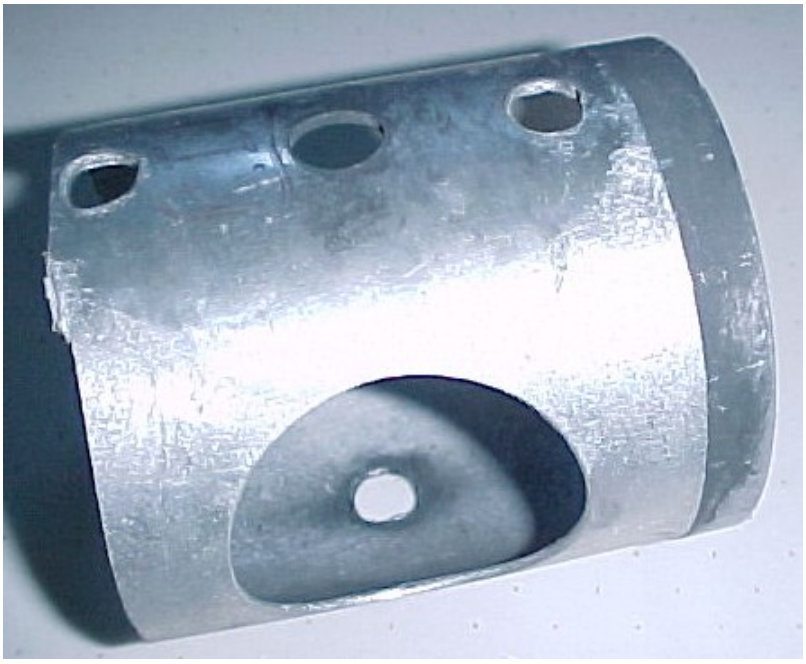


Figure 792 remains of a boom end with eaten out screw holes

This one was cut off the end of a 3 element 20m monobander. Note the large black area past where the sleeve was, this one was so bad it was black almost all the way around and the element was just flopping in the breeze.

Boom vibration

Another type of vibration I have only seen once is when the Yagi boom flutters. This is similar to the element vibration except it seems to happen in the long piece of boom between the 1st and 2nd directors on my M-Squared 4 element 20m monobanders. These antennas have a very wide space between the directors with an attachment for the boom brace that is fairly far out on the boom also. This leaves a long piece of boom that can vibrate.

Figure 793 Overall view of M-Squared 20M4DX

Since these were already in the air I didn't try to add weight inside the boom. This vibration was fairly robust so it would probably have taken a relatively heavy material to damp it. In this case I went with a second rope on the boom to act as a snubber.

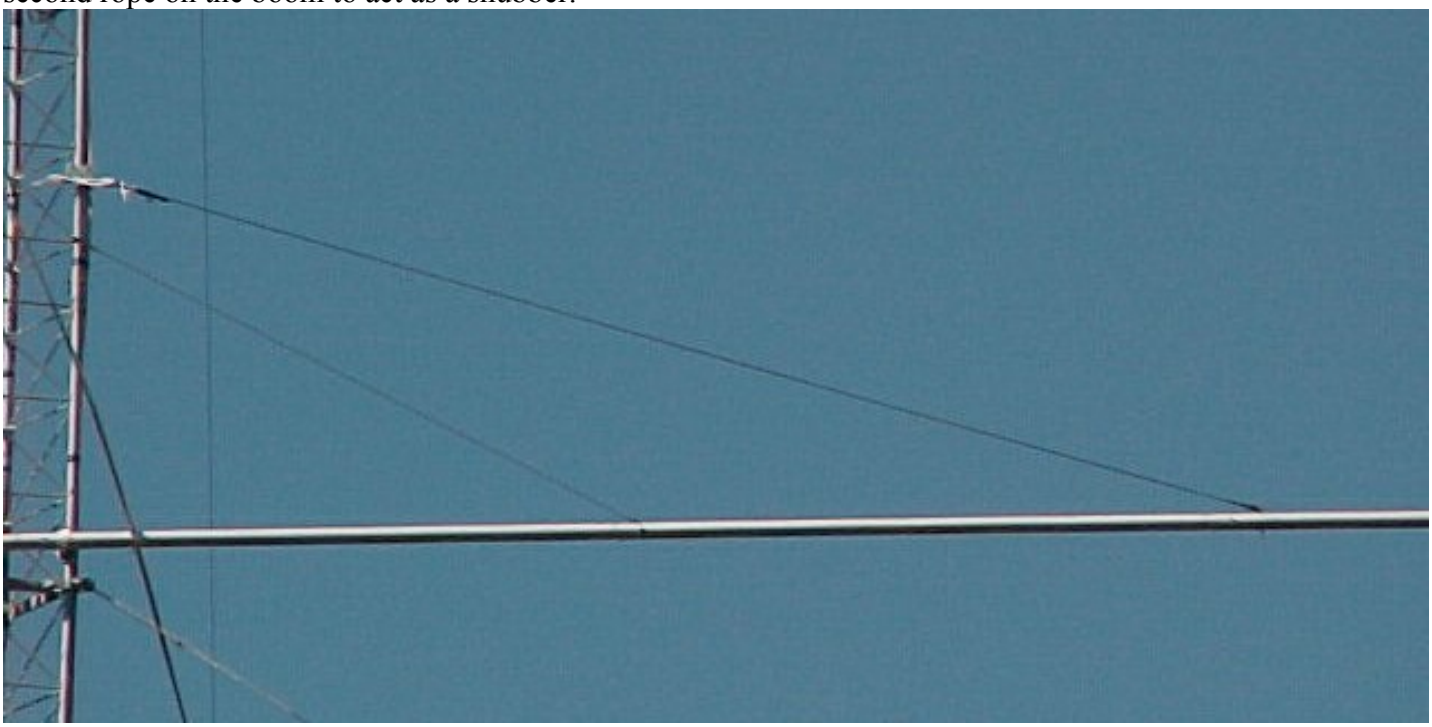


Figure 794 Close up of snubber.

The upper rope is the normal boom brace. The lower one is tied between the boom splice and the tower. It was convenient to attach the rope to the boom at that point because I could tie a slip knot and push it over the bolts at the boom brace with my long pusher pole then pull it tight. This of course prevents having to dismount the antenna and could be done while the boom was vibrating to test the results. This seems to have been completely successful at stopping the vibration in light winds. It is interesting that only the top 3 of them required this modification, the south one and the one on the ring rotor don't seem to have this problem. Both of these are near or below the tree tops which may break up the winds enough to prevent the regular vortex formation. Also the ring rotor with its long boom cradle and different boom brace supports may change the resonance enough to stop it.

Ice and Wind Strength

See these sections in the evolution section for some specifics:

4/5/2008 = upgrade of elements of 40m4lldd
The booms used on both 40m4lldd's were the 125mph versions which have a doubled up center section and forged eye bolts for the boom truss.

3/13/2009 = upgrade of elements of MSquared 20m4dx

Oddities

Backwards 10m Yagi

Got a 40m Yagi on top of a tall tower all by itself? How about sharing it with 10m?? Put a 10m Yagi above the 40m one pointed the opposite direction. This is on I learned from K2TR. This can give you a really high band opening antenna. Why backwards you say?? Well here in New England and nearby areas when 40m is closing down in the morning it is pointing to the west, just about the time when you want to open 10m to the east. And in the evening when 40m wants to open running Europe it points the 10m antenna at the Pacific. During the day when 40m is dead the 10m op can point it at Africa or some other area where you want more coverage.

Tribander poisoning

For years I had interference (arcing type wide band noise) on 10m, 15m, and 20m that we just couldn't get rid of… Until one day I decided to get rid of an old Telrex TB5EM. Suddenly all the splatter went away. The best I can figure there must have been one or more bad joints in that antenna that were causing the driven element to resonate and throw crud all over the place.

Sub-Harmonics from floating transmission line.

For a couple years we had a problem with 20m that was generating a sub-harmonic on 40m, and also a 3f/2 harmonic on 15m. These were exceptionally pure harmonics. They were also power related… So I switched amps, added and removed filters, switched radios, everything I could do in the shack where you would expect a relatively pure harmonic to come from with no results.

Then I noticed it was also dependent on the weather… When it was really wet it started at a much lower power level than when it was really dry. As low as 100w at times, and somewhere above 1500w at other times. Ok, so it was outside… Then I figured out it was related to the direction the top 20m Yagi was pointed. So we took down the 80m wire Yagi that was just below the 20m one with no effect. Checked all the 20m cables and switch box. Decided it must be something with the old Telrex 20m646's feed point and ½ wave balun arrangement.

I was able to replicate the threshold effect and the oscillations using a ½ wave cable and two diodes in the shack(see Technical Miscellany section). So the 20m646 came down and a whole new M-Squared 4/4/4/4 stack of 4 element Yagis went up… New feed lines, new switch box…

Still there! Ok, now I was really annoyed!

The only thing that hadn't changed were the 6m, 2m, and 70cm Yagis above the top 20m Yagi. Ok, up the tower while someone on the ground ran the transmitter and checked the harmonic. Disconnect one, no change. Disconnect another, no change., Disconnect the last one, no harmonic! Put it back on, it came back! Aha! Disconnect, no harmonic, put it back on, no harmonic! Say what? Disconnect, no harmonic?? Scratch my head, it came back! I hate intermittents! Have I said that before?

Well if not, I would much rather something let its smoke out in one burst than fail intermittently. In any case, scratch my butt, no harmonic… now this was getting to really annoying. Then I realized the small movements of my scratching were pushing my belt up against the hard line connectors making one of them touch the tower rung at times and not at others. This stuff is jacketed 50 ohm partial air dielectric stuff with real BIG N connector end fittings. It was pulled out from the tower a bit then the RG-213 jumper to the antenna went back to the tower and up to the antenna. If I pushed the connector in so it

touched the tower rung, no harmonic. If I pulled it out the harmonic appeared… every time, no matter where I scratched!

Reconnect all the VHF and UHF stuff, tape the connectors tight to the rung and vow to bring up a big hose clamp to secure them better later… No more harmonics! The only explanation I can figure is that somewhere down the tower that jacket must have worn through and was making a nice rectifier, with the connector isolated from the tower it must have been just the right length to resonate on 40m. Short the connector to the tower and it killed the circuit… permanently I hope!

Check out the 2008 maintenance blog in the station evolution section for October to see another source of sub-harmonics right in the shack!

Amps

Buy or build?

I hate high voltage. That's why I worked at a High Voltage lab for 8 years… doing software. I had a home brew 4-1000 amp, no I didn't build it, I bought it but had to repair it a couple times… it had parasitic problems. A grounded grid and screen 4-1000 that needed almost 200w of drive to get 1500w out had parasitics. Don't ask me, that was the best explanation I could get for it arcing and scrambling the plate choke twice… both times near the end of a contest fortunately. Ok, get a kit of parasitic suppression stuff, tear it apart, put it back together… it was to the left side of me, the radio was in front… bring up the drive, peak and dip, bring up the drive, peak and dip, bring up the drive… BANG! The other times it sounded like a 22 pistol, this was a 10ga shotgun in my ear! The front of the grid current meter was hanging by the wires out the front of the RF deck… I later found pieces of the plastic lens 24' away on the other side of the shack. Pull the plug, post a for sale ad, and drag it out of the shack… no I couldn't pick up the power supply that was built into a welder cabinet.
From then on I have only used commercial amps. I like having someone I can complain to when things doesn't work right. I used to like Alpha 76 and 77 amps, they always seemed to be good and solid. Except for the band switch in a 3 hole 76 that kept burning contacts off when it was used on 10m. Oh, and the 77 that had a burned load cap that needed to be cleaned up… I think they build those things around the load cap, it must be the first thing on the chassis and then everything else gets attached around it. But now I am using Commander HF-2500 amps. They are good and solid, the tubes aren't cheap but seem to hold up well. They easily run 1500 watts for a whole contest. And they tolerate slight impedance differences from switching antennas fairly well.

New or Used?

Buying someone else's problems. Yes, I have bought used amps. The 4-1000 I told you about was both used and home brew. I had a Henry 2k that was old when I got my first license. I had a whole range of 3-500 amps, 8877's, and others that I either bought or borrowed over the years. When you buy a used amp you have to know why the other person is selling it, and be able to believe them. The 'spare amp that I just didn't need any more' may be a low hours good deal, or it may have been retired from heavy service because it was getting old. The 'only used on 10m at the bottom of the sunspot cycle' may be lightly used, or they may have been CQing at full power for hours on end in SSTV contests!
If you enjoy fixing stuff, used amps are the way to go. Personally at this point in my contesting career I would rather not have to worry if an amp is going to make it through the next contest or not… and getting up at midnight to swap the 10m amp for the 160m one that just smoked is not my idea of fun any more.

Tubes

$$$, what else need be said?

Auto or Manual

Lets see, there was the Alpha that K1LZ wanted to show off one time so we put it on 15m. I forget what model it was, but it had all the fancy LED meters and auto tuning, etc. So he got it tuned up to just barely 1500 watts, switched from the top antenna to the stack and poof, shutdown on one of its protective circuits… retune, re-tweak, up to just 1500w. Tune up the band a ways… poof, shutdown again. Retune, well you get the idea… a couple go rounds of this and I pulled it off, but an HF-2500 back on the band, gave it 100w drive, pegged the wattmeter at something over 2kw, turned the drive back to 1500w out, switched through the antennas without a problem and packed the Alpha back up for the weekend. Something is to be said for a simple solidly built amp in a contest environment.

Cable and wire

75ohm hard line

Where to get it? That is a hard question these days. It used to be available in just about every town for the asking. The reason for this was that when a cable TV company was wiring up a road they liked to use single long pieces. So when they got down near the end of a roll and there were 'only' a couple hundred feed left they would go back and get a new roll. This meant that lots of ends of rolls ended up sitting around their yard which they would have to pay to get rid of. Now however most new work is being done in fiber so there aren't as many sources as there used to be. Sometimes you can get it for dumpster diving when they have taken down old cable to replace with fiber, but that is old cable and likely will be in short pieces. You can still sometimes find it at flea markets from people who horded it when it was available and now have to clean it out. It is also hard to buy connectors for it that match PL-259 or N connectors so I usually make my own.

A big misconception about 75 ohm cable is that you have to do something special to use it with your 50 ohm antennas and transmitters. Not true! I have never done anything special, and while the match may not be perfect it is 'good enough'.

Use good cable

I prefer Belden RG-213 for in the shack and from switches or hard line terminations to the antennas on the towers. This stuff is very consistent and as long as you seal up the connections it lasts a long time. Generic RG-8 or similar coax may not last well in the weather leading to maintenance headaches.

Above or below ground

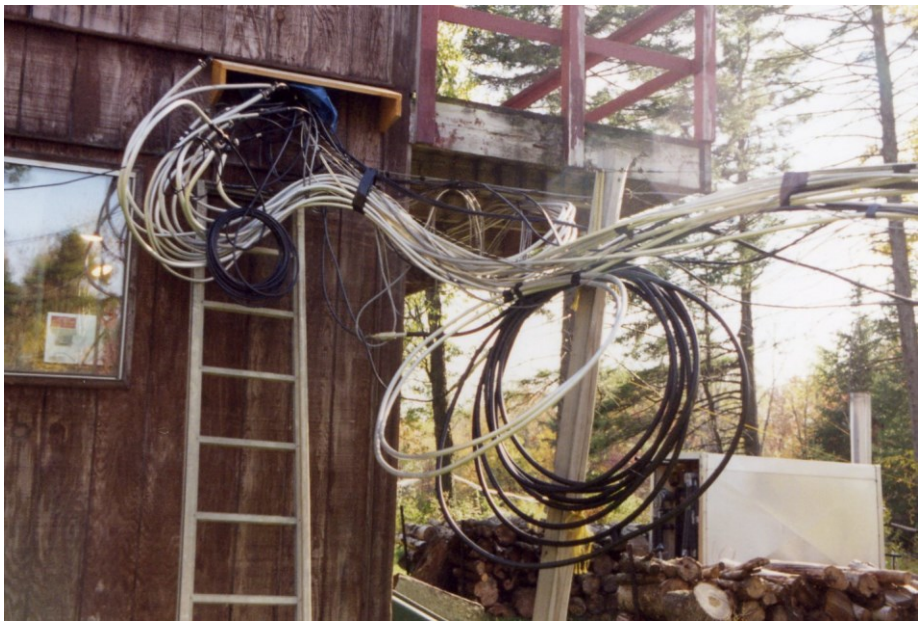


Figure 795 Cable entrance

No, I won't even think about recommending 'on the ground' except in very limited areas of the country where it may be possible. There are just too many animals in most of the country that will step on, chew on, or just plain mangle wires on the ground. In this area the big culprit is porcupines, for some reason they have a taste for not only rubber and PVC but also for aluminum jacketed hard line.

So, it comes down to above or below. Here the choice was simple. It is 200' of boulder laced hardpan to the nearest permanent tower, and with cables like the picture above running out to the towers I would be spending all my time pulling cables or burying new conduit.
If your soil makes it easy to bury conduit and aesthetics are more important then you may consider buried cable. I don't recommend direct burial even if your cable says it is ok, its just too hard to repair, replace, or upgrade. Bury conduit, bury extra conduit while you have the trench open, and bury bigger conduit than you think you could possibly ever use! Use sweeps not elbows at the ends and anywhere turns are necessary. Note, more than one turn will make pulling extremely difficult, if possible run the conduit straight, or only bend it as much as the conduit itself will bend over a long distance.

How to support cables

After you decide to go above ground, or for those cables that go up towers, you have to have a way to attach them to either a support wire or a tower leg. I have heard and seen all sorts of methods used including:

- Nylon tie wraps
- Tie wraps plus tape to protect them from the sun
- Special black UV resistant tie wraps
- Short pieces of wire
- Special Chinese finger trap contraptions
- Short pieces of rope
- Electrical tape
- Duct tape
- Spiral the wire around the support
- Just hang it from the antenna
- Bungee cords
- Probably a few more that I can't remember any more

In any case, the idea is to support the wires so they don't pull out of whatever connector or device is at the ends. A support must also prevent motion that would allow cables to wear through their insulation. And in my view a support must also be easily removed or expanded to add more wires or remove old ones.
My solution to all these needs is cheap electrical tape. No, this is not the time to use the super Scotch 33 tape in the individual plastic containers. This is the time to go to your local electrical supply place and ask for 20 rolls of their cheapest tape. And while you are at it get a few extra ground rods and clamps, you can never have too many around.
I was originally thinking of using tie wraps, until I went to help K1RQ take down a tower when he was moving. On this tower he just grabbed the cable at the bottom and gave a pull and the tie wraps all the way up the tower just popped off. I think these were the generic white ones which are known to break down when exposed to the sun for too long, of course that is good if you are going to remove them regularly and don't want to work too hard. Some people have taken to putting on a tie wrap then covering it with tape to protect it from the sun… seems like too much work for me, and then is harder to remove.
Short pieces of solid copper wire is another popular one. This would seem to be ok for short towers, but on tall ones I would worry about the cable weight slowly pulling it down through the wires. The reason for this is the relatively small contact area and hard surface, there just isn't lots of friction to keep the cable in place. Also if you are using foam insulated cables or some something like 9913 I would worry about the wire crimping the cables.
Cheap electrical tape avoids most of these problems. It has good gripping ability on the tower legs and cables so it holds them tightly in place. I have seen no creeping of cables that have been up for almost

20 years now supported this way. It also does not damage tower legs, at least in my environment, as some have claimed to be common. In fact when removing it the tower leg is shiny and clean under the tape. I use 5 to 10 turns of tape around the cables every 5' or so up a tower. This seems to provide plenty of support and prevents the cables from blowing in the wind. If you go every 10' or more there is enough slop in the cables to let them blow around in strong winds. Much closer than 5' is overkill. One important thing is to not get in the habit of just adding more tape when you add a new cable. You should always remove the old tape, add the new cable to the bundle then re-tape the whole thing. This prevents ugly messes later on when you go to remove a cable and have to sort out multiple layers of tape in between various pieces of cable. Fortunately tape is easy to remove with a sharp carpet knife or one of those disposable razor knives. I frequently come down from working on cables with a pocket or two full of cut off old tape.
Another pet peeve of mine is running cables inside the tower. This is just a general pain all around. It is not only harder to do initially, but much harder to take apart later. Some people claim that it protects the cable from lightning, however the cable has to exit the so called Faraday cage at the top and bottom anyway which exposes it to the full voltage of the stroke at those points anyway. Even with grounding of the coax shield at the base of the tower it is still going to have large voltages between the center and shield which will damage the cable just as much as a direct hit. So save yourself some time in the beginning and end and don't try to do this, just tape the cables to the outside of a leg and be done with it.

Lightning protection

I know, the cobbler's kids have no shoes… Do as I say, not as I do… etc, etc. I worked writing software to help design lightning protection for high voltage power lines and don't do anything special myself. I do have decent ground rods on all the towers. And I do have a 'single point ground', or at least as close as you can get when the shack is 12' by 25' and the service entrance is on the other end of the house.

So do as I say… read the PolyPhaser info on lightning protection, get all the bulkhead coax protectors, control cable protectors, and all that other stuff.

Oh, one thing I don't believe… making sharp turns in the coax is not a good way to prevent lightning from following it to the shack.

General principles for lightning protection:
1. spread out the energy as much as possible, bury radials just below the surface out to about 50' or so... they don't have to be straight, and they don't all have to be the same length, just bury what you can as long as you can.
2. do the ring around the house with radials running out from it. You don't need to use tubing, heavy wire is adequate. Attach it solidly to the tower.
3. Make sure the service entrance is connected to the ring and tower grounds.
4. Have service entrance MOV installed, make sure there are protectors on the phone and cable TV entrance if you have that also. And of course use protectors on the coax and control cable entrance which must be tied to the ring as well.

The idea here is not to stop lightning, you can't do that... but first to spread it out a bit with the radials. And second, to have everything rise and fall together when you do get hit. As long as everything is at the same voltage nothing should be the weak link to get fried.

It is important to know what the purpose of the MOV lighting 'arresters' are in this application. They are not to take voltage off the power or signal lines and put it into the ground, they are to actually keep the voltage difference between the ground and power or signal conductors below the flashover voltage.

This prevents the phenomena knows as 'back flashover' where the lightning raises the ground voltage above the power or signal wire voltage and flashes over to the other wires, often through your equipment.

There are really 2 ratings that are important for an MOV. First is the clamping voltage, you want to pick ones with a clamping voltage 25-50% higher than the highest normal voltage between the line and ground. unfortunately lots of MOVs are rated by the line voltage they are meant to be installed on, so you will see them rated at 120v for use on normal 120v circuits, hopefully they are actually clamping at 150v or more... so read the ratings and applications for them carefully. Getting one that clamps at too low a voltage is worse than one that is a bit high since the one that is too low may turn on and short out the system in normal operation.

The other important rating is how much energy they can absorb before they fail. Unfortunately this is rarely supplied with individual MOVs. if they don't supply energy ratings you have to assume that 'bigger is better', and usually 'bigger $$ gives better protection'. For size, it is the diameter of the disc that determines the energy rating, so one that is 3/4" in diameter will absorb more than one 1/2" in diameter with the same voltage rating.

Rotors, switches, phasing boxes

Buy or build?

I built a prop pitch rotor from scratch. I was lucky enough to have a friend(W1WF) with a lathe to make bushing. Lots of fiddling with limit switches, pulleys, waxed string and springs, a pair of synchros, but it worked. But I underestimated wind forces and kept shearing the pair of ¼" stainless steel bolts that went through the mast. The power supply for the motor was a variable transformer that weighed about 50 lbs I think, but it allowed adjusting the voltage to get 12v at the motor by putting 24v into the 10ga wire in the shack. Would I do it again? Probably not, but it was interesting and economical at the time when I had only that one real rotor to worry about.
Since then I have gone through the range of Yaesu G series rotors. I have G-1000sdx, G-2700sdx, and G-2800sdx versions and they have done well. Only one of them has been back to the factory to be rebuilt when the 6 element Telrex 20m monobander turned out to be too much for it in my ice and wind. But I am also still running a Ham 3 or 4 or similar thing with an old CDE control box for a 10m and 6m antenna.

I buy remote switch boxes. By the time you buy relays, boxes, connectors, and put it all together it just makes more sense to get one ready to install and then do small modifications if needed.

I have both built and bought phasing boxes. For Yagi stacks I build my own, I use a very simple arrangement that is built easily with some coax and an RCS-8v box. I built my first 4-square vertical phasing networks using the design method in the Low Band DXing book by ON4UN. Except instead of using lumped components I built it using coax transformers and stubs… much cheaper and easy to build, but probably not as consistent a performer as the ComTek boxes I am using now on the 40m and 80m 4-square arrays.

Simplicity is nice

If possible I like to keep things simple. Where its not possible I prefer to have someone else do the complicated part. Designing Yagi antennas that perform well, stand up to ice and wind, and finding or making all the parts is complicated. Wiring up a couple pieces of coax and modifying a switchbox into a stack match is simple.

