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NCCC - 50 years of Contesting Excellence

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NCCC January ZOOM Meeting
Sunday Jan 24, 2021
1330-1530

"Automated Antenna Switching"

Bill Fehring, W9KKN

Special Guest — Claudio, I4VEQ

"WRTC 2022"

Details: See

<http://nccc.cc/meetings.html>

President's Report - WD6T

Roundup Redux

By all measures, ARRL RTTY Roundup was a huge success for NCCC. This was a focus contest for us and we all managed to assemble the components to make it fly. Inspired by Ed W0YK's expert presentation at the December meeting, stations were repaired and upgraded, software was wrestled to submission, and RTTY newbies and veterans alike pulled out all the diddle stops.

For me, the week prior to the contest included helping a number of NCCC members with the more obscure corners of MMTTY, WSJT-X, N1MM+ and Windows. But I wasn't only the giver, but also the recipient of Elmer'ing, as I needed to come up to speed on an unfamiliar station and logger. Many thanks to K6TD, ND2T and K6UFO for their help.

The contest itself was a lot of fun with high rates and great participation. It was particularly gratifying to tune across the bands working KB'ers, knowing that every Q counted double for the club. The NCCC participation was excellent and we well-exceeded our log count from last year.

An Unlimited club competition cannot be won only with big stations. It takes operators of all levels of experience, at stations of all sizes, getting on the air for as many hours as they can. That was how we were able to create a winning strategy and bring it to fruition. While the results will not be out for some time, our showing was so strong that I will not be surprised if we win the Unlimited Club Gavel. Winning both this and the RTTY WPX in the same contest year, if we pull it off, will be quite an achievement.

I don't know about you, but I was pretty worn out after RTTY Roundup. I took three whole days before I started gearing up for NAQP CW. January and February are the home stretch for the KB contest, so mark your calendars, take a running start and jump in . . . the solar weather's fine!

73, Dave WD6T



Northern California Contest Club

Excellence In Amateur Radio Contesting

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Thursday Night Sprint:

The Northern California Contest Club sponsors a Thursday Night Contesting session of thirty minutes duration.

Often, on Fridays prior to a major contest weekend, a special practice session is held.

Generally, on Thursday evenings, a special format is followed, called NS or "NCCC Sprint". The NS began in the summer of 2004 as a snappy, concise contest occurring most Thursday nights, North American time. The power limit is 100 watts. Occasionally multi-week ladder competitions are held. See www.ncccsprint.com for details.

| | |
|--|---|
| Thursday Night Contesting Director and Founder | Bill, N6ZFO |
| NCCC CW Sprint | Tom, N3ZZ (initially, Ken N6RO) |
| NCCC RTTY Sprint | Ken, K6MR |
| NCCC Sprint Ladder | Bill, N6ZFO |
| Sprint Web master www.ncccsprint.com | John, K6MM |
| Ladder Scores Manager | Tim N3QE |
| Thursday night Contesting Advisory Group: | N6ZFO, Bill (Chair) |
| | Mark K6UFO, (with W4NZ, N4AF, W9RE, K4BAI, N3BB, VE3YT and W0BH). |
| | Ken, N6RO |
| The Thursday night NCCC Net | |



40m Observations During RTTY Roundup

Dean, N6DE

cqden6de@gmail.com

The 40m band produced some surprises during the RTTY Roundup contest. In this article, I will share an analysis.

Ron N6EE and I operated the RTTY Roundup contest using his GXP 7L7B Yagi. This antenna has 2 elements on 40m and is mounted 60 feet above ground with flat terrain in all directions. Before the contest, propagation analysis showed that the band would be in good shape to run to the USA around 0Z, would keep getting better every hour, and that there would be a European opening between 7Z to 9Z.

On Thursday before the contest, Ron tested 40m. The station was being heard well on 40m by RBNs in the 0Z hour. At 0023Z, N6EE was spotted with 32dB SNR by the WZ7I RBN in PA. However, during the NS RTTY Sprint, our signal was down nearly 3 S-units at 02Z by the same WZ7I RBN. Ron was unable to contact anyone on 40m, noting that everyone sounded weak on the band.

During the Friday RTTY Roundup practice, 40m was open surprisingly well during the 2200Z hour. K3WJV in PA returned my CQ at about 2230Z — much earlier than I expected to be heard by the east coast on 40m.

Then during RTTY Roundup contest, we moved from 20m to 40m at 0Z and were able to generate a good stateside run. We got answers from several east coast stations. At 0029Z, DF2CB returned our CQ with a shockingly strong signal. At 0045Z, we turned the antenna toward Europe and worked Poland, Slovakia, Croatia, Ukraine, Czechia and Spain, all in a 15 minute S&P period. The opening was stunning! Then we resumed beaming stateside, expecting to continue our stateside run even better than before. We could not get a stateside run to save our lives. It was as if the band had dramatically changed. Stateside stations had become really weak, yet we were still able to work some Europeans. We struggled through 40m for the remainder of the evening, mostly S&P. We ended up contacting more PA stations on 80m than on 40m Saturday evening. During 7Z to 9Z hours, we found almost no Europe, making just one European QSO (Portugal). It seemed as if EU was slammed shut during the predicted hours, but opened strongly and unexpectedly about eight hours prior. The reality for us on 40m was very different than propagation predictions. How could this be? The 40m weirdness could not be explained by solar conditions, as the A and K indices were quiet during the contest. 40m behavior should have been a no-brainer, but wasn't.

