JUG

Publication of the Northern California Contest Club

NCCC

Issue **563**

April 2019

CALIFORNIA REPUBLIC

Inside this Issue:

NCCC May Meeting

Cattlemen's, Restaurant
2882 Kitty Hawk Road, Livermore,
CA 94551

May 11th, Saturday

11:30 am Social Hour, 12:30 pm Lunch,
1:30 pm Program (approx.)

Presentation: Activate Fifty-Eight - The
County Expeditions of CQP 2018
by Glen W6GJB
Or Visit http://nccc.cc/meetings.html

Presidents Report:

Contest Automation

Remember the "good old days" of contesting? Paper logs, pencils, paper dupe sheets, hand keys, mechanical pencils, Vibroplex keyers, tape loops… These things, and many more have come and gone in contesting. What do they share in common? Tedious tasks that required manual work just to be able to compete. Things we thought hard about, dreamed to replace somehow, researched, saved, and finally found a way to do better just to improve how we contest.

Let's take a look. At one point all contacts were recorded on paper, normally written in pencil. The normal choice was to sharpen a few dozen pencils before the contest, then swap the one you were using out as it became dull. The first automation here was to replace the dozens of wooden pencils with one mechanical pencil. Just click and we have more sharp lead to write with. The hand key we used in CW contests gave way to mechanical paddles and then finally to electronic keyers, made from vacuum tubes, transistors and finally integrated circuits. What a treat when WB4VVF came out with his Accu-Keyer! In time these gave way to keyboard keyers where you simply typed the message on the keyboard and didn't have to touch a paddle at all. Imagine that!

Officers:

President	Jack Brindle	W6FB	jackbrindle@me.com
Vice President /Contest Chair	Hank Garretson	W6SX	w6sx@arrl.net
Treasurer	Tom Carney	K6EU	treasurer.nccc@gmail.com
Secretary	Greg DesBrisay	N6GD	secretary.nccc@gmail.com
Past President	Bob Hess	W1RH	w1rh@yahoo.com
Director	David Jaffe	K6DAJ	k6daj@arrl.net
Director:	Bill Haddon	N6ZFO	n6zfo@arrl.net
Director:	Bill Fehring	W9KKN	bill+nccc@w9kkn.net

Volunteers:

New Member Mentor	Al Rendon	WT6K	wt6k@arrl.net
Charter Member	Rusty Epps	W6OAT	w6oat@sbcglobal.net
Awards Chair	Gary Johnson	NA6O	gwj@wb9jps.com
CQP Chair	John Miller	K6MM	k6mm@arrl.net
K6ZM QSL Manager	George Daughters	K6GT	k6gt@arrl.net
K6CQP,N6CQP,W6CQP QSL Mgr	Ed Muns	W0YK	w0yk@arrl.net
NCCC Email reflector Admin	Phil Verinsky	W6PK	kb-w6tqg@verinsky.com
Webmaster	John Miller	K6MM	k6mm@arrl.net
Webinars	Bill Fehring	W9KKN	bill+nccc@w9kkn.net
JUG Editor	Ian Parker	W6TCP	w6tcpian@gmail.com

Thursday Night Sprint:

The Northern California Contest Club sponsors Thursday evening (NA local time) contest practice sessions of 30 minute duration.

On the Thursday (and, sometimes Friday also) prior to a major contest weekend, the practice format follows the upcoming contest.

Generally, on other 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.

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.
non-NCCC:	Tim N3QE (Ladder Scores manager)
Thursday night Contesting Advisory Group:	N6ZFO, Bill (Chair)
	Mark K6UFO, (with W4NZ, N4AF, W9RE, K4BAI, N3BB and W0BH).
The Thursday night NCCC Net	Ken, N6RO

Eventually computers became somewhat inexpensive and many enterprising hams began to use them in their contesting efforts, replacing at first the paper dupe sheets and then quickly the paper logs. The very first of these to be advertised was the Scelbi 8008 system from a small company in Connecticut. It didn't do much, but it did allow us to dream more!

And so we dreamed. And worked. Automating anything we could to make things easier for us to contest. As more features were built into our rigs, such as CW and voice keyers, we made use of them to eliminate tedious tasks so we could concentrate on making more QSOs and drive our scores higher. Pretty soon it became clear that you were at a huge advantage if you didn't have the latest technology. We have continued to evolve, and now a computer running one of the modern contesting programs is a must-have just to enter the contest. In fact mode contest sponsors expect this and don't even accept paper logs any more. Things progress, better technology, things like signal waterfalls and bandmaps are now common to help us pick out stations, skimmers to help us identify them, and so forth. The assisted vs non-assisted debate continues, but it is clear that technology marches on, driven by us, and created by many of us who have the vision to make things easier as we contest. One of the main purposes of amateur radio is to drive technology forward, automating contest operation is definitely one are we do this. Is it good? Bad? Perhaps both, and neither, but it does move the marker forward. As in piloting a complex jet aircraft, the idea is to offload chores from the operator to the automation to make our experience easier and better.

Over the years there has been talk and several magazine articles about the "ultimate" in contest automation, complete computerization of the contest effort. Most of these have been humorous articles, perhaps where the computer locks the human out of the shack or something similar. Most had one thing in common - this was something we definitely did not want to do. But, is it?

From a technology standpoint, there is great difficulty in fully automating voice contesting, a but less for CW and perhaps RTTY contesting, but with recent development in the digital area the technology is now catching up to the point where we can actually automate the QSO, along with the selection of stations to QSO with. FT8, and the new FT4 modes require small bandwidth, while giving us the engines needed to power complete error-free QSOs. The software is becoming smart enough that it can select stations we haven't worked previously or need for multipliers. All that is needed is for the human operator to push a button to enable operation after each QSO. It is a short step to automating this as well so that we simply watch as our computer works the contest for us. What would be the next step? Perhaps the computer can monitor other bands while it works the current one so that it quickly determines the best time for a band change in order to keep the rate high. Again, with the digital modes the received signals are always error-free, and contain information needed to make these choices. Essentially we are on the threshold of being able to fully automate every aspect of a digital contest operation. Just start the program before the contest, then sit down and watch as the computer does all the work. In this case the real work lies in setting up the computer and software for the effort, something that takes brain power outside of contest times, although even that is getting easier with the various hardware and software modules that are becoming available.

But, is this legal, and is it allowed in contests? Let's take a look at the FCC rules. The pertinent section is in 97.221, "Automatically controlled digital station." This is a short section that outlines the frequencies that are allowed along with bandwidth. It states:

97.221   Automatically controlled digital station.
(a) This rule section does not apply to an auxiliary station, a beacon station, a repeater station, an earth station, a space station, or a space telecommand station.

(b) A station may be automatically controlled while transmitting a RTTY or data emission on the 6 m or shorter wavelength bands, and on the 28.120-28.189 MHz, 24.925-24.930 MHz, 21.090-21.100 MHz, 18.105-18.110 MHz, 14.0950-14.0995 MHz, 14.1005-14.112 MHz, 10.140-10.150 MHz, 7.100 -7.105 MHz, or 3.585-3.600 MHz segments.

(c) Except for channels specified in §97.303(h), a station may be automatically controlled while transmitting a RTTY or data emission on any other frequency authorized for such emission types provided that:

(1) The station is responding to interrogation by a station under local or remote control; and

(2) No transmission from the automatically controlled station occupies a bandwidth of more than 500 Hz.

Now let's apply this to the new FT4 operation. FT4 requires 90 Hz of bandwidth, which fits nicely in the bandwidth requirement stated in subsection (C)(2). Most likely we can set things up so that the interrogation point is maintained, but this does bear the question as to who initiates the operation. Perhaps pushing the "go" button at the beginning of the contest enables this and all other operation is in response to being called. I am sure if we work hard enough we can satisfy this requirement. And while there isn't very much bandwidth available on each band, we certainly should be able to fit quite a few stations into the specified frequencies. Just looking at 20 meters, we have 5 KHz to work with, which should fit at least 5 FT4 stations simultaneously without overlap in a given area.

What all this says is that from a legal standpoint, we actually may be able to make the operation happen. Next we need to look at contest rules. Every current contest has a prohibition against fully-automated operation. It is a choice the contest operators have made, preferring to include human operators instead of silicon ones. What this means is this: we would have to create a new contest with our fully-automated operation and rules to make it happen. Another roadblock removed.