Single band on a coax

There are many different ways of bringing coax into the shack. Small stations commonly bring only a single coax into the shack and have a remote switch that selects antennas. This is fine as long as you only ever want to do one band at a time and only use one radio. Yeah, you could be fancy and rig up a second receiver, but there is always that fear of blowing up the other one if something doesn't switch properly.
After that you work through several steps of breaking up feed lines until you get to one feed line per band. This is a good place to stop for most of us. It provides lots of flexibility while still only requiring 6 feed lines for HF contesting, plus Beverages of course. I have a couple exceptions to this, for instance I have 2 feed lines for 10m, 40m, 80m because I have antennas on different towers that couldn't be easily switched outside. Then add the Beverages, and VHF/UHF stuff, and some listening antennas on another tower, and you end up with a crammed entrance hole like I have.
Going beyond 6 HF stations requires more feed line of course, if you really want to run 2 stations on each band you can again play with shared feed lines or run more separate lines into the shack. This could quickly get expensive and hard to maintain.

Remote switches

I like the RCS-8V boxes. These are relatively simple 5 position boxes that use a control cable. They are easy to modify for grounding or not and for use in switching in matching stubs or transformers(see section on stack matching). They do have occasional problems with moisture or dirt on contacts since they are simple open frame relays in a box that isn't sealed. The newer versions are better as they are using an aluminum plate for the bottom instead of a plated steel one that is prone to rust.
Also the new control boxes use an external wall wart for power so you can easily stack them or use your existing 12v supply for added flexibility. I now use two of them for 10m because I have one antenna on a separate tower. One switch selects the 120' tower with the stack or the single antenna at 180'. When the 120' tower is selected the first box supplies power to the second box that picks the stack combination to use.

Simple stack matching vs. bought boxes

I do my own stack matching. I have been using the same method for years for stacks of 3 or 4 (or sometimes even 5) Yagis. The whole system is a slightly modified RCS-8V relay box, two ¼ wave sections of coax, and a few diodes on the back of the control box. With all this I can switch 5 antennas in 5 different combinations and not have to retune the amps, at least most of the time as long as the antennas are all the same.
The whole key to the design is understanding how a ¼ wave feed line transformer works, and how a shorted ¼ wave stub looks like an open circuit. The circuit below shows how the setup work. The important part are the two ¼ wave lines in parallel. In most cases when just one or two antennas are selected the coax that goes to relay 5 is shorted by the grounded output modification to the box. A shorted ¼ wave piece of coax looks like an open circuit at the input, and coincidently also makes a nice harmonic filter right at the switch box. When 4 antennas are selected then relay 5 is also energized, this puts the two ¼ wave sections in parallel making an effective 25 ohm coax section. With four 50 ohm antennas in parallel you get an effective 12.5 ohm load, transform that through ¼ wave of 25 ohm line, and you get what?? 50 ohms! Proof is left to the student.
By the way, this matching network is not perfect, nor is it intended to be. I don't care if the SWR is exactly 1:1 on every antenna in every combination all the way across all the bands. But they are close enough that in most cases as long as you stay within normal contest parts of the bands you don't have to retune the amp when switching antennas.

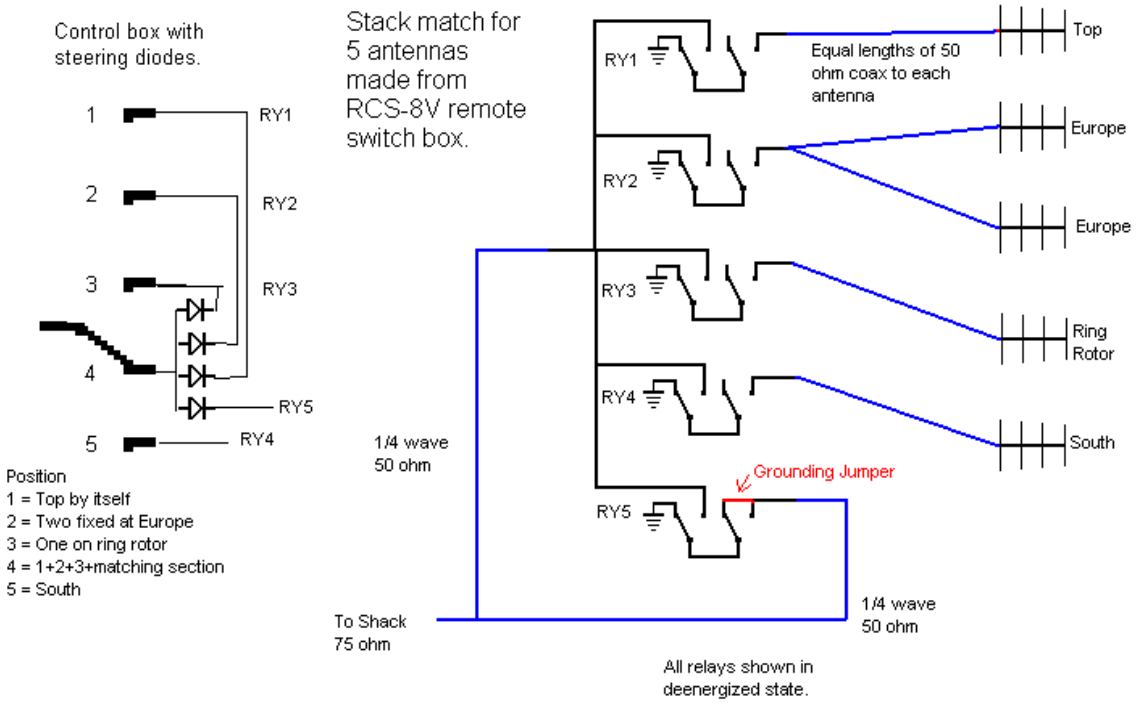


Figure 796 Schematic of simple stack match

Figure 797 mod to ground RCS-8V output when not selected

Figure 798 How the diode switching of the stack is really done for 10m/15m/20m

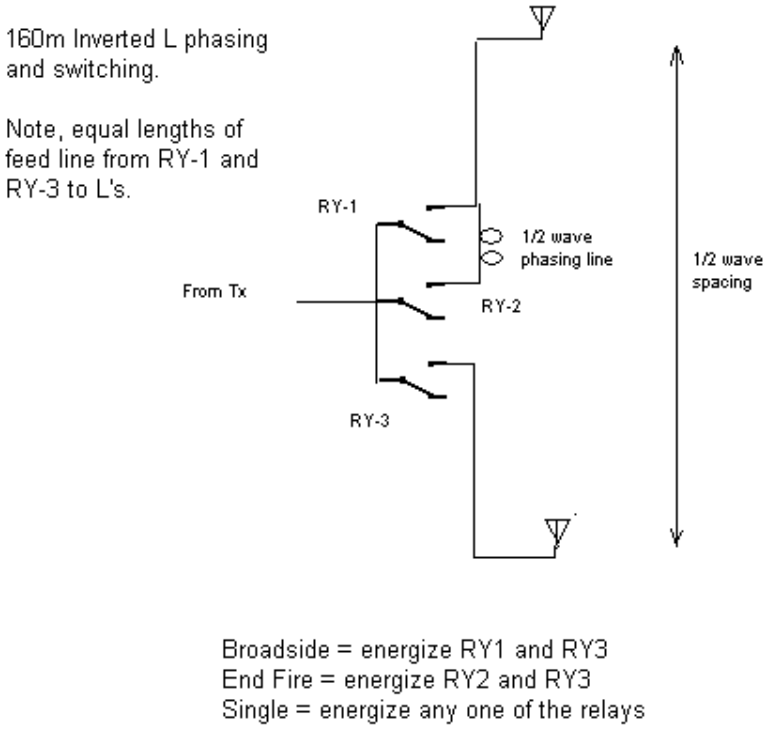


Figure 799 160m Inverted L switching schematic

I do my own phasing on the 2 inverted L's for 160m. This is another RCS-8V system. Again, a very simple design. But this time not requiring the modification of the box to ground the end of the phasing line. Note, in this case you don't want to ground the end of the ½ wave line or it would short that leg of the network!

Outside Enclosures

I have seen lots of discussions about how to protect switches and phasing networks and other outside stuff. I like to keep it simple. Before switching to ComTek 4-square boxes mine were just in galvanized trash cans.

Figure 800 4-square phasing network enclosure.

Figure 801 4-square phasing network in enclosure.

Tools

If you are going to have as much hardware up in the air as I have accumulated you need lots of tools. Don't count on the ground crew bringing what you need, or having to borrow some from a neighbor. Invest in your own and you will always know that you have the right tool for the job and that it is in good condition.

When you collect tools, toolboxes become another necessity. I like good big ones that have different depth draws for different types of tools. In the shed where most of the tower tools, ropes, and parts are stored I have one tool box that contains mostly the big tools. Then in the shack I have another one that has mostly the smaller tools, test instruments, connectors, adapters, soldering stuff, etc. Then there is a third one that lives in the spare bedroom that has rarely used stuff like boxes of crimp on eyes, cables for things I don't have any more, odd tools, and lots of other stuff that I don't think about till I need it.

I have come to think over the years that there is a migration that happens between nearby tool boxes. It seems that every time I need a screwdriver in the house I have to go out to the shed to find one. Then I will bring back in to the house two or three of them, and still the next time I need one I have to go out to the shed.

Oh, and keep a separate toolbox for only metric stuff. Some equipment, like Yaesu rotors, now uses metric hardware. Keep these some place special so you can easily forget where they are when you need them in a hurry. Then forget them completely and use a 1/2" socket for those Yaesu bolts, it's a tight fit but it works.

Chain saws

If I haven't said it yet, I'll say it here. Trees are bad for towers, and trees are bad for antennas unless they are supporting them. This was the first tool I used for all the tower installations here.
A good chainsaw helps eliminate these problems while at the same time providing an aerobic workout, firewood, and possibly even raw materials for other hobbies. I made some slices from one tree into living room tables.

Select a chainsaw based on the size of trees you need to cut down. If you have some very large trees you may need to have two different ones, a big one for felling and a smaller one for small trees and branches. Be sure to also get a sharpener and learn to use it regularly. A dull chainsaw is a dangerous chainsaw, and takes much more effort on your part and strains the engine.

Figure 802 Stacked chainsaws

Wrenches

A good set of wrenches is a must have. After getting a set that covers the range of 1/4" to about 2", go back and get more. You will particularly want extra 7/16", ½", and 9/16" open and closed end wrenches.

Figure 803 Wrenches

Please ignore that automatic grabbing thing on the left side, it came with something else free and I have never found a use for it. The big crescent hammer in the front goes up the tower every time I climb though.

Crescent hammers

Get, but never use, a large and a small adjustable wrench. These make nice paperweights to keep antenna assembly instructions from blowing away.
I always carry both of them up the tower, but consider my planning a failure if I have to use one of them for anything other than as a persuader.

Pliers, cutters, and other nasty things

Another thing to always have but never use. Large slip joint pliers make nice things to extend your reach a couple inches. They are also useful to make sure PL-259's are tight, but not TOO tight!

Figure 804 Pliers

These are another tool that goes up the tower every time but rarely comes out of the belt loop.

Figure 805 Coax Cutters

These are probably the best coax cutters I have ever found. Just don't try to cut Copperweld or aircraft cable with them!

Figure 806 Bold cutters

On the other hand, these are good for cutting everything else! Be sure to have a good rope on them if you are going to use them up a tower. The big ones make short work of cutting ¼" EHS cable and bolts up to about 3/8". The smaller ones are good for aircraft cable and those stupid element clamps that used a machine screw to tighten a ring around the element joint that are always rusted tight.

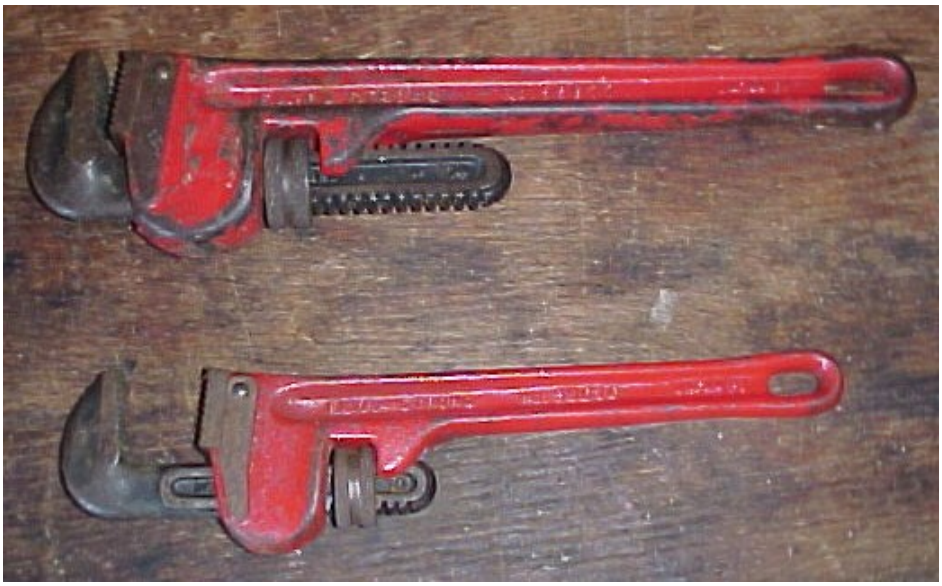


Figure 807 Monkey wrenches

I know of only 2 good radio uses for these off hand. Pulling ground rods, and getting elements out of Telrex booms. Oh, and they are handy for straightening lawn mower blades after hitting rocks and stumps.

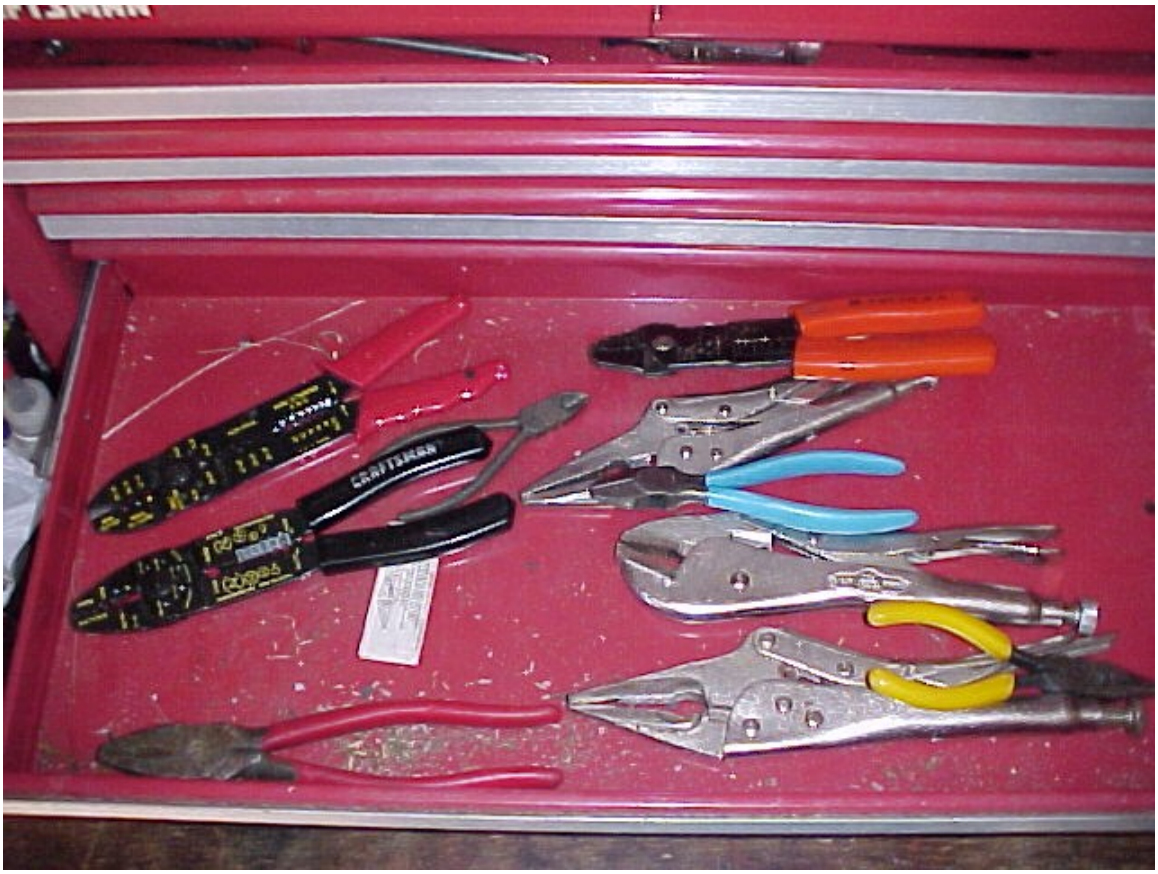


Figure 808 Toolbox trash

The rest of the nasty things, these usually just stay in the drawer. You know you all have junk like this in your toolbox, multi-purpose crimpers that don't quite line up right, cheap locking pliers that won't let

go, wire cutters with notches in them from cutting screws or steel wire. Why don't we ever throw these things out?

Misc Stuff

Figure 809 More toolbox trash

Here are all the rest of the odd things. The useful things in here are the 3 tape measures, one short 25' one for the high bands, and two 100' ones for the low bands.

Figure 810 Persuaders

These are the real persuaders. Also an important tool is in the box on the right, small Ziploc bags are the best thing to keep hardware organized and easy to grab up the tower.
When working on the ground a muffin pan makes a great way to separate and organize the dozens and dozens of nuts, bolts, washers and other stuff needed to assemble antennas.

Figure 811 Drift punch

This is an odd little tool that is virtually indispensable for putting together Rohn towers. The long drift punch is used to line up and gently enlarge leg holes when putting in the first bolts in the tower legs.

Socket sets

Get two or three, you can never have enough. I have a ¼", 3/8", and ½" drive sets. Then go back and for the 3/8" and ½" drive sets get deep sockets for 7/16", ½", and 9/16" for both of them. These are essential for working with u-bolts on boom to mast plates and other long bolts.

Figure 812 Socket sets

These are the most used sets I have. However only a couple of them get much use. On the 1/2" drive set the ½" and 9/16" deep reach and ratchet go up the tower every time. If I am working on antennas the 3/8" drive ratchet and the 7/16", ½", and 9/16" deep reach sockets go up. I only use the normal sockets for things like tower leg bolts, they are just too short for U-bolts and other long bolts.
I rather like those socket holders also. Each one has the exact number of clips for all my sockets of that size. This makes it easy to be sure you haven't left something behind, especially when going to someone else's station to help out.
From the ¼" drive sets I normally only use the 5/16" socket, which I have bought and lost several times. These happen to fit 1/8" cable clamp nuts that I used to have all over when I used aircraft cable for inverted V's.

Figure 813 Drill press

This is the most used power tool I have for working on antennas I think. Its not a real expensive one, and I don't use 90% of the features. But it is handy to have the fully adjustable table and bench vise on it. Not shown is an important attachment, a 2x2 about 1' long with a v cut in it. This is clamped in the vice to provide a way to center tubing for drilling. When not in use I leave the top lid open, when I don't do this the mice like to move in up there.

Belts and harnesses

I am an old school climber. I use a simple lineman's belt with a single strap. Though I have at times used a second strap when I knew I would be doing odd things above the top of the tower and wanted to be able to move without being disconnected at all. At least at the last OSHA training class I had at work lineman belts were still allowed for vertical towers like hams usually use and some other miscellaneous purposes. For everything else full body harnesses are required for safety.

For harnesses, get a good one, get the fall arrest shock cord, get someone to show you how to properly use it. You will want to have the capability to have a belt wrapped around the tower so be sure it has properly positioned clips for that. Learn about how the shock cords work and never use one that has been stretched.

Buckets

Nothing beats a good bucket with a snap hook for holding spare tools and parts. The ones with little side pockets are especially nice

Figure 814 Klein bucket with pockets

Pulleys and other rigging

Consider these a long term investment. A few bucks more to get good ones is worth it and with a bit of care they will last a lifetime. I have 3 pulleys. 2 are large ones that are used for rope, the third one is a smaller one that is used as the running pulley on tram systems. I like the ones that have a removable roller which makes them easy to grease and helps get them on and off cables over large end fittings.

Figure 815 Pulleys for tram and rope use

Get a couple heavy shackles also, these are good when the hook is 90 degrees from where you need it, or you want a quick way to disconnect from a cable.

Figure 816 Shackles

Come-along

These are another investment item. If you are doing guyed towers you want 3 of them. One ton is heavy enough unless you are doing BIG towers. Figure that for ¼" EHS you need to tension the guy wire to 600#, and adding a 100% safety factor you are over the cheap half ton limit.

Other specialty stuff

'Gorilla Clips', how did I ever live without them. A few of these make rigging so much faster to set up and take off. They are also good for clipping stuff to your belt or to tower rungs or just about anywhere with one hand. Don't fall for the cheap aluminum ones, get good stainless ones with interlocking clip ends.

Figure 817 Clips

A long pole with a hook. No, not a tall Polish fisherman! I use a half of a broken 20m element with a u-bolt attached at the end of it. Using this you can reach out to grab a dropped boom brace rope, push a temporary boom brace out the boom for a repair. With practice you can tie, or untie, a knot at 15' or 20' out from the tower. It is also good for retrieving that weight that just won't pull the string over the branch in the tree where you finally got it after 20 tries.

Figure 818 Long pole, short pole, tram wires

Figure 819 The fancy hook

Capstans, winches, cars, tractors, and other lifting power

The neatest little tower tool I ever saw was an electric capstan that KC1XX brought when he put up some Rohn 55 for me. It clamped to the base of the tower and he could stand there with one hand and raise and lower sections of tower with no effort. Note, this is not the same as a winch which winds a cable around a drum. A capstan is just a spinning wheel that you wrap your line around once and then use the friction of the wheel on the rope to do the lifting. You control it by a light pull on the free end of the rope, when you pull a little bit it tightens the loop on the wheel and pulls more on the other end of the rope. Stop pulling and the loop loosens just enough to keep the load where it is. Just watch out, ropes used on capstans get polished and have a limited life.

I don't like winches, usually they don't have enough cable and are jerky starting and stopping.

Most of my heavy lifting here has been done with a Jeep set in 4wd-low. This provides plenty of lifting power and reasonable control… You just always have to watch where the rope is and make sure it doesn't bind up since the vehicle could easily break most lifting lines. Also another danger is that when lowering with a vehicle is that you may not recognize that the rope has gone slack because it is bound up somewhere which could result in sudden dropping of loads.

Light loads are easily pulled up by hand which is usually the safest method since you have positive control and excellent positioning, just make sure you don't overload the ground crew. Want to have fun? Pull up a 4 element 15m Yagi with the rope around your waist and the tag lines in your hands, maneuver it into position, then run up the tower and fasten it down.

Ropes!

These are your lifelines when up the tower! Get good ones and know how to use and care for them. You will want a main lifting rope that is about 2.5 to 3 times longer than the tallest tower you expect to work on. This gives enough extra length to get up and down, be pulled out from the base a fair distance for a tram, and still have enough to get the lifting power away from the base of the tower. Note that a common length for a roll of big rope is 600' which is conveniently near 3 times my 180' tower so there is plenty of rope to go around. Splitting a 600' roll of lighter rope gives two 300' tag lines. Tag lines can also be made out of a retired lifting rope if it isn't too heavy.

Major types of ropes:

1. Hemp: has no place in tower work. It decays quickly, is rough and hard to work with, is horrible when wet, and otherwise is only suited for temporary light work. The only use I would put this to is for stuffing elements to prevent vibration.
2. Polypropylene: There are two different types of this out there. One has thick shiny fibers and is normally sold as floating boat rope and in smaller sizes. This is totally unsuitable for antenna work as it degrades quickly in sun light. It becomes stiff and brittle and fills hands with sharp little poly needles. The other type uses finer soft fibers. I used this type for years as a lifting rope and it is now my tag lines, it has held up well and is very light. It does have a bit of stretch and will spin unsecured loads when lifting.
3. Nylon: Hate it! With one exception. Most types have too much stretch, and become stiff after exposure to sun and rain. When it's new the surface is so slippery its hard to tie knots in it. The one exception is a couple of short pieces of 1" Nylon that were in the garage when I bought this place. Those two short pieces have been used for probably 90% of the antenna lifts here in one way or another… as well as pulling logs out of the woods, cars out of ditches, and just about anything else that needed some heavy rope.
4. Polyester (aka Dacron): The dark green 'military' look woven Dacron in smaller sizes is great for wire antenna guys. It holds up great in sun, has relatively little stretch, and is very strong for its size. I have used this for years for guys for inverted V's, holding up 4-square wire arrays, and holding up my 160m inverted L's. It also makes a good utility rope for all sorts of things outside.
5. "Rhino Rope": This is a braid on braid polyester rope. This is what I am using for my current lifting rope. It is interesting in that it has a woven core that is covered by a woven cover. It is strong, but heavier than it looks. If handled properly it won't spin loads. It is prone to snags in the outer braid so be careful with it. It is also easy to tie knots in and isn't slippery like Nylon or some other ropes. Note there is also a Nylon version of this, I haven't tried that one yet). See: http://www.wellingtoninc.com/commercial/doublebraid.htm

Cranes and Helicopters

Leave these for the professionals. If you have an antenna that is too big to fit your yard and lift up the tower, or a tower that is in a confined space, you may need this type of assistance. But it is not a job I would want to learn by trying it out. Nor would I want to hire a crane or helicopter who is not familiar with the type of lifting that you need done. Lifting antennas is much different than putting an air conditioner on top of a building, or a sign on a post. It requires close coordination between the operator and the person on the tower.