After the contest, I noticed that the ND2T and W7RN efforts had the highest 40m totals of all NCCC stations. I wondered how they had so much success and why we found 40m challenging at N6EE during the predicted successful hours toward stateside. Since we had experiences with PA on Thursday and Friday, it made sense to try to find an answer using data from the two RBN stations in PA: WZ7I and W3RGA. I compared RBN readings between ND2T, W7RN and N6EE during the RTTY Roundup. I also had email discussions with WK6I, K6UFO, WD6T and ND2T. The results were fascinating.

N6EE: 2-el on 40m at 60 ft. above ground with flat terrain toward the east, running 500W.

ND2T: @K6MTU station: 4-el Yagi at 110 ft. above fantastic downsloping terrain toward the east. Ran 700W max.

W7RN: 4-el at 140 ft. pointed at 45 degrees, permanently phased with a 4-el Yagi at about 70 ft. pointed at JA.

With W7RN on 40m splitting its energy between east and west, power output toward the east could be roughly assumed about equal between all three stations. The big difference between stations is antenna height and terrain. This translates to a major difference in elevation angle energy between stations. A smaller difference is antenna gain of about 3dB stronger at the K6MTU and W7RN stations.

The RBN plots and table of key readings tell the story. In the 0Z hour, the 40m signal from N6EE, W7RN and ND2T were about equal in PA. However, from about 0130Z onward, there became about a 3-4 S-unit difference between the N6EE station and the K6MTU and W7RN stations! Note: ignore the two low ND2T SNR readings around 0100Z. That was when the array was pointed to JA for 20m. (20m and 40m are on the same rotator at K6MTU)

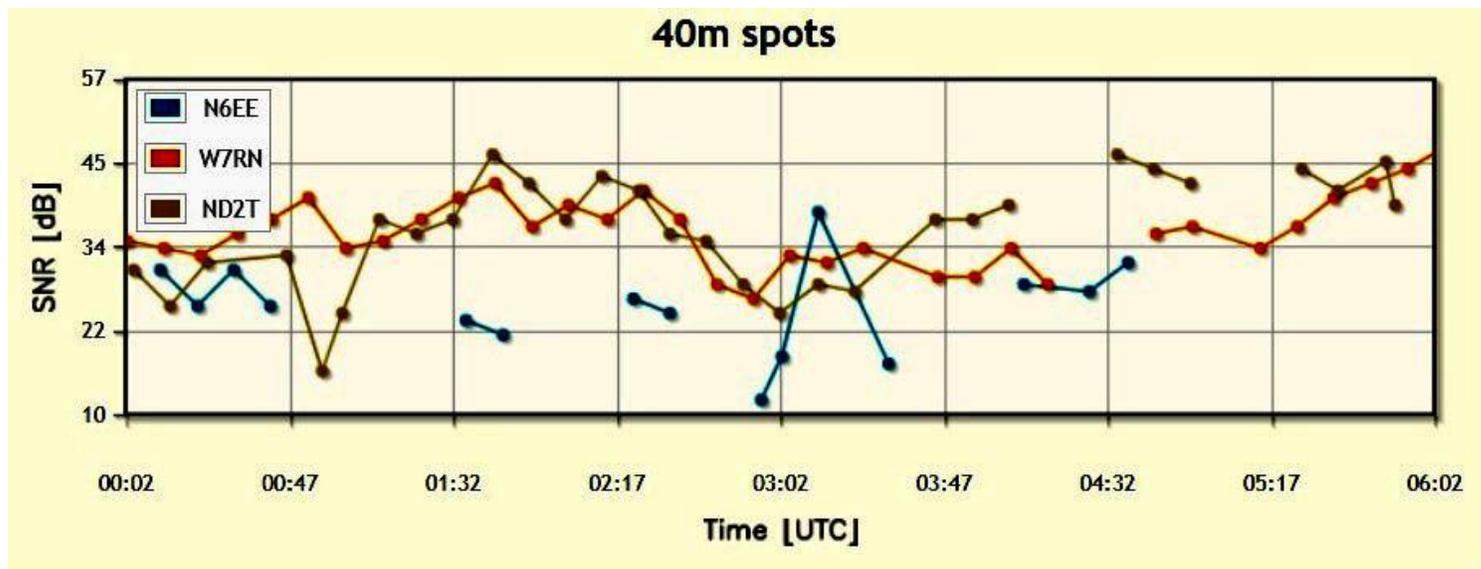
| 40m RBN 03-Jan-21 | N6EE SNR | ND2T SNR | W7RN SNR |
|--------------------|------------|------------|------------|
| WZ7I (PA) 0Z hour | 31dB 0011Z | 31dB 0004Z | 34dB 0012Z |
| | 31dB 0031Z | 32dB 0024Z | 33dB 0022Z |
| WZ7I (PA) 1Z hour | 24dB 0135Z | 38dB 0131Z | 41dB 0133Z |
| | 22dB 0145Z | 47dB 0142Z | 43dB 0143Z |
| WZ7I (PA) 2Z hour | 27dB 0221Z | 42dB 0223Z | 42dB 0224Z |
| | 13dB 0256Z | 29dB 0251Z | 27dB 0254Z |
| WZ7I (PA) 3Z hour | 18dB 0331Z | 38dB 0344Z | 30dB 0345Z |
| W3RGA (PA) 0Z hour | 23dB 0011Z | 27dB 0005Z | 26dB 0010Z |
| | 20dB 0022Z | 21dB 0025Z | 24dB 0023Z |
| W3RGA (PA) 1Z hour | 16dB 0117Z | 38dB 0114Z | 40dB 0119Z |
| | 20dB 0137Z | 38dB 0144Z | 34dB 0143Z |
| W3RGA (PA) 2Z hour | 25dB 0221Z | 39dB 0225Z | 40dB 0224Z |
| | 11dB 0256Z | 30dB 0251Z | 28dB 0257Z |
| W3RGA (PA) 3Z hour | 20dB 0331Z | 40dB 0344Z | 31dB 0345Z |