We have now come down to the point where we have the technology, the legal requirements and rules for a contest that not just allows, but encourages fully-automated operation. Can it be done? Well, yes. And we have a champion for this, our own K6MR. Ken, the ball is in your court, perhaps it is time to make it happen.

Now that leads to another question - is it worthwhile to do? The challenge of setting up a fully auto-mated station and operation is very interesting, and I am sure there are some who wish to do this. If you look at other sports you will find very few that are fully automated with no human operation dur-ing the contest. Perhaps we really want to be involved after all, or perhaps there are other reasons. What this leads me to believe is that while there may be some folks who want to participate in the effort, in the long run it will be short lived as folks will prefer to do the actual operating themselves. At the same time, the technology that is developed in the effort will most likely become very interest-ing and will itself become integrated into the human-operated contests. Perhaps it is that technology that makes this not just worth doing, but something we need to do. The roadblocks are gone, is it time for the new adventure?

73!
Jack, W6FB

VP/CC Report:

I am honored and delighted to be your new VP/CC.

My goals are: 1. Encourage and help NCCC members enjoy contesting. 2. Encourage and help all hams to try contesting and perhaps become one of us. 3. Continue the NCCC tradition of excellence in all we do.

W6SX Prime Directive: The first rule of contesting is to have fun.

W6SX First Corollary: Share the fun.

W6SX Second Corollary: We all get better together.

CQWW WPX. We did great in the SSB contest. Lots of really big scores and, just as important, lots of participation. 3830 analysis by N6ZFO and N6DE shows we are is in the hunt with PVRC and YCCC for the combined SSB/CW WPX Aggregate Club plaque. Everyone, please get on for WPX CW. We can win the whole thing. What we need is lots of participation. Big score, little score, just get on and have fun. Watch nccc.groups.io for more WPX information.

W6SX Antenna Report. It has been a super winter. Lots and lots of snow, which is one of the reasons I live in Mammoth Lakes. But, also ferocious winds did a number on my inverted-V fan legs.

I've made temporary repairs and am limping along until I can fix things properly when the snow melts, probably not until late June. In the meantime, thank goodness for sixty-five-year-old Matchboxes that can tune just about anything.

Contest Exuberantly,

Hank, W6SX

NCCC Officers 2019-2020

the 2019-2020 NCCC officers/BOD members were elected at the meeting this evening. In a rarity for the club, we actually had paper ballots to vote for the board members, selecting three form the slate of four candidates. So, who was elected?

President: Jack, W6FB
Vice President/Contest Chair: Hank, W6SX
Secretary: Greg, N6GD
Treasurer: Tom, K6EU
BOD Member: Bill, W9KKN
BOD Member: Bill, N6ZFO
BOD Member: David, K6DAJ
and, returning as past president: Bob, W1RH

Congratulations and thanks to all, and a big thank you to the 2018-2019 board members. We really appreciate all your work and help to make this the best contest club anywhere.

Also, Congratulations to the many award winners this evening, including those who won RTTY RU awards, KB awards, CQP awards, and the various club awards.
For the latter, congrats to:

CQWW DX Founders Award: Bob Wolbert, K6XX
NCCC Rookie of the Year: David Jaffe, K6DAJ
NCCC Most Improved Contester: Bill Fehring, W9KKN
NCCC Elmer of the Year: Gary Johnson, NA6O
NCCC Team Builder: Gary Johnson, NA6O
NCCC Inspiration Award: Bill Fehring, W9KKN
NCCC Operating Excellence Award, CW Mode: Tom Georgens, W2SC
NCCC Operating Excellence Award, SSB Mode: Bob Cox, K3EST
NCCC Operating Excellence Award, Digital Modes: Ed Muns, W0YK
NCCC Most Valuable Player: Bill Fehring, W9KKN
NCCC Contester of the Year: Dave Tucker, KA6BIM

Three President's Awards were given out, these for:
Rob Brownstein, K6RB: "For advancement of the art of CW and long-term service to the club"
Ian Parker, W6TCP: "For service to NCCC above and beyond the office of Secretary"

and a Technical Merit Award to:
Jim Brown, K9YC: 'For service to the amateur radio community through research and technical publications"

And, not the least, another award was given out. This one made by Jim Tiemstra, K6JAT on behalf of the ARRL Contest Branch.
It was the gavel for winning the 2018 RTTY Roundup, awarded to NCCC VP/CC Chris, N6WM for NCCC.

Congratulations and a big thank you to all! Now lets do it again this next year, even bigger and better!

Jack W6FB

In Support of (or Defense of) Phone Sprint

By Andy Faber, AE6Y
4/07/19

Sprint contests are definitely an acquired taste. Whenever the Club CW Sprint Organizer, Bob, W6RGG, emails me to ask about participating in an upcoming CW Sprint, I invariably hesitate and try to explain my love-hate relationship with those contests. Then I usually do participate. After all, they really get the adrenaline flowing, and ultimately only last four hours so they don't wreck your weekend. However, the activity level seems to have been static for years. I almost always finish a little below 300 Qs, typically 15 or 20% behind TV-Bob, and somewhere mid-pack on a Club Team. I've broken 300 once or twice, but generally each such contest gives me a feeling of déjà vu all over again, as my 300-QSO goal is like Kipling's Yellow-Dog Dingo, never getting nearer, never getting farther.

But Phone Sprints are a horse of another feather, so to speak. For some reason, the Club's big gun CW operators avoid the phone versions, and that seems to be true of many North American top-tier CW guys. But they really are a lot of fun, and I'd like to urge greater Club member participation.

The NCCC won both Phone Sprints in 2018, and we appear to have just narrowly dropped into second place, behind the SECC, in the most recent one in March of this year. Phone Sprints went into a period of serious decline about 10 years ago, but have been revived recently due to the efforts of a number of contesters, including Bob, KW8N, and our own Chris, N6WM. In the inaugural event of the "new series," in 2015, participation was great with plentiful mults (for example, I worked 59 mults, an unheard-of number for a CW Sprint).

Participation has leveled off lately; thus, only KH7XS topped 300 QSOs in the most recent version (at 302!), whereas it is typical for winning CW scorers to hit 350-60 or more. However, since the phone version is less intimidating than CW, there are more casual contesters active on phone, resulting in mult totals being typically higher than on CW.

A nice feature of Phone Sprint is that, like many phone contests, it is an intrinsically friendly environment. Since your name is part of the exchange, it is common to be greeted by name when you make a call, and to hear someone say "nice to hear you", and even to have a brief chat with other operators. And it seems to be less stressful and intimidating than CW for many operators. After all, not everyone can barrel along at 35-40 wpm on CW, but everyone can talk!

To get reluctant ops to dip their toes in the water, here are a few simple operating tips:

Phone Sprint is a really good SO2R contest. For the portions of the contest when two bands are open (20/40 or 40/80), if you can CQ on one band while tuning around on the other, you'll pick up a number of callers answering CQs even if the band sounds pretty dead – this happened in March on 40, which was basically usable from CA for portions of all four hours.

But if you have just one radio, don't spend all your time tuning around. It's easy to waste time by getting into the habit of tuning around to look for someone to call to start a couplet (i.e., you work someone, then inherit the frequency and can make one more Q there before moving). Particularly after the pack has been on a given band for 45 minutes or so and it's harder to find guys you haven't worked, CQing can be fruitful to get calls from casual ops or guys who just turned on the radio and want to make a few Qs.

On 80, stay below 3800 and the pig farmers won't complain.

You'll sometimes hear part of an exchange but maybe not even a call sign. You can call by name, e.g. "Jim, this is AE6Y", particularly if Jim is a new mult – an advantage of phone contests. And since Jim will naturally give his call as part of the exchange, you won't typically have to ask for it.