Gin Poles

Like other rigging this is something that is an investment. Get one that is heavy enough for lifting whatever tower you expect to use. Gin Poles are designed for stacking tower sections they should not be used for pulling up antennas where you are pulling it sideways away from the tower. Do some quick calculations, if the pole is up 10' above the clamp and the clamp is 1' wide there is a 10:1 lever trying to break the pole, clamp, or tower leg.

Also, get the right Gin Pole for your tower. Poles that are meant for stacking Rohn 25g/45g/55g type tower sections will not work with HDBX types of towers. I have used one for this, but it takes some extra rigging and is not recommended.

Inside Tools

Now that you have seen all the tools used outside there is a whole different set that stays inside for use in the shack. These live in a rolling toolbox that doubles as a small workbench. This is just a quick tour of what has accumulated in this box.

Figure 820 Lots of small tools.

The top drawer has lots of small tools in it. And one BIG screwdriver that serves as the HV discharge bar when opening up amps. The grey box on the left is a small socket set, there is a pouch of small wrenches next to that. The plastic tray on the right has jeweler's screw drivers, Allen wrenches, and other small things. Note the plywood on the top, this was added when I tried to put an amp on this to work on it and the lip around the edge made it hard to work on. This is where you will find the good set of crimpers that actually cut and strip reasonably well, the good sets of side cutters without the gouged jaws, and the needle nose pliers that actually line up and work.

Figure 821 Level 2, the soldering station

This has all the soldering stuff and various kinds of tape, heat shrink tubing, and a big Zippo grill lighter that is much better for doing heat shrink than one of those pocket size lighters. The big red thing in the back right is a plastic cap from something, I keep it just to hold all the little screws when I'm opening up a radio or amp so they don't get knocked on the floor.

Figure 822 Level 3, the rats nest

From left to right: Serial cable adapters, short serial cables, spare audio cables, spare batteries, all sorts of adapters for coax and audio. Everyone has a drawer like this somewhere I think.

Figure 823 Updated Level 3, no more rats

Figure 824 Expanded Level 3

This shows the latest replacement for the rats nest. A drawer organizer with lots of small compartments organizes small cables and adapters. The mess of serial cables and adapters has been put in a plastic bag and stuck in a closet. They just aren't needed as much as they used to be when we had to connect up different radios and stuff Friday nights. Also the wireless logging network has eliminated lots of cables running around the shack.

Figure 825 Level 4, bigger stuff

This is where the big rolls of packing tape and other assorted tapes ended up. This also has my volt-ohm-amp-c-l-diode-transistor little multi meter, the MFJ-269, the battery powered AM/FM radio for tracking RFI, and under the other stuff a plastic box with all sorts of fuses. The can at the top right is my supply of PL-259 connectors, silver/Teflon only please. And the big red thing is a HV probe for the volt meter. The little AM-FM radio has been supplemented by a Grundig G5, that is a fairly small and rugged shortwave and FM radio that also does SSB.

Figure 826 Bottom Level, cables and odd stuff

The plastic bags on the left are each full of a different type of cable. One has phono-phono cables, another has phono-1/4" phone cables, each one made for a specific use, and now just waiting to be needed again. The other cans have other spare plugs and adapters that are only rarely needed, but if you don't have them you will surely need them just before a contest.

Figure 827 Pegboard of parts

This pegboard has had all sorts of things on it over the years. It started with lots of different headphone styles and a bunch of coax cables. Now it has just 2 types of headphones, spare Heil ProSets for the operating positions and 4 pairs of light weight ones(with their own volume controls) for guests to listen in with. There are also spare muffs and covers for the Heil headsets. The tangle on the bottom left are the wireless 48MHz sets I use for tower work. Then across the top there are extra coax jumpers, long serial cables, and assorted Ethernet cables.

Doing the work

Planning, planning, planning

Before any tower work starts I usually spend hours, if not days, thinking about just what I am going to do. I think about tools, parts, ropes, how heavy everything is, how much wind I could stand for what I have to do, do I need help on the ground or up the tower, and all sorts of other things. Then I lay out the tools and make sure I have everything I'm going to need up the tower. I may even stand or sit back for a bit with binoculars just looking at where I'm going to be making sure I have room and all the parts I think I'll need.

For big jobs like replacing all the 20m antennas I even used Microsoft Project to make a critical path chart listing all the things that had to be done in the order they had to be done. This included things like making sure the 160m and 80m inverted V's were out of the way before rigging the tram wire, and making sure the tram wire was removed and coax dressed before trying to rotate the top antenna. And each step was marked as either something I could do alone or that I needed a ground crew for so I could plan which weekends I needed to arrange for help. While this may seem like overkill for a ham project I think it helped avoid lots of those last minute surprises, like starting to lower an antenna and realizing there is a rope in the way that has to be moved while everyone stands around and waits.

Ground control to Major Tom…

Always know who is in charge! In my case, I am always in charge when doing work around my station. You should always make sure everyone knows who is in charge when you are doing tower work. If its not you then make that clear to everyone and make sure you don't get in the way. One important exception, if there is someone on a tower and they say STOP, then everything stops instantly until they are happy again. The person(s) up the tower are the ones most at risk and if they aren't happy with how something is going it needs to be changed.

I have been using a pair of 48MHz vox operated headsets from Radio Shack for many years while doing tower work. These are handy when you need to talk from the tower to the ground and don't have a spare hand. A vox operated HT would be good also. Yelling to the ground crew just doesn't work above 50' or so, especially if there is any breeze.

Rigging – or how to break a boom in one easy lesson

Long booms have braces because they can't handle much more of a load than just the elements they are holding up. Many of them can't stand the forces generated by tag lines that are trying to pull the antenna out from the tower to get it over guy wires or past other obstructions. See the section on tramming and look at the forces needed to keep an antenna away from the tower and imagine that pulling on tag lines tied to the boom of an antenna. Then imagine the boom folding in half on its way up the tower.

There are four (or more) ways to avoid this type of accident. The 'best' (at least in my mind) is the tram which I talk about elsewhere. The tram takes all those side forces off the antenna by using a cable or rope under tension and a pulley that the antenna just hangs from.

If you can't or don't want to do a tram you can get most of the advantages of it by properly rigging the ropes to the antenna. Normally you need 2 tag lines from an antenna to the ground crew to help steer the antenna up to the tower, to help save the boom you add a third rope. This third rope gets tied to the same point as the lifting rope and is used to pull the antenna out from the tower. This lets the steering ropes that are best tied as far from the balance point as possible to just use small forces to steer the antenna while the much larger force needed to pull the weight out from the tower is done by the third rope.

The 'third' method is to not pull the antenna out from the tower at all, but rather to take it straight up. This is easy on un-guyed towers that have nothing in the way of course, but on guyed towers it can get much trickier. One way that works with small antennas involves someone climbing along with the antenna and basically flipping it end for end over each set of guy wires. This is pretty much limited to antennas with a turning radius less than the distance between guy wires… it can be done with longer ones but it gets much harder. If you can't do that then you have to move the guy wires out of the way as you go. This I consider a job for professionals as you are mucking with the stability of the whole structure and it requires careful coordination and planning.
The fourth method is to just use a big honking crane and forget about all the other stuff. Again, this is the time to call in the pros, I don't know how to wave at a crane operator to make sure he doesn't lower the antenna when I want it to go up, or left when I want it to go right, so that is something for someone who knows the secret handshake to take care of.
A fifth method?? Can't get a crane in to the tower, use a helicopter or cargo lifting blimp. If I had anything big enough or that was so hard to get at that this was needed I would be sitting on the deck sipping a cold drink while someone else did the work.

Knots – back to the basics

Three knots are enough for just about anything to do with towers and antennas. And one of them is just a minor variation on one of the others, so there are really only 2 that you need. And one of those is reserved for special uses… so learn one knot and you are pretty much a rigging expert in my book.
The basic, must know knot in my book is the 'two half hitches'. No, two half hitches don't make one whole hitch. At least I don't think so. I use this knot for everything from attaching ropes to inverted V ends to riggings the lifting line to the boom of a Yagi. Once around the object you want to tie to and two half hitches around the rope and it is done. It tightens as you pull on it and unties relatively easily. In some ropes if you over load the rope this knot can become very hard to untie.
The pipe hitch is a minor variation on the 'two half hitches'. Just go around the object you want to attach to two or three times then tie the two half hitches. Besides tightening when pulled on, this grips a pipe as it tightens and doesn't slip along it. I have used this to attach a lifting pulley to a mast on a tower to raise large antennas. When done correctly it will really grab a pipe and stay put.
A Bowline is the odd knot. It is meant for tying around your waist as a quick rescue method. It is good for that because when properly tied it will not tighten when pulled on. It is also very easy to untie, even after having lots of tension on it. I use this for attaching tag lines to the boom of a Yagi for lifting. If you tie this with a large loop you can attach the tag line beyond your reaching distance out on the Yagi's boom and all you have to do is get the knot in close enough to the tower to untie and you can remove the tag line easily. I have used a light string to pull in the tag line to the tower, but its usually not necessary unless the attachment point is way out the boom. Just be careful when removing the rope from the boom that the free end doesn't whip around and snag on something or you will have a hard time getting it off up the tower.

Tripods – get out Boy Scout lashing book

Tripods. These are some of the greatest tools for assembling antennas that ever existed. Just think about the last time you had to assemble a large antenna, were you always bending over to work on the antenna sitting on the ground? Did you have to constantly pick up the antenna and move it around? How would you like to work on it at a nice comfortable standing position? How about being able to raise and lower it to work on different parts easily? How about turning it or moving it around without picking it up? Need to find the balance point? Want to check rough tuning without trying to wrestle it around to stand it on end? Do it with Tripods!

Don’t know where to buy tripods? Well, except for over priced camera ones that wouldn’t hold up a little 10m Yagi neither do I. So, where do you get them? Well, the easiest way is to buy 6 pieces of that otherwise worthless TV mast that Radio Shack sells and some rope and make them yourself. Don’t know how to do a tripod lashing? Find a Boy Scout and either have him do it for you or borrow his handbook.

Figure 828 Tripod holding end of 40m Yagi

In the picture above the legs of the tripod are spread out so the boom is relatively low, in just about a nice height to work on it. If the legs are brought closer together the antenna can be raised to about 8’ and the tuning can be roughly checked. To walk the antenna around you alternately raise it by moving one leg in toward the boom, then lower it by moving the two legs on the other side away from the boom… doing this you can walk the antenna sideways or rotate it around.
Just be careful of a couple things. If you get the legs too close together not only does the tripod become less stable, but it pinches the boom. Also you can slide the boom through the tripods to move it lengthwise, just watch the balance and make sure it doesn’t get stuck and pull over a tripod.

Figure 829 Four legged tripod for balancing Yagi

In the rig above a taller and stronger tripod was put over the boom. Then a fourth leg was added to attach the boom to mast plate. Using just one loose U bolt to hold the boom you can slide the boom back and forth to find the balance point.

Trams – the easy way up a tower

Trams, trolleys, high-wires, and probably a few other things fall into this category. They are all ways to get heavy loads up a tower where you need to have better control than is offered by just pulling it up on the end of a rope with or without tag line(s).

In many cases it is possible to just put a pulley up on a tower, run a rope through it, and pull up antennas. In most cases this means having usually two or more 'tag lines' tied to the antenna and used by the ground crew to pull the antenna away from the tower and steer it around guy wires or other obstacles.

Warning! I do not recommend using gin poles for the pulley on the tower. The brackets and poles of gin poles are usually designed to lift tower sections straight up from the ground and to put them down right next to the pole. They are not normally designed to handle the side forces often encountered when pulling antennas out from the side of a tower to get past guy wires and other stuff. If you absolutely, positively, have to use a gin pole for this it is best to lower the pole so the pulley is just above the leg clamp, and preferably position the clamp so it is directly in line with the antenna so its not trying to twist around a leg.

When antennas get too large or there isn't enough room to get tag lines far enough back to work properly it becomes necessary to use a tram system. The big advantage of trams is that they remove the forces needed to pull the antenna away from the tower from the tag lines. Because of how forces work the more side force you need to pull the antenna out the farther back you need to get to do it by hand. If you can't get far enough back from the tower to pull out then you end up pulling more down and the

required forces skyrocket quickly. If these forces aren't properly handled it is possible to break booms or do other damage to the tower.
There are two major types of trams. Those with the wire above the antenna, and those with wires below the antenna. I prefer the wire above type because of the inherent stability and simplicity. When you put the wires under the antenna then you need to make sure the antenna can't flip over, this is normally done by using a spreader at the tower to make sure the wires are far enough apart to keep the antenna safely balanced. The rest of my discussion and illustrations will be on the wire above the antenna type, though the forces calculations also apply to the other type.

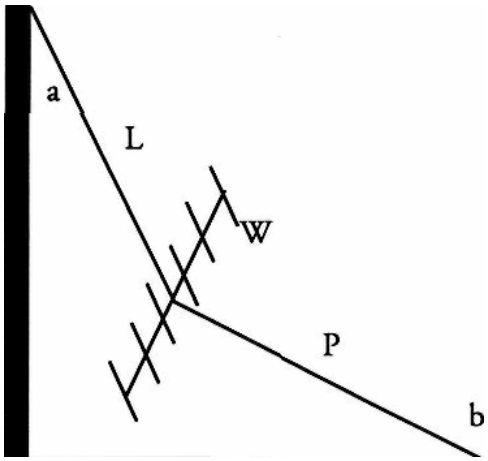


Figure 830 Tram forces diagram

a=angle between rope and tower
b=angle between rope and ground
W=weight of antenna
L=force on lifting rope
P=force on ground crew rope

P= W*sin(a)/cos(a+b)
L=(W+P*sin(b))/cos(a)
Lh = side force on mast = L*sin(a)
Lm = down force on mast = L+L*cos(a)
The calculation of Lm assumes the pulley is mounted on the mast, the force downward on the pulley is then the tension on the rope going down the tower plus the downward part of the tension on the part of the rope holding the antenna.
As an example, take a 100 Lb antenna going up 150' with the ground crew 200' from the tower(about as far as they can get from my tower). Near the top, if the antenna is out at 38 degrees from the tower the ground crew is pulling with 505 Lbs of force and the lifting rope has to hold 581 Lbs, ignoring friction in pulleys. The breaking strength of ½" stranded poly rope that I use is about 750 Lbs, not much of a safety margin! And how many people would it take on the ground to pull that hard? I forget the exact origin of 38 degrees, it was probably the angle needed to clear the top guy wires.

Examples:

W	a	b	P	L	LH	LM	comments
100	38	45	505	581	358	1,038	example in text
100	30	45	193	272	136	507	closer to tower
100	30	30	100	173	86	322	move ground crew out
100	0	30	0	100	0	200	lift straight up

The top line of the table is the baseline example above. The other lines are to put the problem in perspective. The second line reduces the angle at the top from 38 to just 30 degrees, not much of a change you think? Look at how much it reduces the forces on everything though! Then move the ground crew out some more and it really goes down in the 3rd line. The last two lines are just a sanity check, when pulling straight up the only force on the rope is the weight of the antenna.

Now, lets build a tram. Attach a guy wire above where you want the antenna to end up on the mast and run it down to a ground anchor with a come-a-long to tension it. Run a second one the opposite direction to keep from bending the mast. Put a pulley near the guy wire attachment point on the mast and another one at the base of the tower, run the lifting rope through them. Add a third pulley on the guy wire with its hook holding the antenna and tie the lifting rope to the antenna at the tram pulley. Now lets look at the forces again.

The table below shows the forces on the guy wire for lifting angles near 45 degrees. The formulas are the same as in the figure above except for LM. Assuming the back stay wire is at the same angle from the tower 'a' as the lifting wire, and is tensioned to just balance the guy wire side force LH the equation for LM gets more complicated. (The extra 2Wcos a term is from the pulley for the rope that is pulling the antenna up the guy wire.)
LM = downward force on mast = 2*L*cos(a) + 2*W*cos(a) = (W+L)*2*cos(a)

All of these are for the point where the antenna is just half way up the tram so the angles at the top and bottom are the same. Also note that the P force is all assumed to be supplied by the tram. The L forces are split between the rope and wire such that Lrope=L-P and of course Lwire=P. How can this be? This would mean that the tension on the rope that is pulling up the antenna is less than the weight of the antenna? Correct!

Consider the case where the tram wire is horizontal, obviously not a practical case but sometimes extremes are handy checks on calculations. In this case there is no force needed on the rope to lift the antenna so

W	a	b	P	L	Lrope	LH	LM	comments
170	38	38	432	553	121	340	1139	
170	40	40	629	750	121	482	1409	target for my 20m lift
170	42	42	1088	1208	120	808	1795	just a bit less sag!
170	44	44	3383	3504	121	2434	5285	just 4 degrees tighter!

Ok, so lots of big numbers… so what is that big help? Well, the big forces for P and L are almost completely handled by the tram wire and ground anchors. The tag lines the ground crew uses simply steer the antenna, they aren't trying to pull it out from the tower. And the lifting rope actually doesn't even have to lift the full weight of the antenna. All this makes for much easier antenna lifting, both on the antenna and the ground crew.
HOWEVER! You knew there had to be an 'however' didn't you? Note the forces LH and LM. Now, LH is balanced by the back guy. You did remember your back guy didn't you?? But LM is straight down on the mast and tower. The worst part would be if this were all just put on an unprotected rotor. Its better if there is a thrust bearing to take the load. And even better if you add an extra clamp or two above the thrust bearing to keep the load off everything except the tower.
Another point to watch is the tension on the tram wire itself. Using ¼" EHS I want to keep it down to about 10% of the breaking strength or about 600 Lbs. This is what set the target point for the lift I

described above. This tension also has to be held by whatever anchors you use, and also by the come-a-longs if you use them to adjust the wire.

Tilt and tip - working in 3 dimensions

Once you are off the ground you have a whole new dimension to work with. This can make moving antennas around the tower much easier than you would think when standing on the ground. It is possible to tip and flip antennas around guy wires, past other antennas, and do lots of other things that would be impossible if you were just thinking 2 dimensionally.

For instance consider lifting a Yagi up an empty tower. Before you get to the first set of guy wires you tip the elements so they are parallel to the tower, then pull the boom up till it is just under a guy bracket. Stuck here?? Nope, rotate the boom around the guy wire and viola, you are ready to go up another level. Get to the next guy wire and rotate the other way and continue on up. Using this method it is possible to take antennas straight up and down towers with only a single rope and one person ground crew. You do have to keep in mind that the turning radius must be less than the distance between the guy wires or when you try the rotation the element will get stuck on the next guy level.

Need to move a side mounted Yagi like a 40-2cd down one guy level on a tower? Attach a lifting rope near the boom-mast plate and take it off the tower leg. Tip one end down and rotate it so the end of one element goes under the guy wire. Start to lower it down and continue rotating it around the tower so that the end you have tipped down stays under the guy wires. When it is about half way around then watch the higher up elements to get them under the guy wires and then lower straight down. This is a minor variation on the flipping over a guy bracket described above that you can use when the antenna is a bit bigger.

Having the fun

M/M Operators

Finding operators can be a challenge for multi op stations. Especially in the winter in places that get snow like here. Did I mention that Peru got a bit of snow every now and then?? A good contest club can help, there are usually at least some operators who don't have any station but who want to make a contribution to the club.

I know there are some stations that bring in operators from around the world, and there are some who run Multi-Multi with only 4 to 6 operators and score right up with the top stations. While it may be nice to get all the top ops and win big contests, I prefer to get more than enough good ops, and not over work anyone but make a nice contribution to the club competition score. I also think that its nice to be able to have some time to rest so that no one is totally burned out by the end of a contest. For major contests like CQWW or ARRL DX I like to have 8 to maybe 12 operators. For ARRL DX we can get by with 8 to 10 because of slightly less activity and no need to try to work VE during the day. For CQWW a few more is nice. Quite often some of my operators can't stay the whole weekend so having 10 to 15 operators on the list isn't unusual, but some of them may only be there for a one day or the other.

I have also tried organizing operators by bands. Some stations have success with this, but it takes a good set of operators who really want to stay on the same bands all weekend. I prefer to let operators move around and try different bands. I think it keeps them fresher to do different things also, instead of just sitting and running on 20m all day they can have a rest and S&P on 10m or whatever else is open.

Over the years I have tried many variations of operating schedules. From absolutely no schedule, which doesn't work worth beans, to an hour by hour schedule, which only works a bit better. My current best practice for big contests with lots of ops is to make up a schedule in 3 hour blocks. This seems to be long enough to get a good run, but not too long for most operators. Some operators can also be scheduled for 2 slots back to back which also makes a good long running shift. I have an Excel spreadsheet that uses some operator characteristics and contest propagation predictions to come up with an initial schedule and then allow for manual changes. This is available on my web site.

I post the schedule in the shack, but everyone realizes it is not a hard and fast schedule. If someone oversleeps and the operator who is on keeps going then things change. I mark the schedule up and then usually revise the second day after we get into Saturday night just to make sure there are fresh ops for Sunday morning.

Guest Operators and recruiting

I like to open my station up to anyone who is interested for many of the smaller contests. This gives new operators a chance to try out the station and for me to see how they operate and maybe recruit them for multi-op operations.

To find new operators I often advertise in the YCCC news letter and on their e-mail reflector. When I don't get any responses from those I also go to the CQ-Contest email reflector and some of the local club reflectors and VHF nets. I have also in the past given presentations to local clubs on contesting and about my station.

Every year I also try to have a picnic, open house, contest university, or whatever you want to call it. This is usually done in the summer in conjunction with some QSO party or other summer contest. This gives everyone a chance to see how the station works under real conditions while not being pressured to do lots of operating.

Another good way to find operators is to invite other clubs and groups to come operate in a contest or for some special event. I was lucky to have a Boy Scout Venture Post interested in coming up the last couple years to do the WPX SSB contest. This gives them some good experience and will hopefully result in some more contesters joining the ranks in the future.

My call, your call, club call??

I have again tried many variations on this. My preference is to use my call for the big multi-op contests. This makes it so that everyone recognizes who we are. Not only does this keep some of the QRM away from us since they know we normally won't move. But it also helps with passing since the DX stations know we have good antennas and plenty of power so they probably won't be wasting their time.
For single-op guest operations I let the operator pick what they want to use. If they have been a regular participant in a particular contest it may be an advantage to have them use their own call. Or if they want to take advantage of my call recognition they can do that also. And in some cases, like WPX, a club or other borrowed call may be better.

Propagation

In the beginning traffic handlers defined things like MUF and LUF (Maximum/Lowest Usable Frequency) to help them figure out what frequency to use to have the best chance of getting a message through with the strongest signals and therefore minimal errors. This was good, but generally contesters don't care about getting to that mythical S9 signal strength to pass traffic. More often, especially in large multi-op stations, we are looking more at the MOF or LOF (Maximum/Lowest Observable Frequency). These frequencies are the highest and lowest ones that can possibly be heard over a given path. The difference is that at the MUF the signal strength is something strong enough to pass traffic, at the MOF the signal is just audible over the noise.
Also, since most traffic passers are interested in point to point circuits day after day the data that was available when I started contesting were for specific paths and used mostly to pick what time of day you could contact a given area. When planning a multi-multi operation though I wanted to know two things, which bands were possibly open to anywhere in the world so we could be sure to have someone on the band. And secondly, what part of the world we should be looking at.
To get this type of planning I created my own MOF/LOF predictor program. This program started from the algorithms published by the US Navy for a program called MiniMuf that did a physical model of the ionosphere by calculating sun angles, ionization and recombination times, layer heights, and geomagnetic field effects. They had a nice idea, but it wasn't exactly what I needed. So I took the basic calculations, stripped out all their fudge factors, and added my own set of adjustable factors. I then collected contest logs from many large multi ops around the world for basically a whole solar cycle and optimized the constants to match the observed openings. When I first started it would take 24 to 48 hours to run one set of comparison calculations and score the results, then I would pick a constant or two to adjust and run it all again. Eventually I got to a set of constants that seems to give reasonable predictions. The results of this project are available on my web site in the Free! Software page.
The result gives maps like the following. The colors are Black=MOF<14MHz, Blue MOF>14MHz, Green MOF>21MHz, Red MOF>28MHz. Note, I don't care about the WARC bands… this is for contests after all. I also show the sunrise and sunset lines as the filled in and hollow little sun icons. The map can also be displayed in a polar projection from either your location or the North Pole (or South Pole on the on-line Java version). The polar projection around your location is good to show what direction is probably the best to be beaming. The windows version also will sync to your computer clock and automatically advance the map at whatever time period you calculated it for.
Something that can not be predicted is the effect of solar flares, coronal holes, CME's and other sudden disturbances of the geomagnetic field and ionosphere. In my experience when sudden events like this happen you just sit on the bands and keep calling CQ. It is amazing some times what will pop out of a dead band during a disturbance like that. Common effects from a flare on the sunlit side are for 20m and 15m to suddenly close, try CQ on 10m, it may open… but don't give up on the other bands, if the flare is short they may return suddenly and even better than before the flare. This may not last long so

make the best use of it while it lasts. And don't give up if there is Aurora, some of the best 75m signals I have heard out of Europe were when the K index was 9 for virtually a whole day and Aurora was visible into Florida. Your mileage may vary, no warranties are either expressed or implied, predictions void in New Jersey and where ever the FRC or PVRC may have expeditions.