Table 1. 40m RBN Analysis during RTTY Roundup 2021

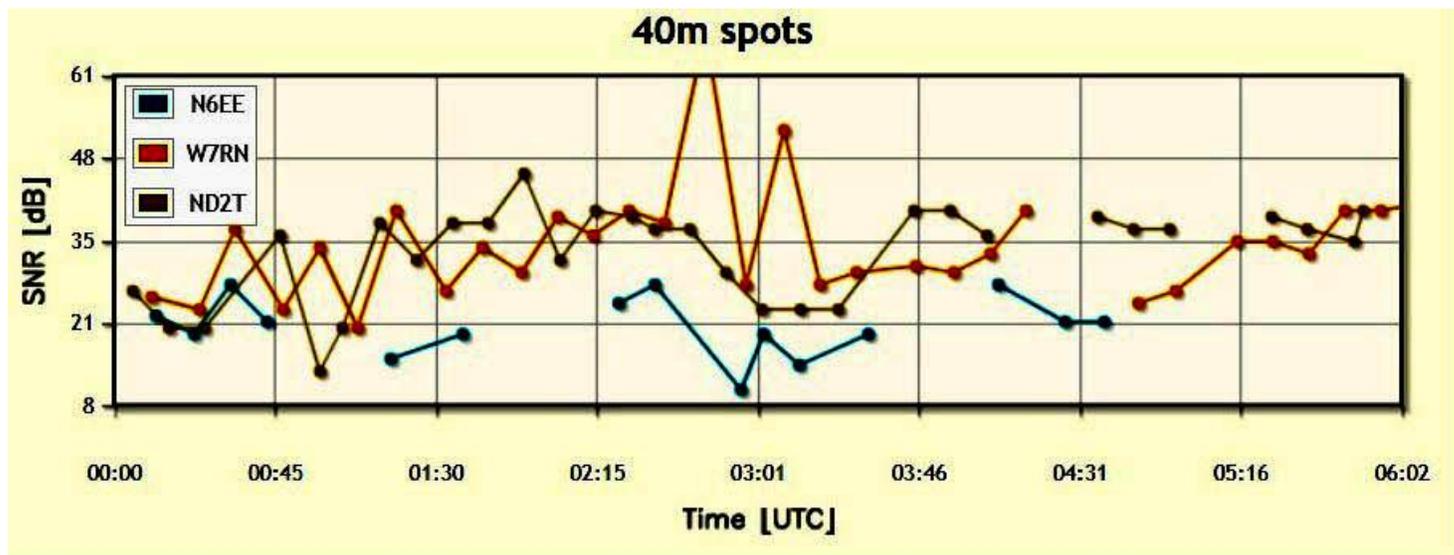
The only explanation for all of this is a steep change in the required elevation angle. It seems clear to me that the elevation angle of the 40m path to PA was quite high in the 0Z hour, then dropped significantly in the 1Z hour for the remainder of Saturday evening.

I have been under the impression that the required elevation angle for a given path is low at the beginning and end of band openings, and rises during the heart of openings. Therefore, I would have expected W7RN and ND2T to be much louder than N6EE early in the 40m opening, and for N6EE to catch up in signal strength as Saturday evening progressed. That clearly was not the case during this particular example. This was a good case study to challenge assumptions about when to move to different bands and on relying too heavily on propagation predictions. It was also a lesson to not ignore experiences on Thursday and Friday before the contest. In hindsight, we could have left 20m at 2300Z and gotten in another hour of running stateside on 40m, instead of working a lower rate of Asian stations on 20m. However, we picked up three new mults at that time on 20m that we didn't pick up the rest of the contest. From a mult perspective, it was the right decision to stay on 20m. This is one of several examples where the stations that had 2 radios highly benefited from being on both bands simultaneously, picking up the best of both worlds.