Occasionally, you will call a casual contester and he will just repeat your call, then seem to wait for you to say something. Under proper Sprint procedure, he should go first, but he may not understand the exchange protocol. This is hard to deal with on CW (though it actually doesn't happen often on CW, since there are very few casual participants). But on phone it's easy to handle: you can just jump into the silence to give your exchange, turn it over for his exchange, then come back with something like: "Roger. Under the contest rules this is now my frequency. So thanks and 73. QRZ Sprint AE6Y…"

Because of the QSY rule, QRM can be fleeting and evanescent. So even if someone CQing is hard to copy due to QRM, you can call, and usually will be able to make the contact; you may need some repeats, but generally in that time the QRMing station will have moved off to allow you to finish the Q.

So here are my top reasons to pick up the mic and jump into the next Phone Sprint: (a) It is easier and less intimidating than CW; (b) It's a friendly and social activity; (c) What a shame it would be to lose a contest, as we almost did before the new sponsors took over. And finally: (d) The Club has won it and can win it again!

Andy, AE6Y

NCCC May Meeting

Cattlemen's, Restaurant
2882 Kitty Hawk Road, Livermore,
CA 94551

May 11th, Saturday

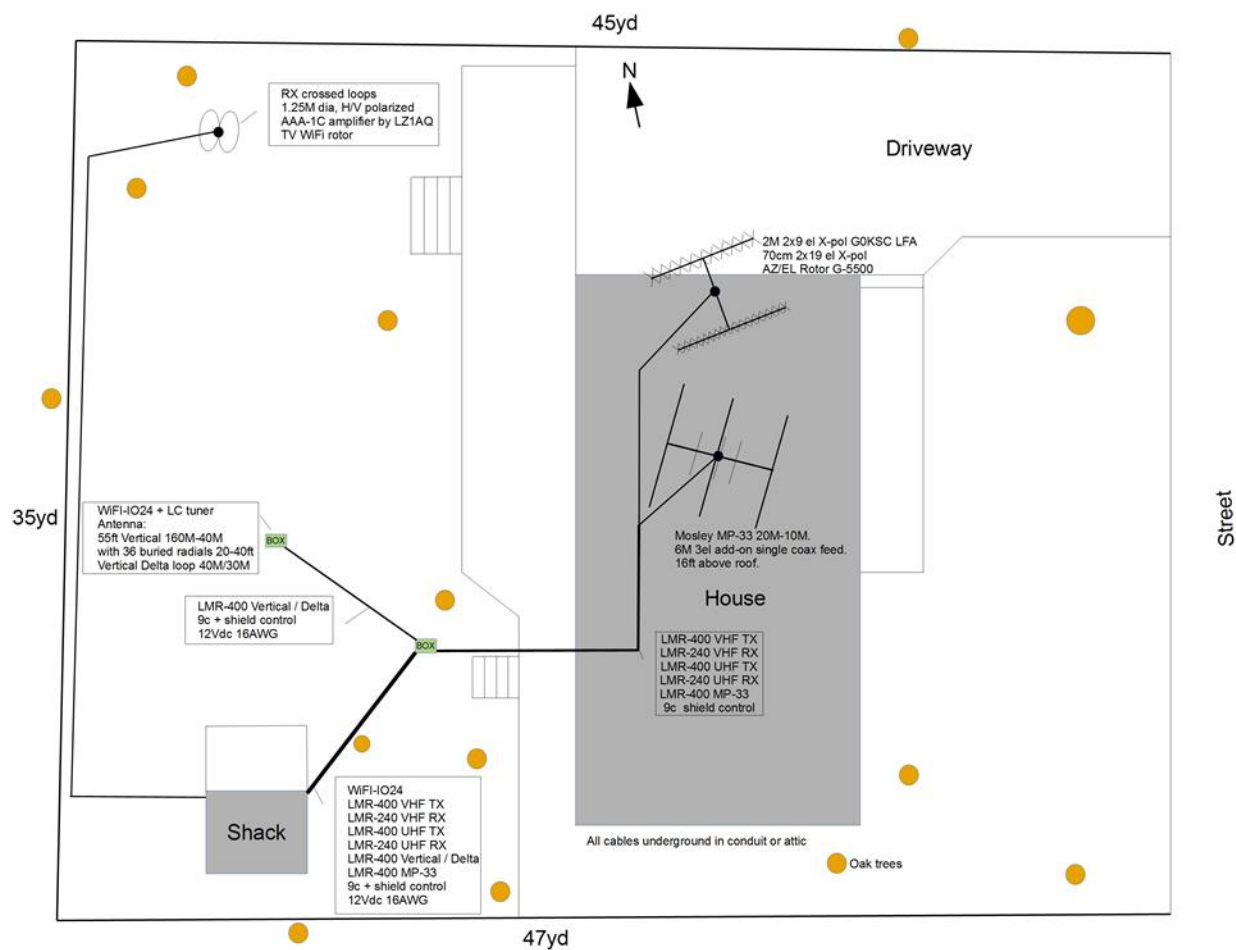11:30 am Social Hour, 12:30 pm Lunch,
1:30 pm Program (approx.)

Presentation: Activate Fifty-Eight - The County Expeditions of CQP 2018
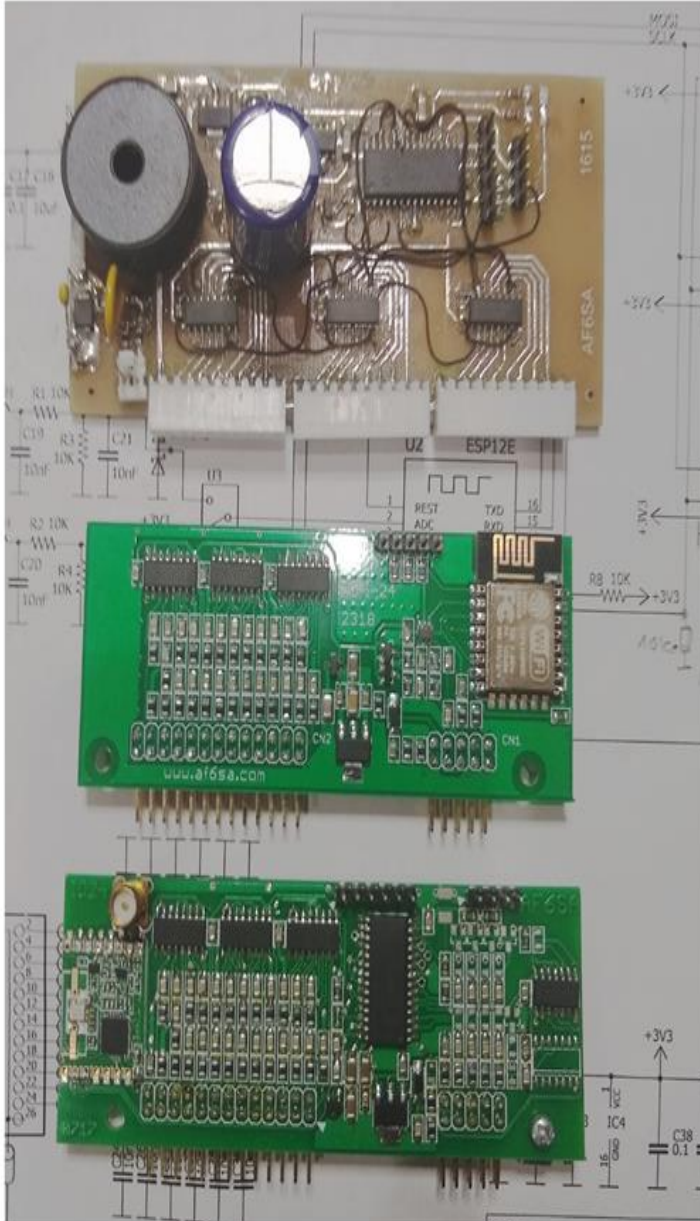by Glen W6GJB

RSVP here

Building a station on a small lot with antenna restrictions is a challenge with limited options.

Started with some wires in the backyard and 2el W8JK beam on the roof and they all need an antenna tuner. To minimize feeder losses, tuner needs to be placed close to the antenna feed point.

Went through a couple ideas for how to remotely control a tuner / antenna switch. Tried to send pulses and DC power over the coax cable, similar to SatTV DiSEqC, but it was too noisy on the lower bands. Building a control network, like Shacklan, can lead to RFI problems with cables close to the antenna. Decided to cut the cord and go wireless. Explored some 900MHz TRX modules and settled to a 2.4GHz WiFi module based on ESP8266 chip.