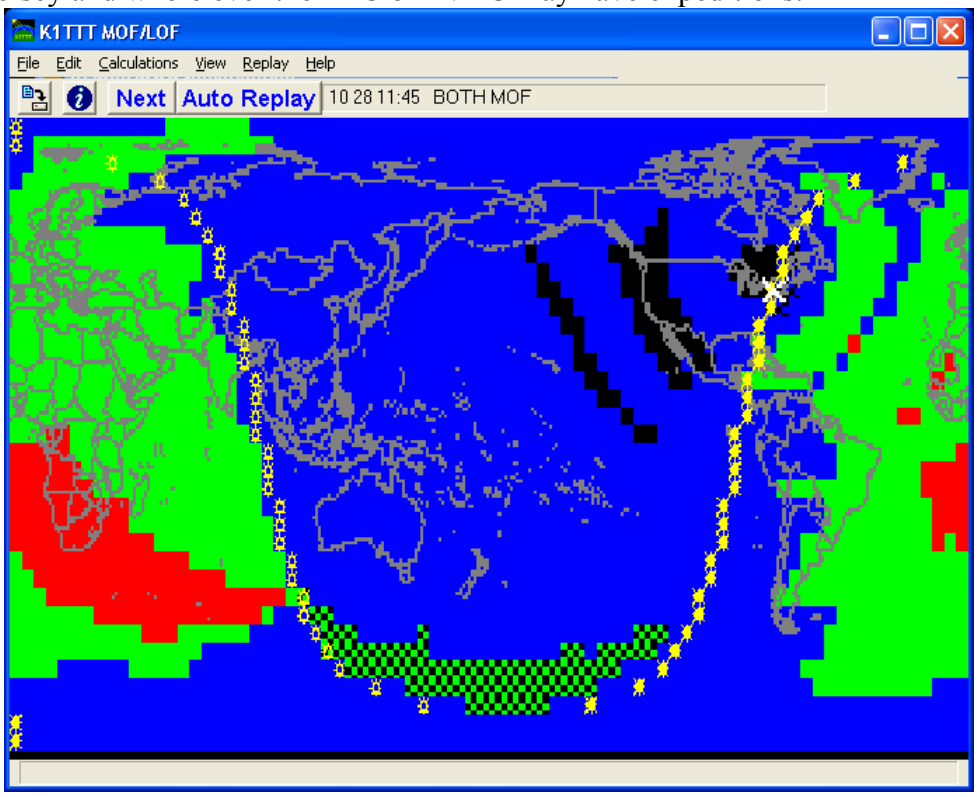


Figure 831 MOF/LOF program map at sunrise

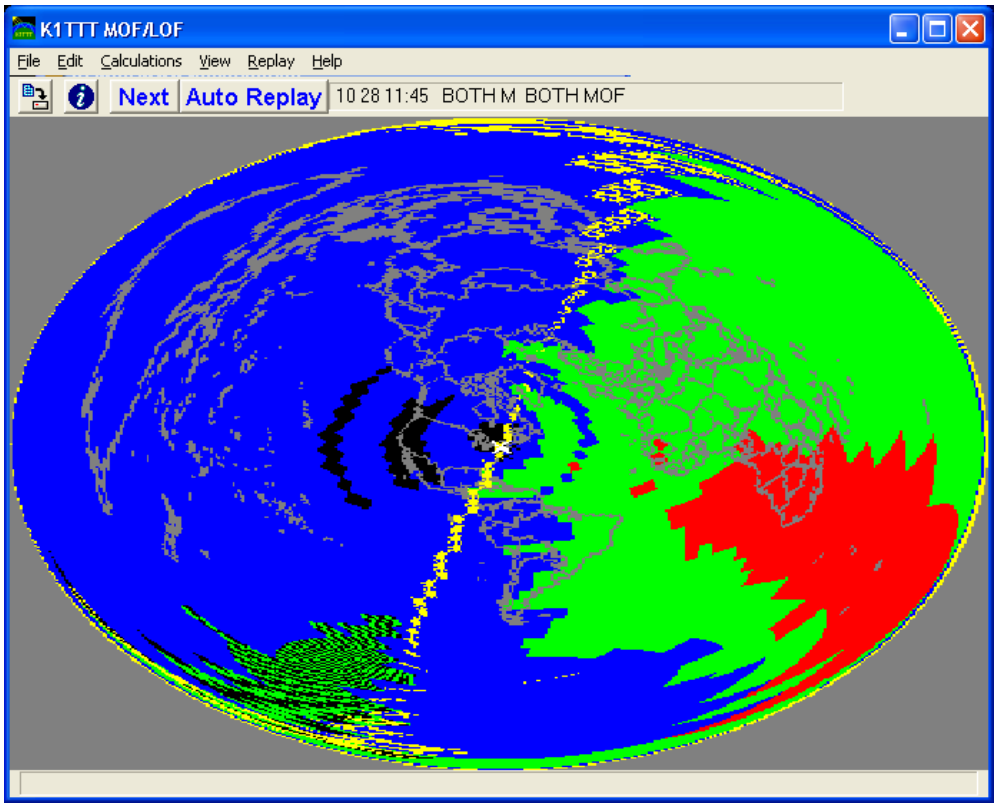


Figure 832 Same map, centered on my station

Goals

It is good to have a goal for a contest if you are going to participate seriously. Goals for QSOs and multipliers by band is a minimum, hour by hour rate goals is nice after you get some experience. Loggers like N1MM Logger let you have hourly goals that show how you are keeping up with expectations, at least on QSOs. When setting goals you have to take into account not only what your station and operator capabilities are, but also propagation. Year to year in the sunspot cycle your goals should change to reflect expected propagation and its effects on each of the bands. A good way to do this is the study the top 10 scores in old results for the same contest and see how they go up and down with the sunspots.

Special Techniques

Well, not all that special. Passing multipliers from band to band in contests that have band multipliers is very important for multi ops. There are a couple important things to know about passing. First, you start doing it Friday night. I still remember the best pass ever made here, it was early Friday evening running on some band and a kg4 called… The operator he called moved him to another band, then that one moved him to another one, and so on through all 6 bands in about 15 minutes. Turns out he wasn't really serious in contesting and wasn't spotted on any band after Friday night during the contest.

Passing takes a few steps:

1. The recipient must have a frequency that the sender knows. You can't wait until you have someone you want to pass to another band to ask the other operator what frequency. Each band should have a designated pass frequency already set and waiting. Loggers like CT and N1MM have commands to set those frequencies so they can be seen by all computers on the network. If you are running on a band you should set your pass frequency to match your CQ frequency preferably… no use leaving a perfectly good run frequency to try to catch a pass on an untested frequency somewhere else.
2. You have to realize that you need the station on another band. This means you have to be looking at the right spot on your logger screen to get the cue that you need the station you are working somewhere else. In most cases you want to pass multipliers for sure, however sometimes it is best to try to pass QSOs. This is especially true when propagation is poor on bands like 10m or 15m at the bottom of the sunspot cycle… just trying to pass lots of stations gets them to try the other band when maybe they wouldn't otherwise… and hopefully they make you their first stop. Even in decent runs I will try to pass every third or fourth caller up to 10m in the morning when it should be opening, in cases like this make it more generic, like 'we are now on 28555, please call us there… QRZ.' Unless it's a real interesting multiplier, just make it a quick advertisement and keep running.
3. You have to tell the station where to go before he goes away. Don't do it after you send your 'TU', when I hear 'TU' come back from someone I called I'm gone, why would I wait around any longer? There are more QSOs to be made. So send it to him before you acknowledge the receipt of his exchange. And I find it best to NOT ask. Don't bother asking 'can you do 10m now?', the easy response to that is 'not now' or 'no antenna' and go away… TELL the station something like 'we are now on 28555, we need you there please'. This has 2 effects, it lets the other station know that you need them, which makes them feel important, and it gets your frequency out there in one shot with no delay. Now even if that station doesn't go there is the possibility the next guy waiting to call heard the frequency and may go there after working you.
4. An optional step after telling the station to QSY is to let the other band operator know he is coming. For odd direction multipliers, or REALLY rare ones, or rare ones that aren't really big contesters, this is a good idea. Most logging programs have a quick keystroke or mouse click to pass the information to the other operator. For really rare ones the receiving operator may want

to make a special call or two or three for them, this again makes them feel more important and improves the chances they might go to yet another band.

Another interesting technique is use of multiple languages. There have been several articles in magazines about useful phrases in various languages for contesting. I think it is sometimes useful to know at least the numbers and common phonetics used in South America, in most other cases its probably just as well to stick to the 'standard' phonetics and English digits. I have found that separate digits are best for serial numbers and such, avoid 'twenty-one' and instead use 'zero two one', use 'zero five five' instead of 'fifty-five', etc. At least in contests that will get you through reasonably quick in most cases.
I have been 'blessed' with a variety of guest ops and multi-op operators who speak a wide variety of languages. Sometimes it comes in handy… Once upon a time there was a Russian operation from Franz Josef Land and the 20m operator just couldn't break the pileup. So I got NT2X to call him in Russian, which got through… and then moved him out from under the pileup to 15m before anyone knew what was happening.
There are problems the other way though. There was one contest when we were still using Nel-Tech Labs external voice recorders, before the DVP and CT days. WA1ZAM sat down and started pushing the CQ message button and stations started calling him in Russian. He called for NT2X to work them then did it again, and more Russian stations called. He finally turned up the monitor and found out he was calling CQ in Russian!

There was one contest that I think was organized by K1NU where sometime late Saturday evening he exclaimed something to the effect "We don't' have multiplier bells!". Not knowing what those were he proceeded to explain that they were bells that were rung when you worked a new multiplier. And all about how it builds interest and a feeling of accomplishment in digging out those rare multipliers. He proceeded to drive a half hour down to Pittsfield's only office supply store that was open Saturday evening and bought them out of those little service desk bells… one for each of the 6 stations. They have been in use for many years now, with the exception of the WPX SSB contests when the Explorer Post operates! That contest just has too many multipliers and I do need to get some sleep in my room just above the shack.

Spotting network notes

I was asked to provide some 'rules' for the use of the cluster for a particular newsletter. But I think these may help out with wider distribution also, and may have forgotten some along the way. In any case this is what I sent in response:

There are no real rules that are written anywhere. Each sysop has their own ideas of how to use the network. And many users also think they are the rule enforcers, with their own ideas of what the rules should be. I can give you some ideas for good practices:

1. Do not make bad comments about any body else's use of the cluster using announce or DX commands. If you must comment use talk or mail to contact the station directly.
2. Do not make bad comments about how someone is operating on the air using announce or DX commands. You do not know if the station you are commenting about is there to see it and it is considered rude by many. If you do know the station is on the network contact them directly via talk or mail.
3. Do not respond to personal attacks or comments directed at you by using announce or DX commands. Reply only via direct talk or mail to the station if you must. But it is often best to just ignore personal attacks since the attacker usually just wants to get you mad.

4. During contests do not spot yourself or the station you are operating at. While some contests do allow this it is considered bad form by some. If you are not in a contest then spotting yourself is ok, but you will likely be attacked by some users who think it is not allowed. (follow rule 3 in this case)
5. If you are going to spot a friend many times during a contest also spot some other stations. Cheerleading for one station during a contest is considered to be bad form by some.
6. Spot things that you actually hear on the air. Do not make spots with comments that you can't hear a station. These spots can be confusing and give a wrong impression about propagation or who is really on the bands.
7. Do not worry about how far away or what country someone is in before you spot them. If you hear someone on the air they can be spotted. Some users will complain about spots of 'common' stations, but during a contest everyone needs to work a 'G' on 6 bands and all modes. And with poor sunspots it may be hard to work many countries on 10m. And it is often hard to work some of the common European countries on 160m. So lots of spots help.
8. Do not worry about spotting dupes. The cluster software has dupe filters and so do logging programs that use spots.
9. If you find a spot that has the wrong call sign do not re-spot it with that call sign or 'bust' or anything like that. Just spot it again with the proper call sign. Logging software with band maps will show both spots on the same frequency and it is up to anyone else using the spots to figure out which one is bad. Using things like call sign/bust or other mangled call signs can cause more work for other users who then have to delete the comments in addition to the original bad spot. (this follows from rules 1 and 6, do not attack or comment about someone else's use of the cluster, and spot what you hear)
10. Do not use announce or DX commands to chat with someone else. If you can't use talk or mail then arrange with some other way to talk to them on the air, or in conference, or via some other method off the cluster.
11. If you have a problem with spots or filters or how to do something, ask your local sysop or talk to another user on your node. Do not try to ask for help via announce or DX commands. Likewise do not offer help with commands via announce or DX commands. Not all nodes use the same commands and your question or suggestion may just cause more confusion. If someone on your node needs help use talk or mail to give it to them.

While these days it is easy to connect to spotting nodes around the world I think it is best if you connect to a node that is local to your area. This way you have more of a chance of meeting local contesters who may be able to help you along. The network backbone is so well connected that most nodes should have the same world wide spots available.

On use of spots from other areas of the world. I have found that having spots from the whole world provides useful information for contesting. On bands like 20m and 40m when they are open here we can pretty much hear anything that is spotted from anywhere in the world. While this is not as true on 80m and 160m it helps to have the spots on the band map so you know who is under the pileups and are ready to grab them at grey line. On 10m and 15m in the morning it is nice to have the European spots of the rare African and Indian Ocean stations, we can often grab them from those spots well before they get spotted by stateside stations. And it is often amazing how many of those stations get spotted by Europeans but never get spotted by stateside… or they don’t get spotted until the pileup is already big and ugly.

"Skimmers" and "Reverse Beacons"

VE3NEA started a revolution with a piece of software called CW Skimmer and later the Skimmer Server. This software decodes CW from audio or from a wideband Software Defined Radio(SDR). The amazing thing starts happening when you use the SDR, the software will decode and generate DX Spots for all the signals it hears in up to 192khz slice of a band. The Skimmer Server when used with an SDR like the QS1R will do that for up to 7 bands at once!

Now just decoding all that CW, and now also RTTY and PSK with software from DL4RCK, is good, but the magic really occurs when you combine dozens of decoders from around the world at a web site called the Reverse Beacon Network(RBN). The 'Reverse Beacon' part of it is that you can get on and call CQ and within seconds get DX spots from all the Skimmers around the world that heard you. So instead of tuning around looking for beacons from various locations to see where you might have propagation you get instant feedback from listening stations around the world. Post contest analysis of the data is also possible letting you compare your signal strength and frequency selection against other stations over a period of time.

All that is well and good, but now take all the spots coming into the RBN and put them out in real time to a cluster node and you can fill your bandmaps almost instantly with a very large percentage of the stations on the band calling CQ.

All this has a down side. The spot rates from the RBN topped 100k/hr in CQWW CW in 2013, and will only go up as more skimmers come on line. Both the N1MM Logger and AR-Cluster Version 6 have been improved to handle the spot volume and provide better filtering of spots. I won't try to provide the exact commands as they are still evolving, but using AR-Cluster you can reduce the volume of spots tremendously by using the 'unique=n' filter that only shows you one spot for each station every 10 minutes after 'n' Skimmers have spotted it. Setting this filter to n=2 or 3 also does a good job of reducing busted spots from single Skimmers… You will still get busted spots if the station has an odd sending style or station problems like slow vox or amp keying.

The shear volume of spots was also saturating my outgoing DSL connection. This was causing the AR-Cluster to crash after the spots backed up and used up too much memory. So after CQWW CW in 2013 I removed the RBN spots from the outside user node and created a separate node for internal use that does provide them to local users.

Food and drink

For single ops here I usually let them bring their own food. Most serious single ops seem to have a specific contest diet that keeps them going so I don't try to mess with that. It is interesting sometimes to see the combination of things they come up with to keep going.

For multi-op contests I have pretty much settled on the following basic menu:
All weekend: Coffee, assorted soda, whatever anyone can find in the kitchen
Friday night: Wings or other finger food, sandwiches, chips and cookies
Breakfast: Bagels and doughnuts
Lunch: Sandwiches, chips, cookies
Saturday Dinner: Spaghetti or Lasagna or other type of big pot casserole, garlic bread, salad, chips, cookies
Sunday Dinner: Pizza

Breakfast is up to the operators to arrange, usually those getting up for the day time bands grab something on their way to the radios. Those going to bed eat going the other way. I usually try to make sure that everyone gets a break for lunch. That is usually about the time the morning operators need relief anyway and the bands are starting to change so it's a good time for a break. Saturday dinner can be harder since the low bands are starting to open so more operators are needed on the radios. I try to have it ready early so those getting ready to go on for the evening can eat, and then keep it hot as long as possible to get the ones who are hanging on till the high bands start to close down after sunset. Cycling extra operators though the bands to get everyone a chance to eat is also a good strategy as long as it doesn't disrupt a good run. Sunday dinner I just take the pizza, with lots of napkins, down to the shack. As you may remember from the evolution chapter there used to be plenty of alcohol available. This kind of phased itself out as the operators became more interested in making big scores. While I still stock beer it is not in the shack fridge and rarely finds its way down to the shack from the kitchen fridge. We do however go through lots of caffeinated soda and coffee during major contests.

Sleeping

An important thing if you are doing multi-op contest is to have ways for operators who aren't on the radio to get some quality sleep. While there are some true iron pants ops who can keep going the full 48 hours of a contest, most of us can't. And in my opinion a sleepy op is a sloppy op. Or something like that anyway. Having a spare room away from the noise of operating and chatter and TV or other noise is the best way. I am lucky to have 2 spare bedrooms, one of which has 2 sets of bunk beds. Also the living room has 2 large couches (one of which is a fold out sleeper) and a recliner. So everyone who isn't operating who wants to catch a bit of sleep should be able to find a comfortable place.

Checklists

There are just so many details that need to be accounted for to have a multi-multi contest come off without last minute rushing around that I have made up some checklists of things to do. Here are the 3 checklists that I use.

Early pre contest(within a couple days of the start):

- op welcome letter (last minute propagation or station info)
- vacuum
- clean baths
- stock fridge
- food shopping
- check antennas
- plow and sand drive and walk
- check Beverages

Most of those are self explanatory I think and probably good for just about any station.

Just pre contest(Friday sometime):

- setup logs
    - logger version _____
    - cty file _____
    - supercheck _____
    - history file _____
    - logger f-keys _____
    - MMTTY buttons _____
    - exchange _____

Setup propagation data displays
- MOF calculation and display
- greyline map
- NOAA displays

Misc. final checks and changes
- check radio keying
- warm-up/tune amps
- window fan
- change heat ducts

The heating ducts have to be shut off to the radio room and a fan put in one of the windows for the peak of the amplifier user times. The MOF calculation and display is setting up my propagation program (available on my web site) for that weekend's expected SFI/A/K and setting it to automatically run for the weekend on a monitor in the shack. We now use the N1MM Logger's link with DXAtlas for a small greyline map on each computer, this used to be another monitor at the end of the shack. The NOAA displays are 3 automatically updating sets of graphs showing solar flux (to spot flares as they happen), geomagnetic activity (to see geomagnetic disturbances as they happen instead of waiting 3 hours for WWV to report them), and one from ACE which can give a bit of warning for geomagnetic disturbances caused by solar wind or CME passages.

Post contest:
- Unplug coffee pot
- Restore heat ducts
- Log processing
    - fix notes to log
    - check for typos
    - add operator list to Cabrillo and summary
    - send Cabrillo to sponsor
    - 3830 web report
    - ops summary email
    - LOTW convert and upload

There are some more items I cut out that have to do with setting up my webcam, creating an AVI movie of major contests, updating web page scores and things like that which are really dependent on things I like to do here that probably not many other stations do. I have found that making a time lapse movie of major contests can be fun. It can also be helpful in sorting out who was on what band when in trying to sort out UBN reports in case operators forget to sign in on a station when they sit down. Beside that watching everyone jumping in and out of chairs and jerking around in a movie taken at 1 frame per minute is just plain fun!

Networking

No, not the social kind, though that can be included in the side effects. This section is about being connected to the world, mostly using the Internet. I have gone through many variations in this over the years, a small bit of it is in the evolution section where I almost tried to put this. But it would have been spread out and hard to follow over the years. While it is a relatively small part of the overall station design and setup it has grown to be a very important tool for staying in touch with operators, club members, and the rest of the world.

Outside

How do you connect to the Internet, let me count the ways… I have used just about all of them from here except for digital cable, Peru has no cable TV. One of the last towns in Massachusetts that doesn't I think. We only recently got DSL service, and only on one side of town so far, fortunately its my side. There are two big considerations in picking basic internet service, speed and reliability. Speed is nice, but if the service keeps going down it doesn't do you any good. Reliability is great, but if you can't get the data you need in or out it doesn't do you much good.

The evolution of internet service here:
In the beginning there was Plastic Brain. You can see pictures of this in the first year or so of the shack evolution. Plastic Brain was a Radio Shack Color Computer with extra disc drives and a 1200 baud dialup modem. It was a free bulletin board system, the first in the central Berkshire county area if not the whole county and much of way western Massachusetts. It had its own dialup line coming in and was quite active for a while, until this darn internet thing started taking hold. Actually, it kind of died out a bit before the internet became common when it couldn't handle the forwarding service provided by other more sophisticated bbs packages.
Around the time that Plastic Brain got retired the new Packet Radio network started to evolve. This quickly grew into a network of store and forward bulletin boards and other mailboxes, but that isn't where I was. Early in the evolution the Packet network split. The bbs use and related store and forward type traffic was incompatible with the DX Spotting network of cluster nodes and real time backbone and user connections. This real time data could not wait for forwarding like email on the bbs system and could easily overwhelm the bbs backbones, so we split that off and established our own network for the YCCC, which intermittently connected with surrounding contest club networks. Usually it would be connected during the week and would forward DX Spots to keep the frequencies occupied, then disconnect the various links on Friday night to support local club groups during contests.
And now along comes the Internet. First as dialup 14.4kbps or 28.8kbps, I could at best get about 24kbps here. But that was enough to support the new Telnet user connections and a faster backbone connection than the 1200 baud or 9600 baud Packet radio backbone. Unfortunately this lead to the first of many disputes with ISPs.
All my disputes with ISPs over the years had to deal with the word 'unlimited'. It seems the legal definition of 'unlimited' doesn't really mean unlimited, as in 24/7. As I started to transfer over from the Packet radio backbone to a rapidly growing Internet backbone of cluster nodes my usage of the internet connection quickly grew to require a full time connection. The bandwidth of the dialup line, even at 24kbps, was adequate for quite a bit of DX Spotting traffic, but if it was going to replace the Packet backbone had to be up 24/7. For a while this was ok, but then the ISP realized that I was using one of their modems full time… Turns out this ruins their cost model or something, it takes one modem out of their pool so no one else can use it. We argued for a while about what unlimited meant, but eventually they cut me off and rewrote their terms of service to put a cap on hours per month or something like that. So I went shopping and found they also offered an ISDN service that I could get. This was still the same local ISP. Their ISDN service was more expensive and aimed at businesses, but they were willing to

provide it to me also. They didn't last long in the ISDN business though, apparently not enough use in the area for them to bother provisioning it, so that got dropped. Again I went shopping… This time I found there was a whole new growing market of bandwidth resellers. These are basically ISPs that resell bandwidth provided by the big phone companies. The phone company has the modems and rents them to the ISP who provides individual billing, mail services, maybe some web hosting for personal pages, etc. I found a provider in Vt who was providing ISDN service fairly reasonably priced into western Massachusetts and signed up with them. This lasted for a year or so before they decided that unlimited wasn't really unlimited either.

About this time I started hosting my own web server. Initially on a Windows 2000 desktop box. This was ok for the telnet cluster server and a small web site, but is a bit limited because the desktop operating systems limit the number of connections and have other restrictions. If you are thinking of serving your own web site and other services locally, definitely invest in a real server, its much more cost effective in the long run.

Also about this time the direct satellite internet services were growing rapidly. I thought briefly about getting that here, and actually had a system delivered, but before it could be installed I read the terms of service and decided it wasn't for me. They don't consider unlimited to be unlimited either. Direct satellite service is basically meant for end users. While it can do some basic services the delay in round trip time up to the satellite and back breaks some things like VPNs. They also reserved the right to limit bandwidth and the types of things you could do, like they don't like streaming audio or video, certain types of servers, etc… so back to the store that one went.

ISDN is a weird thing. It's really a leftover from dialup service before DSL and the proliferation of direct T1 and faster digital lines for businesses. A single copper pair can provide two 64kbps channels plus a slower control channel for digital data. These can be split to provide one digital channel and one audio channel or combined to provide a single 128kbps (up and down) digital connection. Billing is often done by the second of connection time, and its actually a dialup service. You dial a phone number using the slow control channel that connects you to the other ends ISDN modem. You can also use it to dial 'normal' phone lines using an analog capability, which makes for a slow but useful backup if the ISDN service to the ISP goes down.

Eventually the Vt ISP decides that 'unlimited' doesn't mean 24/7 also, so they dump me. This time I go to Crocker communications and sign up for a business class ISDN service. It's a bit more expensive but comes with a static IP address and guaranteed 24/7 access and support. Static IP addresses are nice if you are providing services. While you can kind of map domain names like k1ttt.net to a dynamic IP address, there are glitches and sometimes connections get lost. Go static if you really want to run a server, at least until IPv6 becomes common.