I still don't have an answer about why there was such a good EU opening during the 0Z and 1Z hours, and a poor EU opening during the 7Z-9Z hours.



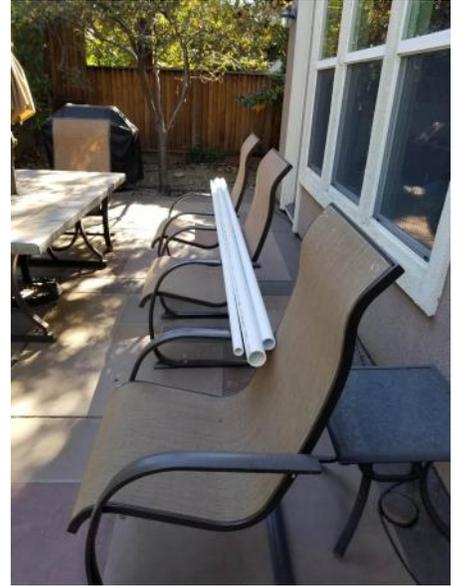
WZ7I Spots of N6EE, W7RN and ND2T During RTTY RU



W3RGA Spots of N6EE, W7RN and ND2T During RTTY RU

Super Compact 160m Band Antenna: Roberto K6KM

For quite some time I have been wanting a 160m antenna. 18 months ago I stumbled upon the article "The no excuses 160m Vertical Helical Antenna" by K6MM. I immediately started to buy the supplies: PVC, 14 gauge wire, etc.... Other projects took precedence and the material was stacked in the garage. Now that the 160m contests are coming up I started the project. Initially I was going to have the vertical against a fence. It is a fact that the performance of a vertical is highly dependent on the radials. I have no room for 1/4 wavelength radials and even less running in all directions. I quickly realized I was in trouble. Then I stumbled upon another article: "The elevated folded counterpoise" by K2AV. It needed only 66ft of length that I could stretch along the fence at 6ft height. One more detail, the counterpoise is short for 160m so he used a transformer to connect to the feedline. Then I stumbled upon another article by Jim Brown, K9YC on a presentation given at Pacificon a few years ago. He replaced the transformer with a simple loading coil and one of his famous feedline chokes. So that was going to be my project, the conjuncture of 3 different approaches to completely minimize the size of my vertical for 160m.



First the PVCs are telescoped with one another making a 24 foot support for the helically wounded wire.



Simulations done by K6MM showed that in order to resonate at a certain frequency a length of wire of half wavelength helically wounded on even spacing is needed. This corresponds to 256ft 5 inches for 160m.

The wire is carefully wound at around one half inch pitch along the support. A hat on top helps distribute the current more uniformly along the mast helping raise the radiation resistance. To make the capacitor hat I used a very nice clamp that I got from Clancy, N6FQQ. He got it from a friend (SK) from a homebrew vertical and he gave it to me. I knew one day it would come handy. Thanks Clancy!

Once the radiator is ready it's time to put a support in the ground so the lower PVC (2 inch inner diameter) can be fit into it. This was done by using a 3 foot piece of a wooden tree support pole purchased at a big home

improvement store. The end usually comes pointy so you can drive it into the ground. I happen to have a piece that did not have the pointy side so I made it myself with a reciprocating saw. To drive the support into the ground I filled up an empty milk jug with water, cut a small hole at the bottom and let the water soak into the ground slowly. Did this a few times until the soil was workable and then pounded the support into the ground with a 6lb sledge hammer.



Super Compact 160m Band Antenna: Roberto K6KM, con't

The next step was to make the counterpoise. A year ago I got a multi-wire cable at the LARK meeting that was brought by one of the members (thanks, whoever that was). It was 50 ft long and it had about 12 wires. It took me a long time to disassemble the wires from the cable but provided me with all the wire I needed for the counterpoise. I used CPVC for the separators, as it is lighter than normal PVC (CPVC is used for hot water and can be found at Lowes in Dublin, CA). The inductor needed to be 17 micro Henrys. I used online calculators for air core inductors. They are surprisingly very accurate. After winding THHN 12 gauge insulated wire on a 3 inch piece of drain pipe I measured the inductance with my NanoVNA



and it came at 17 micro Henrys at the frequency of interest (1.8MHz). Amazing!

Next was to hang the counterpoise on the fence which was a nasty task as I had to trim trees to get around.



Now it was time to build the feedline choke. I got my core from Jim Brown himself in one of the NCCC meetings (actually my first one). It's a 4.2inch type 31 ferrite core and for 160m there are 23 tightly spaced turns of RG400.

This choke prevents signals from coming back to the shack, given the antenna is not perfectly symmetrical.



The way the counterpoise, antenna and feedline choke are connected together is shown in the next page.

The next step was to paint the antenna with a light brown color so neighbors won't notice much. I used the same color as the house and I had to run quickly to the store because my touch up container had completely dried out.