Networking over coax cable (2015)
PIC24F32KA202
24 OD 0.15A outputs
2 analog inputs

WiFi - IO24 (2017)
ESP8266 WiFi module
CPU 80 MHz, 32KB RAM, 4MB FLASH
24 OD 0.15A outputs
2 analog inputs

900MHz TRX module (2017)
PIC24F32KA202
24 OD 0.15A outputs
2 analog inputs
80MHz frequency counter

Moving my operating position from garage to a new Shed/Shack building required major station re-configuration. Built WiFi telnet to serial bridges, so I can control the rotors with PstRotator over the network, spared me running 3x120ft rotor cables. Later added WiFi TV rotor to turn the RX loops.

Built an L/C tuner with switched 8 inductors (0.3 – 14.5uH) and 8 capacitors (7-2633pF) banks, SWR bridge and 3 port antenna switch.

Tuner is controlled by WiFi-IO24 board that has 24 outputs and two analog inputs to measure forward and reflected power. Tuner is using 18 outputs (8 inductor + 8 capacitor banks, 1x LC/CL, 1x bypass) the other 6 outputs can be used for antenna switching. Another WiFi-IO24 board is located in the shack for additional antenna and radio switching.

WiFi-IO24 board can be controlled simultaneously in 3 ways:

- **UDP** listen to packets from N1MM++ or DXlab and change band and antenna accordingly.
- **WEB interface**. Used for setup, diagnostic and firmware update. Tuner has WEB page to monitor Power / SWR and manually change frequency and select antenna. When frequency or antenna selection are changed it will send an UDP packet to inform all other devices.
- **telnet** used for setup, antenna tuning and frequency / antenna selection.

N1MM++ UDP broadcast packet includes information about RX/TX frequency, antenna selected, mode, station name, operator name and SO2R settings.

```
// N1MM++ UDP boradcast
<?xml version="1.0" encoding="utf-8"?>
<RadioInfo>
      <StationName>HAMSHACK</StationName>
      <RadioNr>1</RadioNr>
      <Freq>708465</Freq>
      <TXFreq>708465</TXFreq>
      <Mode>USB</Mode>
      <OpCall>AF6SA</OpCall>
      <IsRunning>True</IsRunning>
      <FocusEntry>357636</FocusEntry>
      <Antenna>9</Antenna>
      <Rotors></Rotors>
      <FocusRadioNr>1</FocusRadioNr>
      <IsStereo>False</IsStereo>
      <ActiveRadioNr>1</ActiveRadioNr>
</RadioInfo>
```

For detailed fields description visit: http://n1mm.hamdocs.com/tiki-index.php?page=UDP+Broadcasts

DXlabs UDP packets does not include antenna selection field - hope that Dave / AA6YQ will include it in future.

```
// DXLabs UDP boradcast
<?xml version="1.0" encoding="utf-8"?>
<RadioInfo>
      <RadioNr>1</RadioNr>
      <Freq>183821</Freq>
      <TXFreq>183820</TXFreq>
      <Mode>CW</Mode>
</RadioInfo>
```
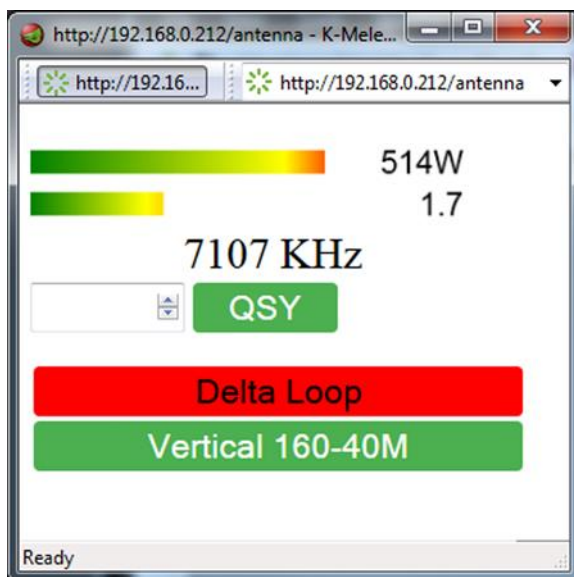
Both programs send UDP broadcast packets every 10s or after an event where any of the information in one of these fields changes. Just spin the VFO dial or change band and all WiFi-IO24 switches will follow, with tuner settings and antenna selection for that frequency segment. When using N1MM++ toggle through all the antennas defined for the current band with ALT-F9.

Based on information in <TXFreq>, <RadioNr>, <ActiveRadioNr> and <Antenna> fields each WiFi-IO24 will look at non-volatile memory for a list of defined antenna settings for that band. Setting for the antenna number specified in <Antenna> field will be applied to the module outputs.

If <Antenna> field is missing (DXLab) or antenna number is not found, the last used for that band or first in the list will be applied.

WEB interface can be used to monitor transmitting power, SWR and manually change frequency and antenna selection. UDP packet with the new settings will be send to inform all other devices.

Transmitting on 40M with Delta Loop. Two antennae on this band to chose from.

Connecting to WiFi-IO24 board via telnet protocol with a client like PUTTY opens keyboard friendly interface, used for configuration, tuning and changing frequency / antenna.

Antenna is defined with `ant` command. The `ant list` command prints a list of all antennae defined as commands, that are ready to be copied for editing or backup. Use copy-paste to a text editor for backup, editing and sending back.

```
---
>ant list
ant 1 xxxxxx "Mosley MP-33"
ant 2 xxx00x "Delta Loop"
ant 3 x0x11x "40M Array"
ant 8 x0x01x "Vertical 160-40M"
>
---
```

First parameter is the antenna number / index, second is the 6 bit antenna selection outputs Out23 - Out18 state. '0' means this output is to be cleared in OFF state, '1' to switch it ON and 'x' means do not change it when this antenna is selected. Last comes the antenna name.

Some other commands implemented.

```
---
>freq                       ← read current frequency
3573
>qsy 7074 8                 ← QSY to 7074KHz and select antenna 8
>ant 2                      ← switch to antenna 2
>qsy 10136                  ← QSY to 30M and use last antenna selected
```

At the moment there is no automated search for lowest SWR implemented. This is not an automatic tuner and it will not start tuning by itself in the middle of a Q. A manual tuning using the keyboard is implemented, similar to turning the knobs. QSY to the desired frequency, select the antenna, then type *mtune* command.

```
---
>qsy 7077 8
>mtune
Tune WZASQE, Vertical 160-40M at 7077KHz. CTRL-Z to end.
==          SWR= 1.3   15W Tx ON  L-C L= 739nH C= 376pF
---
```

Now using the keyboard, press a key to change or hold to scroll:

> W - increase C
> Z - decrease C
> A - decrease L
> S - increase L
> Q - toggle tuner ON/OFF
> E - toggle L-C / C-L topology
> CTRL-Z to end tuning and back to prompt.

Transmit 10W - 100W carrier. On the bottom line there is a bar of up to 10x = showing SWR 1 to 3, next is the calculated SWR, Forward power, Tx shows that carrier is found, ON|OFF is inline or by-passed tuner, C-L or L-C topology and last are the current L/C values.

Note that Forward power and SWR are measured at the antenna and they can differ from shack readings. Press CTRL-Z to exit tuning routine.