ISDN, ah, those were the days. Every 4 to 6 months it broke. I was on a first name basis with the techs that would have to troubleshoot it. I had the direct phone number to the regional test center. I knew how to tell them where to start looking based on testing the circuit from my end. Loads of fun. ISDN is range limited like DSL, and I was pretty much at the limit of it's range. It also is wired differently than regular phone lines and DSL, and not all techs knew that. Because of how it is provisioned by the phone company and my special version that they called the 'Virtual Office' circuit, my connection was to an ISDN hub in a phone company office 4 towns away. This meant my line routed through Hinsdale, Dalton, Pittsfield, and then to Adams Ma where the actual phone number on my circuit was issued and where I connected to. Unfortunately when it is routed through these other offices they can mess it up also. Several weeks right after I got it the Pittsfield office on Friday night would do some kind of maintenance, see an incorrectly (so they thought) wired circuit and 'fix' it. Saturday morning the ISDN line would be broke, the technicians would be called out, and find the problem, put it back the way it was, and all would be well… until the next Friday night. Finally they figured out what was happening, when an ISDN line goes 'through' an intermediate office they only put cards in 2 of the 4 slots in some kind of rack. The other 2 slots are supposed to be open. Well the Pittsfield office would fill those other 2 slots and break the line. The solution was to put two dummy cards in those slots.

One day on his regular visit to troubleshoot the ISDN line… A new tech found the final fault in the line that had been made by the original installer years before. The original tech had left in a line filter in the box on my outside wall that should have been removed for ISDN use. This filter acted as a DC block, which would occasionally block the ISDN signal. He pulled that and the line worked perfectly to the day it was disconnected. Ironically that same day he told me that the cards to serve DSL were installed in the roadside central office box that served my road. Maybe they were tired of sending techs up here so often?? I had been on the Verizon list for DSL for quite a while, and every time I checked on status it wasn't even on their schedule yet.

In any case I called Verizon, worked up through 2 or 3 levels of supervisors that said, 'no dsl in your area'. I finally got to one who could do something and she found out that yes, the DSL installation is in progress, the cards were being tested and should be available in a week or so.

I checked with Crocker, yes they offered DSL service also. So I told them to sign me up for a business class DSL line to replace the ISDN. They seemed happy about that, I think the ISDN was starting to be a pain for them also with all the repair calls. But they checked and said there was no DSL service. I told them to check again, and they finally got Verizon to admit that it was coming but wasn't in the reseller database yet. A bit of complaining on both Crocker and my side got it into the reseller side and Crocker set me up with a line.

DSL has gone through some evolution also. The original DSL was limited to something like 1000' or maybe 1500' from the central office, this was slowly extended with more advanced modem technology. The current version called ADSL2+ or ADSL-RE (range extended) can go out to at least 3 miles and with good copper even a bit farther. When Crocker turned on the DSL for me, it didn't work. They said that was no surprise and got Verizon to send a tech out to 'condition' the line. I was working at home at the time and saw my phone line light blinking, when I picked it up there was a tech on the line. He said he was testing as he worked his way up the road and would be here shortly. Before he got here the DSL modem came alive and I was able to get a speed test to run showing about 1mbps down and 500kbps up or something like that, not what was promised, but much better than ISDN. The tech comes in and says he didn't think it was going to work, I was too far away. Then I show him my speed test and even he is amazed. He puts his tester on and confirms it and goes away. I then have to go back and forth with Crocker for a while to get the static IP working and a few other little problems, but it basically works ok, not at full speed, but ok.

Remember reliability? Well, this DSL line was not very reliable. It did well for days, then would randomly disconnect and reconnect. Not bad for me, but it would dump all the users off the AR-Cluster node and make them reconnect. Ok, that's not too bad, but not nice either. I went through a period when Crocker must have been resetting their routers every 12 hours or something, or had some other problems and would drop my connection for short periods. It took massive filtering to keep RF out of it. Eventually I decided this wasn't normal, and Crocker's repair process got too slow and eventually they pretty much discontinued weekend support, not a good thing when it dies on a contest weekend. And since it was provisioned through them I couldn't call Verizon directly. And the speed never really did get up to the promised 3mbps down.

Well, after maybe 6 months of fighting with DSL from Crocker I called Verizon direct, told them to run me a dedicated phone line and sign me up for their DSL business service. A new line is run, I put my own router on it in place of the cheap one Verizon provides, and its been working great ever since. 3+mbps down and 800+kbps up.

Turns out that the reseller provisioning is completely different than the direct Verizon provisioning. The reseller basically gets a PPPoE type connection from the central office to their network, so the router had to login to the Crocker network to get access. This made for extra complexity, longer reconnect times, and explained the dropped telnet connections, each time the circuit was reestablished everything had to reconnect. The Verizon direct service is essentially direct to their ATM switch, there is no login or other delays it is instantly on as soon as the modem connects.

Inside

The connection to the outside world is just one part of the problem. What you do with that bandwidth once you have it into the shack is the more important part in many ways.

Again, in the beginning… The internal network consisted of operators yelling across the room to be heard through the headsets of the other operators. That progressed to slips of paper carried from one room to the other as the station expanded. Eventually we got computerized.

CT could do a serial network to trade logging data between stations in a multi-op environment. But it required a computer on each station with multiple serial cards, lots of cables, was a daisy chain system so if any computer went down the network was split, logs wouldn't update, etc. I got K1EA to give me the source for CT 6. I had one 386DX24 computer. Yes, that's right not 25MHz, 24MHz. It was a custom made overclocked 20MHz box with two 40MB disks that were really 25MB ones with RLL controllers that compressed them in hardware to get 40MB. In this I stuffed 2 Digiboard 8 port com cards. So on the back side this thing had 18 com ports. I took CT and rewrote the user interface to communicate with a variety of dumb terminals, added a few multi-user features, added capability to control AEA MM-3 keyers and we had a 6 station logging network with dumb terminals and MM-3 keyers at each station. One com port connected to the Cluster node and one ran a dumb terminal upstairs in the living room. This ran quite well for a couple years and was much cheaper than trying to get 6 computers at the time.

Eventually the price of computers comes down and I decide to get separate computers for each station. I buy 6 386DX boxes with CGA monochrome monitors to keep the RFI down. I give K1EA one of the Digiboard cards so he can add support into CT itself and put the other one in one of the boxes. Now one box can act as a hub station so the network is a star instead of daisy chained. The logs can still get out of sync, but not nearly as badly as with the daisy chain network. This works fine for a while.

Ethernet, fast, and finally cheap. But how to use it? By this point you could get fairly cheap Ethernet cards that ran 10mbps. I had a hub and shared my internet connection internally between the server and my desktop. But then had to also have the serial connection to the logging network. And there were times when the serial network was getting overloaded. So I found some open source driver source on the quickly growing 'world wide web' on the Internet and figured out how the serial port drivers tied into CT. I then created an Ethernet plugin replacement for the com ports in CT. Viola, a CT Ethernet at 10mbps. For years this is the standard of networking with CT. I ran it here as 10base2, using coax running around the shack and upstairs. Some places used 10baseT with hubs. Some of the hubs have RF problems though and I had the coax network so I stayed with that. This lasted for quite a while running the old 386 boxes.

Eventually the 386 boxes start to give up. It becomes harder to get replacement parts, especially for the DVP boards that did the voice keying. So the next big upgrade was to P4 Windows-XP boxes, N1MM Logger software, and wireless networking. Wireless networking is definitely the way to go, no wires! I was able to keep the same DSL router box and just plug in a wireless access point and instantly have network availability for all the logging computers, the upstairs computer, and anyone else who brought a laptop. I eventually added a 2nd access point to keep guests laptops off the logging network. This prevented hang-ups if a guest computer used too much bandwidth or got the access point stuck. The only computer that is hard wired to the router is the server, even my desktops and laptop are wireless now.

The next best thing to happen was the cheap LCD monitors. No more CRTs wrapped in aluminum foil, well except for the TV anyway… but that will change as soon as that one gives up.

Maintenance

Annual inspections

When you have as much hardware as I have here now you have to have an organized way to make sure everything is checked periodically. I don't of course, but you should. Things that should be included to be done at least once a year:

On the ground

- Twang guy wires (check tension)
- Weed whack around anchors and inspect anchor hardware
- Clean tower bases of debris and check for rust
- Check for trees getting too close to tower and guy wires
- Open remote switches, look at contacts, check for water
- Check hard line and coax connectors for water
- Look up each guy wire set from near tower, they should all line up straight up the side of the tower and disappear behind the lowest one, this is actually a pretty sensitive way of checking for straightness of the tower.
- Check tightness of lightning ground cables around house/shack

Up each tower

- Open remote switches, look at contacts, check for water
- Check hard line and coax connectors for water
- Check all hardware for tightness
- Check all steel for rust, including guy wires
- Check rotor coax loops for wear or other damage
- Check coax and hard line hangers, tape, tie wraps or whatever you use
- Look up and down to check for straightness
- Check inverted V pigtails and insulators
- Check tightness of lightning ground cables at tower

In the shack

- Rotate all rotors full range
- Compare SWR across band with your baseline data (you do have baseline SWR curves for every antenna don't you??)
- Blow or suck dust out of amps, radios, and computers
- Check contacts of any relay boxes used in the shack
- When each band is dead do a good sweep looking for local noise sources, preferably when all computers, TVs, and other normal appliances and stuff in the house are running.

Repairs – Danger, Will Robinson!

Many repairs are simple things. Replacing coax, cleaning relay contacts, replacing a broken rope are all simple and quick and usually pretty safe. Some other repairs can be very dangerous and should be left to someone who is very experienced or may mean calling in the pros.

Removing a broke Yagi can be very dangerous. An unbalanced antenna or one in unknown condition can easily get out of control. You have very limited range of motion up a tower and therefore a limited ability to reach out and apply force where needed. So while it may be easy to pick up and work on a Yagi that is missing an element, or worse yet half an element, on the ground it can be darn near impossible up a tower.
Some methods that I have used to deal with broken antennas:

1. On an antenna with a half an element missing: Loosen boom U-bolts and allow broken half element to turn the antenna vertical. Then slide it sideways toward the broke off element to find the new balance point. It is then safer to remove the mast bolts and take it off the tower.
2. On an old Telrex Yagi that had a damaged boom: Fortunately there was still a good boom brace holding the boom together even though a it was broken inside one of the element rings. I rigged this one so that the boom brace was kept tight as the antenna was lowered down the tower. The whole time I kept on the opposite side of the tower out of reach of the broken piece in case it got loose… I used lots more rope than normal tying this one up for lowering just to be sure nothing could break completely free.
3. On a Cushcraft 40-2cd that had ½ of each element broken (on the same side of the boom). This was another one where I loosened the boom U bolts and let it pivot the rest of the way down. Then I removed the plate from the mast and lowered the boom down so that it was parallel to the tower. I could then remove the half elements and tie them to the boom so it could all be lowered down the tower. Note, this is one I would never do again without help, or at night, or when it was below zero, and would definitely use a rope and ground crew instead of just tying it to my belt to bring it down the tower.

Broken towers: if they can't be safely cut loose and dropped in an open area get professional assistance! And beware of cutting over stressed guy wire or ropes, they can spring lots more than you would expect and cause major damage or injury. Handling a damaged tower is not something for amateurs.

Broken Rotors: This is where those extra thrust bearings earn their cost. Having a thrust bearing as far below the top of the tower and just above the rotor makes it easy to clamp the mast in place and just remove the rotor without having to deal with a top heavy mast flopping around. If you don't have a way to restrain the bottom of the mast you may need to remove or somehow tie down the antennas to keep them from breaking the top of the tower.

Those are probably the biggest things that you will have to fix. However, there are lots of times there will be little things that need fixing… and some times you won't be able to get to them right away. When this happens, especially if it is during or just before a contest, I make sure I clearly mark it or disconnect it so that it can't be easily used. For things like stuck rotors, bad switches, or an undiagnosed problem, I will often put a piece of red electrical tape over the switch or indicator that shouldn't be used. This is a good reminder that something is wrong and that it shouldn't be used. For instance, right now there is something wrong with the 40m verticals that causes them to splatter all over the other bands. Since it is not easy to actually remove that from the switch it just has a piece of tape over that position to note that it shouldn't be used.

Repair or replace?

Sometimes it is better to replace than to repair. When things get near the end of their life failure rates go up. This is the far end of the well known 'bathtub' curve that is often used to predict equipment failure rates. This curve says basically that lots of things fail immediately after being built, hence the common practice of doing initial burn-in on electronics. And it also says that after a long period of relatively low numbers of failures the rate will start to rise again. This is due to fatigue, rust through of parts, degradation of insulation, and a whole bunch of other things. The following section gives some rough estimates of how long you can expect different types of items to live.

The key to the repair or replace decision usually comes down to cost. How much will it cost to keep it going, for how long, and how that compares with the replacement cost. Each piece of the station must be evaluated separately so I can't say for all cases that you should replace one item and repair another one. It can also depend on how much you value your time, if you have lots of time to spend cleaning and rebuilding antennas then it may be better for you to repair them, someone else who is too busy and has plenty of money may just replace them.

How long do things live?

- EHS Guy wire. Plan on replacing EHS guys after 20 years or so depending on your location. When my 150' tower guys started showing signs of rust after 20 years I hired KC1XX to replace them. I could have done it, but would have taken much longer because I would have replaced them one at a time instead of a whole level at once.
- Remote coax switches. The older RCS-8V boxes had a steel plate that rusted after 5-10 years. The newer ones have an aluminum base so that problem should be fixed. Since the relays in the older ones still seem to be ok I would expect the new versions to last much longer with only minor cleaning of contacts.
- Rotors. If not over stressed rotors should last 10-20 years or more. I am still running a Ham-4 type rotor that I bought used almost 20 years ago and the only repair has been to the terminal strip. The Yaesu G-2700/2800 rotors appear to be doing good also now that they aren't loaded with those monster Telrex antennas.
- Ring Rotors. I am seeing lots of surface rust on my oldest TIC 1032 ring that I think was plated instead of galvanized but the structure is just fine. It did require a replacement of the terminal strip and limit switch mounts after about 15 years as the small machine screws rusted out. The newer 1022 or 1122 TIC rings are galvanized and seem to be holding up just fine despite repeated removal and reinstallation, I expect them to easily go 20 years.
- Turn buckles, anchor rods, tower bases, towers themselves, these should all last 50 years or more if they are properly installed and maintained. The worst case is damage to the galvanizing that allows rust to get started. Your annual inspection should watch for signs of this on exposed surfaces.
- Coax. RG-213 is probably good for 10 years or more. Generic RG-8 may last anywhere from 1 year to 10 years, but I won't use it outside here any more, its just not worth the gamble. Hard line with well sealed connectors should last almost indefinitely, just watch out of water infiltration at the ends and damage to the shield from abrasion or crimping that can let in water.
- Control cable. Good control cable should last 20 or more years. The simplest test is to just bend an exposed piece, if it cracks its time to replace it.
- Yagis. I plan on replacing or doing a major refurbishment on aluminum Yagis every 10 years or so. Some may last longer, but I think after about 10 years they should probably have all the hardware checked and replace the coax, maybe replace the balun, and check exposed insulators for damage.
- Wire antennas. These depend a lot on the wire and rope you use and how exposed they are to wind and ice. Up here I don't plan on wire antennas lasting more than 5 years or so. After about 5 years

its probably time to replace ropes and check the wires carefully. If you are using the good insulated Copperweld and the insulation isn't damaged it should last at least 10 years, probably much longer. Many other wires not rated for outdoor unsupported spans might as well be replaced along with the ropes.

Trees and Weeds

Keep trees trimmed back. This is of course a never ending job. It is much better to do it a little bit at a time rather than waiting until there are branches between the guy wires and the trees are too big to cut down. Trees are probably the biggest threat to Ham towers that I have seen. Frequently when you hear stories of (well constructed) towers coming down it is due to a tree falling on the guy wires. Just think of the forces on an already taught wire when a heavy object like a tree is propelled into it by a strong wind! And once the guy wire breaks the tower can't stand.

DR Field and Brush Mower – best thing since sliced bread for rough terrain cutting. Even takes out small saplings and bushes. If the ground is too rough for a regular mower you should look into one of these things. Just a warning, they are not quite as easy to walk around as they show on TV, especially over rocks and stumps! But they are much better for getting in close to tower bases and anchor points than a large brush hog if you can't use a normal mower.

Technical Miscellany

Sorry about this section. This is probably stuff that should have been worked into the rest of the book one way or another, but I was getting tired and had to get about finding paying work so just stuck it all in the catch-all section. In any case this is just a collection of miscellaneous things, some good, some not so good, but hopefully interesting one way or another.

Filters…

Filters, filters, and more filters. There are so many types of filters available that anyone could be confused. I use 3 different filters in my setup.

1. Band pass filter between radio and amp. This has 2 purposes. First it removes any harmonics generated by the radio from the amp input, yeah, right… most modern radios are clean enough anyway, plus the tuned input on the amp should get rid of them anyway… so what is the real reason? They are fixed receiver pre-selectors that reduce out of band signals before they get to the receiver. My choice for these was ICE individual band filters since the original concept had just one band per operating position. When I went to setup SO2R I got two of the ICE 419A switch able filters.
2. Coax stubs after amp. These act as an additional band pass filter on the output of the amp. The are also notch filters for harmonics on other bands generated by the amp. And, last but not least, they are another layer of receiver protection and filtering.
3. Band pass filters on Beverage antennas. These not only act as receiver preselectors but also act as isolators on the Beverage switch box. See the discussion on my Beverage system for more specifics.

I see no need with modern equipment to add any more filters for things like TVI. Any combination of these filters after a decently designed amplifier should be plenty of attenuation for any harmonics that are up into the TV bands. Besides, doesn't everyone have cable or satellite these days? I have several times had a portable TV sitting on top of, or next to, amplifiers so an operator on a really slow band could watch a race or football game with no problem. My problems with TV's go the other way, see how that gets filtered later!

Stubs

Coax stubs are just another type of filter. They are easy to make and tune, but are not as narrow as a multi stage lumped filter. Their big advantages are that they are cheap and can handle 1500w easily. The basic idea is that a ¼ or ½ wavelength piece of coax can exhibit a very high impedance on one band and a very low impedance on a harmonic of that band. This lets you make a basic band pass or band reject filter.

The lengths below are for solid dielectric coax with a velocity factor of .66. I use RG-8, but you could also use RG-213 or RG-11. If you want to use a foam coax most of them have a velocity factor of .80. On the high bands (10, 15, 20) I use CATV hard line that has a velocity factor of between .81 and .83. The basic formula for a shorted 1/4 wave stub is 246*V/f. Where V is the velocity factor of the cable and f is the frequency in MHz.

Band by Band these are K2TR's stub plans. The copy of the article I have I think was from an old YCCC Scuttlebutt.

- 10 Meters. 2 Stubs
    - 11' 6" OPEN nulls 20m
    - 23' OPEN nulls 40m and 15m
- 15 Meters. 1 stub
    - 23' SHORTED nulls 10m and 20m
- 20 Meters. 2 stubs
    - 23' OPEN nulls 40m and 15m
    - 11'6" SHORTED nulls 10m
- 40 Meters. 3 stubs
    - 23' SHORTED nulls 20m and 10m
    - 15'3" SHORTED nulls 15m
    - 7'8" OPEN compensates for reactance from 15'3" stub. This pair of stubs works out to a 1/4 wave on 40m that is tapped at a point that results in a 1/2 shorted stub on 15m.
- 80 Meters. 1 stub
    - 46' SHORTED nulls 40m, 20m, 15m, 10m
- 160 Meters. 1 stub
    - 92' SHORTED nulls 80m, 40m, 20m, 15m, 10m

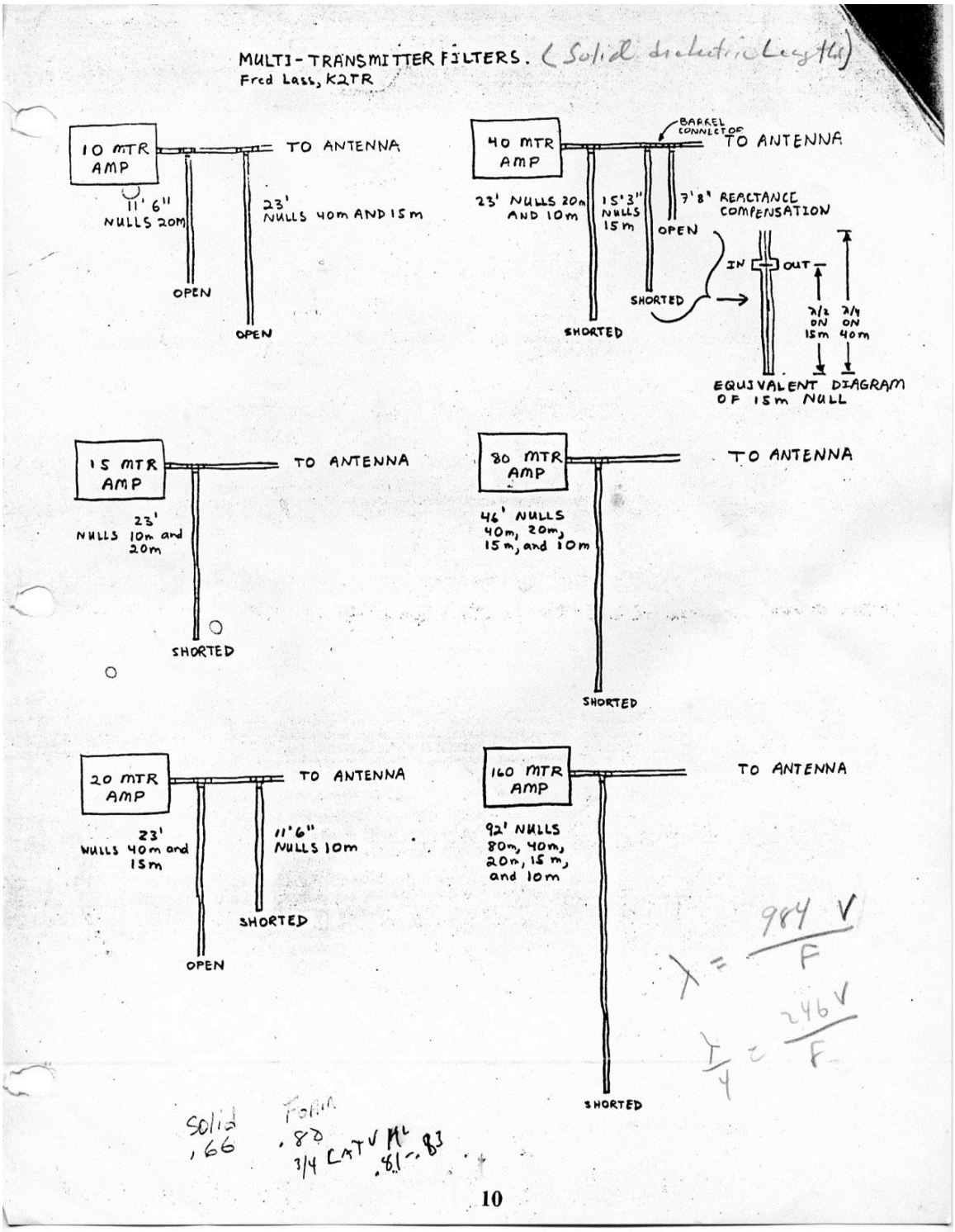


Figure 833 My copy of original article with notes.

I have also analyzed the theoretical attenuation and bandwidths of stubs using MathCAD. My results follow:

Analysis of Single Coax Stub

An article originally written for the YCCC Scuttlebutt

By David Robbins K1TTT

Since I started entering M/M contests I have been using Coax Stubs for filters to help separate stations. They have worked just fine and have provided around 30 to 40 db of attenuation of harmonics. I have been curious about a few points of using them though, like:

1. How much attenuation should a stub provide?
2. What kind of bandwidth should a stub cover?
3. How does the cable loss affect attenuation?
4. How much power gets dissipated in the cable? (I didn't consider this until a stub made out of RG-59 melted down in one contest.)

This 'document' was created by using "MathCAD". "MathCAD" is a program for IBM PC's and compatibles(and also Unix workstations) that provide the capability to write formulas and then plug in numbers to calculate results, solve equations, and plot results. The original equations for this calculation were from the "MathCAD" electrical engineering applications pack.

In this initial example I will attempt to answer the first two questions using a 1/4 wave shorted stub of RG-8 for attenuating the second harmonic of 20 meters that would interfere on 10 meters.

To get the calculations started I have provided the following characteristics of the cable itself:

Impedance

$Z.0 = 50\Omega$

Velocity Factor

$V = .66$

Loss

$\alpha = 1$ db/100'

Length

$d = 11.5'$

Termination Impedance

$Z.L = 0\Omega$

The frequency range I want to plot will cover the lower end of the 10 meter band that could be covered by a 20 meter harmonic.

Now the calculations begin, this is where "Math CAD" really does its job:

Define complex wave number.

$\beta(f)=\alpha+2i\pi f/Vc$

Define impedance as a function of frequency and distance to termination:

$$Z.trans(freq,len) = Z.line \left(\frac{(Z.L + Z.0 \tanh(\beta(freq)\, len)}{(Z.0 + Z.L \tanh(\beta(freq)\, len)}\right)$$

$$loss(f) = 20 \log(1 + ((Z(f,d) - Z.0)/(Z(f,d) + Z.0))$$

This is a plot of the attenuation provided by the stub. You can see that it provides about 32db of attenuation at 28.25Mhz. The bandwidth seems much narrower than I had expected, but I don't really have anything to measure it that accurately. I have seen about 30db of attenuation in some rather crude tests here so the overall result seems reasonable.