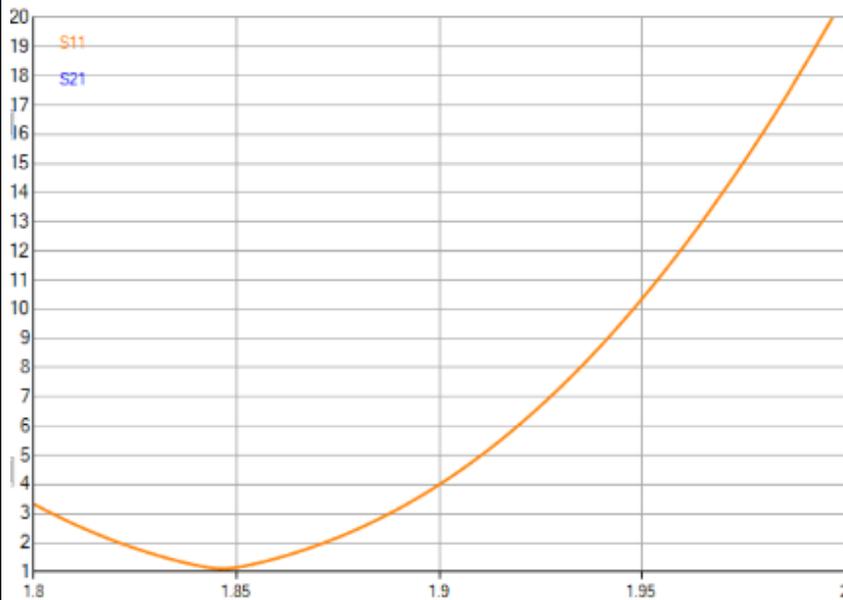


Super Compact 160m Band Antenna: Roberto K6KM, con't

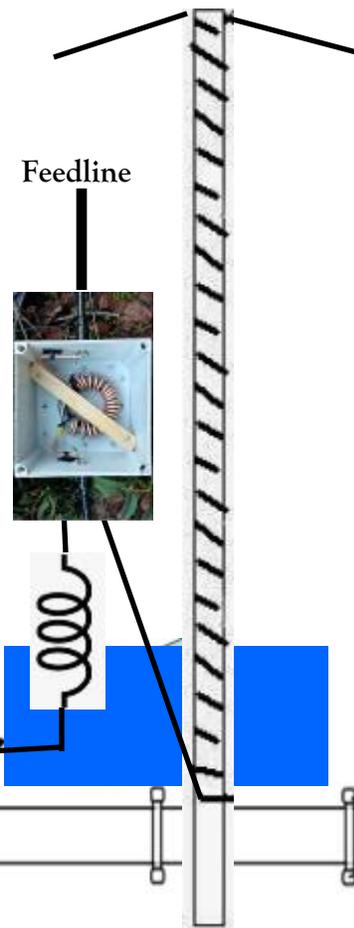
Once everything was ready it looked very intimidating to raise this beast as it was a big noodle flapping around. Gary:, NA6O offered to help me raise the beast and tune it up. There were several ways to tune it, remove turns in the resonator, play with the length of the counterpoise or change the inductance of the loading coil. I knew I had more turns than needed so I decided to tune the antenna by adjusting the number of turns. When Gary measured the resonance, sure enough it was low: 1745 kHz. We removed a few turns and measured the resonance again so as to get a figure of KHz/turn removed. Then I proceeded to remove turns to get closer to where I wanted to operate: 1850 kHz. The FT8 waterhole is at 1840 kHz and I'll enjoy great SWR there.

The final SWR plot is shown and the bandwidth is about 50 kHz with most of the remaining band been available through the antenna tuner.

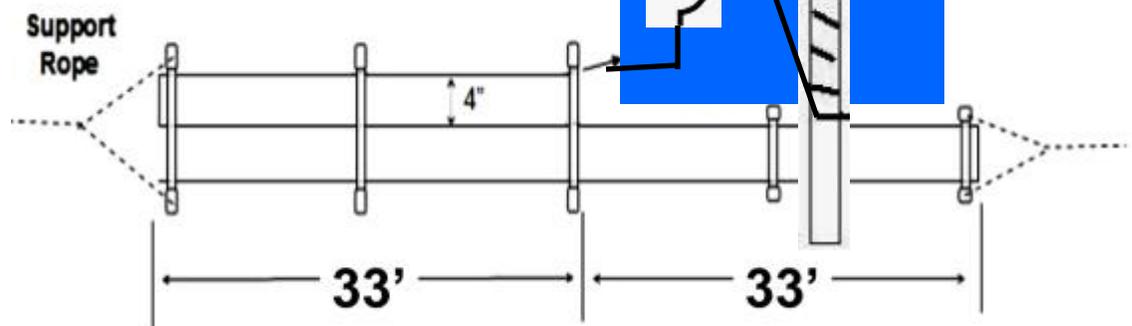
A map of PSK reporter shows the stations that heard me the first night running 500W.