Command `tuner list` will list tuner memory settings, sorted by frequency and antenna, as commands.

```
---
>tuner list
tuner set  1804  8 o l  8626nH  1424pF
tuner set  1810  8 o l  9134nH  1231pF
tuner set  1822  8 o l 10154nH  1029pF
tuner set  1830  8 o l 12036nH   983pF
tuner set  1842  8 o l 13312nH   840pF
tuner set  1851  8 o l 14017nH   742pF
tuner set  1861  8 o l 14588nH   699pF
tuner set  1873  8 o l 15037nH   614pF
tuner set  1885  8 o l 15037nH   571pF
tuner set  3525  8 o c  2843nH   961pF
tuner set  3550  8 o c  1950nH   894pF
tuner set  3580  8 o c  1315nH   675pF
tuner set  3600  8 o c   354nH   517pF
```

```
tuner set   3625   8 o c    354nH    714pF
tuner set   3650   8 o l   2206nH    788pF
tuner set   3690   8 o l   3799nH    571pF
tuner set   3715   8 o l   5045nH    412pF
tuner set   3752   8 o l   7212nH    323pF
tuner set   3789   8 o l   8361nH    226pF
tuner set   3802   8 o l   8179nH    180pF
tuner set   3850   8 o l  10283nH    128pF
tuner set   3870   8 o l  10602nH    104pF
tuner set   3890   8 o l  10987nH     82pF
tuner set   5357   8 o c   2394nH    234pF
tuner set   7050   2 o l   1315nH    195pF
tuner set   7050   8 o c    803nH    419pF
tuner set   7100   8 o c    483nH    391pF
tuner set   7100   2 o l   1315nH    226pF
tuner set   7150   8 o l    354nH    391pF
tuner set   7150   2 o l   1374nH    202pF
tuner set   7200   2 o l   1503nH    202pF
tuner set   7200   8 o l    739nH    434pF
tuner set   7250   2 o l   1567nH    195pF
tuner set   7250   8 o l   1122nH    412pF
tuner set  10136   8 o l   2650nH     61pF
tuner set  10136   2 o c   2206nH    525pF
----
```
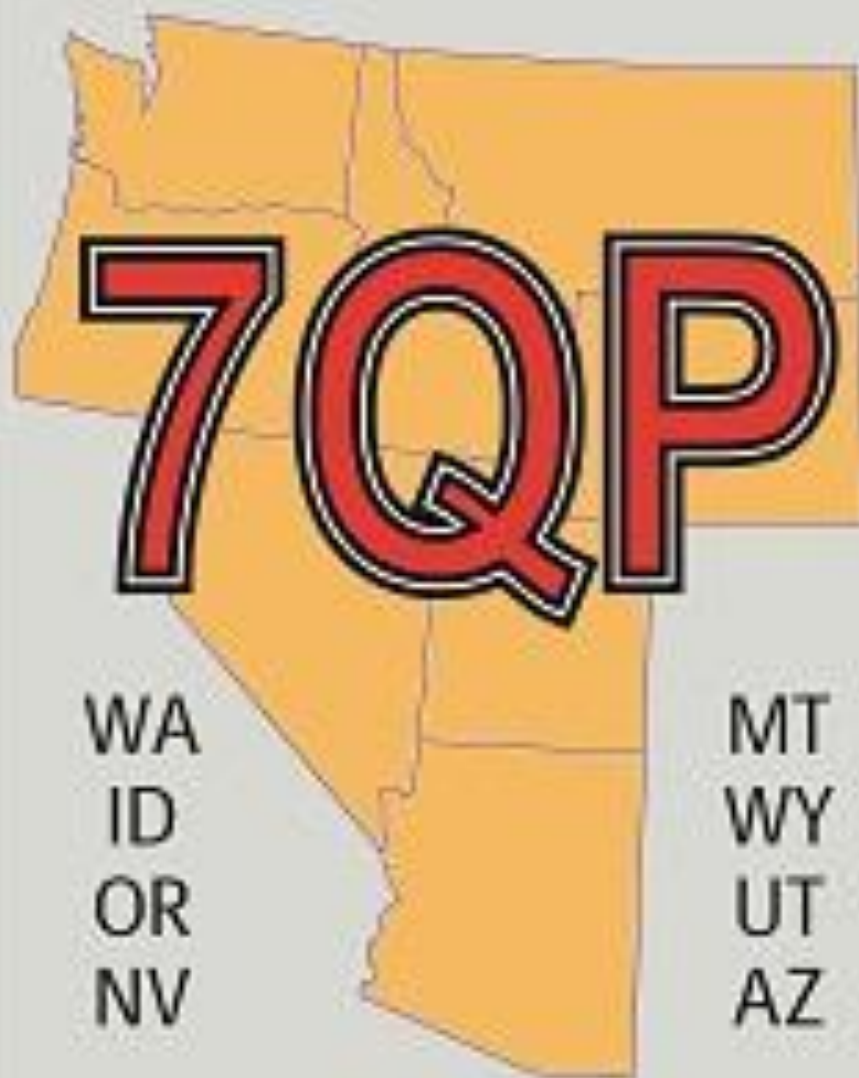
First parameter is the frequency in KHz, antenna number, o for online or b for tuner bypassed, l for L-C or c for C-L topology, followed by inductance and capacitance set. To modify an entry, QSY within +/-1% and re-tune or just send a modified command. Command tuner clear 7000 7300 will delete all 40M settings. To save tuner and antenna settings in non-volatile memory, type *tuner save* when done.

It is a work in progress that worked fine during the 2018 contest season with my modified auto band switching ALS-600 amplifier. Swapping TS-2000 and Flex-6600 transceivers was just a matter to change the CAT settings in N1MM++ and DXlab.

Next automation project will be a USB CAT to WiFi cable for Flex-6000 series. It will send UDP packets with frequency information, based on the active slice. This will allow me to operate remotely, without PC running in the shack.

73's de Stefan / AF6SA

http://www.af6sa.com/

7QP

WA
ID
OR
NV

MT
WY
UT
AZ

The 7th Call Area
QSO PARTY
May 4-5 2019

Awards Meeting - April 9th @ Tied House

The Annual awards meeting and Officer Elections took place on Tuesday 9th April at the Tied House in Mountain View.

Thirty eight members/guests turned up for the meeting:

Andy AE6Y, Roberto AJ6CY, Ed AJ6V, Bobby K0XI, David K6DAJ, Tom K6EU, Don K6GHA, Jim K6JAT, John K6MM, Alan K6SRZ, Bob K6XX, Joanna K6YL, Jim K9YC, Jennifer KB4TGE, Lee KI6OY, Tom N3ZZ, Dean N6DE, Greg N6GD, Rich N6KT, Rick N6RNO, Chris N6WM, Rick N6XI, Gary NA6O, Tom NW6P, Tom W2SC, Judy W4JJY, Jack W6FB, Glen W6GJB, Mark W6IA, Steve W6IFN, Ian W6TCP, Ron W8RJL, Bill W9KKN, Bob N6TV, Michael WA2FHF and Mike WA6O.

Online were AE6JV, KA6BIM, K6MR, KA6W, W6FDU

The following two members were voted in. Welcome to Carl N6TVN and Bill N6FFC

Congratulations to the many award winners this evening, including those who won RTTY RU awards, KB awards, CQP awards, and the various club awards.
For the latter, congrats to:

CQWW DX Founders Award: Bob Wolbert, K6XX
NCCC Rookie of the Year: David Jaffe, K6DAJ
NCCC Most Improved Contester: Bill Fehring, W9KKN
NCCC Elmer of the Year: Gary Johnson, NA6O
NCCC Team Builder: Gary Johnson, NA6O
NCCC Inspiration Award: Bill Fehring, W9KKN
NCCC Operating Excellence Award, CW Mode: Tom Georgens, W2SC
NCCC Operating Excellence Award, SSB Mode: Bob Cox, K3EST
NCCC Operating Excellence Award, Digital Modes: Ed Muns, W0YK
NCCC Most Valuable Player: Bill Fehring, W9KKN
NCCC Contester of the Year: Dave Tucker, KA6BIM

Three President's Awards were given out, these for:
Rob Brownstein, K6RB: "For advancement of the art of CW and long-term service to the club"
Ian Parker, W6TCP: "For service to NCCC above and beyond the office of Secretary"

and a Technical Merit Award to:
Jim Brown, K9YC: 'For service to the amateur radio community through research and technical publications"

And, not the least, another award was given out. This one made by Jim Tiemstra, K6JAT on behalf of the ARRL Contest Branch.

It was the gavel for winning the 2018 RTTY Roundup, awarded to NCCC VP/CC Chris, N6WM for NCCC.

Photos by N6TV

After Contesting Exuberantly, Hank W6SX won First Place Platinum Bracket
in the NCCC KB competition ! Congratulations Hank !

Photo W6TCP

© 2019 N6TV

© 2019 N6TV

Northern California Contest Club
Excellence In Amateur Radio Contesting

Visalia International DX Contest - NCCC Table

Glen W6GJB, Ian W6TCP

Point Generator Profile – W7IV
(Interviewed by Bob, W1RH)

Paul, W7IV, is this month featured Point Generator. As you can see from the pictures, Paul has got some serious aluminum going on in Templeton. Unfortunately, Templeton is outside of our ARRL circle and is currently outside of our CQ circle, which favors that other big contest station, KA6BIM.