From these results I am considering making 2 sets of stubs, or providing a way to add or remove a few inches between CW and SSB contests since there could be over 10db attenuation difference across the band. Using a better cable would make the attenuation better, but would also make the bandwidth even

narrower.

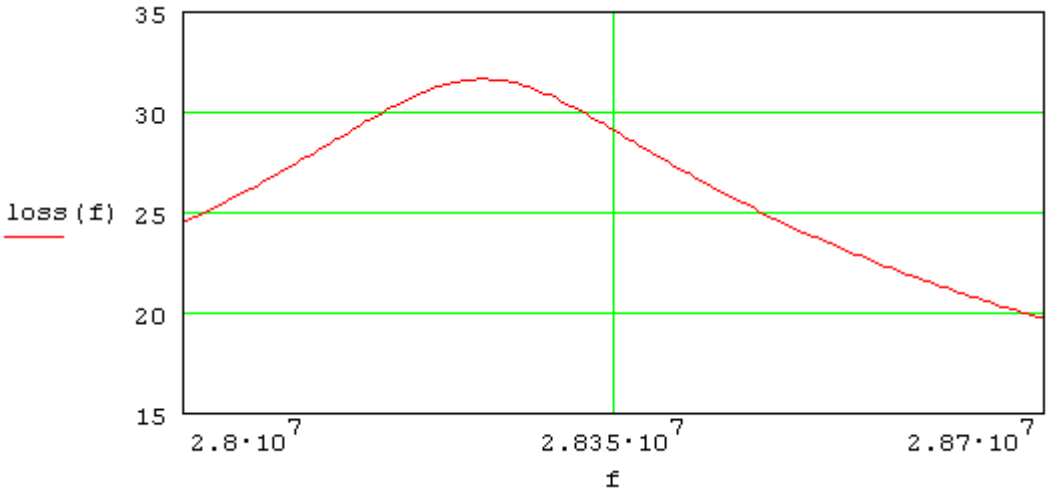


Figure 834 Coax Stub Attenuation vs. Frequency

Analysis of pairs of Coax Stubs

An article originally written for the YCCC Scuttlebutt
By David Robbins, K1TTT

This is the second installment of my article about coaxial stubs for filters on transmitters. In the first installment I derived the basic attenuation features of a 1/4 wave length stub connected between a transmitter and an antenna. In this installment I will attempt to answer the question about using 2 stubs together to get better rejection. Before I start this time I must make one note about the previous article... I made an over simplification in the calculation of the loss function that added about 6db of attenuation, the max attenuation for the single stub should have been about 31db instead of 37db as plotted.
I am now using the new version of MathCAD for Windows 3.0, it is much nicer than the original and I highly recommend it for anyone seriously planning to work on anything like this. (for you legal eagles out there: MathCAD is a product of MathSoft, Windows 3.0 is from Microsoft)
In working on this document I changed it quite a bit from the last version, I added separate parameters for the cable for the stubs so I could look at using different cable for the stubs than for the transmission line. I also added the formulas to vary the distance between the two stubs as well as the length of each stub. This results in a much more complex problem and it becomes very difficult at times to visualize what is happening. I will attempt to show the various relationships by the use of plots of attenuation vs. frequency and the distance between the stubs. First I will define the parameters for the feed line.
Z.0 is the characteristic impedance of the line
V is velocity factor,
α is loss in db/100'.

The values used here are:
$Z.0 = 50\Omega$
$V = .66$
$\alpha = 1$ db/100'

Now for the stubs.
Z.stub is the characteristic impedance of the stubs,
V.stub is the velocity factor and alpha.stub is the loss for the stub.
d.1 and d.2 are the lengths of the stubs and Z.L is the termination impedance.(0 ohms is of course a shorted stub).
$Z.stub = 50\Omega$
$V = .66$
$\alpha.stub = 1$ db/100'
$d.1 = 11.5'$ $d.2 = 11.5'$ $Z.L = 0\ \Omega$

These values are for a pair of shorted 1/4 wave stubs on 20 meters. These will of course reject the second harmonic that would fall in the 10 meter band.
The formulas for Z.trans and Z.par are defined at the end of the document. What they do is simple, Z.trans just uses Smith Chart formulas to transform an impedance from one end of a line to the other. Then Z.par uses the basic formula for paralleling two impedances. The index values (n) and (m) added to some of the variables enable me to vary them over a range of frequencies (for (n)) or to change the gap between stubs (for (m)).

The basic flow of calculations is as follows:
1. Calculate Z.1 which is the impedance at the end of the first stub
2. Parallel first stub with main line = Z.a

3. Transform Z.a to connection point of other stub = Z.gap
4. Calculate Z.2 for impedance of second stub
5. Parallel second stub with Z.gap to get Z.net
6. Use Z.net to get reflection coefficient and then 'loss' value

Z.1(n)=Z.trans(Z.stub,V.stub,α.stub,Z.L,f(n),d.1)
Z.a(n)=Z.par(Z.1(n),Z.0)
Z.gap(n,m)=Z.trans(Z.0,V,α,Z.a(n),f(n),gap(m))
Z.2(n)=Z.trans(Z.stub,V.stub,α.stub,Z.L,f(n),d.2)
Z.net(n,m)=Z.par(Z.2(n),Z.gap(n,m))

Now we can play with fancy graphs to see what we have. First lets plot attenuation vs. frequency for a gap of 0' (i.e. the two stubs are connected to the same point).

This shows the attenuation as the frequency is swept across the 20m band. Note that the max attenuation is about 6db better than a single stub.

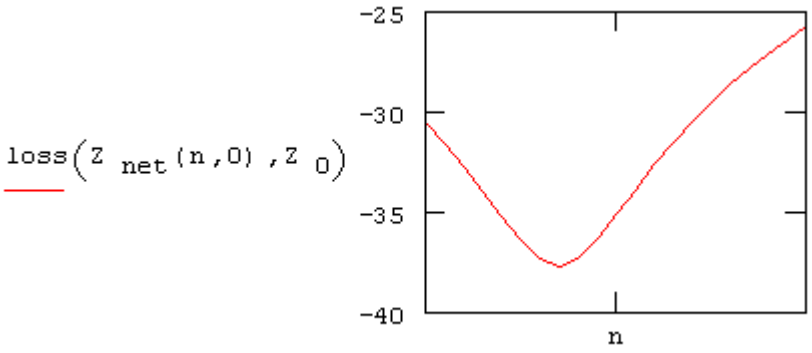


Figure 835 Two Coax Stubs Attenuation vs. Frequency

Now lets see what happens when the distance between the stubs changes. For this plot I will hold frequency constant and vary the spacing. This shows the change from a spacing of 0' to 46', or about 1 wave length at 14.1 MHz. Note the dips at 0, 1/4, 1/2, and 3/4 wavelengths.

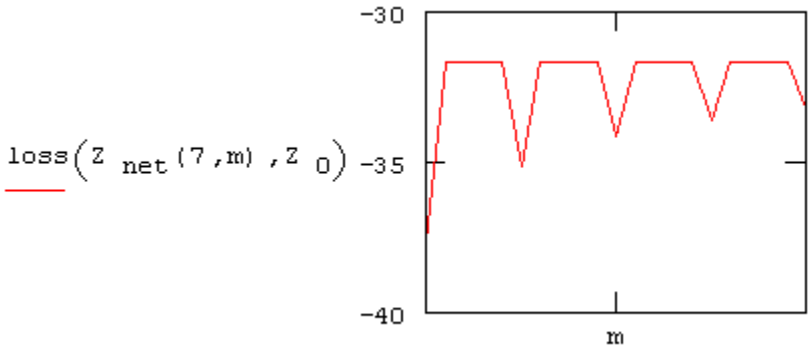


Figure 836 Two Coax Stubs Attenuation vs. Spacing

This is a very interesting result, nothing at all like I had expected. But after long contemplation it seems to make sense. Consider first the farthest stub from the transmitter. It presents a very low impedance to the harmonic that is trying to be rejected, this low impedance is then moved along the transmission line toward the second stub. As this impedance is transformed along the 50 ohm line it changes from low to high and back over each 1/2 wave of the line so that after each 1/2 wave it is back to the original low value. At a point 1/4 wave along the line it presents a very high impedance. When the second stub is added it also presents a low impedance, but the total impedance seen by the source is a parallel combination of the transformed impedance from the first stub and the impedance of the second one. If

they are both low at the same time the net impedance is even lower and better rejection results. When the transformed impedance of the first stub is high at 1/4 wave from its connection then the 2 stubs are fighting each other and the rejection is lower.
Now lets take a look at the pass band characteristics, in particular the impedance presented to the radio. This shows the frequency dependence of the impedance at a spacing of 0' between stubs. Note how it changes over the width of the 20m band. It shouldn't be enough to affect most transmitters, but it does add another factor to tuning.

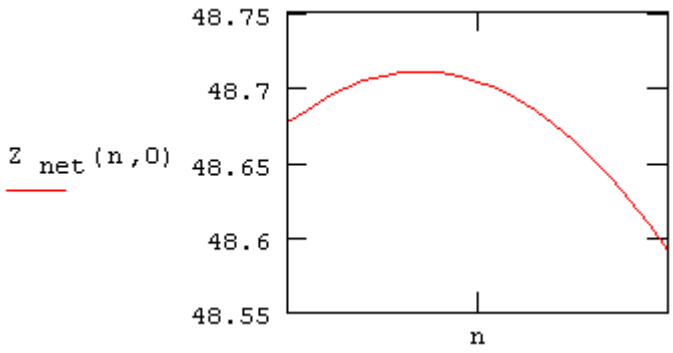


Figure 837 Two Coax Stubs Impedance vs. Frequency

Now we take and hold frequency constant and vary spacing. Note that at 1/4 wave and 3/4 wave spacing the impedance is almost exactly 50 ohms.

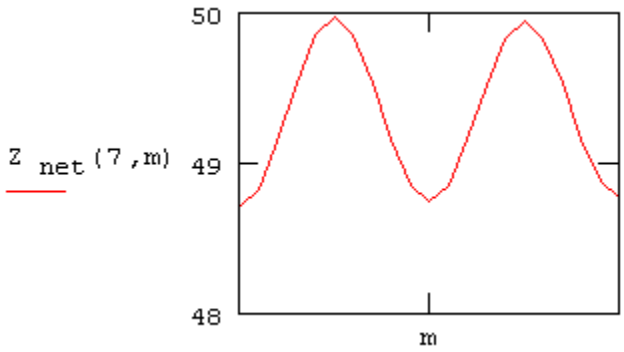


Figure 838 Two Coax Stubs Impedance vs. Spacing

And now lets sweep the frequency across the band at a spacing of 1/4 wave to see how this arrangement behaves. This change shouldn't bother any of today's transmitters or amps.

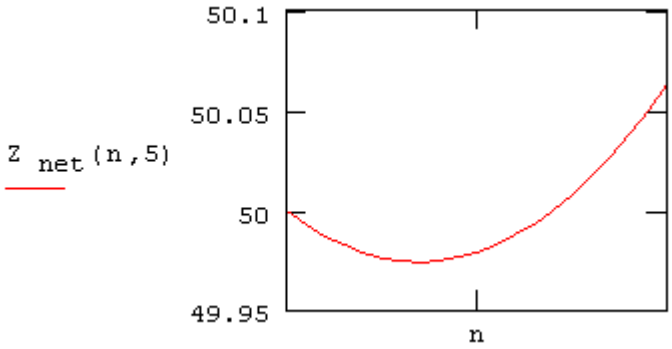


Figure 839 Two Coax Stubs Impedance vs. Frequency

Now the trade off... For best rejection of harmonic, as I showed above, put the two stubs at the same point. For least effect on tuning of radio/amp put the two stubs 1/4 wave apart. Personally I put both

stubs at the same point, it is easier to build, and I don't feel the change in impedance is severe enough to spend the extra time and effort to space them out.

Formula definitions for use above.
For parallel impedances x and y. This can be used to figure net impedance of stub connected to feed line
$Z.par(x,y)=1/((1/x) + (1/y))$
Reflection coefficient given impedance of transmission line Z.0 and impedance of load Z.load.
$\rho=(z.load - z.0)/(z.load + z.0)$
Complex wave number, given f=frequency, V=velocity factor, alpha=loss of line. Constant c=velocity of light
$\beta(f,V,\alpha)=\alpha+2i\pi f/Vc$
Formula for transformed impedance along length of coax cable.
Input values are:
Z.line = characteristic impedance of transmission line
V = velocity factor
α = loss of line
Z.start = impedance at starting point(far end of line)
freq = frequency
len = length of line (in feet)
$Z.trans(Z.line,V,\alpha,Z.start,freq,len) =$

$$Z.line \left(\frac{(Z.start + Z.line \tanh(\beta(freq,V,\alpha)\ len)}{(Z.line + Z.start \tanh(\beta(freq,V,\alpha)\ len)}\right)$$

This is formula for loss due to reflection from mismatched load. Used here to figure reflection from intersection of stub with main transmission line.
$loss(Z.load,Z.line) = 20 \log(1 + \rho(Z.load,Z.line))$

419A input isolation

When I first hooked up all the SO2R stuff I had rather poor isolation between the two stations. I finally tracked this down to crosstalk in the power and control leads of the ICE 419A filters. Both of these were driven from the same power supply, which also powered the rest of the band decoder and driver boxes. I only wanted to fix this once so I went 'brute force' on it. I bought a bag of .1uf caps and started soldering. My added caps are the big green ones in the pictures below:

Figure 840 419A input line caps on control and power

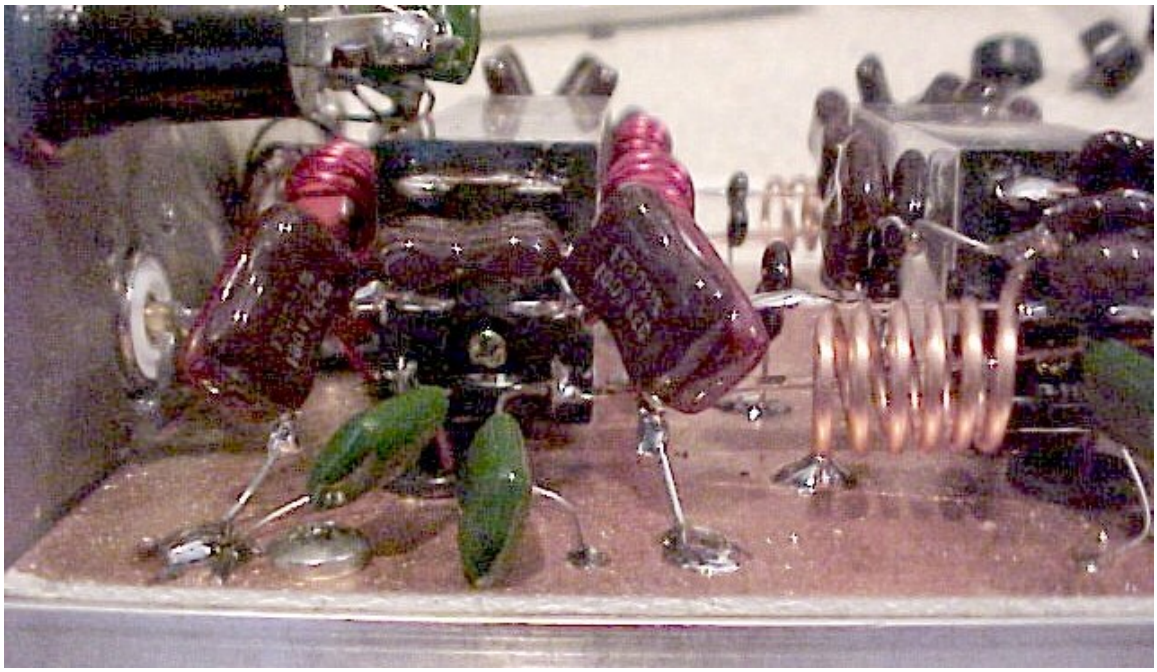


Figure 841 419A Two caps on each relay.

By the time I was done I had 6 on the input control lines, two on the power jack, and 2 on each relay for 20 in each case. This got rid of the crosstalk through the filters.

Model 419 bandpass filter capacitors

I have seen failures recently in Model 419 bandpass filter capacitors. The most common failure is the 10m section, but others can be affected also. After some discussion it appears to be the selection of capacitors might be the problem. If you go to a parts retailer web site and search for Silver Mica capacitors you will likely find at least 2 and sometimes 3 different specifications for the same value capacitor. For instance if you search for 27pf 500v radial lead mica capacitors on Digikey's web site you get about 20 hits. Besides the obvious differences in tolerance and packing type (bulk or tape) and some other stuff there is a column that has either 'General Purpose' or 'RF, High Frequency'. On other sites I have also seen some called something like 'Pulse rated'. To see the real difference you need to go to the manufacturer's data sheets. Below are some excerpts from the Cornell Dubilier spec sheets provided by Digikey.

Mica Capacitors, Standard Dipped

Types CD10, D10, CD15, CD19, CD30, CD42, CDV19, CDV30

Stability and mica go hand-in-hand when you need to count on stable capacitance over a wide temperature range. CDE's standard dipped silvered mica capacitors are the first choice for timing and close tolerance applications. These standard types are widely available through distribution

Highlights

- Reel packaging available
- High temperature – up to +150 ºC
- Dimensions meet EIA RS153B specification
- 100,000 V/µs dV/dt pulse capability minimum
- Non-flammable units that meet IEC 695-2-2 are available

Types CD17, CD18 & CDV18, High-Frequency, Mica Capacitors

High-Frequency Capacitors for CATV and RF Applications

Types CD17 and CD18 assure controlled, resonance-free performance through 1 GHz. Insertion loss data is typically flat within ±0.1 dB over the entire frequency range, and is specified to be flat within ±0.2 dB. Interchangeable with the most popular, common mica capacitors, Type CD17 is available in the same case sizes and lead spacing as CD15; CD18, in the same case sizes and lead spacing as CD19, and CDV18, in the same as CDV19.

Highlights

• Shockproof and delamination free
• Near zero capacitance change with (t), (V) and (f)
• Very high Q at UHF/VHF frequencies
• 0.0005 typical dissipation factor
• 100,000 V/µs dV/dt capability minimum
• Low, notch-free impedance to beyond 1 GHz
• Ultra low ESR for cool operation

The standard capacitor spec sheet pretty much stops after the highlights and goes into the mechanical specs and lists the values available. The HF sheet has a section of graphs and other data measured up through 1GHz. Don't be fooled by the pulse capability being the same, it is the lower dissipation factor and low ESR for 'cool operation' that I think are more important.
Remember, in resonant parts of filters like the 419's bandpass sections you can get very high circulating currents, much more than the current implied by 100w in a 50ohm circuit. This can lead to heating and changes in value of the capacitors which just adds to the losses by detuning the circuit while the radio wants to keep pushing it's 100w output through it.

Sub harmonic analysis

Sub harmonics? Why not regular harmonics? Why, because I said so, that's why. Everyone analyzes harmonics, and I've already written about filters for harmonics. Now its time for something completely different. And why should you care? Because this can happen in the real world, its odd, and relatively rare I think, but I had it happen here and it took a long time to figure it out so hopefully this can save someone else all the time and trouble that I went through trying to find this problem.

In case you have skipped ahead the problem I was seeing was that when 20m was transmitting it was creating a very clean 'harmonic' at exactly 1.5 times it's frequency. This would not normally be possible just due to the common methods of generating unwanted harmonics. It was also very sensitive to weather and transmitter power. At times it wouldn't be present, and at other times it would abruptly start at power levels from 100w up to almost 1500w. Once I figured out what to look for I also found the ½ frequency component on 40m, this may have been less noticeable because the 40m tower was further from the 20m tower than the 15m tower was.

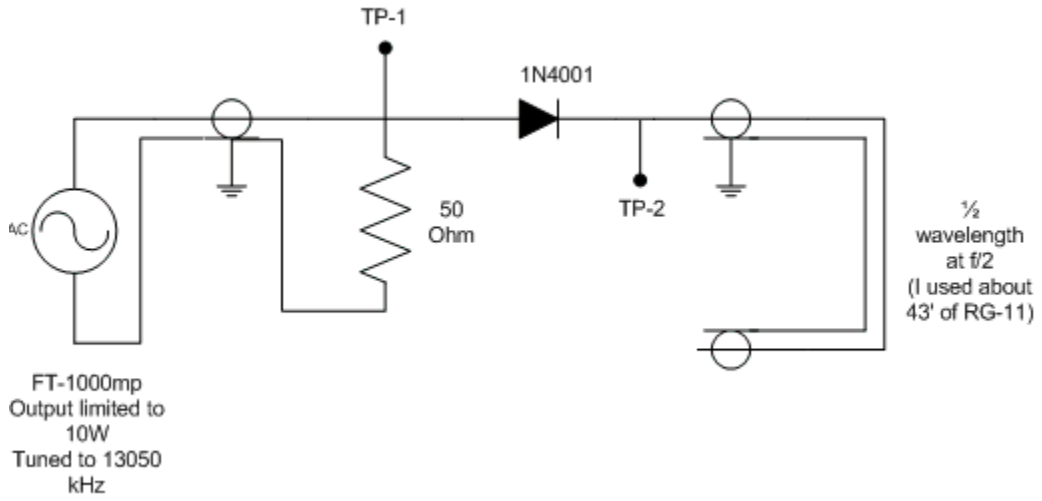


Figure 842 Sub harmonic test circuit

The theory of this circuit is that on the first half cycle of the pump generator the voltage on the TP-2 side is zero so the diode turns on and conducts the pulse into the coax. The pulse travels down the coax and reflects back just in time to reach tp2 when the next positive half cycle start. When this happens the diode does not conduct and so there is no new pulse going into the transmission line. So when the 3rd positive half cycle occurs the diode again conducts and the process starts over. This essentially divides the incoming frequency by 2 creating a 'sub-harmonic'.

The sub-harmonic is phase locked with the pumping source so the output is surprisingly narrow banded. There is of course some noise and instability from the rectification which gets worse as the pump frequency gets away from the resonant frequency of the coax.

There is also a very sharp threshold effect. As the input voltage is increased there will be a very sharp turn-on point where the sub-harmonic starts to be generated. This is related to the characteristics of the diode. In the case of my 20m problem it was controlled by the weather since the diode was between the tower and hard line shield, this made it harder to find as sometimes the power needed to start the rectification was above 1500w, other times it was as low as 100w.

This circuit is of course going to generate other products. In fact the first effect we found was that 20m was showing up on 15m at exactly 1.5 times the 20m frequency. This is an obvious side effect of the circuit, since the pumping frequency and ½ the pumping frequency are mixing at the diode it is logical to get the sum and difference, or 1.5f and .5f.

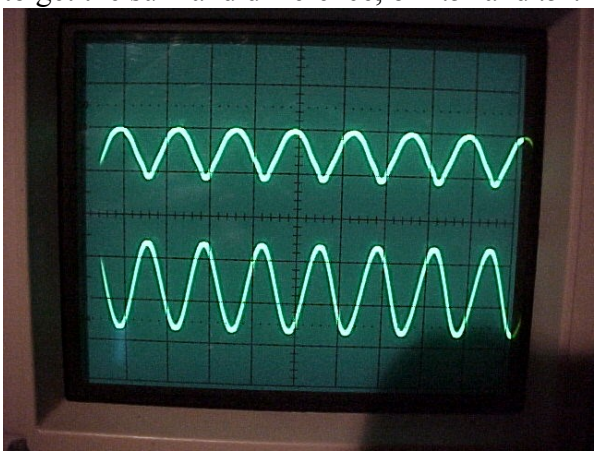
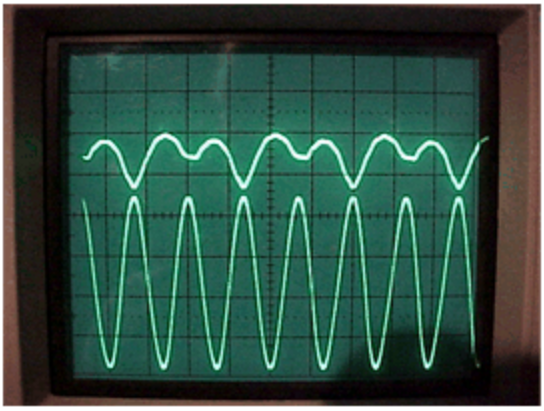


Figure 843 Below the threshold



TP2 On top showing f/2 component at 6525 kHz

TP1 on bottom showing 13050 kHz pump frequency.

Figure 844 Above the threshold

The two traces are apparently not properly synced (or is TP-2 inverted?) in this display, but it is obvious that there is an f/2 component in the TP2 trace from the alternating variation in the peak voltages.

Cheap TDR

What is a TDR? And what do I need one for??

A TDR is a Time Domain Reflectometer. Basically it's an oscilloscope and pulse generator combined so that you can send a pulse down a transmission line and watch for reflections coming back. Kind of like a radar for your transmission line.

Why do I need one? That's easy, I have literally miles of hard line and coax between the shack and antennas. And trying to find a bad connection or damaged cable without one is lots more work. Hooking up a scope and getting an instant end to end picture of a feed line makes finding faults simple without even leaving the shack.