SWR vs Freq (MHz)



Vertical support at center of elevated counterpoise.



Super Compact 160m Band Antenna: Roberto K6KM (con't)

I'm ready now to take on the big guns in the contest, well... not quite but I certainly will have fun fighting the pile ups and can focus on getting WAS on top band and work some DX .

So far I moved from WAS=9 to WAS=35 in FT8. Need those hard W1's... I also made a DX QSO with South Cook Islands. In the Sweepstakes CW, I had no luck. The only station I heard did not hear me.

I'm looking forward to the ARRL 160m Contest coming up. With more activity, I have more chance to fill the gaps in the log.



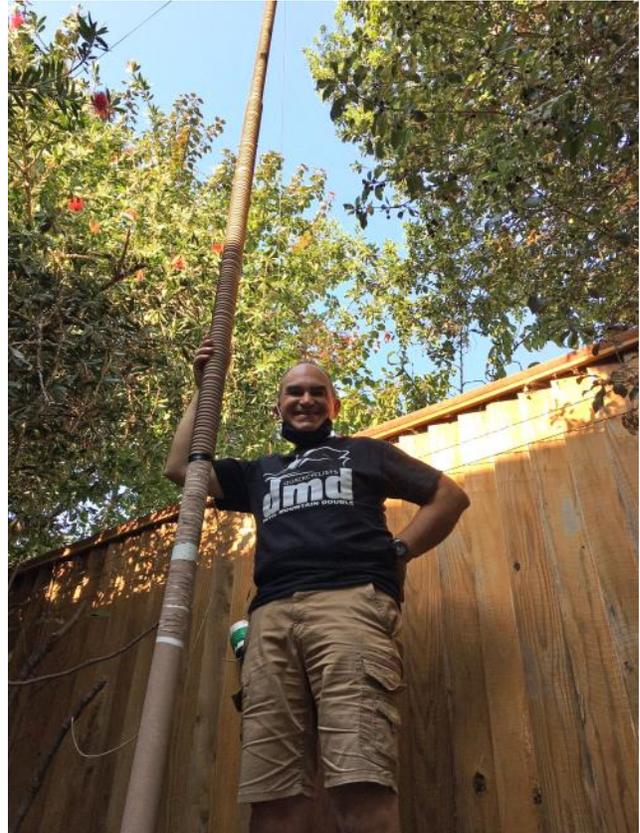
Here is a proud owner of a super compact 160m helical vertical with a folded counterpoise. Quite a mouthful... [WSPR 12hrs overnight 10W](#)

References:

The "no excuses" 160m vertical. John Miller K6MM <https://k6mm.com/antennas/160M-QST.pdf>

The FCP: A 160m folded counterpoise for a postage-stamp lot. NCJ May/June 2012 Guy Olinger: K2AV

Working 160m from a small lot (and large lot too). K9YC Jim Brown. <http://audiosystemsgroup.com/160MPacificon.pdf>



Point Generator Profile

Jim Varney, K6OK

Interviewed by Bob, W1RH

In late August of this year, I was standing next to Chris, N6ICW (not a contester), on Mt Vaca, just a couple of days after the lightning caused LNU Complex Fire burned over the top of Mt Vaca. There are five ham groups (I represent one of them) who lease a building and own a 100 foot Rohn 45 tower at the site. Chris and I were surveying the damage to our site, which included 1200 feet of hard line and some antennas, but our primary concern was the condition of the blackened guy wires. At that point, I suggested that we have Jim, K6OK, who is a PE, do an evaluation. We had him up there the following week and Jim did an extensive evaluation and pretty much gave us a clean bill of health. I asked Jim for his opinion because I know he knows tower engineering. Jim had done many building permit applications for ham towers, including one for me. His attention to detail is next to none, which is why his applications generally sail through the permitting process.

Jim has quietly been building a very nice, remotely controlled, contest station in El Dorado County over the last few years and now both Jim and NCCC are seeing the results of his efforts. In the past year, Jim has become one of the top FT8/FT4 contesters in the Club. A look at 3830 Scores shows K6OK with 568 Q's in the 2020 Bativa FT8 Contest which resulted in a plaque, rewarding Jim for the top score in North America. In 2019, Jim placed #12 in the world, out of 791 entries, in the FT Roundup, with 595 Q's. In this past December's FT Roundup, Jim came in with 665 Q's so he should place very well in the final results of this contest. K6OK also did very well in this year's RTTY Roundup.

Jim is not a one-mode contester, however. He had a claimed score of 264,248 in the 2020 CQWW CW and 84,000 in the ARRL Sweepstakes CW. In the phone contests, Jim did 130,467 in CQWW SSB and 113,400 in the ARRL Sweepstakes SSB contests.

Now, let's hear from Jim:

Name/Call Sign: Jim Varney / K6OK

Past calls: K6VAR

Location: Pilot Hill, El Dorado County (remote station). Residence: Carmichael

How much property do you have? 5 acres. Half is usable, half is jungle.