Nevertheless, Paul is NCCC all the way, and we can use his scores for contests like NAQP. Also, all of Paul's points count towards the KP Award program.

It just kills me, however, to see Paul's big scores that currently cannot be added to NCCC's totals in the ARRL and CQ contests. Most recently, Paul did 5.7M in WPX SSB, which just shows you want a great operator he is and what a superstation he has.

Now, more from Paul:

Name/Call Sign: Paul Merrill / W7IV
> Rolling Ranch Contest Club / KK6P

Past calls: KA6DBB (1978 while in High School in San Francisco)
KL7OO
I was inactive from 1985 to about 2006.
KK6P - I use my club call for any contests needing a "CA" exchange, CQP, 7QP, WPX, etc.

Location: Templeton, CA

How much property do you have?   10 Acres, oriented N/S, so room for listening antennas at one end, TX at the other.

Describe your antenna system:

Current: 160' Rotating 65g Tower. 3 JK Big Tris, 4/4 on 40 (JK) at about 75 and 154. 80M JK rotable dipole with Tornado Tuner at 165'. 7/7 LFA-Q at 25 and 50.

HDX689 Crankup – SteppIR MonstIR at 90'. 7L LFA at 95. 2L Optibeam for 80 at 106'

75' top loaded N6BT vertical dipole for 160.

Future: 160 TX 4SQ, 80m TX 4SQ. 160 DXE RX 4SQ, DXE 80 RX 4SQ. SAL30, another PGXL, 160m dipole, Fixed long boom yagis for JA and EU.

What's in your shack? Flex 6600M, 6700, PGXL. 6700 and PGXL from the 3Y0Z Trip. 4O3A Station automation.

What are your previous QTH's? San Francisco, Juneau, AK, Bellingham, WA, Ketchikan, AK. Operated from Maritime Mobile, KH6, T2, 3D2, A41, LZ, SV8.

If you're working, what is your career? If not, what was your career?

I am a graduate of Cal Maritime in Vallejo (1985.) Got my Unlimited Master's License in 1989. Sailed Master on oil tankers for 8 years. I'm now a pilot in Southeast Alaska piloting primarily Cruise ships. I basically work 6 months on, 6 months off. At least I am home for most of contest season!

Married? Kids? Grandkids?

Married, no kids. Two dogs.

How many DXCC entities have you worked? 323. A few fairly easy ones still out there and others I may never get. Need Bouvet!

What's your favorite contest? WPX RTTY

Any tips for contesters? It's fun to run, but don't ignore the mults. You never know which big station is going to have a bad day – work it like you want to win it.

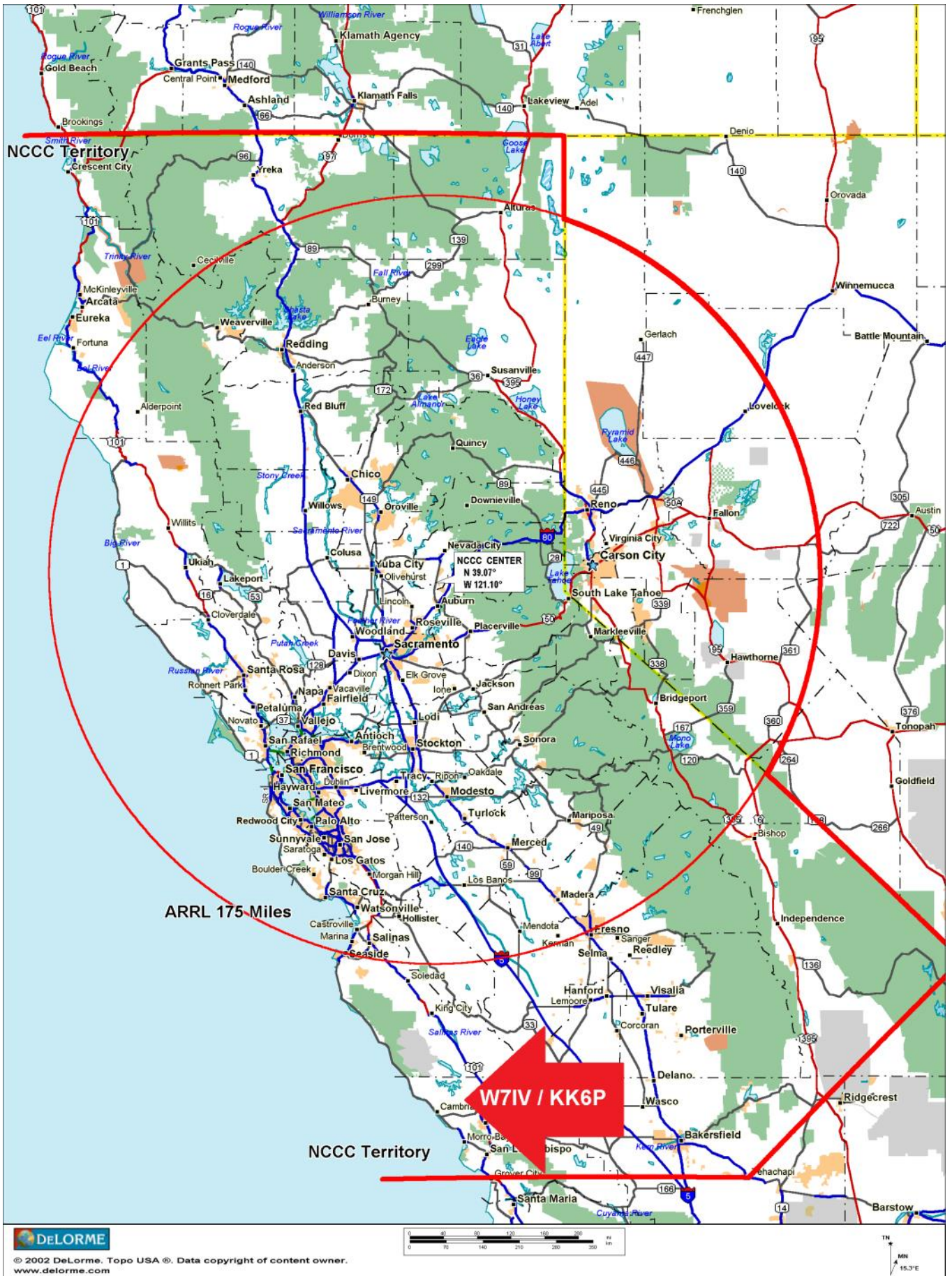**What would you like to see changed in NCCC?** The 175-mile ARRL Circle ;-)

Any other hobbies besides ham radio? Travel. Digging holes with the tractor one day and filling them in again the next.

NCCC Territory

ARRL 175 Miles

NCCC CENTER
N 39.07°
W 121.10°

W7IV / KK6P

NCCC Territory

DeLORME

© 2002 DeLorme. Topo USA ®. Data copyright of content owner.
www.delorme.com

NCCC Annual KB Competition Rules

Revised March 1, 2019

Current rules and standings are always available at http://nccc.cc/awards.html.

Purpose: To provide a means of rewarding NCCC members who are DX contesters, sprinters, VHFers, and especially active contesters in all modes.

Time period: The contest year starts at 0000 March 1 UTC. ARRL DX SSB is the first contest of the year. NAQP RTTY is the last.

Eligible contests: Currently, points from 29 contests are counted. See the table on the next page

Scoring:

Score = N_Contests * sum of (points for each contest * each contest's multiplier).

Where N_Contests is the number of contests you participated in, with a maximum value of 20. Points for all contests in which you participate are always counted.

NCCC weekly sprints are special. Points for the entire year are added up, but it is only counted as a single contest.

Multi-ops: Points = total score divided by the number of operators.

Station owners: A station owner who does not participate in a particular contest receives 25% of the points.