Ok, so I look in the books and there are all sorts of TDRs, some costing thousands of dollars… I don't want to pay that for something I may only use once or twice a year! Well, neither do I. Fortunately TDRs are actually very simple if you know what to look for at flea markets. Of course if you are really lucky you may find a real one at a flea market also. My TDR cost $100 at a Deerchester flea market one year, and half of that was for the scope cart! The rest of it is just a half decent oscilloscope and a relatively good pulse generator, plus a few cables and dummy loads to hook it all up.

You want a decent scope, something over 25Mhz bandwidth is good, 100Mhz is better. The higher the bandwidth the better resolution you can get. The pulse generator is also important to the resolution. Specifically the shorter the rise time of the generated pulse the better the resolution will be. The actual voltage or repetition rate isn't all that important, except you want to be able to make pulses that are longer than the round trip time of your longest coax run.

Figure 845 My flea market TDR

In the picture please disregard the TV sweep generator in the middle, that I use for tuning band pass filters. In this setup I actually have it set up to test the transformers for my 2 wire Beverages. In this arrangement I use the normal TDR setup plus use the second channel to watch the return pulse on the other port of the transformer. I use 2 connections from the pulse generator (bottom) to the scope. The one on the right is an external trigger signal which is optional, but provides better stability of the display. The other one on the just goes to one channel input of the scope. At that point there are 2 T connectors since you have to have a dummy load to prevent reflections between the scope and pulse generator and also the connection out to the cable under test as well as the input from the pulse generator itself.
I'm not going to go into trying to teach you how to read TDR traces, there are plenty of books and web sites that have that information. There are just a few tricks to setting it up and testing that are handy to know. First, to be sure its working right attach a known length of cable to the test jack with no termination. I like to use something like 50' or 100' so I can set reasonable sweep rates. You should be able to easily see the length of the cable and use that to calibrate the sweep rate on the scope. Then you can test with a dummy load that matches the coax Zo and with a short circuit at the far end to see those effects. This also gives you a quick check for internal reflections between the scope and pulse generator, these can be eliminated by using dummy loads at one or both ends of the cables. Internal

reflections show up as over shoot or ringing that is on a much shorter time period than the length of the cable you are looking at.

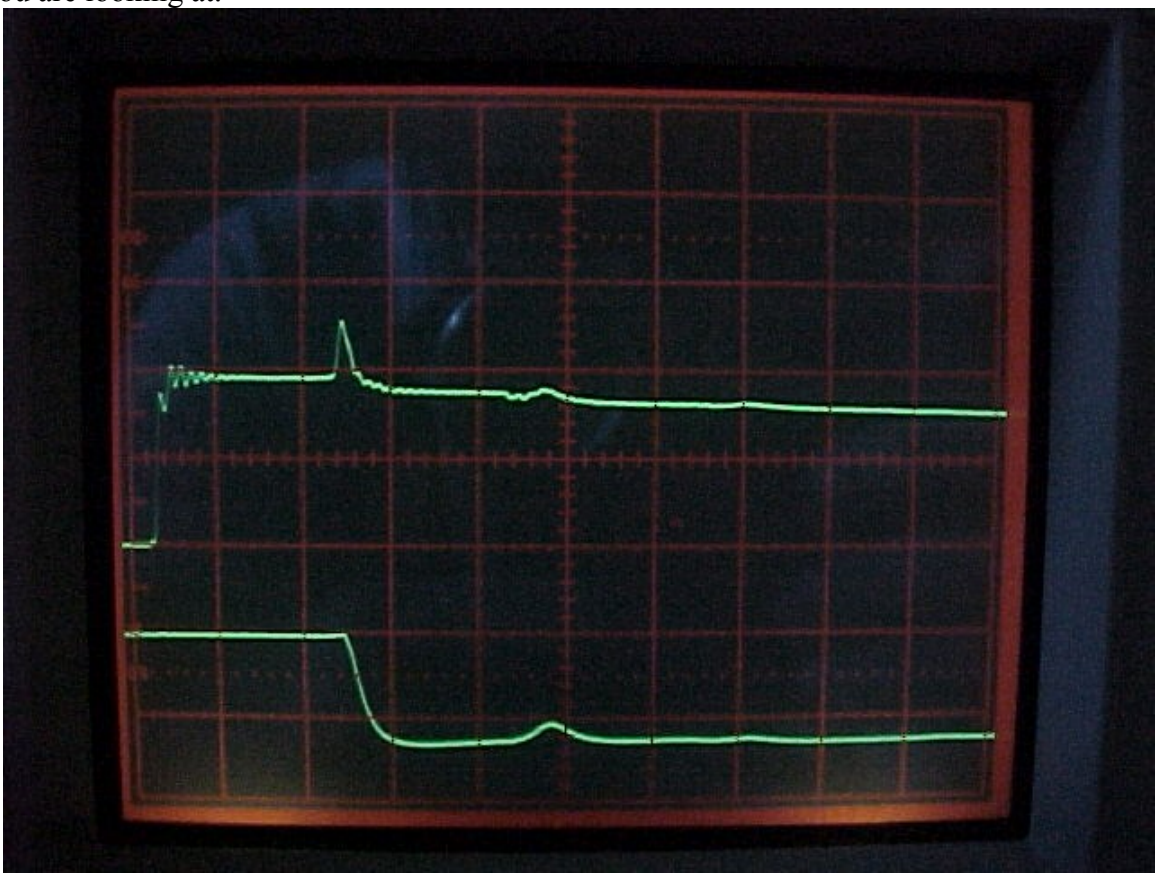


Figure 846 Typical TDR display

In this display the top trace is the actual TDR trace, the bottom one is from the other side of the Beverage transformer. The top trace shows the initial pulse (with a bit of ringing) going out to the Beverage transformer which shows as the big blip. The next small blip is a re-reflection of that first one from the scope, this happens when the feed line you are testing doesn't exactly match the impedance of the pulse generator and dummy load. In this case the coax is 75 ohms and I was using 50 ohm loads so there is a bit of reflection at the connection point that causes the re-reflection and also the initial ringing. And if you are really picky you can see the 5' 50 ohm jumper I used to get from the scope to the 75 ohm cable, it is that first short blip in the initial ringing. Using this system I can easily see 50-75 ohm transitions, spot bad connectors, and watch remote switches do their thing.

Remember, the length of time between the pulse going out and the reflection you see is TWICE the travel time to the discontinuity!

Calibrating to a known cable length is most useful if you have a cable that matches the velocity factor of the cable you will be testing, otherwise you have to calculate locations of things you see. It is often possible to calculate the relative location of problems if you know the length of the cable you are testing… for instance if I am testing a cable going up to the top of my 150' tower I know the cable is physically about 350' long so I can use that to calibrate the sweep rate and measure relative locations directly off the scope's scale. Doing this is it possible to get reasonable locations without the need to have a well calibrated time base on the scope… which is one of the things you pay the big bucks for with a 'proper' TDR.

Tuning gamma matches

It is important to understand how gamma matches work. The gamma rod is really one half of a short parallel wire transmission line. The far end of the rod is connected to the driven element at some distance out from the center of the element. At this tap point there is some (usually complex) impedance. The gamma rod and driven element make up a short transmission line of some characteristic impedance. Transmission line theory tells us that the impedance transforms along the length of this line to the feed point. At the feed point there is normally a capacitor that is used to cancel out the reactance leaving what is hopefully a purely resistive load that matches the feed line impedance. One confusing thing is that some manufacturers (like Cushcraft) hide the gamma capacitor by using the inside of the gamma rod and another insulated rod inside it as the capacitor. To adjust this capacitor you slide either the gamma tube or the inside rod, depending on the construction. This is actually a good way to make this capacitor since it has to handle full transmitter power and is exposed to the weather. You can use transmitter grade variables or solder in fixed capacitors, but the rod in tube is usually much simpler.

There are really 5 variables you have to juggle to design and tune a gamma match. And to make it more fun, they all interact with each other:

1. The capacitor - tunes out the reactance left at the end of the gamma after the parallel tubing transmission line transforms it from the tap point.
2. The tap point - selects the impedance fed into the parallel tubing transmission line
3. The spacing between tubes - affects the impedance of the tubing transmission line
4. The relative diameters of the tubing - also affects the impedance of the tubing transmission line
5. The length of the driven element - affects the impedance at the tap point

My 12 step program to happy Gamma Matching

1. Set driven element to calculated length
2. Pick a tap point
3. Set capacitor to mid range
4. Sweep band, find minimum SWR
5. If minimum is out of band lengthen or shorten driven element to get it in the band.
6. Tune radio to min SWR freq, sweep capacitor to find minimum SWR
7. Adjust tap point a small amount
8. Sweep capacitor to find minimum, if its higher than before adjust the tap the other direction
9. Repeat adjusting tap and sweeping capacitor for minimum until SWR is reasonable (NOT PERFECT!)
10. Sweep band and plot SWR curve
11. If you like curve return to 9 and continue until you get as low as you have time for, then do 10 again. Adjustments should keep getting smaller, if not something is wrong so lengthen or shorten driven element a bit and start at 2 again.
12. If the curve has moved from where you want adjust the driven element length to move minimum and go back to 6.

The one most people forget is the use of the driven element length to move the minimum. You can move it with the tap point or capacitor a bit, but it will usually take much larger adjustments and often won't allow adjusting for low SWR at the same time.

50 vs. 75 ohm cable

My opinion on this… Just use it. There are all sorts of 'matching' systems, from special un-un's to synchronous coax transformers and requirements to use even ½ wave length multiples. Forget them! You have CATV or other 75 ohm hard line? Cut it to reach, slap on a few plumbing fittings, and put the power to it! I have been doing this for years and with a few minor exceptions it has worked just great.

Hard line connectors from plumbing fittings

Want to have some fun? Cut off a 6" piece of CATV hard line, grab a barrel connector and a PL-259 and walk into your local plumbing supply store and ask for an adapter to connect them. The looks on the clerks face when they try to figure out why the pipe is full of foam can be priceless!
Finding the proper fittings for flea market or scavenged hard line can be lots of work and expensive. So over the years I have usually made the connectors I needed. I have made 4 different basic types of connectors for hard line from plumbing fittings over the years. These are not the only ways to do it, lots of variations exist, its just up to your imagination

1. ½" CATV to PL-259. This is just a ½" copper compression fitting. Strip back the shield and foam, then just slip one side of the compression fitting on the hard line and tighten. Put the back of the PL-259 in the other end and tighten that one down. Then solder the center conductor into the pin of the PL-259.
2. ¾" or 5/8" CATV to Barrel Connector. This is a bit more work. First take apart the barrel connector, save the center pin and the two Teflon inserts… you can mung up the threads on one end as much as needed to get it apart. Solder the munged up part into a 5/8" or ¾" to 1/2" copper reducer, it should fit easily, if its too loose add a couple of turns of copper wire and just fill the gap with solder. In the big side of the reducer cut 2 or 4 slots with a hacksaw blade. Trim back the shield and foam, cut the center conductor so the center pin of the barrel connector comes up flush when the shell is all the way down on the shield. In some cases I have soldered the pin to the center conductor, in others I have just used the Teflon around it to hold it tight. Add the Teflon back to the far end of the pin and put the shell over the cable, add a hose clamp and lots of sealant.
3. ¾" CATV to Barrel Connector: Just about like #2 above except using a threaded pipe to ½" copper tubing reducer. Assemble as before except thread the reducer onto the shield until the pin is flush and then goop it up well. I don't really like these as they are harder to take off and put back on, but they are quick and simple.
4. 7/8" or 1" odd stuff to Barrel Connector. This gets harder because the center conductor is too fat for the pin. So I build like #2 above except cut the center conductor short and dig out some of the foam around it. Solder a piece of coax braid to the center conductor and solder the pin to that. Depending on the size of the cable shield and reducers you can find you may end up putting the reducer inside the shield, instead of cutting slots in the adapter you cut slots in the shield and use a hose clamp to secure the adapter inside the shield. Goop to seal as before.

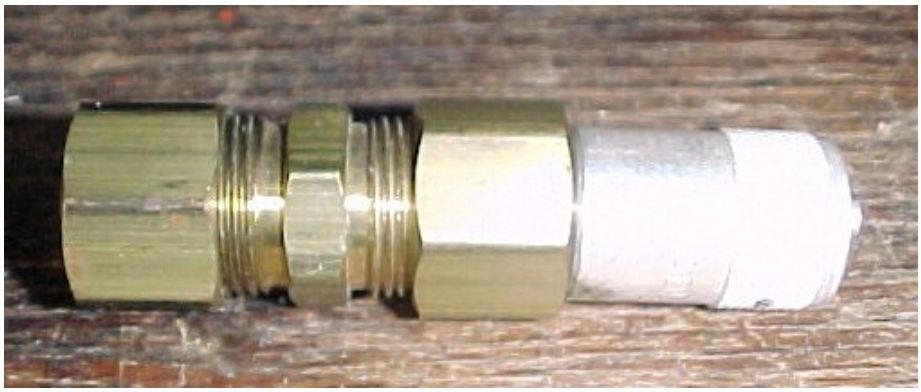


Figure 847 PL-259 on a compression fitting for ½" CATV hard line

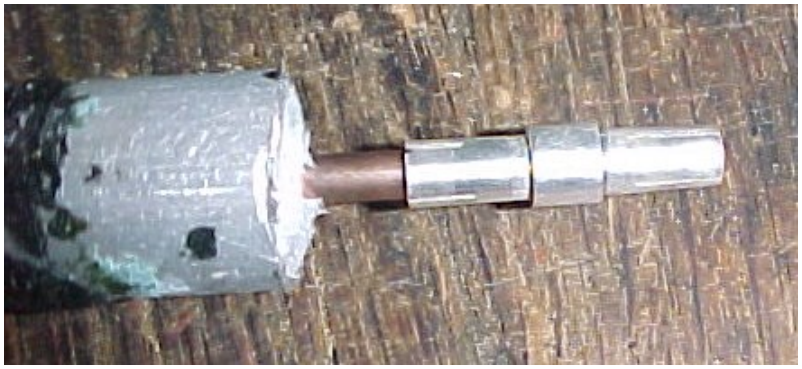


Figure 848 Center pin of barrel connector ready for shell

Figure 849 Reducer with barrel connector on CATV hard line

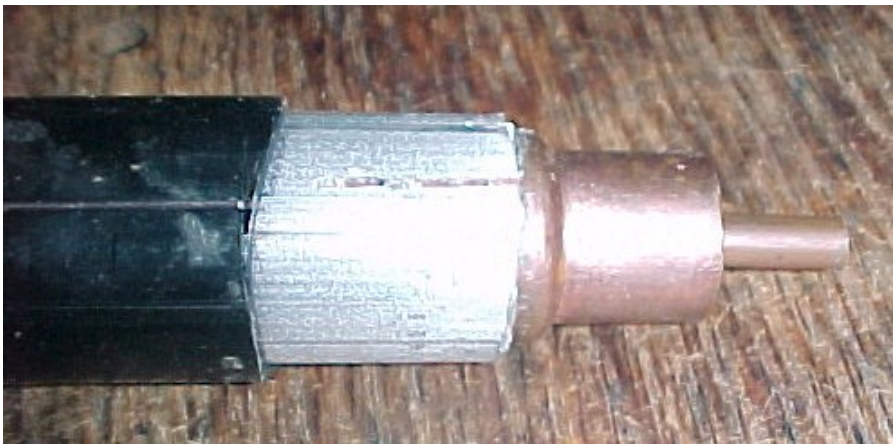


Figure 850 Reducer inside hard line shield

An important part of all of these is water proofing. I used to use brand name “Coax Seal” that came in little rolls and was fairly expensive. I gave that up for electrical supply store Duct Seal in 1 Lb blocks. Basically the same stuff, but much cheaper and locally available just about everywhere. Apply liberally and the cover with a layer of cheap electrical tape to squish it into the joints and protect from the sun.

Need a quick connector inside? Try this:

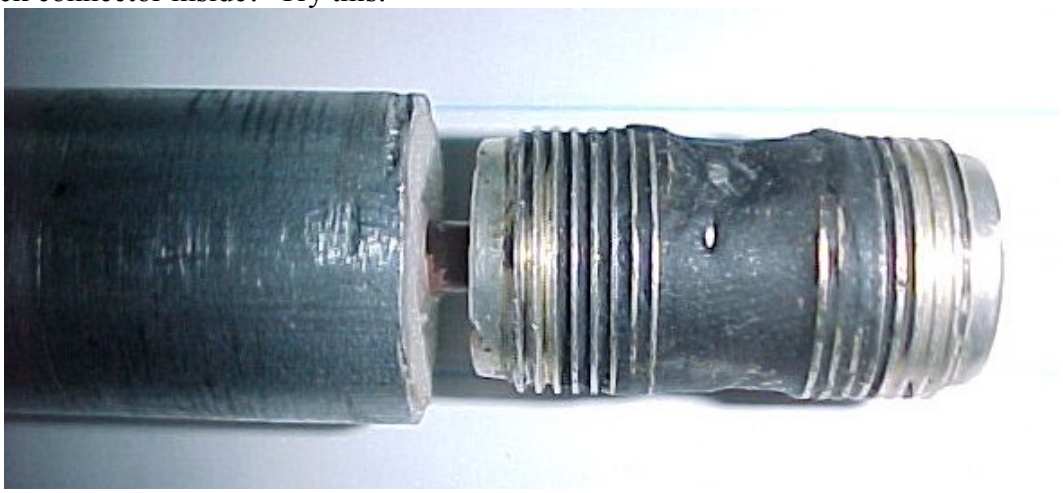
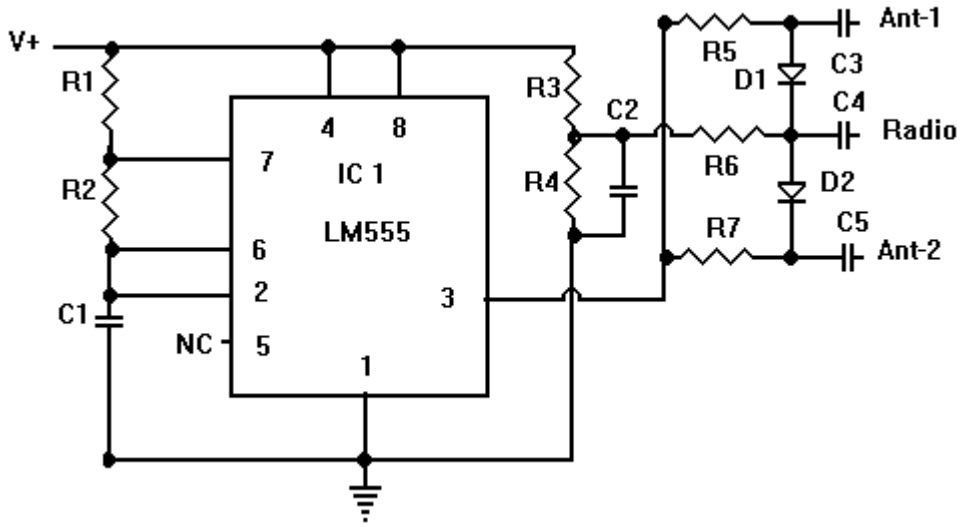


Figure 851 Barrel connector on center conductor

Just fill the gap with braid and tape or clamp with hose clamps. This makes a quick connector for inside the house.

Cheap Doppler DF

(An article originally written for the Berkshire County Radio Association News, Aug 1993.)
This is a derivation from the Handi-Finder project from the May 1993 issue of QST. I didn't happen to have the IC they called for, but did have a 555. I also preferred to reverse bias the off diode instead of letting it just float. In the circuit shown almost none of the values are critical, the only thing that is required in fact is the 555 IC timer. Construction is not real critical either, but I do recommend putting the whole thing in a metal box and keeping the leads from the antennas to the diodes short, preferably using coax. The antennas should be spaced 1/4 to 1/2 wave length apart for decent operation. Be sure to use an FM receiver, this will not work with an AM or SSB receiver... Although it can DF an AM signal. This circuit operates by rapidly switching from one antenna to the other. This creates a phase shift that FM receivers can turn into a tone. When both antennas are the same distance from the transmitter there is no phase shift so the tone disappears.
WARNING! Do not transmit through this circuit. It might be able to handle low power on an HT, but more than a watt or so may blow the diodes. Also, the SWR that the radio sees may be radically different than 50 Ohms! so your radio may not like it either.



Parts List:

R1,R2	1.8 KOhm
C1	.1 uF (pick for nice tone)
R3 - 7	3.32 KOhms
C2	.05 uF (bigger may be better)
C3,C4,C5	.01 uF
D1,D2	SK9150A/555 PIN Diode (any good switching diode should be OK, maybe 1N914)
V+	6-12VDC (<10 mAmp load if my meter is working right) >

I used ceramics for C2-C5, and mica for C1, but just because they were handy. The resistors are all 1/8 Watt carbon, but only because they were handy also. The only restrictions I would put on playing around is to keep D1 and D2, R5 and R7, and C3 and C5, identical. This doesn't mean use what I did! just keep them the same so that the paths from each of the antennas to the junction of D1 and D2 are identical. Actually, C3 and C5 are optional.

Added note on easy construction techniques from a satisfied user:

Not sure if I finished this thought last night -- but on the unit that I built, I used a 36" wooden yardstick for the boom and used two of the cheap radio shack twin lead/rabbit ear TV antennas for the elements. The plastic housing can easily be used to mount the antennas to the yardstick, and the twin lead can be removed leaving the remaining little brass solder tabs to connect the coax and PIN diode to the elements. The advantage of using the yardstick for the boom is that you can collapse and fold your elements and easily re-lengthen them to the proper length when it's time to use it. No guesswork or estimating!
One does have to look pretty hard for the rabbit ears at RS -- they have the more expensive ones in plain view, but the cheap $2.99 ones are hidden
-- the cheap ones are the ones you want.

For some reason I didn't put this in the original article or on my web page, but you can have a unidirectional null with this simple system. To do that you make the antennas 1/4 wavelength apart and make one feed line 1/4 wave longer than the other. In this way you get a cardioid pattern since the only direction that won't have a phase shift is when the signal gets to the antenna with the longer feed line first and the other one exactly 1/4 cycle later. Just be sure to take the coax velocity factor into account.

Yaesu G-xxxxSDX series control box problems

The Yaesu G-xxxxSDX series of rotors uses a very complex control box. While the remote angle sending unit is a simple potentiometer like most other rotors the resemblance ends there. The control box takes the voltage from the pot and uses it to drive an active server system with a gear train, limit switches, position feedback pot, and indicator needle that covers the 450 degree range of the rotor. The weak point in the system is the drive motor. Typical problems include sluggish response or stuck indicators.

IMPORTANT! If you use one of these rotors turn off the control box when you aren't using it. This can greatly extend the life of the motor since the feedback system has a tendency to hunt which keeps the motor moving lots more than is really necessary.

If you notice that the rotor indicator isn't moving when you press the button, first verify that the rotor itself is turning. Point it somewhere other than in the counterclockwise stop. A quick test is to unplug the control cable, if the indicator isn't fully counterclockwise already it should cause it to go to the counterclockwise stop on the indicator. If the indicator does move quickly to the stop then you have to troubleshoot the remote pot, but in most cases I have seen the indicator just sits there or may very slowly turn to the stop… both are symptoms of the same problem.

Temporary fix for stuck indicator:

For a quick check to see if that is the problem do the following:

1. Turn the antenna so it is 90 or more degrees from where the box indicates.
2. Unplug the rotor
3. Remove the metal cover (2 screws on sides and 4 feet)
4. Remove front panel (3 screws on bottom, 2 on top)
5. Pull front panel out about 1-2cm and look in to the gear mechanism on the left side. You should see a small pulley with a rubber belt on it on the shaft of the motor.
6. Plug in the rotor power. Be careful, there are exposed connections where line power is available but they are on the bottom side of the front panels on the other side of the indicator at the switch.
7. Turn on the rotor. With a small screw driver gently try to turn the small pulley with the rubber belt, if it starts to turn the needle it confirms the motor is the problem. If it doesn't start operating it could still be the motor, but may also be the control board.

What happens is the commutator segments in the motor are too soft so after a while the metal 'wipes' and creates enough metal powder to get in between the commutator segments and essentially shorts out the motor. If the controller is left on for long periods in this condition it can also burn up the 2 current limiting resistors and/or drive transistors on the little circuit board behind the motor. Giving the motor a push gets it past the shorted spot and at least shows you that the rest of the drive and control stuff is working, but it won't last.

A temporary fix goes as follows:

1. From the above condition, pull the power plug.
2. Remove the small circuit board behind the drive motor (4 screws)
3. With needle nose pliers un-crimp the 3 crimps that hold the plastic back onto the metal case of the motor.
4. Very gently pry the plastic back off the motor.

5. With a needle or other very small type of dental pick tool carefully scrape the gunk out from between the segments of the commutator, you can remove the small nylon washer on top of the shaft for better access.
6. Use a paper clip or small pair of tweezers inserted through the small slots on the plastic back to hold the commutator brushes out of the way and carefully replace the plastic back.
7. Re-crimp the metal back and replace the circuit board.

This should restore operation for a while, but eventually the motor will need to be replaced. This process is much more involved as you have to disassemble basically the whole front panel to get to it.