Describe your antenna system:

Current: I have two 65 ft towers, one with a modified Optibeam tribander and a restored 40-2CD 2 el coil loaded beam for 40 meters on the other. An 80 meter dipole at 60 ft is strung between them. There's an elevated 30 meter ground plane vertical, and a 60-ft inverted L for 160, both using 3-inch aluminum irrigation pipe. For the low bands I'm using two supersized K6SE receiving loops, one pointed NE for EU and East Coast, the other pointed NW for JA and Asia.

Future: I'm thinking of adding an 80 meter vertical for transmit.

What's your station design philosophy? My design goals are:

1. Build a homebrew remote station where everything is IP addressable with no proprietary black boxes.
2. A medium pistol station that supports both contesting and DXing, in equal measures.

It's a work in progress. I could have had my remote capability done a long time ago if I had purchased off the shelf devices. But that's not for me, I wanted to roll my own so I can configure it exactly how I want and to be able to fix

whatever breaks. I'm fascinated by internet-of-things devices. I've learned a lot: Linux, Bash scripting, Python programming, the Qt GUI designer, networking with ZeroTier, KiCad circuit board design, sending Gerber files to China to get PCBs made. I still have more to do and learn!

What are your previous QTH's? I used to contest with 100 watts from home, a small suburban lot. I'd put up fan dipoles on contest Fridays and pull them down on contest Sundays so no one would complain about ugly poles and wires.

If you're working, what is your career? If not, what was your career? I'm retired after working 32 years for the state as a civil engineer.

Married? Kids? Grandkids? Christine and I have been married for 32 years. We have one daughter. She's in her final year of law school and lives with her husband in Kansas City.

How many DXCC entities have you worked? 207 worked, 202 confirmed.

What's your favorite contest? Not easy to choose one favorite, but I'd have to say WW Digi. I like how it emphasizes long distance DXing instead of rate, rate, rate. The scoring rules are as close to a level playing field as I've seen. In the last one I edged out a famous east coast station who was SO2R while I was only SO1R. My guess is he was busy doing 3-pointers with Europe while I was going long doing 4- and 5-pointers with Asia and Oceania. West coast advantage!

I also very much enjoy the WPX contests, RTTY Roundup, and CQP of course.

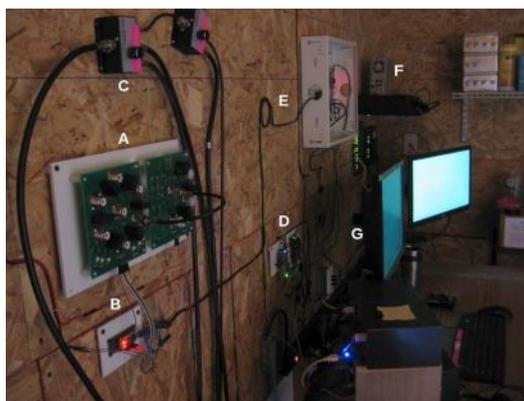
Any tips for testers? Ha, I've had some late starts because I thought I could get N1MM, the function keys and the radio set up 10 minutes before the contest starts. Now I try to get things configured at least a couple of days before, and I do some pretend practice QSOs to make sure all goes smoothly.

What would you like to see changed in NCCC? I'd like to see more club members use the online scoreboards. Seeing scores in real time during a contest is fun and it encourages you to stay in the chair longer!

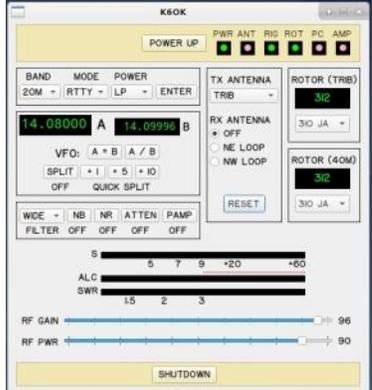
Any other hobbies besides ham radio? Not a hobby but on the side I very much enjoy using my civil engineering background to prepare plans, calculations and reports to help hams obtain permits for towers. When I see a club member on 3830 reporting a score after using my services, I get a lot of satisfaction out of that.



Jim, K6OK, standing, with pride and satisfaction, by his tower.



Controller application used to run the station remotely. Written in Python using the PyQt5 GUI environment. The learning curve was quite steep here.



A. Homebrew antenna switching, version 3. It's designed to be compatible with either Raspberry Pi (3.3V logic) or Arduino (5V logic).

B. Chinese Arduino Nano clone that flips the antenna switch relays. Long black cord is a USB cable.

C. Cheap temporary manual switches for use until A is completed.

D. Two Linux devices: a NanoPi Neo Plus2 is connected to my Icom 7300, while a Pine Rock64 drives two HyGain rotor boxes. These linux devices either command the radio and rotors or report their status, via the VPN using UDP packets.

E. In the cabinet is a NanoPi Neo linux device, dedicated to antenna switching. It takes UDP commands from the VPN and sends them to the Arduino. There is also an old Raspberry Pi that acts as a TX/RX switch when the receiving loops are used (the ICOM 7300 does not have an RX only connector).