Valid scores: Only scores posted to 3830scores.com are counted. Scores obtained by use of High Power in the 6 NAQP competitions and the NS CW/NS CW Ladder series will not be counted for the KB competition, either as scores or as contest multipliers. Scores are counted regardless of which club received the contest points (NCCC, MLDXCC, REDXA, PL259, etc.). The only requirement is that you MUST be an NCCC member to receive credit for the contest, and to be eligible for an award.

Brackets: There are four independent brackets for the purpose of awards: 1-Platinum, 2-Gold, 3-Silver, and 4-Bronze. Brackets are assigned at the beginning of the contest year according to your final position in the previous year's standings.

Awards: Paid NCCC members may receive awards.

How to Improve Your Standing

Post all your scores on 3830. Those are the only ones that count.

Participate! Even the smallest score has value. Every contest on the list is a multiplier.

Try a new mode or a new band (VHF, 10, 160).

Try the sprints. Small score, big multiplier.

Go for a big score in WPX: Exponential score growth and a big multiplier.

Join a multi-op: The score is split among ops.

Let someone else use your station: You get 25%.

Comments are welcome, as always. I log and track every comment and suggestion and try to improve the KB Competition each year. The one thing I can guarantee is that each year will be different!

Contact: Gary NA6O, NCCC Awards Manager, gwj@wb9jps.com

NCCC Annual KB Competition Table

Contest	Month	Mult
ARRL DX Contest SSB	March 2	10
CQ WPX SSB	March 30	10
7QP	May 4	20
NEQP	May 4	150
CQ WPX CW	May 25	5
ARRL June VHF	June 8	500
RAC Canada Day	July 1	15
IARU HF World Championships	July 13	10
NAQP Summer RTTY	July 20	25
NAQP Summer CW	August 3	25
NAQP Summer SSB	August 17	25
CQWW RTTY	September 28	5
NA Sprint Fall CW	September 8	150
CQP	October 5	10
Makrothen RTTY Contest	October 12	1
CQWW SSB	October 26	6
ARRL Sweepstakes CW	November 2	15

ARRL Sweepstakes SSB	November 16	15
CQWW CW	November 23	3
ARRL 160 Meter Contest	December 6	30
ARRL 10 Meter Contest	December 13	100
ARRL RTTY Roundup	January 4	50
NAQP Winter CW	January 11	25
NAQP Winter SSB	January 18	25
NA Sprint Winter CW	February 2	150
CQ WPX RTTY	February 8	10
ARRL DX Contest CW	February 14	4
NAQP Winter RTTY	February 22	25
NCCC Sprint CW	Weekly	50

KB Award Brackets

There are four independent brackets for the purpose of issuing awards: 1- Platinum, 2- Gold, 3- Silver, and 4-Bronze. Your bracket is assigned automatically at the beginning of the contest year according to your final position in the previous year's standings. New members or those who have never posted a score to 3830 default to the Bronze level. On the left, is an alphabetical list of the current assignments to the top three brackets. If your call is not listed, you are in Bronze. If you believe your current bracket is incorrect, please contact NA6O.

Platinum	Gold	Silver
AD6E	K3EST	AE6JV
AE6Y	K6AW	AJ6CY
AF6SA	K6DGW	K0BEE
AJ6V	K6IJ	K0JP
K2RD	K6JS	K6KR
K5RC	K6MR	K6MI
K6DAJ	K6NV	K6OK
K6EU	K6RIM	K6RB
K6GHA	K6TQ	K6ST
K6LRN	K6UFO	K6TD
K6MM	KH2TJ	K6UM
K6SRZ	KH6LC	K6XN
K6XX	N0KQ	K6XV
K7XC	N2NS	K7GK
K9YC	N5KO	K7MKL
KA6BIM	N6EE	KA6W
N3RC	N6IE	KD6WKY
N3ZZ	N6JV	KE6GLA

Platinum	Gold	Silver
N6RO	N6KT	KE8FT
N6TV	N6PN	KF6NCX
N6WM	N6RK	KI6OY
N6ZFO	NC6R	KM6I
N7MH	NJ6G	KU7Y
NA6O	VE3RUA	KX7M
NW6P	W6DR	N6DE
W0YK	W6EU	N6DW
W1RH	W6FB	N6GD
W1SRD	W6IA	N6JS
W2SC	W6JTI	N6NU
W6FA	W6LD	N6XI
W6OAT	W6NV	N6YEU
W6SX	W6RC	NQ6N
W9KKN	W7IV	NR6Q
WC6H	WB6JJJ	OH1VR
WX5S	WU6W	VY1JA
		W6GJB
		W6NL
		W6RGG
		W6SC
		W6SR
		WA6O
		WE6Z
		WK6I
		WU6X
		WX6V

NCCC Life Membership!

The NCCC Life member program was introduced for a flat fee of $250. If you are interested in becoming an NCCC Life member, please contact secretary.nccc@gmail.com

80/20 Rule:
Members who have reached 80 years young and been a NCCC Member for 20 years are eligible for Honorary life membership. Contact secretary.nccc@gmail.com

---

Forthcoming NCCC Meetings

May 11th, Saturday
Activate Fifty-Eight - The County Expeditions of CQP 2018, Glen W6GJB
Cattlemen's, Livermore

June 11th
6pm Tony & Alba's, Pizza and Pasta, San Jose Program: Rick N6XI, Bandmap/
N1MM

July 27th,
Joint meeting with MLDXC Program K9YC

BoD meeting minutes
The monthly minutes from the NCCC BoD meetings are available in the members only section of the NCCC website. See http://nccc.cc/members/minutes.html

---

JUG Articles Wanted!
Without your help we cannot reproduce a quality newsletter so please consider submitting a suitable article!

We welcome any and all relevant articles for inclusion in the JUG.

Deadline is 7 days before month end. Preferred format is MS Word, Arial 12 point and pictures should be full resolution. Send your material to Ian, W6TCP at w6tcpian@gmail.com Don't worry about the formatting, we can take care of that if necessary !

Tube Of The Month
Norm, N6JV

Visit the Museum: www.n6jv.com

THYRATRONS

The first triode tubes were made to be sensitive detectors. They had a low vacuum and were gassy. The best sensitivity was achieved when the operating parameters were set just before the tube went into conduction due to the gas. With the gas ions adding to the electron flow, the tube became a switch. In the future, this switching action was used for many applications and these tubes were called thyratrons. They were made as triodes, tetrodes and pentodes and used several gasses such as hydrogen, mercury, argon and neon.

Thyratrons are very fast, high current switches. They are used in electronic speed controllers for power machinery as they will operate with small control voltages. A simple DC power supply will work with a thyratron as a rectifier when the grid is positive and it can be turned off with a negative voltage. No need for heavy switches or relays. The famous proximity fuse used a miniature thyratron to fire its explosive.

RADAR is a common use for high current and voltage thyratrons. The grid voltage can be controlled by a timer to produce the required pulse duration. When the thyratron fires, a capacitor that is hooked to a pulse transformer discharges. The surge in the transformer secondary causes a pulse of voltage to a magnetron over the required time interval required to "see" its target. A tube such as the 5949 that was used in the AN/MPQ-21 RADAR, could handle 25,000 volts at 500 amps. These tubes are made much larger.

Modern thyratrons, like this CX2708, are being made with ceramic insulation.

Visit the museum at N6JV.com
Norm N6JV

Tube Of The Month
Norm, N6JV

Visit the Museum: www.n6jv.com

.

.

Hornet ARC needs our help…   Jack W6FB

Historic Landmark Restoration Project

I recently received a note from Mark Gang, N6SF of the Hornet ARC. The club has started a go-fundme page to raise money to repair antennas on the ship. In the spirit of originality and preservation the antennas they use are only those that were installed on the ship when it was decommissioned in 1970. These antenna installations are now 50 years old and in need of serious repairs. Most are located on the ships mast, the top of which is 190 feet above the water line. Due to possible corrosion and other issues the only safe way to reach some of the antennas is with a large crane which will be very expensive. Thus the reason for the gofundme page.

You do not have to be a ship volunteer to be a member of the Hornet ARC and guests are welcome with coordination. Members and guests do not have to pay the ship entry fee to access the club station. The station includes 6 operating positions using military radios on loan from the Air Force.