Replacing indicator motor:

1. Remove 2 screws on top sides of case
2. Remove 4 screws in rubber feet. Pull case off of control box.
3. Remove 2 screws in top of front panel
4. Remove 3 screws in bottom of front panel
5. Lay front panel down on table.
6. Remove 4 screws with lock washers and flat washers from small circuit board on back of indicator drive assembly
7. Unsolder red and black leads from motor.
8. Remove pointer cover, pointer, and compass overlay.
9. Unplug cables from large circuit boards to right of drive assembly. Be sure to mark the two eight pin ones to get them back in the right spots.
10. Remove 4 screws with lock washers and flat washers from the large circuit board.
11. Remove 4 standoff bolts with lock washers and flat washers from the bottom large circuit board.
12. Remove 2 screws from the small bracket that holds the main power switch.
13. Remove 4 screws that hold the indicator assembly to the front panel. One of them should have a plastic insulator stuck on it under the large circuit board.
14. Remove 3 screws with plastic spacers that hold the clear degree dial on the indicator assembly. (now is the time to replace the indicator bulb if that is bad!)
15. Remove 4 screws that hold the large metal plate on to the front of the indicator drive assembly.
16. Take the rubber band off the motor pulley.
17. Remove the motor pulley from the shaft.
18. Remove the 2 screws that hold the motor to the frame.

Reverse process to reassemble with new motor, just watch out for the following steps:

17. Make sure the motor pulley aligns with the big pulley that the rubber band goes around
15. I think the holes only line up one way.
6. Test repair here, chances are 50-50 that you got red and black wires on motor reversed. If the indicator drives the wrong way and into the stop just reverse the two wires.

ALL. watch out for pinched wires or wires with too much strain, they are probably wrapped around the wrong way.

Rotor turns faster one way than the other:

This is an odd one that I have heard about a couple times. It appears to happen because of how the motor speed control circuit is designed. Basically the whole circuit that powers the motor is floating. There is a dedicated transformer secondary for the motor power and it has its own full wave rectifier. The negative side of the motor power is referenced to ground through a 10k resistor.
This would normally be ok, except that there are a couple places where control circuits, including the speed control are referenced to ground instead of the circuit's negative bus. What this does is adds the voltage across that 10k resistor to the speed control signal that regulates the voltage on the motor drive circuit.
As long as the motor drive circuit remains properly isolated this is not a problem. However… the two wires that power the motor in the rotor go outside, so what are the chances of that?? To add complexity to the pot Yaesu added some nice filtering in the rotor housing to prevent RFI from the DC motor. This filter includes some feed through capacitors and a module that has an inductor and a couple capacitors potted in it. And don't forget the two limit switches and bypass diodes. Oh, and in the 2700/2800 versions there are also two more diodes and the 'near the limit' switches for the automatic slowdown. What is nice about this is if any one of those components develops a short or low resistance leakage path to ground the circuit is protected and won't blow up. What is bad about it is that any leakage current from one side or the other has to go back across that 10k resistor. The effect of this is that when turning one direction the voltage adds to the speed control voltage and turns the rotor faster, and going the other direction the voltage is reversed and slows the rotor. If the leakage is due to water in the control cable or in the rotor housing the effect could be weather sensitive, getting better when its dry or below freezing, and worse when raining.

'Rain' static

There have been many arguments over the years about what is commonly called 'rain static'. First, the same noise can be caused by snow or blowing dust or sand. And second, its not really caused by the rain. It can, and often does, happen without any precipitation or even wind.

This static often is described as sounding like sparkplug noise, but at its worst it is just broadband static that can be s9+20db and totally wipe out a band. There are a couple odd things about this noise, at least until you understand why it occurs. First, it is usually worst on higher antennas. In fact in my setup you can switch to the bottom Yagi on the stacks and have almost no noise while the top one is totally unusable. Second, if it is associated with a thunderstorm the speed of the sparkplug type noise gets faster and faster then can suddenly stop when a lightning stroke occurs, after which it starts to build up again. Ummm, just a warning… if you are hearing this type of the noise it's probably time to get off the air until the storm passes!

What really causes this noise is corona. No, not the beer. Corona is the breakdown of the air caused by a high electric field. It is also called St Elmo's Fire. This is caused by high electric fields stripping electrons off molecules in the air. If you ever see corona it looks like a blue glow, it is really a series of very small electron avalanches, each one essentially a tiny spark. This process has lots of random factors that cause the breakdown effects to generate high frequency noise.

One of the alternate theories that has been pretty well shot down is that the noise is from charges on the rain drops or snow flakes discharging to the antenna. Unfortunately the charge on individual drops is not high enough to cause this effect. Also this would not explain noise in the absence of precipitation. And it doesn't explain why lower antennas (that also get hit by rain just like the higher ones) don't have the same noise or even more since they would be closer to ground potential than higher ones.

The better explanation, and one that is easily measured, is that the electric field under a charged cloud attracts charge to the top of any conductive structure. Small points on antennas (brackets, screw heads, tips of elements) have much higher electric fields due to the curvature and will start corona sooner than other parts. As the field increases more and more of the structure starts to generate corona and the noise increases.

Now, how does this explain the odd effects cited earlier?

First, the amount of the noise is proportional to the field strength. As the field increases so does the chance for lightning. So as the field increases the noise gets worse and worse, when lightning strikes it removes a large amount of charge from the cloud and quickly reduces the electric field. The sudden reduction in the field reduces the corona and the noise stops. However, most storms immediately start recharging their charge reservoirs and the field starts to increase again until the next lightning stroke.

The height dependence is obvious from the cause of the noise. The charge attracted from the ground heads to the high points on the structure where it tries to start streamers to connect with the cloud. Since these are relatively low power discharges they don't radiate very far so basically only the antenna that is generating the corona hears them. So the top antenna can have lots of corona noise while those further down the tower may not have any.

TV RFI cleanup

A couple years back the old TV finally gave up the ghost, or got a ghost, or something like that. In any case it had to be replaced. I considered getting a plasma set and some other flat screens but was not convinced that they were going to be quiet enough. So I settled for a regular old big tube box. While I was at it I also picked up a DVD player. Great, get it home and first chore is getting it upstairs to the living room. After considering several options I determined that even with the help of my neighbor we couldn't carry this monster up the stairs. So we just took the box (which fortunately fit between the outside deck stair railings) and rolled it up the stairs end over end. Then we had to take it out of the box since it wouldn't fit through the door. Great, build new stand, get neighbor back to pick it up and put it on the stand, wire up all the other stuff, and enjoy!

Then I turned on a radio on 160m… oops, what is that horrible noise?!?! Turn off TV and it goes away. Double oops. Check other bands, nothing there, just on 160m. Ok, try line filter, wrap cables though some ferrites I had laying around, not much help. Take a roll of aluminum foil and wrap up the set a bit, noise drops way off, must be coming right through the case.

Step 1. Slide a piece of aluminum under the set to shield the bottom. Then get a roll of heavy duty aluminum foil and wrap up the rest of the TV. Also, add a small fan in the back to make sure it doesn't overheat. Noise all gone!

Figure 852 Shielded TV

This was good before the contest. All the noise was gone from 160m and there wasn't anything on other bands I could hear. However once the contest started there was TVI! Not too bad on the satellite receiver, but pretty bad on the DVD player with it surround sound system. I suffer though a couple contests by telling the off operators that they should be sleeping rather than watching the TVI… but this is not good.

Step 2,3,4,5… Ok, fall contests over, time to fix this thing. So I order up a bunch of ferrites and a box of shielded speaker wire. First run shielded wire to all the speakers and leave a few extra feet in the back of the enclosure. Set up antennas for stress test, turn the bottom 10m, 15m, and 20m Yagi's right at the house, and fire up all the amps… the run a long ptt wire from the shack to the living room. Run through all the bands and make notes on interference levels to video and audio. Then start on the ferrites… big ones for the power cords, smaller ones for every speaker, video, and RF wire between all the components. After each component is done test again. Getting better. The DVD audio is cleaned up just fine, most of the video interference is gone except from 15m. But playing the satellite receiver through the DVD audio link is really bad! The funny part is that this link is digital data from a fiber optic output on the satellite receiver that goes through a converter and into a phono jack on the DVD player. Anyway, now that everything has ferrites there aren't many other things to try. The last of the video interference is stopped by running separate chassis ground wires to the shielding foils. The last one that stops the 15m interference is a jumper from a phone plug shield under the cover on the front of the TV to the shield foil.

So now the only problem is that digital audio link. And it is bad, it doesn't take much RF at all to totally wipe out the audio. I double up the ferrites on the power and copper line to the DVD player, but that doesn't help. So I go back to the roll of foil and wrap the case in foil and ground it to one of the phone plug shields. At last, no more interference. Stupid plastic cased converter!

Oh, and yes, in the picture above that is a UPS. It is there more for the phone line lightning protection than anything else. But it does let me watch events for about 15 minutes while our power was out here during the big NYC blackout. I have had two of those satellite boxes fail due to lightning surges on the phone line, but not since putting the line through the UPS.

Many ways to do 4-squares

I have built 4-square arrays several different ways now. Not only have the elements changed several times but also the ground system and the phasing and switching networks.

The elements I have used:

- Half's of 40-2cd elements
- Rohn pushup pipe towers shortened to work on 40m
- 48' of chain link fence top rail base loaded for 80m
- 10ga Copperweld for 80m raised verticals hanging from 120' tower

The ground systems:

- Galvanized electric fence wire, lots of it, with galvanized nails soldered on the ends just run on the ground… very messy. This was under 40m and 80m ground mounted verticals when they were concentric for a short time.
- Single raised radial for 80m vertical wires hanging from tower
- 2x4" dog wire plus some galvanized radial wires in swamp under base loaded 80m verticals.
- 4 raised radials per vertical around 40m raised pipe towers
- Single raised radial plus 150' of 2x4" dog wire under 80m vertical wires hanging from tower.

The phasing systems

- Wilkinson power dividers
- Coax stub and transformer system based on Christman method from Low Band DXing book
- ComTek hybrid networks

The first try with the short 40 verticals was with the Wilkinson power dividers. I forget which book this was out of but this is the basis of the design.

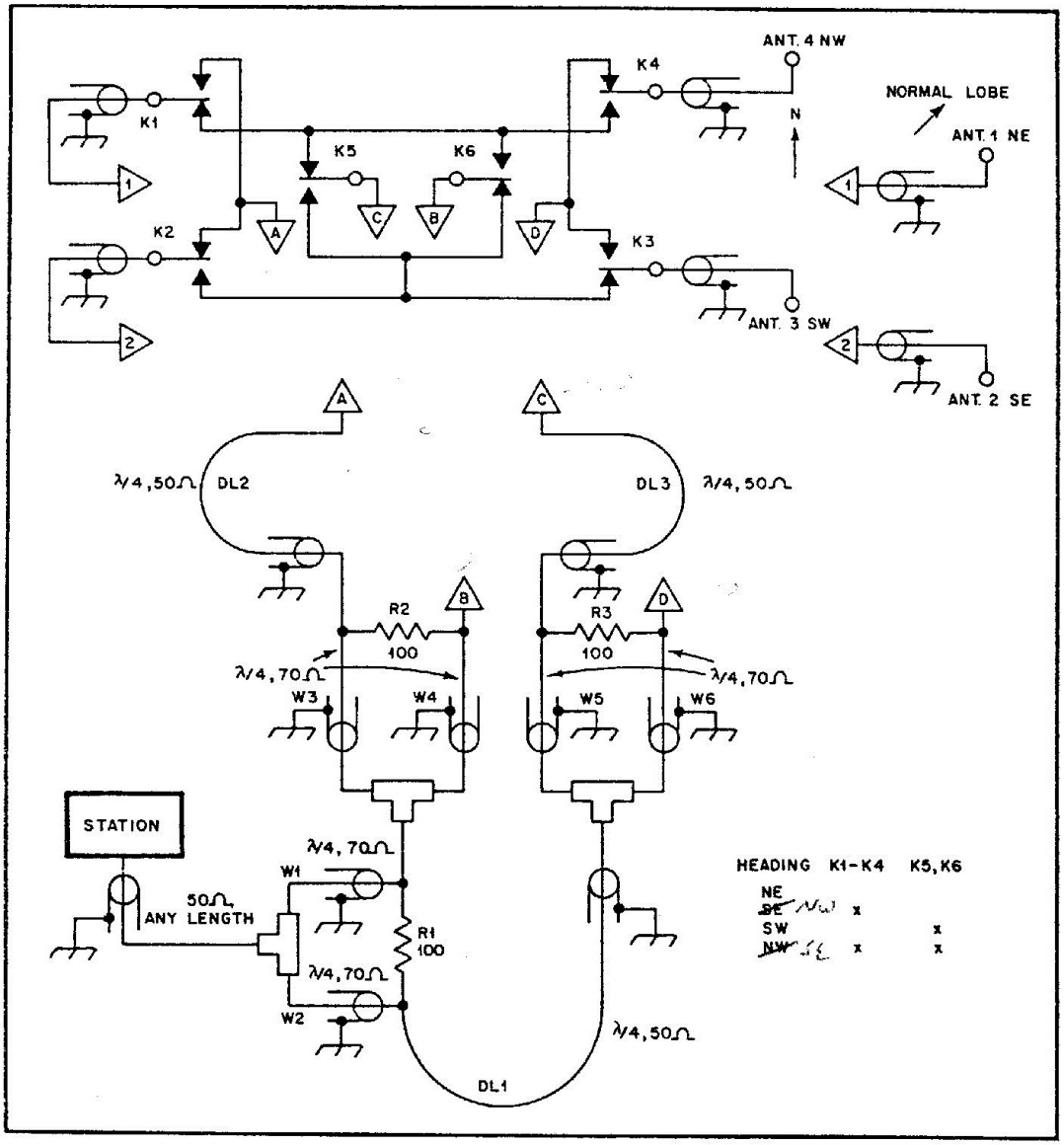


Figure 853 Wilkinson power divider 4-square feed system

The next step in the evolution was a design based on the Christman method in the Low Band DXing book. This method uses capacitors and inductors to build the phasing and matching networks. The advantage of this of course is that there is much less loss in the network. In the Wilkinson system the imbalance in each of the dividers is burned up in he resistors. While this may be ok if you have power to spare and don't care much about receive sensitivity it really is kind of a waste. I used the same switching system as the Wilkinson drawing above, I just replaced the dividing and phasing system with this:

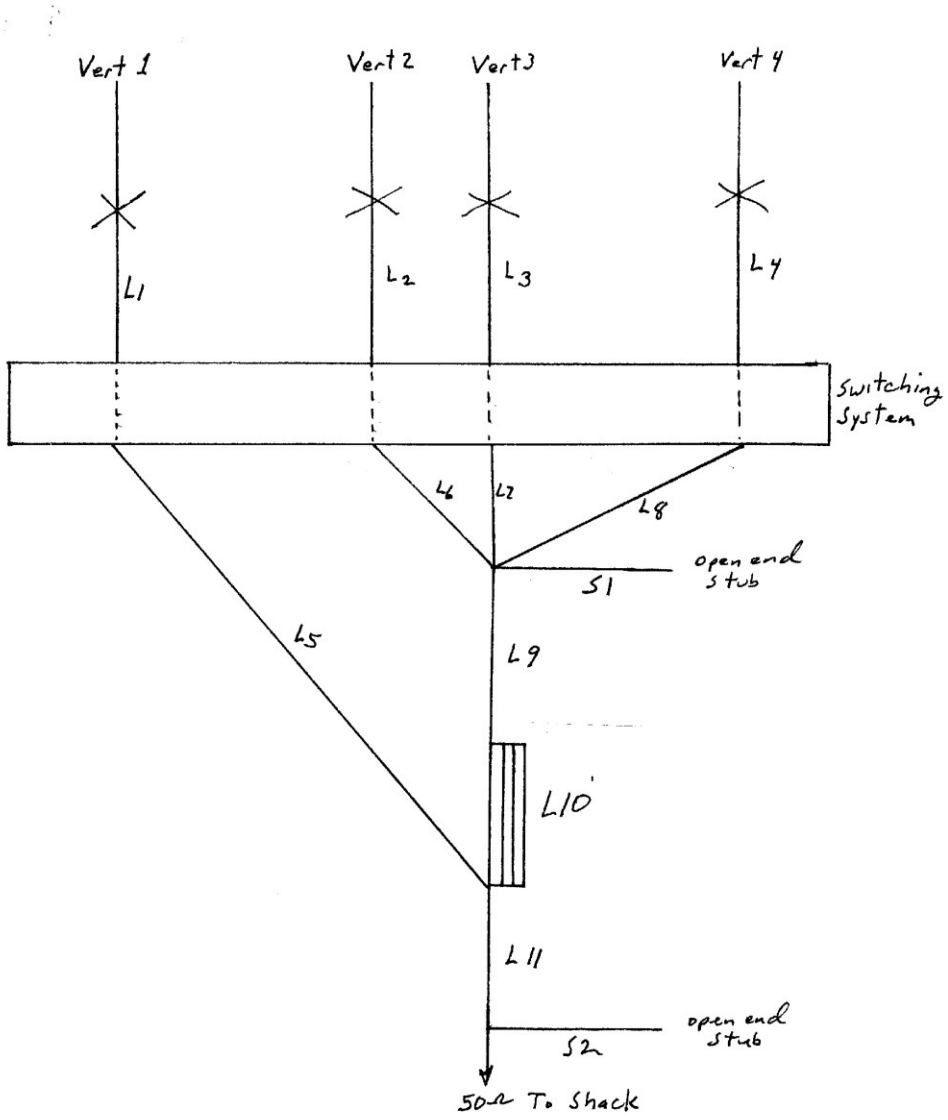


Figure 854 4-square phasing with coax only

The calculations for the sections are as follows:
ALL VALUES BELOW CALCULATED FOR 7150KHZ.

LINE #	z	LENGTH (DEG)	(PHYS)	
Ll-4	50	99	354"	WAS EXISTING LINE, COULD LENGTHEN BY SHORTENING L5-8 THE SAME AMOUNTS
L5	50	40	143"	
L6-7	50	10	35.75"	
L8	50	48	171.75"	
S1	75	77.5	234.5"	OPEN END STUB, COULD BE 50 OHM
L9	50	12	43.5"	
L10	12.5	41	146.75"	4 PIECES OF 50 OHM IN PARALLEL FOR EFFECTIVE 12.5 OHM LINE
Lll	50	29	103.75"	
S2	75	67	202.75"	OPEN END STUB, COULD BE 50 OHM

Electrical Analysis

Ant 1	Ant-2	Ant-3	Ant-4
Feedpoint	Feedpoint	Feedpoint	Feedpoint
Z=3.4-j12.5	Z=39.4-j17.5	Z=39.4-j17.5	Z=63.4+j47.5
I=1A 0°	I=1A -90°	I=1A -90°	I=1A -180°
After L1,5	After L2,6	After L3,7	After L4,8
Z=9.69-j70.8	Z=70.97+j17.73	Z=70.97+j17.73	Z=27.78+j23.64
I=0.59A 175°	I=0.75A -.41°	I=0.75A -.41°	I=1.52A -26.99°

Parallel L6,7,8 S1 Impedance
Z=16.54+j8.54 Z=0-j16.5
I=2.93A -14.01°

After L9
Z=12.8+j0
I=3.33A 53.48°

After L10
Z=12.54-j0.29
I=42.17A 93.8°

Parallel L5,10
Z=11.82-j2.27
I=3.51A 104.5°

After this the current doesn't matter. L11 and S2 are calculated to bring the impedance up to 50 ohms and cancel out the reactance. 50 Ohm coax was RG-8X with velocity factor of .78, 75 Ohm coax was RG-59 with velocity factor of .66.

While this was better than the Wilkinson system it is relatively complex, and is dependent on the feed point impedances of the verticals. I calculated the impedances from a model of the array since I didn't have anything to really measure it with. I used these types of networks for both 40m and 80m for several years and they performed adequately, so I must have been close enough to get reasonable results. The latest iteration of the arrays was changed over to off the shelf ComTek boxes.

TS-870 Beverage Switch

I bought one of the early 870's before I really knew much about it. At first I wanted to use it on 80m or 160m, but quickly figured out that the front end couldn't handle that. So it ended up running 10m. But while setting it up on the low bands I found that it didn't have a provision for a receive only antenna input. To remedy this situation I came up with a quick little project to give it that capability.

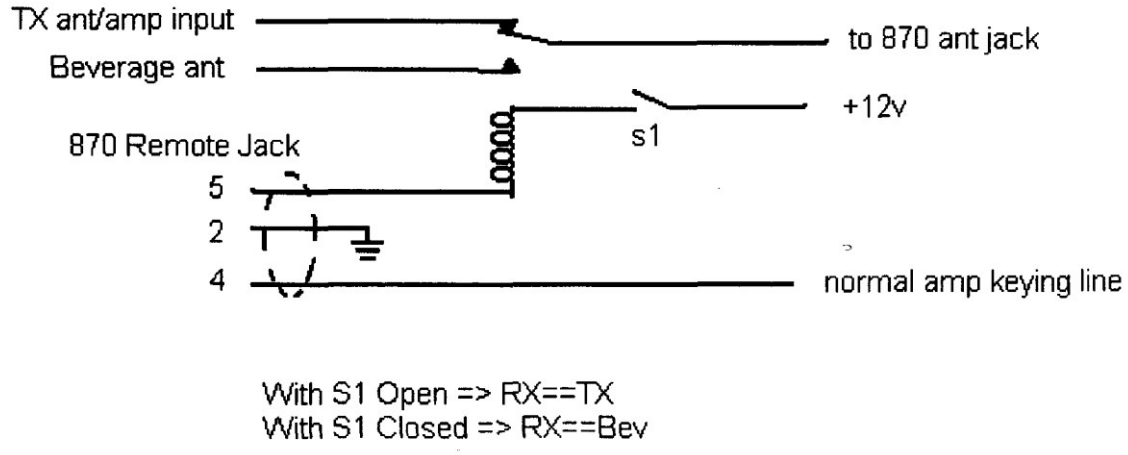


Figure 855 TS-870 Beverage Switch

U-L-BIP-BOP

No, this isn't a new type of music. It is something that was played with for a while but seems to have pretty much fallen out of favor… or at least the BOP part has. The idea was that in addition to being able to choose the top or bottom or both antennas in a stack you might also want to choose both antennas but feed them out of phase. So BIP=Both In Phase and BOP=Both Out of Phase.

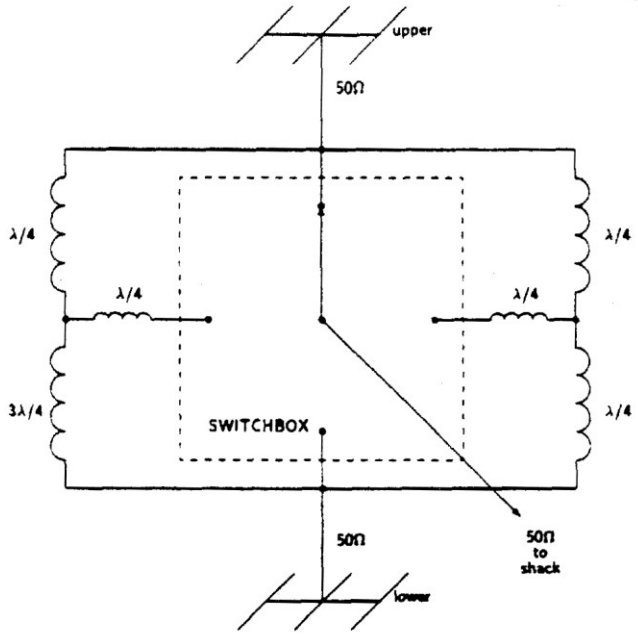


Figure 856 U-L-BIP-BOP Box

This setup uses a non-shorting switchbox like the old Heathkit remote switches or the RCS-8V. There are easy variations to use shorting boxes also. All coax sections are 75 ohm in this design except the lines to the antennas themselves.

Point antennas into the wind or sideways?

I have been asked many times how to point antennas when its windy. Personally I prefer pointing the antenna toward the DX rather than worrying about the wind. Around here we get high winds, but when we do they often don't stay the same direction for very long, so trying to point a particular direction relative to the wind would mean tracking it regularly… my personal feeling is that if the antenna is strong enough to survive the wind then it shouldn't matter. As far as protecting the rotor, a strong constant wind shouldn't bother a properly sized rotor with a well balanced antenna, the problem comes with gusts. In that case if you know there are gusts coming from a particular direction EITHER dead into or out of the wind OR broadside shouldn't matter, the bad direction would be at an angle to the boom. Having gusts hit at 45 degrees off the boom probably is a worst case for rotors since it provides lots of force on one end of the antenna to turn one way, then a large force on the other end trying to swing the other direction. Again, if you can't predict a good constant direction it would take constant monitoring, I prefer well built antennas and good insurance.

Yaesu CAT mod

Many logging programs poll the radio to get frequency and mode information. CT and N1MM are the ones I have used with Yaesu radios and they both needed this modification. Of all the radio modifications I have done, this one is probably the simplest. You start with a roll of electrical tape, black is best, and cut a piece about ¼" by ½". You then carefully sit in your operating chair in your normal position and stick the tape to the front of the display until it just covers the blinking CAT light.

Figure 857 Completed Yaesu CAT modification

The End

Well, if you have read this far I hope you have enjoyed and learned something from this book. I may add stuff in the future, or possibly split out the history from the technical or some other such thing if I get time. (Un)fortunately my long summer vacation that gave me the time to work on this project may soon be coming to an end so I won't have as much time to work on a sequel. Maybe after another 10 or 20 years I'll find time to do another installment.