F. Old small office PC running linux. Currently testing GStreamer to provide low latency audio in and out. This box will be dedicated to that.

G. Not visible is a NanoPi linux device that commands a DLI 120V power relay to turn power on and off remotely. The shack PC under the desk is dual boot Windows and Linux, configured to self boot on power up.

Tube Of The Month

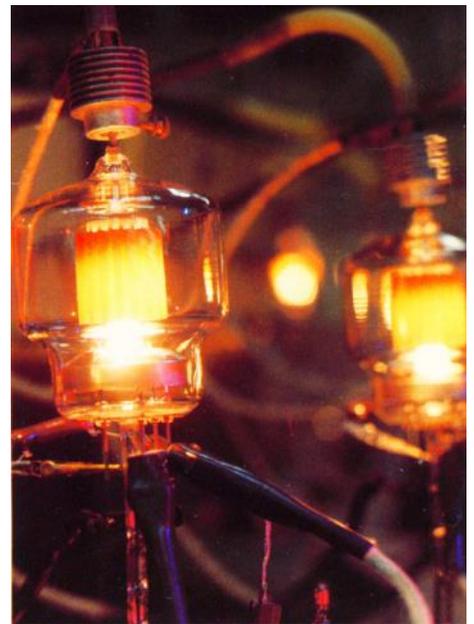
Vacuum Tube Processing

Norm, N6JV

In the late 1930s, the military was busy developing RADAR. They were searching for vacuum tubes that would handle very high voltages in pulse mode. Most manufacturers used “getters” to complete the evacuation of transmitting tubes. In high frequency RF use, this worked fine, but when the tubes were run at five to ten times the rated voltage, they tended to be damaged when they shorted. EIMAC had long used “hard glass” to handle higher vacuums and their tubes tended to survive the pulse service. They also used tantalum grids and plates as that material could be used at high temperature and would act as a getter. EIMAC also found that running the tubes at heavy overloads during the vacuum pumping process would remove even more gas. In pulse service the 4-400A was run up to 20,000 volts. The tube would need to be tested at even higher voltage. The photo shows a rack of 4-400A tubes being processed at the EIMAC plant in Salt Lake City. This photo was courtesy of the late Lane Opton, a former EIMAC plant manager at Salt Lake City.

No matter how much you pump, there will still be some particles clinging to the tube's elements. This is dust at the ion level. Under an electron microscope, a pane of glass looks like the surface of the Moon. The plate of a tube is even rougher. Any high spots on the elements surface will be the first places that voltage breakdown would take place. Using a high voltage, low current, DC power supply called a hi-pot tester, the voltage is advanced until an arcover takes place. It's at a low current and no damage occurs, but the high spot is zapped and it release any gas on it. The process is then repeated until the tube handles the desired voltage. The polarity is then reversed and the process repeated to process the opposite surface. In tubes of 35,000 to 100,000 watts dissipation, this test voltage would be around 60,000 volts with a current limit of 3 ma. If a tube was transported or bumped around, it might need to be re-processed. This isn't a big problem with ham equipment, but it does exist with both tubes and vacuum capacitors. The GS-35b Russian triode is famous for its destructive arcing when stored for 30 years, but it can be re-processed and saved.

The internal surfaces of the plates of high-power vacuum tubes are usually unplated copper. The external surfaces are plated to stop oxidation. Copper, when exposed to high vacuum, will actually result in the copper crystals starting to grow. Eimac called the growth of high spots as developing barnacles. De-barnacling was recommended when tubes were shipped or stored for long periods. The process actually melts the tiny crystals that grow and produce a sharp edge or peak.



4-400A's in the processing rack
EIMAC plant in Salt Lake City

*Photo by Lane Opton, former
plant manager for EIMAC*

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If you wish to join NCCC, please fill out an [application for membership](#), which will be read and voted upon at our monthly meeting.

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- Northern California, anything north of the Tehachapi's up to the Oregon border, and
- A part of north-western Nevada (anything within our ARRL 175-mile radius circle centered at 10 miles North of Auburn on Highway 49).

Life Memberships.— \$250.00 Contact secretary.nccc@gmail.com. The 80/20 Rule: Members who have reached 80 years of age have and been a NCCC Member for 20 years are eligible for Honorary life membership. Contact secretary.nccc@gmail.com

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Your help allows us to produce a quality newsletter. Please consider submitting an article!

The editor welcomes any and all relevant articles for inclusion in the JUG.

The preferred format is MS Word (.doc or .docx), Arial 11 point. Indicate the insertion point and title of diagrams and pictures in the text and attach photos separately. Pictures should be full resolution. Avoid PDF files and email text. Please contact us if that's your only format.

Send material to Bill, N6ZFO at n6zfo@arrl.net 415 209-3084

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The NCCC reflector is devoted to the discussion of contesting.

Topics include, for example, contests, station building, dx-peditions, technical questions, contesting questions, amateur radio equipment wants/sales, score posting, amateur radio meetings/conventions, and membership achievements.

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