Aircraft Carrier Hornet Foundation preserves and honors the legacy of USS Hornet, a national historic landmark, and its role in naval aviation, the defense of our country, the Apollo Program and exploration of space. The USS Hornet Sea, Air & Space Museum connects the greatest generation of Americans with future generations, educating and inspiring them to meet their challenges.

Go Fund Me page   https://www.gofundme.com/uss-hornet-antenna-restoration

Phone Fray	0230Z-0300Z, May 1
CWops Mini-CWT Test	1300Z-1400Z, May 1 and
	1900Z-2000Z, May 1 and
	0300Z-0400Z, May 2
AGCW QRP/QRP Party	1300Z-1900Z, May 1
NRAU 10m Activity Contest	1700Z-1800Z, May 2 (CW) and
	1800Z-1900Z, May 2 (SSB) and
	1900Z-2000Z, May 2 (FM) and
	2000Z-2100Z, May 2 (Dig)
SKCC Sprint Europe	1900Z-2100Z, May 2
NCCC RTTY Sprint	0145Z-0215Z, May 3
NCCC Sprint	0230Z-0300Z, May 3
Araucaria World Wide VHF Contest	0000Z, May 4 to 1600Z, May 5
10-10 Int. Spring Contest, CW	0001Z, May 4 to 2359Z, May 5
SBMS 2.3 GHz and Up Contest and Club Challenge	0600 local, May 4 to 2359 local, May 5
Microwave Spring Sprint	0800-1400 local, May 4
ARI International DX Contest	1200Z, May 4 to 1159Z, May 5
7th Call Area QSO Party	1300Z, May 4 to 0700Z, May 5
Indiana QSO Party	1500Z, May 4 to 0300Z, May 5
FISTS Spring Slow Speed Sprint	1700Z-2100Z, May 4
Delaware QSO Party	1700Z, May 4 to 2359Z, May 5
New England QSO Party	2000Z, May 4 to 0500Z, May 5 and
	1300Z-2400Z, May 5
MIE 33 Contest	2300Z, May 4 to 0300Z, May 5
ARS Spartan Sprint	0100Z-0300Z, May 7
Phone Fray	0230Z-0300Z, May 8
CWops Mini-CWT Test	1300Z-1400Z, May 8 and
	1900Z-2000Z, May 8 and
	0300Z-0400Z, May 9

NCCC RTTY Sprint	0145Z-0215Z, May 10
NCCC Sprint	0230Z-0300Z, May 10
VOLTA WW RTTY Contest	1200Z, May 11 to 1200Z, May 12
SKCC Weekend Sprintathon	1200Z, May 11 to 2400Z, May 12
CQ-M International DX Contest	1200Z, May 11 to 1159Z, May 12
Arkansas QSO Party	1400Z, May 11 to 0200Z, May 12
FISTS Spring Unlimited Sprint	1700Z-2100Z, May 11
50 MHz Spring Sprint	2300Z, May 11 to 0300Z, May 12
WAB 7 MHz Phone/CW	1000Z-1400Z, May 12
4 States QRP Group Second Sunday Sprint	0000Z-0200Z, May 13
RSGB 80m Club Championship, SSB	1900Z-2030Z, May 13
Phone Fray	0230Z-0300Z, May 15
CWops Mini-CWT Test	1300Z-1400Z, May 15 and
	1900Z-2000Z, May 15 and
	0300Z-0400Z, May 16
NAQCC CW Sprint	0030Z-0230Z, May 16
NCCC RTTY Sprint	0145Z-0215Z, May 17
NCCC Sprint	0230Z-0300Z, May 17
Portuguese Navy Day Contest	0900Z, May 17 to 1700Z, May 19
UN DX Contest	0600Z-2100Z, May 18
NZART Sangster Shield Contest	0800Z-1100Z, May 18 and
	0800Z-1100Z, May 19
Aegean RTTY Contest	1200Z, May 18 to 1200Z, May 19
His Maj. King of Spain Contest, CW	1200Z, May 18 to 1200Z, May 19
EU PSK DX Contest	1200Z, May 18 to 1200Z, May 19
Feld Hell Sprint	1600Z-1759Z, May 18 and
2000Z-2159Z, May 18	2000Z-2159Z, May 18
Baltic Contest	2100Z, May 18 to 0200Z, May 19
Run for the Bacon QRP Contest	0100Z-0300Z, May 20
SKCC Sprint	0000Z-0200Z, May 22
Phone Fray	0230Z-0300Z, May 22

CWops Mini-CWT Test	1300Z-1400Z, May 22 and
	1900Z-2000Z, May 22 and
	0300Z-0400Z, May 23
RSGB 80m Club Championship, Data	2000Z-2030Z, May 22
NCCC RTTY Sprint	0145Z-0215Z, May 24
NCCC Sprint	0230Z-0300Z, May 24
CQ WW WPX Contest, CW	0000Z, May 25 to 2359Z, May 26
QCX Challenge	1300Z-1400Z, May 27 and
	1900Z-2000Z, May 27 and
	0300Z-0400Z, May 28
Phone Fray	0230Z-0300Z, May 29
CWops Mini-CWT Test	1300Z-1400Z, May 29 and
	1900Z-2000Z, May 29 and
	0300Z-0400Z, May 30
RSGB 80m Club Championship, CW	1900Z-2030Z, May 30
NCCC RTTY Sprint	0145Z-0215Z, May 31
NCCC Sprint	0230Z-0300Z, May 31

NCCC Membership Information

If you wish to join NCCC, you must fill out an application for membership, which will be read and voted upon at the next monthly meeting.

To join, you must reside within club territory which is defined as the maximum of:

- 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).

JUG Articles Wanted!

Without your help we cannot reproduce a quality newsletter so please consider submitting a suitable article!

We welcome any and all relevant articles for inclusion in the JUG.

Deadline is 7 days before month end. Preferred format is MS Word, Arial 12 point and pictures should be full resolution. Send your material to Ian, W6TCP at w6tcpian@gmail.com Don't worry about the formatting, we can take care of that if necessary !

Northern California Contest Club Reflector—Guidelines

This reflector is devoted to the discussion of contesting.

This includes contests, station building, dxpeditions, technical questions, contesting questions, amateur radio equipment wants/sales, score posting, amateur radio meetings/conventions, and membership achievements.

This does not include personal attacks, politics, or off-subject posts which will be considered a violation of the Guidelines.

Violations may result in removal of the violator from the reflector and possibly from club membership in good standing.

Find us on Social Media

NCCCKB

HAM RADIO OUTLET

MULTI-STORE BUYING POWER!

ICOM

IC-7610
All Mode Transceiver

IC-7200
HF Transceiver

IC-7100
All Mode Transceiver

ID-5100A Deluxe
VHF/UHF Dual Band Digital Transceiver

ID-51A Plus2
VHF/UHF D-STAR Portable

KENWOOD

TS-590SG
HF/50MHz Transceiver

TM-D710G
2M/440 Dualband

TM-V71A
2M/440 DualBand

TM-281A
2 Mtr Mobile

TH-D74A
2M/220/440 HT

YAESU
The radio

FT-991A
HF/VHF/UHF Transceiver

FTDX1200
100W HF + 6M Transceiver

FT-450D
A100W HF + 6M Transceiver

FTM-400XD
2M/440 Mobile

FT-60R
2M/440 5W HT

---

5 Ways to Shop!

- RETAIL LOCATIONS – Store hours 10:00AM - 5:30PM - Closed Sunday
- PHONE – Toll-free phone hours 9:30AM - 5:30PM   • FAX – All store locations
- ONLINE – WWW.HAMRADIO.COM   • MAIL – All store locations

HRO is family owned and operated by active hams!

ANAHEIM, CA	OAKLAND, CA	PORTLAND, OR	PHOENIX, AZ	MILWUKEE, WI	WOODBRIDGE, VA	PLANO, TX
(800) 854-6046	(877) 892-1745	(800) 765-4267	(800) 558-7388	(800) 558-0411	(800) 444-4799	(877) 455-8750
BURBANK, CA	SAN DIEGO, CA	DENVER, CO	ATLANTA, GA	NEW CASTLE, DE	SALEM, NH	ONLINE STORE
(877) 892-1748	(877) 520-9623	(800) 444-9476	(800) 444-7927	(800) 644-4476	(800) 444-0047	WWW.HAMRADIO.COM